

LEED STORIES FROM PRACTICE

CASE STUDY

CHARTWELL SCHOOL










LEED STORIES FROM PRACTICE

CASE STUDY

Chartwell School

Prepared for the U.S. Green Building Council

Case Study Lab
Center for Housing Innovation
University of Oregon

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2		BD+C					
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	NA	.5	1	NA	.5	NA	NA

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Written permission has been obtained from all participants in this project, following an extensive edit and approval process, to include their interviews and videos in this document.

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USGBC Case Study Project

The U.S. Green Building Council, in conjunction with the University of Oregon, initiated this pilot program of five case studies to gather information on green building practices. Through a series of interviews, selected project team members from the Biodesign Institute at Arizona State University tell their stories in this case study. The interviews were recorded, transcribed, edited, and compiled to form the narratives on the following pages.

The USGBC intends to use these narratives as educational content for instructor-led workshops, podcasts, webinars, books, magazines, articles, and other research-oriented and curriculum products. The University of Oregon will use the material for educational purposes only, in classes and conferences. The five pilot case studies comprise a cross-section of certification levels, building types, and themes that occur in practice. The USGBC plans to expand its case study database with more project stories covering different themes, to enhance case-based teaching methods.

CHARTWELL SCHOOL

SEASIDE, CALIFORNIA



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The multipurpose McMahan Building welcomes teachers and students to the Chartwell School.

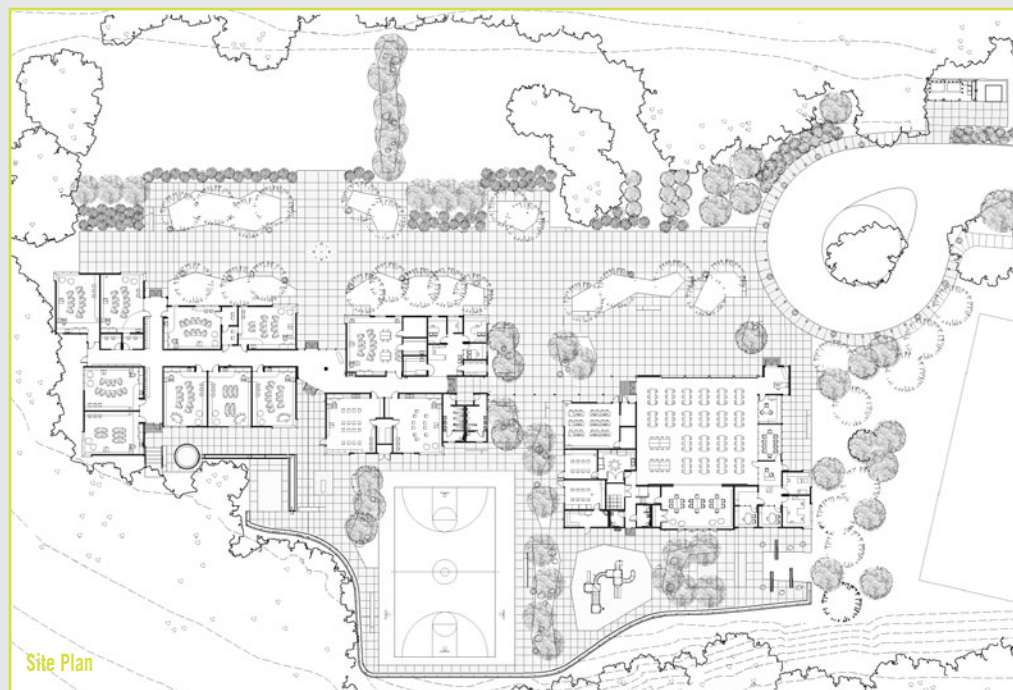
PROJECT TEAM MEMBERS

<i>Architect:</i>	EHDD Architecture, San Francisco, CA
<i>Energy Engineer:</i>	Taylor Engineering, Alameda, CA
<i>Structural Engineer:</i>	Tipping Mar + Associates, Berkeley, CA
<i>Mechanical Engineer:</i>	Taylor Engineering, Alameda, CA
<i>Electrical Engineer:</i>	The Engineering Enterprise, Alameda, CA
<i>General Contractor:</i>	Ausonio Incorporated, Castroville, CA
<i>Landscape Architect:</i>	GLS Landscape, San Francisco, CA
<i>Green Consultant:</i>	EHDD Architecture, San Francisco, CA
<i>Acoustics Consultant:</i>	Charles M. Salter Associates, San Francisco, CA
<i>Lighting Consultant:</i>	Benya Lighting Design, West Linn, OR
<i>Daylighting Consultant:</i>	Loisos + Ubbelohde, Alameda, CA

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes prepared this narrative. © 2009 U.S. Green Building Council and the University of Oregon. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the permission of the USGBC.

PROJECT DESCRIPTION

The Chartwell School is a private school for students with a range of learning differences, primarily dyslexia, located in Seaside, California. The school had leased a building for 20 years when it acquired 30 acres on Fort Ord, a former U.S. Army post on Monterey Bay. Although Douglas Atkins, the school's executive director, wanted to create a sustainable campus, the vision was not simply to build green—the goal was to build a campus that provided students with the best learning environment and honored their unique learning styles and strategies. Through a process that fostered stakeholder engagement, the Chartwell School's board, administration and faculty came to believe that creating the best learning environment meant building a green school. The Chartwell School earned a LEED® Platinum certification in 2006, the first school to achieve this level of certification.



Atkins conducted a visioning process to determine the school's overall goals and to secure support from key stakeholders by helping them see beyond the politics of green and recognize the educational and economic value of a LEED-certified school. The result was a program document that outlined how building a green school provided an opportunity for Chartwell to dovetail its educational objectives and mission with its sustainability goals. The document noted how the new school facilities could be used as teaching tools and its green features and energy-efficient systems integrated throughout the curriculum. An example of how this teaching innovation has come to fruition can be seen in current efforts by Chartwell teachers to use the new energy dashboard system to show students the school's actual energy usage in real-time and using the data to develop interactive lessons.

The project team goals included the desire to create welcoming buildings that calmed students upon their arrival, encouraged respect for the faculty, and changed visitors' perceptions of what a school could be. Scott Shell, the principal in charge from EHDD Architecture, the firm chosen to design the school, noted how Atkins' commitment to this vision was evident from the start, recounting how Atkins came to the project having researched daylighting and how high-quality indoor air can help students stay focused and alert. Atkins understood the critical alignment between the educational vision of the school and the sustainable design vision. The synergy that Atkins brought from his past experience and his initial research was refined in the visioning exercise and infused throughout the collaborative team process.

Atkins showed his investors how to budget for green strategies by thinking of them in terms of investments instead of costs. He demonstrated the lifecycle and upfront costs for each strategy. As a result, key donors shifted their outlook, seeing green strategies as long-term investments rather than simply upfront costs. With that clear focus, Atkins raised an additional 25% beyond expectations due to the knowledge, interest, and creativity of the team's approach to building a green school. The team used a wide range of rebates, grants, and financing mechanisms to keep the project goals attainable and the LEED Platinum certification goal within reach. The school was also able to secure a Kresge Foundation Green Building Planning Grant, which helped fund an advanced energy model, the LEED Platinum certification, and general research on high-performance design.

Shell said that many schools can generate upfront capital to support a construction project, but to ensure the long-term success of a project, two things must be guaranteed: the operating budget must remain affordable and the need for durability must be addressed to ensure future maintenance and repairs are easy. Shell applied for a Design for Deconstruction grant from the EPA to fund the efforts to decrease energy use and increase durability, since those life-cycle costs were outside of the initial scope of the school's construction budget. The funding helped the team explore how to detail the façade so that future maintenance would be simple and affordable. The changes that resulted from the grant will keep Chartwell School in optimal condition well beyond the standard expected lifespan for school buildings.

PROJECT DATA

PROJECT

LEED-NC v.2/v.2.1 Platinum
Completion: October 2006
Cost: 9,000,000 U.S. Dollars (2006)
Area: 55,000 ft²

LOCATION

City: Seaside, CA
Latitude: 36.38 North
Longitude: 121.48 West

CLIMATE²

HDD65: 3125
CDD50: 2574
Annual Precipitation: 30.3"
Solar Radiation: 579 kBtu/sf/year

ENERGY METRICS

Energy Code: California Title 24
Predicted % Below Code: ~50%
Measured EUI₃
30 kBtu/sf/year (2007)
27.9 kBtu/sf/year (2008)

NOTABLE GREEN FEATURES

Seaside, California has a temperate climate, making Chartwell School an excellent candidate for creating a zero net energy building. Meeting this goal required lowering energy demand and balancing the remaining need with photovoltaics. State rebates helped make the photovoltaics affordable, and in the sunny climate of Seaside, the project team sought to further reduce energy usage through daylighting most of the campus, including the classrooms, hallways, and restrooms. The challenge was to ensure that the daylighting did not increase the internal heat gain load.

The team designed the facility to bring the light to the right places. According to George Loisos, principal of Loisos + Ubbelohde, the daylighting consultants for Chartwell, classrooms not only need to light the horizontal working plane, they must also light the vertical surfaces and, in particular, the teaching wall. If the teaching wall is not the brightest thing in the room, students' eyes tend to wander. Keeping students focused was essential to improving the learning environment. To meet these goals, the team placed windows and fisheye skylights carefully, even utilizing corner windows to help direct the light and decrease glare.



Exterior Sunshading

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Even though Seaside is somewhat overcast—producing good, diffuse light—when the sun does shine, it can be extremely bright. To address the potential issue of glare, the project team focused on trying to avoid situations where the glare would be particularly strong at the students' desks, since they cannot change seats in the classroom the way they might in a library. When there is glare, a system is in place so that teachers can close the blinds and the lights

turn on automatically due to daylight sensors. To avoid the heat gain associated with bringing in substantial amounts of daylight, the team added exterior sunshading to protect against the hottest afternoon sun, while still achieving the optimal performance from the light-colored interior finishes used throughout the project. The team used natural ventilation to disperse the rest of the heat gain load.

The mild weather on the central coast of California allowed the project team to design a comfortable building without air conditioning. To accomplish the needed cross-ventilation, the classrooms have low windows on one side and high windows on the other, creating airflow through the space and removing additional warm air. When the team modeled cross ventilation, they found that by making the skylights operable, they could ventilate the rooms by bleeding off the hottest air.

With no mechanical cooling in the building, the team looked for ways to minimize the mechanical system for heating the building. The mild climate, again, meant the team could use a small system, which initially led to the idea of putting furnaces in the closets of the classrooms. They realized, however, that the furnaces would add noise and distracting ductwork to the classrooms, so a radiant heating system was used.

Water is also an important consideration in this region of California. Rain is seasonal, so cisterns have to store enough water from the rainy season to last throughout the long dry season. The team used dual flush toilets and waterless urinals, among other strategies, to reduce overall water use. A cistern large enough to supply non-potable water to the toilets in the buildings was installed, but the team learned that storing enough rainwater to irrigate the school's athletic field during the dry season was neither feasible nor cost effective. The energy needed to pump water to the field added a significant burden to the system and was one of the surprise energy expenses on the project.



Water Cistern

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As with all green buildings, key to Chartwell's success was ensuring the facilities perform as intended, which requires ongoing commissioning and monitoring. Good monitoring requires proper equipment and trained personnel to analyze the data. Allan Daly of Taylor Engineering, the engineering firm for Chartwell, makes the case for the project team to be involved in the commissioning and monitoring efforts early in the design and development process and to continue assessing these efforts once the building is occupied. He believes it is important for architects and engineers to see how their designs are built and actually operate, so they can apply lessons learned to future projects. Daly says that "seeing" the difference between the modeling data and the actual performance data has changed his practice. He noted that it was sobering to acknowledge that the predictions derived from the energy modeling were markedly different than the actual. The discrepancies were from two sources: incorrectly accounting for energy-use patterns and incomplete benchmarking data.

The project team continues to look for opportunities to reduce the Chartwell's energy use. Scott Shell and Allan Daly studied the data from the building control system and realized the site lighting was on throughout the night, which accounted for a quarter of the annual energy use. In the same data analysis session, they noticed high plug loads, which they traced to an old, donated commercial freezer. They replaced the inefficient freezer with an ENERGY STAR model. The school is currently looking for funding to implement a second round of performance studies to glean more lessons from the building as the project team seeks ways to improve the instrumentation and further cut energy use. Even after four years of occupancy, the team continues to evaluate the building, seeking ways to improve the building's operations and maintenance.

Though the project team ended up just short of its zero net energy goals, members learned valuable lessons that they have carried forward into other projects. Since the completion of Chartwell School, some of the project team members have gone on to achieve net zero energy use in a school in Marin, California. The valuable lessons learned on this innovative project have translated into future successes and those who were involved are able to be innovators throughout the community.

BEST PRACTICES AND LESSONS LEARNED

- The integrated design process was an important aspect of Chartwell's success. The process requires a collaborative approach that encourages open discussion and supports divergent ideas and solutions. In hindsight, the mechanical, plumbing, and electrical professionals as well as lighting consultants and facilities management staff should have been brought into the process earlier.
- Better benchmark data on building energy use is needed to make energy modeling more accurate and effective.
- Involve the project team in commissioning and monitoring efforts early in the design and development process.
- Do not assume the LEED credits will take care of themselves. Stay focused on ensuring all desired credits are being implemented as intended. If communicating often and effectively, this will not be an issue.
- Engineers need to think broadly. They need to not only be able to complete load calculations and size ducts, they also need to think about comfort and the way people use the building.
- Develop and implement a plan to educate subcontractors on green building and the LEED process, especially the primary subcontractors on the mechanical, plumbing and electrical systems. Keep it simple by illustrating the relevant features. Train facility management staff as well.
- Communication is critical to success. Develop a process and protocols so all the team members, including key subcontractors, can communicate often and effectively.



Building Control Terminal

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- Seek ways to capture and document lessons learned from current green building projects, so they can be easily applied to future projects. Find ways to make LEED practices the standard practices.
- Look at low-cost or no-cost improvements that can be easily implemented on all building projects.
- Keep strong lines of communications open with consultants until the end of the project. Because they are in the field, consultants can often provide the most up-to-date status report, which will prove invaluable during the last stages of the project.
- Consider tapping staff in the accounting and finance departments to help with LEED documentation. These employees tend to be overlooked, but their job requires a focus on accuracy and the ability to document, tally, calculate percentages and adhere to submittal requirements—all skills needed to ensure the LEED process is implemented smoothly.

- Documentation is critical, but make sure to strike a balance. Too much time and effort can be spent on triple checking data and reviewing the diagrams for submission.
- Involve occupants early in the design process to ensure they understand what a green building is and secure their support of it. Develop and implement a robust, occupant education program. Teach occupants about the building's sustainability features and outline the occupants' role in ensuring these features function as intended. Develop a program that helps occupants feel comfortable using the facility.
- Need to be vigilant about monitoring product usage. Even though green materials and products have been specified, subcontractors—if they do not thoroughly understand LEED—may default to old processes and grab the product that is most easily accessible.
- Facilities management needs high-end, professional as-built drawings to assist with maintenance.
- Develop a process to organize warranties, manuals and drawings to make retrieving these needed maintenance documents easy. Keep up-to-date with all that is happening in green building maintenance.



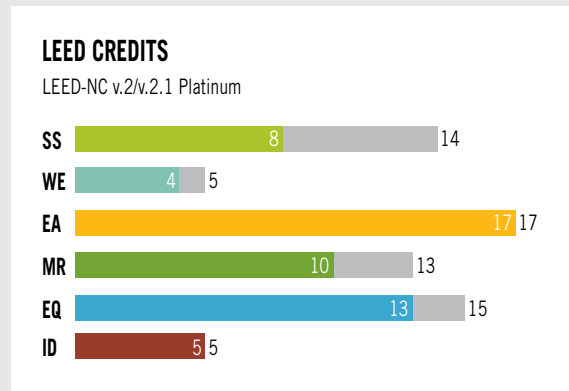
Vegetation

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PROJECT AWARDS

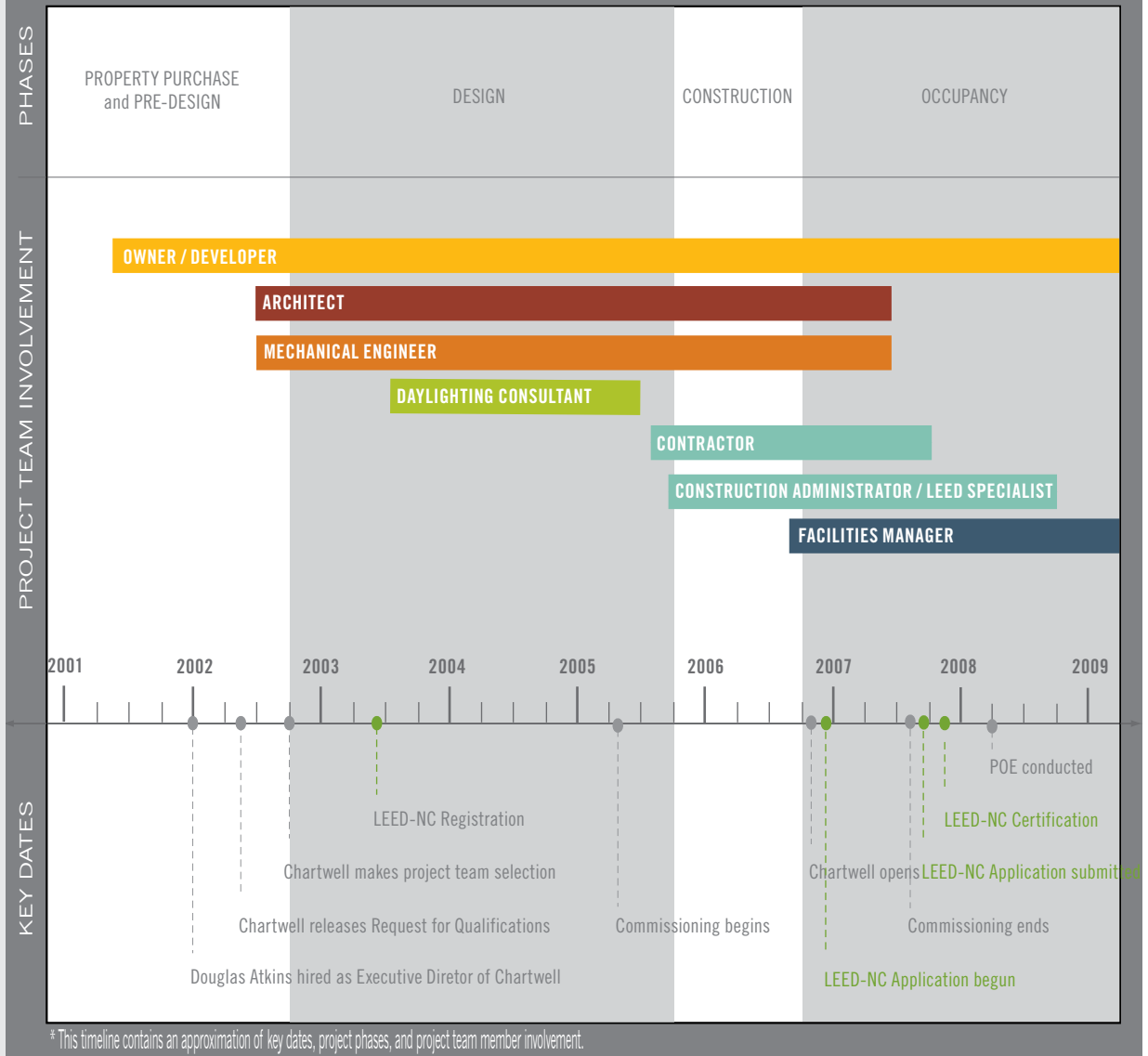
- 2009 Livable Building Award; University of California, Berkeley’s Center for the Built Environment
- 2009 Top Ten Green Projects Award; American Institute of Architects Committee on the Environment
- 2008 LEED-NC v.2/v.2.1 Platinum; U.S. Green Building Council
- 2007 Green Apple Award; Collaborative for High Performance Schools
- 2007 Honor Award – Energy & Sustainability; American Institute of Architects, San Francisco Chapter
- 2007 Environmental Award; U. S. Environmental Protection Agency

LEED CREDIT DISTRIBUTION



TIMELINE

CHARTWELL SCHOOL PROJECT TIMELINE LEED-NC v.2/v.2.1 Platinum



SCORE CARD: CHARTWELL SCHOOL



Rating System: LEED-NC v.2/v.2.1

Platinum 57 of 69 possible points



SUSTAINABLE SITES

8 of 14 possible points

x	x	Prereq 1	Erosion & Sedimentation Control
1		Credit 1	Site Selection
1		Credit 2	Development Density
1		Credit 3	Brownfield Redevelopment
1		Credit 4.1	Alternative Transportation, Public Transportation Access
1	1	Credit 4.2	Alternative Transportation, Bicycle Storage & Changing Rooms
1	1	Credit 4.3	Alternative Transportation, Alternative Fuel Vehicles
1	1	Credit 4.4	Alternative Transportation, Parking Capacity & Carpooling
1		Credit 5.1	Reduced Site Disturbance, Protect or Restore Open Space
1	1	Credit 5.2	Reduced Site Disturbance, Development Footprint
1	1	Credit 6.1	Stormwater Management, Rate and Quantity
1	1	Credit 6.2	Stormwater Management, Treatment
1	1	Credit 7.1	Landscape & Exterior Design to Reduce Heat Islands, Non-Roof
1		Credit 7.2	Landscape & Exterior Design to Reduce Heat Islands, Roof
1	1	Credit 8	Light Pollution Reduction



WATER EFFICIENCY

4 of 5 possible points

1	1	Credit 1.1	Water Efficient Landscaping, Reduce by 50%
1		Credit 1.2	Water Efficient Landscaping, No Potable Use or No Irrigation
1	1	Credit 2	Innovative Wastewater Technologies
1	1	Credit 3.1	Water Use Reduction, 20% Reduction
1	1	Credit 3.2	Water Use Reduction, 30% Reduction



ENERGY AND ATMOSPHERE

17 of 17 possible points

x	x	Prereq 1	Fundamental Building Systems Commissioning
x	x	Prereq 2	Minimum Energy Performance
x	x	Prereq 3	CFC Reduction in HVAC&R Equipment
1	1	Credit 1.1	Optimize Energy Performance, 15% New / 5% Existing
1	1	Credit 1.2	Optimize Energy Performance, 20% New / 10% Existing
1	1	Credit 1.3	Optimize Energy Performance, 25% New / 15% Existing
1	1	Credit 1.4	Optimize Energy Performance, 30% New / 20% Existing
1	1	Credit 1.5	Optimize Energy Performance, 35% New / 25% Existing
1	1	Credit 1.6	Optimize Energy Performance, 40% New / 30% Existing
1	1	Credit 1.7	Optimize Energy Performance, 45% New / 35% Existing
1	1	Credit 1.8	Optimize Energy Performance, 50% New / 40% Existing
1	1	Credit 1.9	Optimize Energy Performance, 55% New / 45% Existing
1	1	Credit 1.10	Optimize Energy Performance, 60% New / 50% Existing
1	1	Credit 2.1	Renewable Energy, 5%
1	1	Credit 2.2	Renewable Energy, 10%
1	1	Credit 2.3	Renewable Energy, 15%
1	1	Credit 3	Additional Commissioning
1	1	Credit 4	Ozone Depletion
1	1	Credit 5	Measurement & Verification
1	1	Credit 6	Green Power



MATERIALS AND RESOURCES

10 of 13 possible points

x	x	Prereq 1	Storage & Collection of Recyclables
1		Credit 1.1	Building Reuse, Maintain 75% of Existing Shell
1		Credit 1.2	Building Reuse, Maintain 100% of Existing Shell
1		Credit 1.3	Building Reuse, Maintain 100% Shell & 50% Non-Shell
1	1	Credit 2.1	Construction Waste Management, Divert 50%
1	1	Credit 2.2	Construction Waste Management, Divert 75%
1	1	Credit 3.1	Resource Reuse, Specify 5%
1	1	Credit 3.2	Resource Reuse, Specify 10%
1	1	Credit 4.1	Recycled Content, Specify 5%
1	1	Credit 4.2	Recycled Content, Specify 10%
1	1	Credit 5.1	Local/Regional Materials, 20% Manufactured Locally
1	1	Credit 5.2	Local/Regional Materials, of 20% Above, 50% Harvested Locally
1	1	Credit 6	Rapidly Renewable Materials
1	1	Credit 7	Certified Wood



INDOOR ENVIRONMENTAL AIR QUALITY

11 of 15 possible points

x	x	Prereq 1	Minimum IAQ Performance
x	x	Prereq 2	Environmental Tobacco Smoke (ETS) Control
1	1	Credit 1	Carbon Dioxide Monitoring
1	1	Credit 2	Ventilation Effectiveness
1	1	Credit 3.1	Construction IAQ Management Plan, During Construction
1		Credit 3.2	Construction IAQ Management Plan, Before Occupancy
1	1	Credit 4.1	Low-Emitting Materials, Adhesives & Sealants
1	1	Credit 4.2	Low-Emitting Materials, Paints
1	1	Credit 4.3	Low-Emitting Materials, Carpet
1		Credit 4.4	Low-Emitting Materials, Composite Wood & Agrifiber Products
1	1	Credit 5	Indoor Chemical & Pollutant Source Control
1	1	Credit 6.1	Controllability of Systems, Perimeter
1	1	Credit 6.2	Controllability of Systems, Non-Perimeter
1	1	Credit 7.1	Thermal Comfort, Comply with ASHRAE 55-1992
1	1	Credit 7.2	Thermal Comfort, Permanent Monitoring System
1	1	Credit 8.1	Daylight & Views, Daylight 75% of Spaces
1	1	Credit 8.2	Daylight & Views, Views for 90% of Spaces



INNOVATION AND DESIGN PROCESS

5 of 5 possible points

1	1	Credit 1.1	Innovation in Design: Blended Cement - Slag
1	1	Credit 1.2	Innovation in Design: Exemplary Performance WEc3
1	1	Credit 1.3	Innovation in Design: Educational Program
1	1	Credit 1.4	Innovation in Design: Green Housekeeping
1	1	Credit 2	LEED® Accredited Professional

DOUGLAS ATKINS

EXECUTIVE DIRECTOR,
CHARTWELL SCHOOL

I. PROCESS

THE FIRST PHASE OF CHARTWELL

For 20 years, Chartwell had been leasing a facility from Salvation Army on the other side of Seaside. It had been built as a public school in the 1930s. The building was literally falling down around us. All the mechanical systems were two or three generations old; it was about as bad as you can get.

I came on in 2002. The board had just acquired 30 acres on Fort Ord,¹ which was a pretty unusual opportunity. The stage was set at that point, and people said: “Here’s a chunk of land, and we’d like to build a new campus. Go at it!” It was really a blank canvas. I had previously worked on a couple of campuses—both K-12 and college level—and each time I had pushed the envelope and tried to see what could be done. Increasingly, people recognized that there is a link between the design of school facilities and the educational outcomes of the occupants. Each time we learned more. Over the decades we said things like: “Well, let’s go after this,” or “We wish we had done this in the last one.” Now things are making more sense, and there are more people willing to talk about and explore that connection.

In essence, our vision wasn’t necessarily that the school should be a green facility. The idea was that we should build the campus that resulted in the strongest educational outcomes for the students. That’s really what the mission should be for every school board. At that point, the process is about answering questions about what things mean, which people are doing what, what research there is, and what the literature shows. We searched for existing case studies; we considered all of those things, and the more we looked into it, the more we found that the U.S. Green Building Council (USGBC) and the Collaborative for High Performance Schools² (CHPS) were paying attention to those issues in a serious way. We collected ideas from all the things those groups had been doing. The USGBC hadn’t developed a program



DOUGLAS ATKINS, Ed.M., has been the Executive Director of the Chartwell School since 2002. Prior to accepting the directorship of the Chartwell School, he founded the Janus School, a K-12 school for children with dyslexia and related learning difficulties, in Lancaster, PA. He also helped found Landmark College, the only institution of higher education to serve learning disabled students in North America, located in Putney, VT.

¹ Fort Ord is a former U.S. Army post on Monterey Bay in California, established in 1917 and closed in September 1994.

² The Collaborative for High Performance Schools (CHPS) is the United States’ first green building rating program designed for K-12 schools. CHPS provides information and resources to schools in order to facilitate the construction and operation of high performance institutions.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes prepared this narrative. © 2009 U.S. Green Building Council and the University of Oregon. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the permission of the USGBC.

specifically for schools, but it had an incredibly strong foundation of principles meant to lead to increased productivity within the commercial sector. We knew there was a link between occupant performance and facility design. In education, productivity is measured in educational achievements. How can we boost the students' ability to be inspired by educational processes and allow them to learn demonstrated skills and content without being able to have more face-to-face interaction? We tried to solve that problem in our own way by looking at the things we know are working in many other venues. We decided to incorporate those lessons by studying the research that had been done. For instance, we looked at information about daylighting and indoor air quality. As we looked at those studies, we decided we shouldn't have to struggle with those problems ourselves, since others had already dealt with those issues.

SELECTING THE DESIGN TEAM

We approached John Boecker,³ an architect who had already begun to make significant moves toward integrated design. I had worked with him in Pennsylvania. He was now on the USGBC's steering committee. I asked him to educate me about the paradigm. I wanted to know how it would apply to a school and what he had learned in the 10 years since we had worked together. As he described these things I asked, "What's the first move to make?" His suggestion was to engage all the constituents at every level: students, parents, faculty, administrators, trustees, donors, and community leaders. He said we should interview everybody in order to create a vision about what constitutes a good school. He suggested we pose questions in such a way that they don't presume what the outcome is going to be. We wanted to listen very carefully to what was most needed in order to take care of the next generation. How were we going to do well by them?

As we engaged that process, we started to compile a programming report, which turned out

to be 50 pages long. It was amazing. We had the students draw pictures of what they thought a school should be. Some of those were whimsical, and some of them were very analytical; it was really amazing to see what they prioritized. We brought all this information together, and what came out of this picture was a programming document. It allowed us to establish a process of sending out the programming document as part of a broad RFQ.⁴ We would ask anyone who was interested in this process to talk with us about how we could do all these things. We were surprised. We got several dozen responses from across the country, and they weren't from incidental, small firms. We thought, "Oh, we're just a little school in a small community. We'll just have some local architects respond." But we got responses from significant firms from across the country. They were saying, "This represents a significant opportunity to do something we've wanted to do for years, and it sounds like you're the client we need. We don't have to convince you of the value of this stuff. So let's work together."

We had a small committee review these responses, and we boiled down the pool to three firms. Then we taped interviews with the final three, studied them, and ended up selecting a team headed by Scott Shell⁵ from EHDD Architecture.⁶ It was the right process. With our luck, and with having the right people from the right team, it turned out to be a great experience. One of the other important things that emerged in the programming report was that we wanted to make the facility a part of the educational experience. We wanted to maximize the educational opportunities by exposing systems and structures, and by designing places where kids could interact in a healthy way with each other and with adults. We looked at how we could create an environment that is an art form. Not everybody focuses on that.

EHDD Architecture had this great project at the

³ John Boecker is a principal of green building consultancy 7group and Director of High Performance Green Design with L. Robert Kimball & Associates.

⁴ RFQ is an acronym for Request for Qualifications.

⁵ Scott Shell was the principal at EHDD Architecture responsible for the Chartwell School.

⁶ EHDD Architecture is an architecture firm in San Francisco, California, and was the architectural firm responsible for the Chartwell School.



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Arriving at Chartwell "I wanted the building to make [kids who might feel anxious about the educational process] feel welcome, and I wanted it to become a place where the faculty could feel respected... it had to be a place that had curb appeal."

Monterey Bay Aquarium, which is right in our community. Anybody who walks into that facility automatically feels drawn into the building by the way things are laid out. You can touch, see, and feel things you couldn't feel in a more conventional building. We knew that they already understood how to create the environment we were striving for; we saw that they had already established a track record of high-level, sustainable buildings. Scott Shell was clearly very passionate and intelligent. What I liked was that when he presented, he brought the engineers with him and said, "Here's the team." That was another paradigm shift. I saw that architecture isn't, as it might have been a couple of generations ago, just about aesthetics, massing, and color selection. You need engineers to be part of the team as early as possible, in order to achieve those sustainability goals and show that your investment is going to perform in energy efficiency, air quality, and daylighting. They have to pencil out the solutions that can't be intuited,

and they have to check that the theoretical performance is actually what you get when you walk into the building and flip the switches.

They worked collaboratively, from the very beginning of their presentation, in a way I hadn't seen in other presentations by other design firms. I really liked that. Allan Daly⁷ was at that presentation as the mechanical engineer, and they were interacting so well, it almost seemed as if we weren't in the room. They brought a model that was just blocks, and they showed us how we could play with things. One of them would come in and say, "What if you do this?" They weren't trying to convince us that the solution was already decided, or that it was about them. They really wanted to get our input. They wanted to know what the mechanical guys thought they could do. They would say, "That's an interesting idea. We hadn't thought about

⁷ Allan Daly is a mechanical engineer at Taylor Engineering, where he was responsible for the Chartwell School.

that.” They both had senses of humor and collegiality. Those things spoke volumes of information we wouldn’t have gotten if we’d just asked for a written response to a proposal.

II. DESIGN

ESTABLISHING PROJECT GOALS

The specific things I advocated for were not necessarily details; they were principles or feelings that I wanted people to experience in the completed facility. I wanted to convey the notion that it was a pleasant place to be. I wanted it to be a place that was calming to kids who might be anxious about the educational process. I wanted the building to make them feel welcomed, and I wanted it to become a place where the faculty would feel respected. The building was meant to be a tool that could be used in the educational process. It had to be a place that had curb appeal. It needed to be a place where people would say, “This is interesting. There must be interesting people here who are doing interesting work, and I want to know more about it.” That’s what I wanted to come out of the process. Then, as people engaged us off the curb, and came through the buildings, I wanted that feeling to be reinforced, layer upon layer upon layer, so that by the time they had experienced everything here, they had fundamentally changed their perception of what a school could be.

There was a lot of emphasis on conventional solutions. We spent a lot of time doing our homework so that we could communicate to our decision makers: the governing board, the school board and the potential donors and investors. I became the messenger who had to express the credibility of this vision so that everybody would get behind the idea of building a great, affordable school. We had to answer the questions about whether we needed the green technologies. People wanted to know if our concerns were political. We had to dispel the myth that green is just a code word for buying a lot of things which are nice to have, but that aren’t necessary. We had to address each of those issues in a way that people who’ve spent their lives developing mobile home parks, conventional tract hous-

ing and commercial buildings could make sense of our decisions. Those people were primarily concerned with maximizing their income per square foot. It was a great challenge for everybody to understand that it wasn’t just about the politics of being green: it was about the deeper meaning of sustainability. Then we began to understand that it’s really about integrated design as a procedure. It’s about how integrated design benefits those downstream, both economically and educationally, if it’s done correctly. That initially wasn’t accepted as a truth; it had to be explored, challenged, and backed up. There had to be hard data, and we had to bring in folks from the private sector. We consulted people like Bill Hayward,⁸ who had already explored those ideas in the for-profit, manufacturing sector, and academics like Dr. Philippe Cohen⁹ who had applied similar ideas at Stanford’s Jasper Ridge Biological Preserve research facility. Hayward discovered that green is good for the bottom line, and Cohen saw how integrated design mirrored nature’s prime directives. Slowly, our governing body figured out that this wasn’t just a fad. They figured out that it makes sense economically, and then they allowed me to assemble a team that understood how to present sustainability and integrated design in a way that was comfortable, intuitive, and answered questions. We learned about things like lifecycle cost analysis,¹⁰ and used it as a way of anchoring our economic decisions instead of looking at each isolated line item in the construction process. If we choose things for their educational benefit, which is our mission, then we spend a nickel more on daylighting, but we’ll get better outcomes from our students. We’ll get lower utility bills, because we need less electricity. We can downsize our mechanical systems, because we’re using passive methods, and we’re making the most of the thermal gains from the window systems. We now talk in terms of investments

8 Bill Hayward is President, CEO and Director of Sustainability for Hayward Lumber Company, based in Monterey, California, and is a member of the Economic Chamber of the US Forest Stewardship Council (FSC-US) Board of Directors.

9 Dr. Philippe Cohen is the Administrative Director of the Jasper Ridge Field Station at the Jasper Ridge Biological Preserve.

10 Lifecycle cost analysis (LCCA) is a method for assessing the total cost of facility ownership that takes into account all costs of acquiring, owning, and disposing of a building or building system.

instead of costs, which has been a paradigm shift for folks who are often chasing the bottom line. Once we started to see concrete solutions emerge during the design process, such as daylighting, then, increasingly, people started to think about where else we could implement those big ideas. We looked at water, and then we decided to capture some water on the roof. Here, water credits drive development: if you can't get them you can't develop.

After daylighting the school we saw that it was economical to develop renewable resources in order to generate our own electricity. We only need 50% of what a conventional school would need because Chartwell is daylighted. We saw that we could shoot for the goal of net zero electricity. That was feasible because we took advantage of the rebates and the state Savings by Design¹¹ program. The technological solutions started to solve the financial problems. Once people saw those goals coming together they really caught on. Internally, we understood the core issues well enough that when we made presentations to donors, investors and bankers, they knew it wasn't a superficial pursuit for us. In fact, they started to see that we knew more than most people who build schools. That showed that we were ultimately centered on the best interests of the students. That mattered to folks who were philanthropically oriented, because they wanted to know if we could be effective in our mission. They needed assurance that if they invested money it was going toward something innovative, long lasting, and sustainable – something that would fundamentally improve the educational experience for our students. We saw a significant increase in our ability to raise money. We brought in an energized base that understood that this was not just fad. They knew it was universally applicable and could be set up as a model for other folks to follow. There were people who were going to give \$5,000, but then all-of-a-sudden decided it was worth it to give \$25,000. We had a number of seven-figure donors who emerged because we decided to

make a commitment to integrated design. They saw this as something very significant, and they wanted to get behind the project to trigger other, similar types of activity in the community.

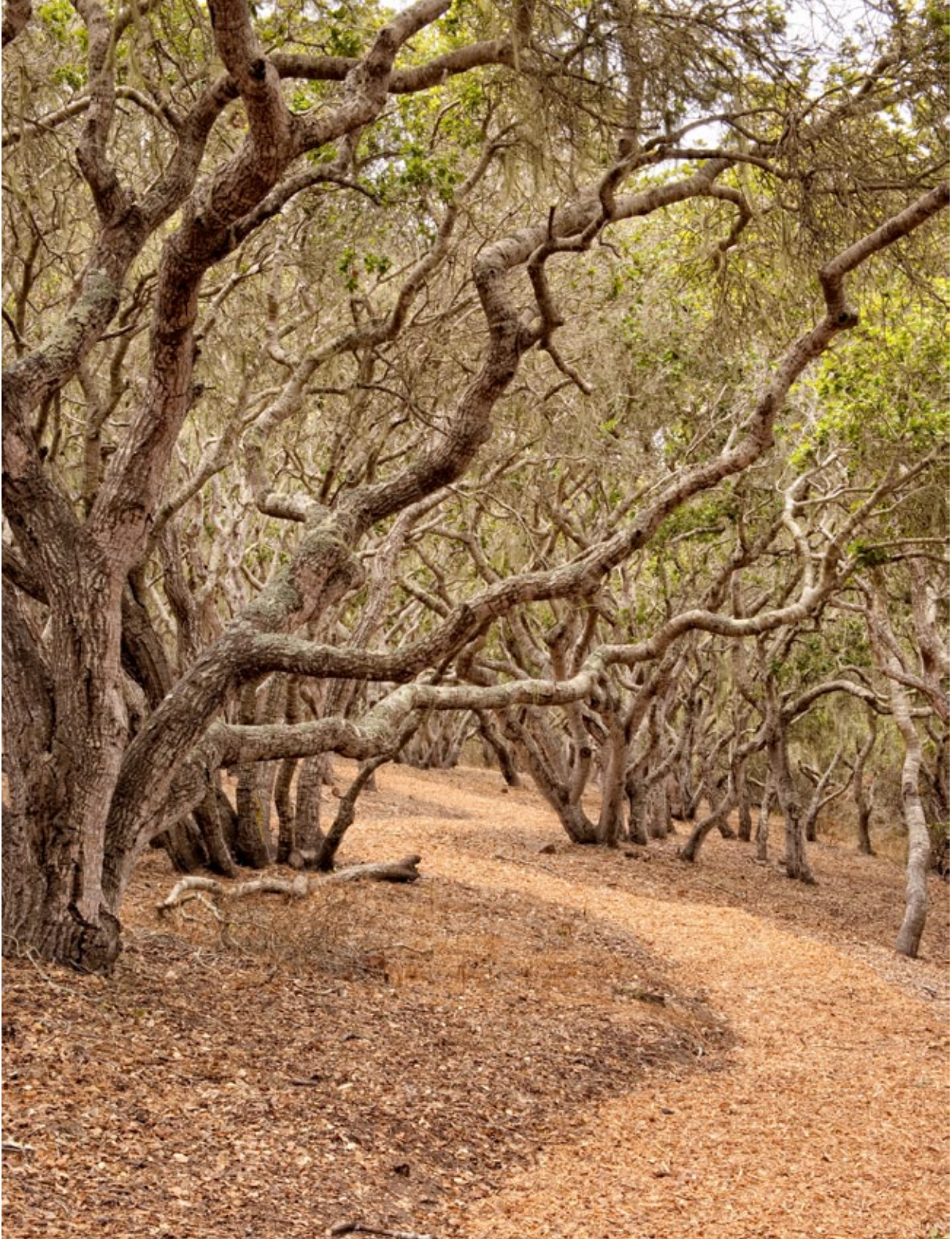
These ideas have been growing over the last few decades, but I added to this mix the somewhat unusual experience for an educator of also having been an engineer. I knew that passive design and thermal control were theoretically possible. Those are not ephemeral ideas if you're an engineer. The issue then becomes what we can and cannot do according to the laws of physics. We were able to challenge the engineering consultants, because we were confident the challenges could be met. We asked how certain things could be done instead of asking if they could be done. That placed the bar at a different point in terms of performance, engagement, and commitment to what the ultimate outcome was going to be. We knew that a lot of stuff could happen, but we had to be smart about it. As a former naval engineering officer, I knew that before there was green or integrated design, there was just smart design: how do you get everything to work together while using the fewest environmental resources? How can you ensure that the people who live in the ship, house, or building are happy about what they're doing there?

SHARING IDEAS

In design charrettes, there are a lot of different opinions expressed, and they can be expressed in a very animated and passionate manner. When trying to reconcile different views on how to accomplish something, egos can emerge. Then people get bruised, and things can happen that unravel the process. What I came to understand about EHDD was that they have always been extremely client-oriented, since the very founding of their firm. It wasn't simply about their virtuosity as designers. It was about melding what the client was looking for aesthetically and functionally, then leveraging the technical ideas to help clients achieve a deeper level of mission effectiveness.

Through these design charrettes, they were able to hear a cacophony of input. Where most people would melt down, or get frustrated, they

¹¹ Savings by Design is a program to encourage high-performance nonresidential building design and construction through design assistance, owner incentives, and design team awards. It is sponsored by four of California's largest utilities under the auspices of the Public Utilities Commission.



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The Nature Path "At a certain point, by being able to stop thinking about the technical aspects of accruing points in a protocol, a wall goes down. You actually have an opportunity to go into some new territory."

would be very congenial and fun. They would challenge themselves by looking for ways to do what we were asking them to do. They showed us they could think out loud. They shared their thoughts. Then, they would leave. They would come back, a couple of weeks or a month later, and present something better than anything from the charrette. After a couple of iterations, we learned that we didn't need to get wrapped up in what we thought the project was going to be. We could leave that to the people who do that work. Now we trust them. We can express ideas, concerns, and fears, especially if we're worried about the cost, even if we don't really know what the outcome is going to be. They'll come back and show us how those things can fit together. It was really a true integration, with lots of input, and it was better than what any of us had imagined the process could be.

THE LEED PROCESS

We didn't start out thinking we were going to build a LEED¹² certified building. You can build and not be certified, and you can build using ideas from LEED, but still not take part in LEED. You'll still end up with a great facility. We thought that we could get a more progressive solution by following the LEED protocol, and so we went for it. We thought, "We'll get a feather in our cap because we went through this process." It's important to demonstrate these things. If folks have gone through the trouble of developing such a thoughtful and deliberate protocol to achieve an important outcome, then let's lend our shoulder to that wheel. Let's engage those ideas, and see where they take us. We didn't know if we could afford the process of achieving the higher levels of LEED certification. We understood that if you were going for a Certified or Silver level, then probably the cost differential was zero; just by thinking differently you don't really incur any additional cost. Gold was a little harder, and since there were no Platinum schools at the time, we were going into unknown territory. Since EHDD Architecture solved many problems in order to meet the

criteria of points in the LEED protocol, we saw that it was well within our reach to get a Gold building. The costs were really not significant, certainly less than 3% of construction costs, maybe even 1%, if that. It was within the margin of error of any construction project, and we could use the funds kept in reserve to deal with unexpected costs. We thought, "Okay, we'll just manage this process professionally, and by not making foolish errors, we'll save the amount of money it costs us to invest in these things." We ended up realizing that we could hit Gold fairly easily, and it was a nice place to reach, because Gold was laudable for a group that hadn't started out to build a green building. We thought we were in good company, and it allowed us to lessen the pressure of thinking about LEED or thinking about green. Then, some of the more subtle benefits of sustainability started to creep into the process. At a certain point, by being able to stop thinking about the technical aspects of accruing points in a protocol, a wall goes down. Then, you have a permeable relationship with things that can happen which are not based on accruing points. You actually have an opportunity to go into some new territory, explore things, and come up with some solutions that may not have been tried before. What we discovered, collectively, was that the financial and educational benefits were derived from our deeper, strategic commitment to sustainability. We then became focused on the pursuit of going beyond Gold. We became adept at understanding lifecycle cost analysis and integrated design, and we started to play with those things. We started applying them in ways they hadn't been applied before. That's where some of the mechanical solutions came from. That type of thinking allows systems like the air handling to be done more efficiently than they had been done before. Those technological breakthroughs allowed us to feel more confident that we were in the right place with our motivation, and we began to pursue more things. We started to attract enough attention in our capital campaign that we could actually pitch some of these ideas to people who had made breakthroughs in other fields, like high tech, and had become quite wealthy. We pitched to foundations that had been inspired by similar, innovative processes in other applications. We

12 The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), is a suite of voluntary standards for green buildings.

really resonated with them, and that's when we found ourselves in a place we didn't anticipate we would be.

We were seen as visionaries, and we weren't just teachers any more. We weren't just the private school that was chugging along and working hard. People wanted to meet us, people from foundations like the Kresge Foundation.¹³ We just couldn't believe that pursuing these good ideas and working with a great team created interest among national foundations. That really had a profound effect on all of us. It bolstered us to continue to do more, and to do it better. We got smarter, and we documented what we were doing. We remain committed to the study of the building and its performance. We want to share the lessons we've learned and the information we've gathered. It just builds and builds.

III. CONSTRUCTION

THE CONSTRUCTION PROCESS

During the design process, we worked for two years with a general contractor who was located outside of the region. They had done a number of incredible LEED buildings and were a dream team in many ways. What we came to understand was that if you have the right design team up front, and you accumulate a first rate specification book, then it's like a cookbook. If you follow it, then you'll get good outcomes. Once we realized that, it was a question of finding the general contractor, which is really an issue of attitude. Once they've demonstrated a certain technical capability, and they have the specifications, they just need to follow them. They need to work in the spirit of the project, know what the client's goals are, and work smoothly with the design team to solve problems. Plus, they need the right subcontractors.

The economic factors of the field had changed in the two years since we started working with

our preconstruction group. The costs of concrete and copper were out of control because of big, civil engineering projects in China. Then, Hurricane Katrina¹⁴ projects were using up all the drywall; a lot of things were happening that started to change the construction cycle. Costs were jumping up by 30%; that triggered us to begin a rebidding process to determine the general contractor. We were always going to bid the construction job. So we followed through with that bidding process. We got large, statewide firms for whom this was just a small project. But we also got bids from some very capable, mid-size firms that had done high quality work. We also got bids from some local firms that had done schools or equivalent buildings; they had demonstrated that even though they hadn't used green construction techniques, they did do high quality work. We got the figures from that bid process. There was a variation of maybe \$500,000 in an \$8 million project. That's enough to pay attention to, but not enough to completely eliminate someone, because this was never about the low bid getting the project. It was about the lowest responsible bid, and it was about who had the right idea about what needed to happen.

In addition to being committed to financial responsibility and the integrity of the vision, we realized that one of the important roles of the project was to build expertise in the community. That was truly sustainable. Then people wouldn't have to go outside the community, and builders could work on a larger scale and capture a larger market share. We wanted to demonstrate that this could be done locally and competently, and that it would trigger other, similar projects in the community. We ended up hiring a local general contractor, Ausonio Incorporated.¹⁵ They came on the project even though they had not done a LEED project before. They hadn't really done a green project at that point, but there wasn't anything exotic about the technology at Chartwell that required specific expe-

13 The Kresge Foundation is a U.S. philanthropic private foundation dedicated to building stronger nonprofit organizations. It was established in 1924 by the founder of Kmart, Sebastian Kresge. One of its main programs, the Green Building Initiative, which was launched in 2003, is intended to increase the awareness of sustainable or green building practices among nonprofits and to encourage them to consider building green.

14 Hurricane Katrina, which made landfall in the southeastern US in August of 2005, was the costliest hurricane in the history of the United States, particularly causing severe loss of life and property damage in New Orleans, Louisiana.

15 Ausonio Incorporated is a construction firm located in Castroville, California.

rience. We broke ground in September of 2005. We opened for the first day of classes in September of 2006. In 12 months, they built everything you see. That says a lot about somebody who has a can-do attitude and can come in and do something they've never done before. It wasn't a wrinkle-free process, but no construction process is. The attitude that they could work out those issues in the field, maintain integrity to the vision and outcome, as well as understand that they're doing something significant is what makes you want to bring that out in the rest of the community.

I was the owner's representative on the project, and Scott Shell had told me that the more the owner is involved in the design and construction process, the better the outcome is. I took him at his word, and was very busy making it my business to know how things were going. I was truly interested in everything that happens from the earth moving, subsurface draining, and engineered backfilling behind a mortar-less retaining wall at the very beginning of a project, through the components of radiant floor heating and the technologies that go behind the wall. I'm naturally interested in those things, and I was at every meeting. Sometimes I would call meetings where lots of folks needed to be brought together to let them know our perspective and commitment to arriving at a solution in a timely, affordable manner. That's an important thing for folks to hear from a client. Then they won't allow things to go too far in a direction that we're not happy with, because that causes repercussions later on. So, I was very involved.

IV. OPERATIONS

OCCUPANT TRAINING

I'm always asked, "What would you do differently?" Occupant training is one of the things I would do more. Our adage now is that it takes a very active occupant to manage a passive classroom. Instead of coming into a room and pushing a light switch or turning a thermostat dial, even if you have access, you now have to consider cross-ventilation, opening windows, and skylights bleeding off warm air. You have to look at

your thermostat settings to predict what the solar gain is going to be two hours from now, when the fog burns off, and it's hot on the south side. There are a number of other things to consider, like the automatic mode of the ventilators connected with CO₂ monitors. What does that level say about your students' ability to pay attention in the classroom?

We spent some time orienting the faculty. We'd come in during the construction process and let them see some things as they were happening, even before the roofs were on. We even had some of the older students come in right after the drywall went up. They had the first class in here so they could say they were the first ones in the school. They wrote all over the drywall, and they had a great time. We tried to develop feelings of ownership throughout the process. We didn't want to just hand them the final outcome. I think that's really important.

Now, I would spend more time orienting the faculty about some of the more significant, yet subtle, implications of working in a facility like this. I'd help the teachers appreciate that they need to deal with technology differently, and let them know they need to give feedback about the building. When they do that, then that informs their behavior, and there's this big feedback loop going on. How do you become a part of that? How do you feel comfortable managing that? How can you take that kind of information and real-time performance data and bring that into your curriculum? What are the opportunities there? Our building information systems have collected all this data since we started up the building, and the teachers can access that wirelessly in each classroom to use it for math or science curriculum, or other kinds of investigations, to the extent that they feel comfortable doing that. Not everybody's going to do that. I would spend more time developing processes, curriculum, and professional development so that they can become more comfortable using the facility. I want them to be comfortable with the building, in terms of managing their classroom, but they should also leverage the building into the curriculum. Then, these kids will essentially be sustainability natives of the building, which is what's happening over time with these little guys. I would do much more of that.

LESSONS LEARNED

Technology will only get you, at best, 70% of the solution. The final frontier, the last 30%, is human behavior; it's a frame of mind. In my opinion, that 30% of investment in what the occupants do should be built into the commissioning and certification processes. That demonstrates that all the occupants know the baseline of what they're inheriting, and what they're going to be using. It's not uncommon when you build hardware, like a ship in the Navy, that you don't just commission the hardware itself. That's the early, concrete part of things, where it either works or it doesn't. You have to put the crew on it; you have to bring the faculty into the building and find out if they know what they have. If they know how to use it, then they'll feel comfortable with it, and then they'll do things which are unanticipated and unknown. Yet this adds an advantage to what the kids are going to be doing in the building. To me, that is a huge thing. On the next school I do, I would spend much more time exploring what that could mean.

If a client is going to go through the trouble of engaging something as involved as LEED protocol, especially at the higher levels, then they're already at the point where it shouldn't just be a core group of people who know why it's valuable. It should be everybody who's going to be involved in the facility, because they will use their networks to magnify the value of what's gone on. That's how this stuff will proliferate exponentially, instead of just in a linear manner.

This narrative is based on a video- and audiotaped interview conducted by Kristen DiStefano on July 24, 2009, at the Chartwell School in Seaside, CA.

SCOTT SHELL

PRINCIPAL,
EHDD ARCHITECTURE

I. PROCESS

GETTING THE JOB

The Chartwell School began when we were contacted to interview for the project. They interviewed a number of firms that were very qualified in the sustainable design and low energy design arena. The head of the school, Douglas Atkins,¹ had previously worked with some good people on the design of a sustainable school project and had a good understanding of sustainable and low-energy design.

SETTING GOALS

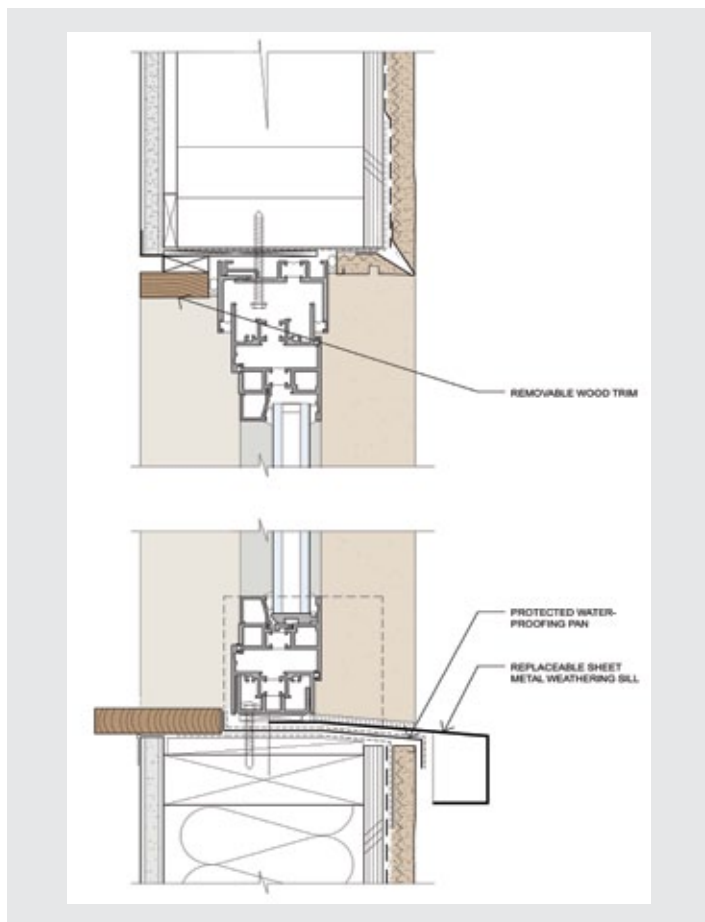
Fundamentally, the goal was to design a high performance school that would really help kids by creating an exceptional learning environment. It is a school for kids with learning differences, primarily dyslexia, and they've come to this school after struggling with their learning challenges. They didn't understand why they were struggling in school, and so of course that was not a positive experience. When they come to Chartwell, they learn how to advocate for themselves and how to succeed in the classroom using specific techniques and highly focused teacher-student interactions. The intent of this high performance design was really focused on helping the kids succeed. Douglas had seen the research on how daylighting and good indoor air quality help kids stay focused and alert, especially after lunch, and that's the kind of environment he wanted to create. He understood the profound alignment between the educational vision of the school and this sustainable design vision. He came to us with that fundamental realization, so we started at a much higher level on the sustainable design discussion than we do with a lot of our clients. From there, we started the process of engaging the design committee and the board. We led them down this path, and worked with them to understand what kind of school they wanted and how the architecture could reflect their vision of the school and support their educational philosophy. It was a wonderful process with a really informed client.



SCOTT SHELL, AIA, LEED AP, joined EHDD in 1996 and is the firm's Director of Sustainability. Scott has directed a number of EHDD's most successful high performance projects.

¹ Douglas Atkins is the Executive Director of the Chartwell School.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes prepared this narrative. © 2009 U.S. Green Building Council and the University of Oregon. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the permission of the USGBC.



Window Detail "We developed details so that we could take a window out of the wall without touching the surrounding finishes while making sure it was still completely watertight."

II. DESIGN

DESIGN STRATEGIES AND TECHNOLOGIES

I've worked on a number of schools. When I first moved to California, I worked for an architect who designed schools; so there were several issues that, in my experience, had been crying out for attention. I worked on a lot of school modernizations where the windows needed to be replaced. You start to take the windows out, and they're buried behind the cement plaster. You start peeling the cement plaster back, and pretty soon you just say, "Well I'm just going to reclad the exterior of the building." Then on the inside you say, "Well, we really need some new internet connections, and we need some new fiber optics here, and we need more power outlets." You start pulling the interior finishes off to update the systems and utilities, and pretty

soon you're down to the structure. Once you've got all that stuff off the structure you find there's some rot and mold here and there. Then you start replacing the structure, and you've got to do a little seismic upgrade, and pretty soon it's cheaper to tear the whole building down. A lot of buildings get demolished because of the cost of those incremental improvements. One of the things we wanted to do was to figure out how the building could have a longer life by making it easier to maintain over a long lifespan. We were very fortunate to get a grant from the local EPA² for Design for Deconstruction,³ and we developed details so that we could take a window out of the wall without touching the surrounding finishes while making sure it was still completely watertight. We found routes for utilities in order to update and replace them without ripping all the sheetrock off the walls. We used carpet tiles so that we could replace areas that were worn or stained, rather than replacing the whole thing. In addition, we developed a series of details that in addition to allowing for disassembly and recovery of materials at the end of the building's life, also allowed for disassembly and access for ongoing maintenance to keep the school in better shape while spending less money.

The other strategy I suggested for the project was to try to daylight every room. Schools are great candidates for daylighting, because they're open predominately during daylight hours, and because we know that daylighting really does make a difference in students' learning rates. Too often people put in windows, and then think they've daylit the space. Our goal was to daylight the space so that we could keep the lights off most of the year. We save the school the energy and cost of the energy, and then they can put that money back into paying for teachers or other educational venues. We decided that we would try and daylight every space in the building – the corridors, the classrooms, the multi-use building, but also the bathrooms, service spaces, offices, and everything else. We wanted it to be

² EPA stands for the Environmental Protection Agency.

³ Design for Deconstruction is a building design movement that encourages adaptation and reuse as methods to extend the usable life of materials and therefore reduce raw material consumption.

daylit in order to save energy, but also to fundamentally create a better learning and working environment. Daylighting has been a hallmark of our firm for decades, and we've found that it makes more of a difference to the people who live and work in these buildings than a lot of the sustainable strategies you might not see, or than some contrived architectural idea.

We like to have a daylighting consultant on a lot of our projects. We work with Loisos + Ubbelohde⁴ a lot. Jim Benya⁵ assisted with lighting and daylighting on this project, and we find that it's one of the most difficult things to get exactly right. You have to balance the desire for daylight with the need to avoid the glare of too much sunlight. In some of our project types — like a library — if the sun is streaming in on a certain seat, you can just move to another seat. In an office or school, you can't. If you're sitting there trying to read, and the direct sunlight is hitting your desk or your face, then it just doesn't work. The teachers close the blinds, and the lights come on because of the daylight sensors. Also, in this case we were committed to designing a comfortable building without air conditioning. If you let the direct sunlight come in through your windows, you're going to overheat. You have to start shading the glazing and balancing that with your daylighting and the colors of the interior finishes. All of those things make a difference. In a classroom, in particular, you want some focus on the front of the room where the teacher is; you want to focus the daylight there and not just at the perimeter where daylight often comes in. George Loisos⁶ really helped us refine that and come up with a system that we thought made a lot of sense, and in practice I think it's working pretty well.

Water is a really big issue in Monterey County, where they have real limits on the availability of new water sources. We focused a lot on water efficiency by using dual flush toilets, waterless urinals, the rainwater collection cistern, and a

very efficient irrigation system. But it's a school, and they have a big soccer field since the kids need to run around and play, which is especially important as an outlet where these students can excel outside the classroom. The irrigation water completely dominates the building; I'm a little conflicted on where to go with that. We've done a number of rainwater cisterns, but they do have ongoing energy and maintenance costs, and embodied energy costs. Since we only get rain a few months out of the year in our climate, our irrigation needs are not well matched with our ability to capture rain in a cistern; it is not practical to store that much water seasonally. If we were in a climate where we got rain on and off all year, then a cistern would be easier to justify. We're still trying to figure out what the best balance is here.

More and more, we're seeing municipal recycled water systems, and I think that is a great solution, though it's going to take a while for those systems to be built out. Some issues make more sense if they are dealt with at a larger scale -- at the municipal or community level, rather than at the building scale. We've been convinced that it generally doesn't make sense for every building to try to treat all its own wastewater independently; that should be a shared function. If we, as the design team, can help facilitate these community scale solutions, then that would be good. We don't have to do everything by ourselves.

One of the great successes of sustainable design has been the treatment of stormwater. That's an area where you really can reduce costs if you deal with it in a sustainable manner, by dispersing it and allowing it to infiltrate the ground. You deal with it in the landscape, as opposed to building an infrastructure, and then you get more attractive site plans, less paving and infrastructure, and you start to stitch the ecology of the site back together. That's been a real success in sustainable design efforts.

GRANTS AND INCENTIVES

The school approached us early in the project with the idea of applying for a Kresge green building planning grant. The Kresge Founda-

⁴ Loisos + Ubbelohde is a design and consulting firm in Alameda, California.

⁵ James Benya is a principal at Benya Lighting Design in West Linn, Oregon.

⁶ George Loisos is a principal at Loisos + Ubbelohde in Alameda, California.

tion⁷ was very generous and really helped support a whole range of initiatives. The Kresge grant helped fund the LEED Platinum⁸ certification, and they helped fund some advanced energy modeling. They helped fund research on the high-performance design; that was a tremendous benefit. There were also the usual incentives for the renewable energy, including the state rebates. One of the goals was to design a net-zero electrical building, or a grid-neutral building, which would generate as much electricity as the building uses over the course of the year. In California you get a state rebate of a certain amount per watt of installed PVs.⁹ You get a federal tax credit and accelerated depreciation if you're a tax paying organization. In the end I was shocked at how cost effective the PVs were. For years I thought that PVs were a great thing, but that they were too expensive. However, the cost of the PVs was about 1.6% of the cost of construction. I was stunned at how affordable they were. We routinely value engineer 10% to 15% out of the cost of our projects; we can afford the PVs, we just weren't prioritizing them. We have had a clear mental shift about that in our office after learning from the first projects we specified them on, and now we have started putting renewable energy on most of our projects. We're now getting not just zero electrical, but zero energy¹⁰ on a number of our projects; it really is feasible. That was quite a surprise and a transformative lesson for us.

FORMING THE DESIGN TEAM

We've found that our team is the critical piece. Those are the people who are going to do the work and who have the ideas. They are able to communicate effectively to the client. I try to keep up with the research, because the field is changing very quickly. A few years ago, we didn't

even have LEED, and a zero energy building was thought to be impossible. Look how far we've all come in a short time. I spend a fair amount of time looking at other people's work, going to conferences, listening to presentations and trying to understand who's doing good work and who's really trying to do exceptional, sustainable design work. I consider Taylor Engineering¹¹ to be one of those groups; they have people like Allan Daly¹² and Gwelen Paliaga.¹³ Gwelen's graduate work was at the Center for the Built Environment,¹⁴ and he had an excellent background in comfort research. He brought that connection to the academic research side, which brought that expertise to our team.

For our in-house team, we try to put together a range of skills. We need a project architect who's strong technically; someone who can put together all of the documents and design a good set of drawings, so it's easy to construct and keep change orders to a minimum. We need younger staff that do a lot of the work and get all of the drawings done. Our job is to mentor them and develop them, while still allowing them to contribute to the process along the way. At the principal level, we focus on design, client communication, and making sure that high-level sustainable strategies are met.

We partner with team members outside of our office from the very beginning. With a school, you have a classroom, and you know roughly what size it is. You can start figuring out how to daylight it right away. The thing that's challenging about daylighting is that too often architects design the building, and then try to figure out how to daylight it. That rarely works. You have to let the daylighting shape the architecture. You have to do it from the very beginning, from the inside out, or it's going to be an afterthought.

7 The Kresge Foundation is a private, national foundation that provides support for nonprofit organizations in areas of health, the environment, community development, arts and culture, education and human services.

8 LEED Platinum is the highest rating in the LEED Green Building Rating System.

9 Photovoltaics (or PVs) are a technology which convert solar energy into electricity.

10 Zero Net Energy is a term used to describe a building with zero net energy consumption and zero carbon emissions annually.

11 Taylor Engineering is an engineering firm specializing in mechanical systems design and construction, energy conservation, indoor air quality, controls, and system commissioning. Taylor Engineering is located in Alameda, California.

12 Allan Daly is a principal at Taylor Engineering in Alameda, California.

13 Gwelen Paliaga is a senior mechanical designer at Taylor Engineering in Alameda, California.

14 The Center for the Built Environment (CBE) is an industry/university collaborative research organization at the University of California, Berkeley.



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The Multipurpose Room "We know that with an exposed structural design, which helps facilitate Design for Deconstruction, the mechanical system is going to be visible... the radiant system really is unobtrusive, in addition to all of its comfort and energy benefits."

It is more integrally connected to the architectural character and building form than any other strategy; it has to be there in the initial conceptual sketch. So, we worked with our daylighting consultants from the very beginning. On the energy side, we start very early as well and begin by talking about systems. We know that with an exposed structural design, which helps facilitate Design for Deconstruction, the mechanical system is going to be visible. What you decide makes a big difference. Going with the radiant system really is unobtrusive, in addition to all of its comfort and energy benefits.

When we collaborate we like to get together in person. This was a small enough project that it was easier to manage and easier to get our heads around the whole thing. With a roughly 20,000 SF school you can invite a couple of folks over, sit down, and talk about it while keeping the whole thing in your head. They can understand your architectural issues, and you can understand all

of their mechanical issues, since they're fairly straightforward. So, we spend a lot of time talking, and we pin everything up in our alcove or in the conference rooms. Then we start working through the issues. Everybody hears everybody else's issues so they know "Oh, you're trying to daylight this. Well I know I can't put my duct right in front of that window." There are ranges of collaborative tools, but the best is spending focused time with the team early in the design process, discussing and figuring out how to make it work.

There were lots of memorable experiences on this project. On the mechanical design side, we had an early work session with Taylor Engineering where we were trying to figure out what kind of system we were going to use. We used scoring metrics. We listed a series of systems, and then we put benefits over them, things such as energy performance, comfort, cost, and so forth. We went through that, and we scored it. We put a

score by each one, and then we added them all up, and it told us which system we would use. We got that answer, and we said, “Darn, that’s not the right answer!” Our scoring system didn’t match our priorities; the categories weren’t weighted to reflect the importance of the educational performance of the school. When we redistributed things to match the vision and priorities of the client, we came up with the system that we have. As a result we have radiant heating, which is extremely comfortable. Based on real, objective feedback from a third party, we can see that they are very happy with it, and they just love it. We also have 100% outside air controlled by a CO₂ sensor, so that the air never gets stuffy. It’s a very simple system and the teachers can turn on that extra fan if they want to get some odors out or bring in some more fresh air. They can turn it off if they want some quiet, and we don’t have the big furnace in the corner of the room with the closet. So we finally came up with a process that helped us tailor the decision to our goal.

RESOURCES

I attend Greenbuild¹⁵ every year, and it’s grown. I loved the early conferences where there were only a few hundred people there, but this success is bringing a lot of people into it, and that’s been a wonderful thing. I always learn something. I always find an idea from somebody else that I can shamelessly steal and bring back here. That’s a great place to keep up with what’s going on in the industry. I think their committees are very well informed, and their standards are continually evolving. They’ve recognized the importance of climate, and Scot Horst’s¹⁶ emphasis on that is helping to reweight that a little bit. That is more in line with our practice, especially since climate change is a critical issue. So that’s a key one. I think Environmental Building News¹⁷ continues to do exceptional work and research. I’ve recently been exposed a little bit to

the world of ASHRAE.¹⁸ I was on the organizing committee for the Net Zero Energy conference here in San Francisco. It was wonderful to meet some of those folks and learn about the expertise they have to offer. Included in that is the research being done by the National Renewable Energy Labs.¹⁹ I also learn from our team all of the time, and we work really hard to find the best team members and consulting engineers and so forth. It’s a lot of fun.

There’s also a tremendous opportunity in finance, in terms of how we incorporate renewable energy and other technologies into our projects, and in how we get them paid for by an outside entity. We’ve been trying to do that on some of our very large zero energy projects. We try to find the appropriate vendor, sign a power purchase agreement, and have them install and maintain a large PV array while we essentially pay the same prices as we pay our utility in California. Yet we have a net-zero carbon impact. I think that on the finance and business side of sustainable design there are a tremendous amount of opportunities that are just beginning to be explored.

Just as we practice integrated design in our buildings, we now need to expand the boundary of integrated design to be much more inclusive. At our office, the principals’ group is going to look at a bunch of buildings and sustainable communities in Europe next week. My sense is that they’re planning much more on a community scale, and not just at the building scale. We’ve done a number of rainwater collection cisterns; we’ve done some on-site wastewater treatment, and all of that stuff is great. But does it really make sense for every building in San Francisco, for all of those hundreds of thousands of buildings, to have their own wastewater treatment? Or, should we approach that more at the community scale? Some of it may be at the municipal scale. Some of it’s at the community scale, while some of it’s the building scale. We need to find the right fit to make it cost effective, but

¹⁵ Greenbuild, sponsored by the U.S. Green Building Council, is an annual conference and exposition dedicated to green building.

¹⁶ Scot Horst serves as chair of the U.S. Green Building Council’s (USGBC) LEED Steering Committee.

¹⁷ Environmental Building News is published by BuildingGreen and contains articles on a variety of green design and construction topics.

¹⁸ ASHRAE stands for American Society of Heating, Refrigerant, and Air-Conditioning Engineers.

¹⁹ The National Renewable Energy Labs (NREL) are a part of the US Department of Energy (DOE). They research energy efficiency and renewable energies.

even more importantly, we need to make it ecologically effective. Those things have significant embedded energy, and we need to design them in the most efficient way we can.

This is a new and exciting concept for me. There are eco communities on the one hand, and sustainable buildings on the other hand. They need to find their way towards each other and merge together. I think that's only just starting to happen, but it's a really exciting frontier for exploration.

LEED CERTIFICATION

I think that LEED has been especially effective in helping people to organize a diverse range of things, to think about them, and to explain them. It's done more than any other single thing in the US that I'm aware of. We saw that clearly at Chartwell. The head of school asked one of his board members to look into LEED and gave him the LEED reference guide. The board member worked his way through it, and came back and reported to his peers on the board about its content. He recommended that they pursue it. Now Douglas had already told us we were going to pursue it, but he needed to bring the board along, and they were a smart group, so he nudged them in that direction and they did their homework. They needed to understand it and make sure that it reflected the school's values, and in that case it did. It was really interesting to watch how Douglas charged the board to educate themselves. They came to this decision on their own, under the guided direction of the head of the school. As a result, we continued to pursue LEED. Michelle Hill,²⁰ in our office, did all the documentation. We like to do it that way, because then our project design team knows all the details, and knows the impact of their design and any changes. It's really great for our staff to have that expertise.

Because we do that documentation in-house, we have a lot of people who know the LEED system very well. LEED is constantly changing, and it does take some effort and energy to keep up. I think there is a strong general understanding among our staff, and the details of LEED are becoming more standardized. A lot of the things

that we used to have to be very explicit about are now just standard practice. For example, the indoor air quality points are really inexpensive and easy to get, and our standard specs cover them on almost all of our projects. Going for LEED is a lot easier if it's just part of your standard specs and process.

III. CONSTRUCTION MANAGING THE PROJECT

We had a reset at the start of the construction process. We were working with a contractor early on in preconstruction. We reviewed the systems with their team; the mechanical and electrical systems were design-assist. We did some early design stuff, but didn't take it all the way through. When it finally came down to crunch-time and the time to select a contractor, the school decided to switch horses. We lost some of the knowledge embedded in the collaboration; so, there were some discontinuities in the construction, most notably confusion about the commissioning scope that we had to sort out. Michelle Hill, in our office, did the Construction Administration. She did a great job on that, and she visited the site every week. You go down there and sit in the construction trailer, and you talk about the issues of the day. Then you walk through the site, and you see if things match our specifications. Sometimes the contractor has a great suggestion about how to make something easier or less expensive, and sometimes we see something that they didn't interpret right on our drawings. Sometimes we didn't see eye-to-eye, as happens on most construction projects; you have to work through that. At other times you are amazed how some challenging piece is beautifully constructed. In the end the school is performing quite well, and I think it looks great. I'm pleased with the way it turned out.

Part of the objectives for LEED is to change practice, to improve practice. Sometimes humans aren't great at change. During construction something may get done in its normal way, and then it has to be redone. Or something may get done without the documentation being done at the same time. Then six months later you have to try to reconstruct the paper trail in support

²⁰ Michelle Hill is an architect at EHDD Architecture in San Francisco, California.



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The Cistern "Does it really make sense for every building in San Francisco to have its own wastewater treatment or should we approach that more at the community scale? We need to make it cost effective, but even more importantly, we need to make it ecologically effective."

of the LEED requirements, in order to make sure that everything was done properly. The documentation did drag out longer than we would like, because we had to go back and get some of that documentation after that phase of construction had passed, and that's time consuming.

EVALUATING COST

The school went through an analysis of the extra costs they paid. I believe the photovoltaics cost an additional 1.6%. That's an additional cost in the upfront, capital cost of the building, but it is a savings in terms of the overall cost to the school as an organization over some period of time. Some of the strategies cost more. All of the framing lumber is from a well-managed, FSC-certified forest, and there is still a slight premium on that for most of the projects that we see. On the other hand, we did twenty-four inch on-center spacing for the wall framing; so we have about 30% less lumber in the building than we would otherwise. Is that an extra cost

or not? Well, the lumber costs more than non-certified lumber, but we're using 30% less, that we don't have to buy, transport, handle, cut, nail, etc. So I think we actually saved money on that. Another example is the radiant heating system: do we credit the extra costs for the radiant heating system to the sustainable strategy, or is that really about the fundamental educational vision of providing an exceptional, comfortable learning environment for these students? Different people would put it in different boxes. I think the extra cost is in the 5% range, given our best judgment of how people would allocate these things. On the other hand, Douglas said that the sustainability strategies generated such enthusiasm and conviction within his community that it increased the fundraising by about 25%. Public schools and independent schools struggle with operating costs, and keeping those low is really critical. So it's not just about the sustainability benefit; it's also about the ongoing operating costs of the school and giving kids the best learning environment possible.

I think we do need to shift the way in which project finances are structured. I think sometimes people talk about that because they're frustrated at not being able to get sustainable design projects done. We are getting them done at very high sustainable levels, within reasonable budgets. So, I often think that issue is overplayed. However, when we're starting to get to zero energy buildings, you do have to be able to find the renewable energy financing. We need to think about the whole life of the building and not separate out the operating expenses by deferring them to future generations. If we do that we can make a cost-competitive project up front, but we still need to think more holistically. It's the same with transportation. If you give people free parking, then the people who don't drive are subsidizing those who do. It's completely unfair. We're doing some family housing for a university right now, and they want to put structured parking underneath the building. Building, maintaining, and lighting those parking spaces costs several hundred dollars a month. Only the students who are wealthy enough to afford a car are going to have one, and the students with the least amount of money are subsidizing those parking spaces for the others. There is this hidden, embedded cost of subsidizing our current transportation system and our unsustainable energy systems. Those systems need to be restructured. We're now advocating unbundling those costs, pulling them out and getting them aligned properly so that the incentives are in the right places, so we are not swimming upstream.

IV. OPERATIONS

GETTING INVOLVED EARLY WITH PROGRAMMING DESIGN

This is something I've learned from some of our clients. Philippe Cohen,²¹ at Jasper Ridge²² at Stanford, cites their very careful attention to programming as the most sustainable thing they did, since they made a building more closely tailored to their needs. Our Stanford global ecol-

ogy client²³ came to us with the idea of pulling out a lot of the equipment, storage, and growth chambers from the lab and putting them into a warehouse that was minimally conditioned to reduce the high energy users in the building that would produce heat. When this happens, you then have to use additional energy to cool down the building, and you have lower efficiency inside a very expensive laboratory. You can separate those things out. There are a lot of opportunities around getting involved early in a project and helping with the programming.

LESSONS LEARNED

The fact that it was so affordable to get to grid-neutral or zero electrical energy was just a complete mental shift for me. It gave us the confidence to do that on a lot of projects. So far we've completed three zero energy projects, and one or two zero electric projects. We've got five or six more underway, on a much bigger scale. With Chartwell we learned how those economics work. The success of the daylighting is something that we continue to learn about in our projects, and toplighting is so easy to do that there's just no reason not to fully daylight the top floors of building. We're learning how to do that, and we're doing it effectively. I saw some statistic, I believe it's from the National Renewable Energy Lab, and it said that 85% of all building area in the US is within 15 ft of an exterior wall or roof. That 85% of spaces should be daylight. We have this incredible potential to improve the quality of spaces and the experiences for people in our buildings. We can improve the learning rates for kids, make more beautiful architectural space, and save a huge amount of carbon emissions.

POST OCCUPANCY EVALUATION AND MONITORING

We do two primary things. First, we use the Center for the Built Environment's Occupant Satisfaction Survey. We try to do that on all of our projects, in order to get an objective, third-party view of how the occupants experience the building in terms of thermal comfort, daylight-

21 Philippe Cohen is the administrative director of the Jasper Ridge Biological Preserve.

22 Jasper Ridge Biological Preserve is located at Stanford University, Palo Alto, California.

23 The Global Ecology Research Center is located at Stanford University, Palo Alto, California.

ing, indoor air quality, acoustics, and all of those things. That gets benchmarked against all of the other projects in their database. We're really trying to stay in the 90th percentile, and we've been doing quite well at it. We're very proud of that, and we work very hard at it. We also learn some lessons. One of the lessons is that the acoustics continue to be a challenge in a lot of projects. Acoustics is the lowest scoring category for almost all of the buildings in the CBE database. We're really trying to put some focus on that, because of the impact it has on the occupants.

The second way we try to document or measure the actual performance of buildings is by looking at the energy side. We have a major initiative to shift away from our reliance on energy modeling and move toward real, measured energy use. There are several components to this. We have some projects where we use the energy dashboard.²⁴ That's great because it allows us to see what's going on in the building; however, we have to be able to access that information. The data has to be rational and useful. We try to disaggregate it into smaller chunks. On Chartwell, we can separate the lighting energy from the HVAC energy. We can separate it from the plug loads, and we can see it over time. As a result, we discovered that all the lighting for the site was on all night long. That was a quarter of their annual energy use. We've been able to dial that way down. We also noticed that some of the plug loads were really high, and it turns out that somebody had donated this gigantic commercial freezer they wanted to get rid of because it used too much energy. We were able to replace that with an Energy Star freezer. You can see those loads and tweak them if you have good monitoring. So that's the visualization piece.

Then, there's the monitoring piece and the benchmarking piece. When you see the energy data, and you get a number, you don't always know if it's a good number or a bad number. Now we've started benchmarking those numbers to other sources, such as The Energy IQ database²⁵

and to CBECS,²⁶ which is a little harder for us to use. The New Buildings Institute²⁷ collected some really nice post-occupancy measured data of a series of LEED buildings. Chartwell has one of the lowest energy uses of those 75 or so buildings. It lets us compare the building to its peers and see how it's really performing by looking at the energy use per square foot.

We are committed to being as open as we can with our building's performance. Every once in a while you get a score back that you don't really want to share. On one of our CBE surveys we completely tanked in one category. You can say, "OK, there are only seven respondents, and there was something that hadn't been fixed yet." You can make all of these excuses; it's hard to put that out there in the public view, but we've put it out there anyway. We try to publish these things, we present regularly at conferences, and we try to give as honest an assessment as possible, because we are learning from our peers and our colleagues as well. We all have to share this information and stop just giving our marketing spiel to each other. We're really committed to trying to provide accurate information and advance the state of practice in our field.

OCCUPANT AND USER RELATIONSHIPS

The occupant training on Chartwell was an area where we could have done better. It's easy for the design committee to get excited about the project, because they know all the details. We spend a lot of time together and they're all excited when they move in. Meanwhile, people move in who haven't been involved in that process, and they don't know what all this stuff does or why it was done a certain way. It is important that they know. Passive buildings require active occupants, and we're not used to doing that. People are used to moving the dial on the thermostat, and not realizing that you can leave the window cracked at night, or that you need to close the window during the hot parts of the day to keep the building cool. Occupants also may not re-

²⁴ An energy dashboard monitors and provides past and present building performance data.

²⁵ The Energy IQ Database is a benchmarking tool developed by the U.S. Department of Energy's Lawrence Berkeley Laboratory.

²⁶ CBECS stands for Commercial Building Energy Consumption Survey.

²⁷ The New Buildings Institute is a nonprofit institute, located in White Salmon, Washington, that works with utility groups to promote improved energy performance.

alize how to get the daylighting to work before they close the blinds and short-circuit the dimming controls. We've tried to provide some support for that through written documentation, but I think it really comes down to face-to-face relationships. The head of the school and the people on the building committee have shouldered more of the burden of communicating with the occupants.

COMMISSIONING

Commissioning is one of the things that has completely shifted. Ten years ago, we could never seem to get commissioning approved on a project. We'd always bring it up at the end of the project and say, "You know we really need to commission this building." If you do that too late in the project, then everybody's tired, the money's running short, and you'll never be successful. So we started putting it into our fee proposals, up front, as an additional service. Our clients would always say, "Oh, great, you've included commissioning!" Since then we've been commissioning all of our projects. That little shift of letting them know that it was something to budget for up front, before all of the fees were fixed and allocated, has made a huge difference. We did commission Chartwell, and that has been a huge help. But what we're finding is a need to stick with our buildings longer. We need a paradigm that lets the professional design and engineering team stick with a project longer in order to monitor and measure it in some ongoing way. Some of our clients have professional management that's able to do that in a sophisticated way, but most of them do not. We recently did a big public library, and one day there was a problem with the cooling. The librarian was traipsing across the roof in her high heels to look at a chiller. Well, I don't know what to do when I look at a chiller, and I'm sure she doesn't know either. You need some professional expertise to manage and run these buildings efficiently. We're trying to find a way to stick with them longer, but I don't know that we've figured that out yet.

SHIFTING SKILLS

I think the education that many architects get isn't an interdisciplinary one. There is varia-

tion among architects in firms as far as how well they mesh with engineering consultants. We think it's essential, and we consider it a basic skill for our staff. Some people have exceptional strengths in that area. That has been a part of our practice for a long time; it's part of our culture and DNA. We're very fortunate in that regard. I think that for some firms that might mean more of a shift, depending on their history and practice.

ADVICE FOR FUTURE PROJECT TEAMS

Schools have a very clear program, and it's all about the education of kids. Once you start talking about architecture with them, their eyes kind of glaze over. You've got to keep it focused on the kids and the education; that's a perfect fit with sustainable design. Indoor air quality: it's easy and cheap. We all need to master that, and it should be standard practice. Schools are a perfect place to daylight every room, and that's critical. Schools are also great candidates for zero energy, or at least zero electricity buildings, because they have relatively low energy use compared to other buildings, and they have a consistent client who will be there. They're great to do your first grid-neutral project on, so I'd go for that.

There are a lot of resources out there. Sometimes not believing you can do it and not having the focus and conviction to do it are more of a barrier than knowledge or technology. That was my experience with doing zero energy buildings. I remember telling clients who wanted to do a zero energy building that they couldn't afford it. What I should have been doing was putting it in the design, and trying to get the costs down as much as possible in order to make a case for it. Once I made that mental shift, people have been able to afford it. You have to work at it, but architects are used to balancing multiple objectives, such as costs and figuring out how to detail and construct things more efficiently. I'm sure you've seen Davis Langdon's²⁸ report on the cost

²⁸ David Langdon is a global construction-consulting firm that provides construction cost management services to architects and owners. Their founding office is located in San Francisco, California.

of green.²⁹ The cost of buildings, per square foot, varies enormously, even when you control for location and length of construction. The decisions we make about buildings affect the cost a lot. The decision to do a highly sustainable building, or even a zero energy building, affects it a little; we can do that.

I think architects in this field understand daylighting and sunshading, and they kind of know if they're paying extra for those or not. The piece people usually don't understand is the added cost of renewable energy. On Chartwell it was an additional 1.6% of the cost of construction. On our IDEAs zero energy office³⁰ it cost less than 2% of the cost of construction to get all the way to zero energy. On other projects it's in the 5% range, but it's not 30% like I might have guessed. We have to go there. California's policy is to go to zero energy buildings. The UK is moving very quickly to zero energy buildings. Trying it out on a low energy building like a school is a great place to start.

This narrative is based on a video- and audiotaped interview conducted by Kristen DiStefano on July 28, 2009, at the offices of EHDD Architecture in San Francisco, CA.

²⁹ Lisa Fey Matthiessen and Peter Morris wrote both "Examining the Cost of Green" (2004) and "The Cost of Green Revisited" (2007).

³⁰ IDEAs Z² Net Zero Office Building is located in San Jose, California.

MICHELLE HILL

PROJECT MANAGER,
EHDD ARCHITECTURE

I. PROCESS

GETTING INVOLVED IN THE PROJECT

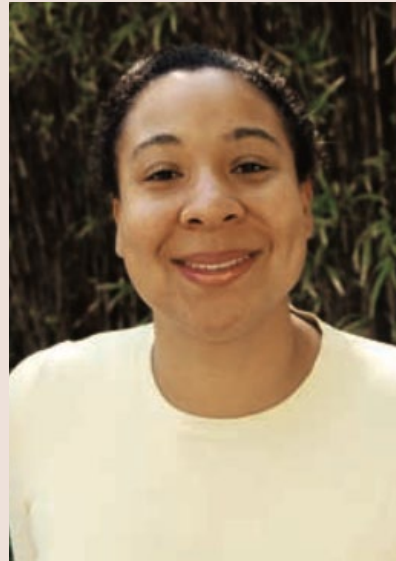
I came onto the project when it was already under construction. I wasn't involved in the earlier phases with the design team, but I was involved in implementing the design during construction. Because the mechanical and electrical systems were design-build,¹ I did have some involvement in getting the intention of our design actually built; that was a big part of what I was doing. I am also an interiors person, so I did the furniture, the finishes, and other things like that. I was part of the project for nine months.

In an ideal situation I would have been working on the project from the very beginning. If that weren't possible, then I would have liked to have joined the project mid-CDs² so that I would have more familiarity with how the documents were set up, what the expectations were, and what the design intent was.

ROLE IN THE PROJECT TEAM

Serving as the interface between the architectural team and the construction team was definitely a challenge, since I was not on the design team. The consultants were really great about helping me out during the process, but because I didn't know some of the fundamental aspects of the design, I wasn't able to anticipate complications. I would have addressed them even earlier if I'd known what the intention was and what to look out for; I could have been more proactive about getting it right.

This was my first time doing full CA.³ Throughout my career I've always reviewed submittals for my scope of work and answered RFIs,⁴ which is a process that I've found to be very valuable.



MICHELLE HILL, LEED AP is an associate at EHDD Architecture, where she has been involved with the Factor 10 house, the Global Ecology Center at Stanford University, and the Christopher Center at Valparaiso University. She focuses on interior architecture, and for the Chartwell School, she was both the Project Manager and coordinated the furniture and finishes.

1 Design-build is a way of going about the design and delivery process in which the architectural firm responsible for the design does the schematic design of the systems designs on a project. The Contractor is responsible for designing the specifications for the systems and building to those specifications.

2 Construction Documentation (CD) is the phase of the design and delivery process in which the architects, engineers, and consultants produce working drawings, specifications, and bidding documents.

3 Construction Administration (CA) is the phase of a project in which the administrator ensures that construction is completed in conformance with contracts and design intent.

4 RFI stands for Request for Information.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes prepared this narrative. © 2009 U.S. Green Building Council and the University of Oregon. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the permission of the USGBC.

This was the first time I was the Project Manager and the very first time I had documented a LEED project. This has been a shift in my personal role. Our office encourages all people, regardless of their design focus, to participate in the CA process. It's an expectation here that you get involved in CA and the LEED documentation process. That may not be true at other firms.

ACHIEVING THE LEED PLATINUM GOAL

This was a more difficult project because of the LEED Platinum goal. It helped that the client was really focused on achieving that goal; every decision that was made was directed toward making sure that we made the Platinum goal. On other projects the clients may or may not want to get certified, and there could be back-and-forth during the Construction Administration phase. At that point they'll say, "Let's forget about getting that point; we'll just go with this other solution." In the end, you're just doing what you can to get as many points as you can. You are usually pulling LEED points together throughout the project. Usually the beginning of the process is less focused and determined to achieve LEED certification than with the Chartwell School project. In the case of Chartwell, LEED was driving a lot of the decisions. At times, they were expensive decisions, but they were ultimately the best decisions for the project.

One of the great things about the process was how actively involved Douglas and the Chartwell School team were in the process. A lot of times, owners take the side of the contractor, because they are the ones talking about saving money and time; owners will go with that argument. In this case, the Chartwell School's main focus was to make sure they got a LEED Platinum building that met the criteria the design team had spent years putting together for the project. It was really helpful to have such a strong voice in that regard.

II. CONSTRUCTION

PROJECT TEAM COORDINATION

We had weekly meetings on the job site for Construction Administration, and I met with the owner's representative⁵ and the contractor. I communicated with the consultants through email. I sent field reports every week, called them with questions once the submittals came in, reviewed the submittals, and answered questions from the field about the intention of our designs and related documents. I went to the site once a week to observe the construction process, sat in on the meetings with the construction manager and the owner, and relayed that information to the rest of the team. They got back to me if things weren't working or needed to be addressed.

INVOLVEMENT DURING THE CONSTRUCTION PHASE

Allan Daly⁶ went to the site a couple of times to meet with the companies doing the installation. A very valuable part of the process was to have Allan there in the field, and I was there every week. Usually, in our office, we go out to the field on a weekly basis for a project, but at certain times, when needed, site visits happen more often. Initially, when I started doing CA on this project, I was supposed to go to the site once every other week, but the owner actually asked me to start coming down every week since things were going so quickly. He wanted to make sure it was being built the way we intended.

A big challenge for the project was the design-build aspect of the mechanical and electrical systems. Because it's a LEED Platinum project there are very stringent requirements for how the systems perform. The contractors and subcontractors weren't well-versed in LEED; they hadn't done a LEED Platinum project before. It was challenging to bring them up to speed on the requirements and make sure it was getting built to the specifications set by the design team.

⁵ In the case of Chartwell School, the owner's representative is Douglas Atkins.

⁶ Allan Daly is a mechanical engineer at Taylor Engineering, where he was responsible for the Chartwell School.

Because our design-build specifications don't show the whole design fleshed out, there are a lot of different ways that engineers and subcontractors can interpret those documents. It took a lot of work on our part and Taylor Engineering's⁷ part to make sure that the specifications were interpreted correctly.

The contractor hired Axiom Engineering⁸ to finish the drawings; they also added another subcontractor who built to the specifications of Axiom's drawings. We reviewed Axiom's drawings several times and, when needed, had meetings in order to make sure they understood our intent.

III. OPERATIONS

LEED CREDIT CHALLENGES

We tried to avoid having tradeoffs in the credits we pursued; we really went for all of the credits. There were only two credits that we went after and didn't get. The credits that we didn't go for were ones that we had no possible way of getting because of where the school is located. Those were identified very early in the process. When I first joined the project, we sat down with the contractor. Lynn had previously prepared a spreadsheet of the credits so that I'd be familiar with what we were pursuing; then we had two or three periodic check-ins with the contractor to make sure that we were on target. One of the credits that we did lose due to the contractor's lack of knowledge is the flush-out credit.⁹ They hadn't built that time into their schedule, and, although we talked to them about it repeatedly, they didn't end up following through with that.

There were two credits that we didn't get. One of them was the Brownfield credit,¹⁰ which we actually spent a lot of time trying to get. We talked to

the EPA¹¹ and the army, and we tried to make as strong a case as possible. It just didn't fly. To be considered a brownfield site you have to be designated as a brownfield site, and you have to do the remediation yourself. It can't be, as Chartwell is, on an army base that has already been slotted for remediation by the government. That was a tricky thing. Another challenge was the commissioning credit.¹² Thankfully, Taylor Engineering and Glenn Friedman¹³ were really instrumental in getting that done. They pushed the contractor and set out very clear requirements for what had to be done. It took a year to do the commissioning. We weren't able to submit for LEED until almost a year after the building was occupied; that timing surprised us all. The engineers provided a roadmap for everything the contractor had to do: having commissioning meetings prior to the commissioning process, taking notes at those meetings, and keeping track of outstanding issues related to the commissioning process. That was all new for the contractor, and it took a lot of encouragement on our part.

TRACKING LEED CREDITS

We do have an in-house LEED consultant, Janika McFeely,¹⁴ who was helpful in navigating the LEED process. We had done another LEED project around that same time, and I could also ask questions of the person who had managed that process. LEED online has been a godsend; I'm so glad it was changed to an online system. That was really great. I set up the consultants to enter their own credits online, and we did the whole process using the LEED online interface the way it was designed, which was extremely helpful. As we were doing the LEED documentation, representatives from both Ausonio and the Chartwell School worked together quickly in order to get

7 Taylor Engineering served as the mechanical engineer and energy consultant for Chartwell School, and is located in Alameda, California.

8 Axiom Engineers, Inc. was contracted by Ausonio Construction for additional specification writing and systems design, and is located in Monterey, California.

9 Indoor Environmental Quality Credit 3.2, Construction IAQ Management Plan, gives the option to flush out the building to ensure baseline air quality.

10 Sustainable Sites Credit 3, Brownfield Redevelopment allows one point for developing on a contaminated site as determined by local, state or federal government agencies.

11 The Environmental Protection Agency is one of the potential governing bodies for brownfield designation.

12 Commissioning is prescribed by Energy and Atmosphere Prerequisite 1 and Credit 3. The prerequisite calls for fundamental commissioning of the building energy systems and credit 3 in this category calls for enhanced commissioning beginning earlier in the process and additional activities to be executed.

13 Glenn Friedman is a principal at Taylor Engineering in Alameda, California.

14 Janika McFeely is a designer and LEED consultant with EHDD Architecture in San Francisco, California.



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The Tree Trunk "We are trying to find more reclaimed resources. Wood is a relatively easy one... I look forward to having more available types of reclaimed resources."

up to speed on how LEED online worked and what the expectations were. Joe Piedimonte,¹⁵ from Ausonio,¹⁶ got LEED certified and was actively involved in the process, and that was great. Chartwell had one of their accounting people, Dennis Duke, join the process, and he was really great. What I realized while I was working on Chartwell was that going through the LEED

¹⁵ Joe Piedimonte is a Corporate Controller for Ausonio Incorporated who also worked on Chartwell School.

¹⁶ Ausonio Incorporated served as the general contractor for the Chartwell School, and is located in Castroville, California.

process is perfect for people who are interested in accounting and finance. I highly recommend that people with those interests join in the process because they're really good at understanding the credit requirements. Those types of people are really good at documenting, totaling, and submitting since it's a lot like doing a tax return.

It would have been hard to achieve Platinum if other members of the project team hadn't taken it upon themselves to learn about LEED. The owner had to jump in and create policies to support some of these LEED credits; the contractor has a huge role in documenting the materials credits. If they weren't able to do it, I don't think we would have reached Platinum.

PROJECT TEAM PREPARATION

We learned from this project that we should prepare the contractor a little better so that they know what to anticipate. We should also encourage them to have more regular meetings earlier in the process.

We started our commissioning kick-off about half way through the construction, and we could have started that sooner. We realized that the commissioning process does take time. It's inevitable that it's going to be a lengthier process than you imagine, because the building has to be functioning for a period of time before you can know if it's working to specification or not. We learned to build that expectation into our client's schedule and the contractor's schedule from the beginning.

From the furniture aspect, we ended up installing right at the wire. It's quite difficult to do the Construction Administration, have furniture meetings, and do furniture selection at the same time. I would have preferred to finish that before construction started. We were really pushing ourselves throughout the project. I certainly didn't expect the construction to go the way it did. We got backed up toward the end, and there was a lot of pressure to complete the project on time. The contractor fell behind schedule, and we spent a good month to six weeks really pushing the contractor to perform and to complete on time. That was right around the same time that I was trying to get furniture orders placed. It was a very rainy

season, and I think that had quite a bit to do with our being behind from the very beginning.

GRANTS AND INCENTIVES

This project had a grant from the EPA¹⁷ for Design for Deconstruction.¹⁸ One of our thoughts in detailing and putting the project together was how easy it would be to disassemble and reuse components. Because of that grant, and because of the EPA's enthusiasm for it, they've started competitions; there are other architects and designers who are contemplating what happens to materials at the end of the building's lifecycle. In general, there is a growing movement to be responsible through the building's lifecycle into deconstruction. I think it will quickly become more and more important.

SHIFTS IN THE INDUSTRY

My role is shifting, and so is the rest of the industry. Our firm has always been focused on sustainability, so I've always been more aware of sustainable materials than other designers may have been. I am starting to see a difference in the manufacturers and the amount of information they're providing to the public about where products are produced and where the raw materials are coming from. I think materials producers have grown substantially in terms of what they offer to the design community; that's the biggest change I've seen. In addition, we are trying to find more reclaimed resources. Wood is a relatively easy one to source. I look forward to having more available types of reclaimed resources. We usually get a lot of mileage out of our structural steel and our concrete, but there's not as much available for finish-level materials. As I said before, manufacturers are stepping up and providing more information and more environmental options; it's making our field, as a whole, more aware, and designers are able to make better decisions.

Before I joined the project, the team did a great job of sourcing the reclaimed woods that were

used on the project. Ausonio did a fantastic job of following up with local sources. That, the history of our firm, and the breadth of knowledge we have about sustainable materials were instrumental in making the selections for me. I've been doing this for almost twelve years; I'm very familiar with the materials available and the representatives we rely on to help us with the selection process. That part was pretty straightforward and easy for me.

One of the challenges was the trunk column in the lobby space. One of the first tasks was to find that piece, which was interesting. I enjoy doing research; I started looking online for people who carve bears, gnomes, and other things out of giant logs. I found a man, and he referred me to a place called Urban Lumberjack,¹⁹ which is about two miles from the site. I went there to see what they had or what they could get for me, and they happened to have a log that had been on the ground for several years. It was already seasoned, and they gave it to us for free and had it taken over to the site. That was a fun little research challenge.

LESSONS LEARNED

I think we overshot on our LEED submittal materials. We worked really hard to make our submittal as perfect as possible so that we wouldn't get a lot of questions back. At the same time I was involved in submitting the materials for Chartwell, the office was submitting for another project, and that team had to resubmit over twenty credits. We did not want to have to do anything like that, so we spent a lot of time making really clear diagrams and checking everything three times. We didn't really need to go to that level of scrutiny or documentation. Basically, our response was that if we had a document that could contribute to the credit, then even if they weren't asking us to submit it, we would submit it. There's probably some balance needed there; we learned that you don't have to do as much as you think they might be expecting.

The biggest lesson that I took away from the project is that when you're doing a LEED Plati-

¹⁷ EPA stands for Environmental Protection Agency.

¹⁸ Design for Deconstruction (DfD) is a building design movement that encourages adaptation and reuse as methods to extend the usable life of materials and therefore reduce raw material consumption.

¹⁹ The Urban Lumberjack is a tree care company located in Salinas, California.

Owner	<p>num project, especially if you're going to do design-build, involve the design-builders much earlier in the process, or go with a more traditional approach where the consultants design the system all the way through. I had a great experience collaborating with all the consultants; that's something that I wouldn't change and would hope could happen more on all of our projects. I would also try to keep consultants involved until the very end. If they're out in the field, they're really up to date on everything that's going on and they're contributing to the process.</p>
Architect	
Contractor	<p>This narrative is based on a video- and audiotaped interview conducted by Kristen DiStefano on July 28, 2009, at the offices of EHDD Architecture in San Francisco, CA.</p>
Engineer	
Consultant	
Facilities Manager	

ANDREW AUSONIO

PRESIDENT,
AUSONIO INCORPORATED, CONTRACTOR

I. PROCESS

GETTING INVOLVED WITH THE PROJECT

Chartwell asked various contractors to come in for an interview. The plans were about 90% done. The mechanical, plumbing, and electrical systems were not yet completed, but the permitting process had progressed pretty far by that point. We assembled the budgets and started going through the interview process. The groundbreaking took place three to five months after that.

We already had relationships with many of the local subcontractors, and Chartwell wanted to use local people. That was an advantage for us in the bidding process. LEED¹ requires that projects not only be responsible with resources, but that they also take care of the local environment, whether that's people, materials, or manufacturing processes. Because of that LEED requirement, we had to acquire the construction materials from within 500 miles of the site. That can be a difficult goal, but luckily, we had just finished quite a few construction management programs, and we're known for our management ability.

It also helped that we had a few people with green building experience at our company. At the time, most people hadn't worked on LEED projects, much less LEED Platinum projects. There wasn't as much of a market for that at the time, and everyone knew that we were going to have to develop the team. It was a competitive process, and the local bids were pretty low across the board. The subcontractors want to go in, do the work, get out, and get paid. But we need documentation for LEED certification. Subcontractors have to be able to prove that each system works as it's supposed to. LEED requires commissioning. Our connections with those local subcontractors definitely helped with our selection and success.

Everyone involved with Chartwell continued learning throughout the project. That knowledge base has helped the community a lot. Once intelligent people get together they'll come up with



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¹ The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC) is a suite of voluntary standards for green buildings. It awards certifications at Certified, Silver, Gold, and Platinum levels.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes prepared this narrative. © 2009 U.S. Green Building Council and the University of Oregon. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the permission of the USGBC.

intelligent answers. They'll follow through with those ideas, and they'll put together the paperwork and the ancillary information that we need to accomplish this type of project.

ASSEMBLING A TEAM

Chartwell was structured as a design-assist² and was then put out to bid. We actually put all the subcontractor trades out to bid. So, it was competitive, but we were the ones negotiating and finishing the plans. The plans had most of the criteria, but the ones for the mechanical, plumbing, and electrical were not completely finished. They were probably 30% complete. Then, there were specifications that dovetailed with the plans. Those specifications determined many of the LEED targets we were attempting, but the specifics hadn't been worked out yet.

ESTABLISHING PROJECT GOALS

When we joined the project, the LEED points were already set up. We did participate in some of the optional credits at the end, and we brainstormed ideas to achieve some of the extra points. We had to be creative in trying to achieve some goals, such as materials reuse, because not all of the materials had been specified. One of the issues of the LEED process is that we're trying to deal with many things on a percent basis. For example, we need designated areas where we can use a recycled or reclaimed product. The reused products are really the issue, because we're trying to take one product and use it with another product. We're already in construction, but we still need to get all of our material quantities, or our denominator, figured out. Until we receive all the feedback from the subs, we don't have that denominator. We have an idea about the numerator, and we're trying to figure out whether that's giving us the right percentage or not. Are we hitting 5% or not? Are we hitting 10% for two points or not? That's a bit of a challenge. We have to work that number, and we need a little flexibility in the design process to change some of the materials we're using.

² Design-assist is a collaborative design method that involves early participation from the contractor on issues of programming and design.

PROJECT TEAM COORDINATION

After we were selected, we set up a design charrette. It took place in Monterey, and we invited a lot of the key subcontractors. The owners and the architects were there, and we brainstormed what we needed to do to achieve LEED Platinum, since it was one of the first Platinum buildings in the county. It was also the first LEED Platinum K-8 school, so there was a learning curve for everyone. Our first task was to start educating the subcontractors, who were from this area of California. They had never really participated in a LEED project, and they didn't know what the documentation requirements were. They didn't know the importance of the goals. We had to bring them up to speed – especially the primary subcontractors on the mechanical, plumbing, and electrical systems. That was incredibly important. We had to develop a program to deal with recycled materials, job cleanup, and construction waste. All that had to be developed since there was really no existing system. We had to brainstorm a way to hit the waste diversion numbers. That was the first step in getting people on board and moving forward with the project. The process was continuous and lengthy, and it lasted until we had the LEED certification. Even then, we were answering questions about the data we submitted. The project is not really complete until all of those questions have been sorted out.

II. DESIGN

COMMUNICATION AND RESOURCES

There is a lot of communication required on a project like this: daily, hourly, and minute-by-minute. If we didn't have effective communication we'd really be in trouble. We would have had a hard time pulling something like this off; the architects are in San Francisco, the owners are in Seaside, and we're here in Castroville. There's still a lot of give-and-take; we're sending them information, and everybody's trying to make decisions. Sometimes it's a very quick process, since with computers we can just CC everybody on any issues, and we can get responses relatively quickly. Then we can implement them.

We had a few consultants we'd bounce things



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The Finished School "Since we were building a school, we were dealing with a starting date. Because of the delays, we had a problem with one of the credits. We quickly and creatively came up with additional credits."

off. Since we also had to go through the LEED process, there was an online question-and-answer section³ with a lot of questions that have already been asked and answered; sometimes we could scan the answers and see something related to our question. That was very helpful.

CHALLENGES WITH LEED CREDITS

There was one LEED credit that was an issue, and that was the two-week flush. An interesting thing about Chartwell is that we had low-VOC⁴ or no VOC materials in all the classrooms, but we also had a deadline. We had a lot of delays in the beginning because of the retaining walls and engineering that needed to be redone. There were a couple of months of delays before we could really get into the foundation, which skewed everything. Since we were building a school, we were dealing with a starting date, such as September

8th or 9th. We were doing a big push at the end because there were some delays from some of the districts. They weren't making the decisions fast enough, even though they had ample time. It wasn't a problem with the architect, and it wasn't a problem with Chartwell. It was just that certain agencies weren't moving with the schedule. A lot of the site work got delayed, and that delayed the buildings getting up and running. Because of the delays, we had a problem with one of the credits: flushing out the building for a 14-day period.⁵ We were getting close to the time when the buildings had to be opened, so we had to let that credit go.

We quickly and creatively came up with additional credits. One of them was for materials reuse,⁶ which means that we're reusing a material rather than using a recycled content material. We were using materials in a different way than we normally would. We had been looking at recycled

3 Credit Interpretations and Rulings are available through LEED online USGBC Company Members, LEED Registered Project Team Members, and Workshop Attendees.

4 VOCs are volatile organic compounds comprised of organic chemical compounds that vaporize and enter the atmosphere under normal pressure. VOCs combine with nitrogen oxides in the air to form ozone. Some VOCs are neurotoxic and carcinogenic.

5 Indoor Environmental Quality Credit 3.2, Construction IAQ Management Plan, gives the option to flush out the building to ensure baseline air quality.

6 Materials and Resources Credit 3, Materials Reuse, calls for the use of salvaged, refurbished, or reused materials in the building. This credit is distinct from Credit 4, Recycled Content, which calls for the use of materials incorporating recycled content.

tiles at one point, and we were very close to the 10% reuse standards, to achieving two LEED points versus one point. Those were areas of the project that were not completely finished; we figured there must be some way that we could incorporate another type of reused material. We were so close, so we worked at finding a way to do it.

We definitely have to look for those opportunities. We have to know how close we are, because if we're just barely above the 5% goal, then we're not going to get that credit. When we're that close we have to tell the owner and the architect that our focus needs to shift from one activity to another. They need that information so that everybody can make a good decision about what needs to happen at that point.

III. CONSTRUCTION

CHALLENGES OF THE PROJECT

The difference between on-site management for this project versus our other projects is that we really had to control the waste stream. That was new and different for us, but not complicated; we just set it up, and then we monitored it. We had to make sure everybody was documenting the process with photos. We had to be on top of that. There are certain requirements for some elements to have photo documentation that we can then upload as part of our LEED application or submittal. We had to be vigilant with monitoring the products. The architects specify low VOC products. The people who are bidding those items, especially the subcontractors and the project managers, tend to know that, but we have to make sure that the guy who is actually on the site doesn't grab something out of his truck simply because he ran out one thing, and he's just going about business as usual. That's the number one thing we have to watch out for. They haven't been trained in many projects like this, so we have to watch what they're doing and make sure the materials are all correct.

At Chartwell, we were working with different specifications for the concrete mix, and all of the lumber was FSC-certified. The lumber has to be covered while it's outside; that's actually a requirement, with visual documentation. These are all good building practices.

The number one thing is that we have to be sure we don't assume that some of the points are going to take care of themselves. We have to do research and figure out which ones we have to deal with. When it comes down to construction, we had around 22 points. We had to delve into the 22 points and use an analytical approach. But, if we keep everybody communicating early on, we're not going to end up with big challenges.

Take, for example, the waste stream. Normally, even if we send all our waste to a third party for recycling, we don't document it and get the construction waste tags to figure out how much we diverted. Now we have to keep the tags we're sending to the normal landfill. It's an ongoing process because the waste stream has to be monitored through finish construction, whether the waste is sheetrock, paint, or roofing materials. The sheet metal for your gutters and downspouts is one of the last things to be used. The further we get into the project, say the last month of a ten month project, the more information we have that needs to be assembled.

TEAM COLLABORATION DURING CONSTRUCTION

Most of our jobs are set up so that we have weekly meetings with the team. Do we meet every single week? Not necessarily, but we have it scheduled, and that way we can cancel a meeting if we don't have much to talk about. For example, if we're in the rough framing portion of a project, then there's not much going on that needs input from the owner. In that instance, we would call and postpone the meeting until the next week. Normally on a job like this we want to schedule weekly meetings, because in a school, especially a school like Chartwell, there is a lot of finish work. A lot of those decisions were still being made after we began installing sheetrock. There are a lot of dynamic changes, but there is also still a schedule at that point. Those finishes take up a large portion of the schedule, and we have to run pretty tight controls on the meetings.

MANAGING THE PROJECT

This project took a lot more involvement than the average project. On a Platinum level build-



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The Enclosure "The waste stream has to be monitored through finish construction. The further we get into the project, the more information we have that needs to be assembled."

ing there are only so many points; you don't have much of a cushion. We have to make sure we get all the points. And, really, we need to get a couple of extra points, just in case one doesn't pan out. I think we had a few cases where, due to the timing and schedule, we missed some points. We intended to do them, but once we actually got into the project, and it was 90% complete, we realized that it just wasn't feasible to get the credit. So, we have to have some backup credits. It takes a lot more effort. We can't just assume that the normal building process for a warehouse is going to work. We've got to have people who are sharp and on-the-ball.

The interesting thing is that once we really got into the certification portion of the project our chief financial officer (CFO) jumped in. At that point, it was interesting to watch the dynamics. When the accountant is documenting all these nuances and percentages, he's basically creating balance sheets; it's mathematical. So, it seems

like a natural fit. My recommendation is that when someone is doing LEED documentation, they get their accountant involved, because he or she really gets into balancing everything to make sure the percentages are right and checking to make sure you get the quantities on the invoices.

TRACKING LEED CREDITS

We used spreadsheets to track the LEED points, and we put together to-do lists. We started with the submittal process, and then, with the submittal, came the backups. We'd have to chase down the backup, and then the backup would give us a lot of the information we wanted. There was actually a lot of micromanaging, because different people had to supply different information throughout the job. We have to be very diligent; we've got to put together a system, know what we want, and keep on working it. We've got to work it all the way through the job, because even though we'll get all the informa-

tion this month, we still have to start again next month and the month after that. Some subcontractors are more responsive. They have somebody in the company who really understands the process. There are other subcontractors who are very busy and might not get it.

IV. OPERATIONS

INDUSTRY CHANGES

Not all projects are going to be LEED certified. But are they going to adapt to the intent behind the LEED certification process? People want cleaner buildings; they want fresh air. That's going to increase the market for the good products that already exist. Then those products are going to come down in cost, and they are going to be more prevalent. LEED is setting the new standard. Communities are buying into it.

Santa Cruz has its own green building standard, and if our project doesn't meet the standards we don't get a permit. It's not the LEED system, but it's a green standard, and it's forcing the building industry to change. A lot of architects know what's going on, and they specify things differently. Some contractors might not know the difference between a regular product and a low VOC product, but because a product has been specified they know that product is better and needs to be used. Some people are going to use greener products without ever knowing they're doing so. Communities are driving this change.

The idea of diverting waste and not filling up the landfills is also becoming accepted. Communities and governments aren't interested in increasing landfills. Nobody wants a landfill in their backyard; we can divert 80% or 90% of construction waste from the landfills. That idea is here to stay. Not everyone is doing it, but there are more and more entities letting people know that there is no room in the landfill for materials that can be reused or recycled. We're going to see people penalized for not being responsible with their waste. They may even have to raise fees on regular drop-offs; then people will want to divert the waste to other places that can shred, melt down, and recycle those materials. When that is the law, then there will be more and

more markets that are able to process and utilize secondary materials. Then businesses will have to divert their waste.

CLIENT INTERACTION AND MARKETING

We've begun asking questions about how we can market ourselves differently in the industry. Earlier I mentioned our controller, our CFO. He was the first in the office to get LEED accredited, and then a few more people in our office got accredited. Since then, we're known as the go-to company for LEED consulting. We help people certify their projects. Other contractors and architects come to us looking for someone to manage their LEED project. They're hiring us to do that process, because it is a lot of work, and it saves them the time and money of having to learn about the process. We're using that as an opportunity to generate business and revenue. We're doing a lot of projects in Nevada, and we're doing projects here also. We had just worked on Portola Plaza;⁷ we introduced a green program there. We're definitely more prepared to handle projects like this in the future. This experience has helped a lot. We have Platinum, Gold, and a few Silver projects that are supposed to be in construction, but they're all on hold right now.

We were already efficient in the way we were operating before we started doing LEED projects. If we were doing a design project, we always looked at the most efficient way to do the heating or plumbing systems. We were always conscientious about that, and we weren't upsizing equipment when we didn't need to. A lot of people do that. We take into account all these issues, and then we use as few resources as possible while accomplishing the same goals. We take the information that we learn from LEED projects and incorporate it into our other projects. We know that if we implement some of those practices, then the client is going to get a better building environment. Can we use low VOC products? Yes, we can. Is it going to cost them any more money? No, it's not. We're implementing certain LEED criteria into our normal process. We're helping the owner benefit from the knowledge gained from doing LEED certified buildings.

⁷ Portola Plaza is a hotel located in Monterey, California.

We just did a warehouse across the street. We thought about trying to make that a LEED certified project, but it wasn't really appropriate; it's a big warehouse with a small office. We've always used an adequate number of skylights. There was light during the day, and it almost didn't need electric lights. Now we have sensors. When the lights are on, they're running on timers. The lighting levels change throughout the day, and depending on whether it's overcast or sunny, the sensors change whether the lights are on or off. Now, as a standard practice, we're incorporating those into regular warehouse facilities.

SELECTING NEW TEAM MEMBERS

We're always looking for high-quality people. They have to have computer and people skills; they have to want to learn and do new things. I can't hire someone who just wants to build warehouses all day. There are only so many of those. It's the same thing with medical buildings; there's a limited market. We try to find people who want to be diversified. Then, they have a number of tools they can use. Before I took over the company, I had been working as a licensed engineer. I had been doing estimating and project management. When I put together a conceptual budget based on a napkin drawing, I was expected to stick to that budget until the end. That placed pretty high demands on people, and everyone had to produce. If people don't produce at that level, they really don't fit in. Anybody that can produce at that level can adapt to work on LEED projects.

IMPROVEMENTS FOR THE FUTURE

If I could change something it would be to bring the mechanical, plumbing, and electrical guys on earlier. I would not do a design-assist project like this again. The problem with the way this design-assist was done is that the specs and schematic plans were already completed. Then, they were turned over to us, and we gave them to the subcontractors to finish them. The subcontractor hired a third party engineer. That disconnect and discontinuity was the number one difficulty we had to overcome. I would start by getting the engineering, mechanical, plumbing, and electrical plans completed, and then I'd put those out

to bid. You could do it as a design-build, whether it's the company doing the design-build or the subcontractors. You could also hire an engineer and then do the design-build together. This is the first job I've done that was disconnected like that, and it made it very difficult, since there was some information that was lost. That could have been avoided. It's easy, with the right architect or interior designer, to write the specifications. Then those subcontractors just need to implement the specifications and show the right documentation.

This narrative is based on a video- and audiotaped interview conducted by Kristen DiStefano on July 24, 2009, at the offices of Ausonio Incorporated in Castroville, CA.

JOE PIEDIMONTE

CORPORATE CONTROLLER,
AUSONIO INCORPORATED, CONTRACTOR

I. PROCESS

CHANGING PRACTICES

Our practices have changed because of the Chartwell project. It's made a huge impact on our organization. The biggest impact is on documentation. We're starting a couple of LEED projects right now; one is trying to achieve LEED Platinum, and the other one is going for Gold. I'm also consulting on some new projects. With these projects, we're making painstaking progress on documentation. Usually, when we're at the end of a project, we have to track down the subcontractors to get recycled content information, regional information, and what adhesives they used. Now we're working ahead of time to get estimates of what the construction waste will be, in addition to getting the actual construction waste tickets. We're making sure that the submittals come in and the materials are applicable.

Pursuing LEED shouldn't delay anything. If anything, it solidifies the project in a lot of ways, and it helps us think a little more in advance. The whole integrated design process makes me realize what has to be done up-front a little more.

TEAM DYNAMICS AND SHIFTING RELATIONSHIPS

We've let six people go due to economic problems, but the one person we've hired, other than replacing a receptionist, is a green building analyst who is helping me. That's an indication that this is the direction in which construction is going.

We have some foremen who are more inclined to do paperwork than others. We looked at the two projects that we're starting, and that was a determining factor on which foreman would be running them. I had some input, and I wanted to make sure that whomever we chose was not afraid of doing paperwork, because they have to do documentation. I had a good talk with both of the foremen we have on the projects that are starting now. I am comfortable with their capacity and motivation to track credits. There are photographs and narratives that have to be tracked and managed throughout the process. We have to take that seriously.

Today, we were talking about a trade partner we had contracted with for Forest Stewardship Council (FSC) lumber. They have no experience. I heard about this, and since I have a relation-



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University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes prepared this narrative. © 2009 U.S. Green Building Council and the University of Oregon. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the permission of the USGBC.



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The Classroom Buildings "We're creating a better environment for the people working on the site and, ultimately, for the people who will occupy the building... it's a very exciting time to be on these projects."

ship with Hayward¹ I said, "Look, you've got to have Hayward on this project because they're going to manage the chain of custody.² They know how to do this; we worked with them on Chartwell. If you bring in somebody new, they're not going to know how to do this, and you put a whole LEED point in jeopardy if you mismanage the process." We were able to make that change right away, which is great. That is definitely the difference: we know how the process runs, and now that we know how it runs, we know where the problems are. These projects are going to go so much smoother as a result. No construction project ever goes smoothly. There will always be changes, and there's always some kind of twist. We don't want to reinvent the wheel in addition to our regular work.

That example about the FSC lumber is a perfect

¹ Hayward Lumber is a lumber and building materials supply corporation with multiple locations throughout the state of California.

² Chain of Custody (CoC) refers to the documentation of paper trail required to track Forest Stewardship Council certified materials through all stages of the production process.

example of changing relationships. The more that subcontractors become experts at what they do, the easier the process is. Just this week, we had a preconstruction meeting for a project in our area. There were probably 30 subcontractors there, and I asked them a question, just to see what the audience was like. I asked, "Okay, how many of you had heard of LEED prior to this project?" Two of them raised their hands. Then I asked if they had actually been on a LEED project. One person raised his hand. It varies from region to region, but at that moment I realized that we're teaching these people how to manage this process, and it takes a little more handholding to make this successful.

Sometimes new subcontractors will be overwhelmed. They always ask what LEED is, and I try to make it very simple for them by illustrating what the relevant features will be for them. That might, for example, be waste management, indoor air quality, or sealants and adhesives. If they're an electrical contractor, it will be commissioning. I try to make it more relevant to

them, and let them know that I'm a resource, and I'll help them. I try to make the forms that much more usable; for the adhesives and sealants, I put the specifics on the back so that they know that "for this application, the VOC³ level has to be at this amount." They can refer to it; it's right there, all on one page. They can use that document more.

II. OPERATIONS

SHARING INFORMATION

The state architect⁴ said the Chartwell School is a landmark building for the state; that was huge. It was great to be part of a project like that. I've been trying to get this information out locally, in order to promote it and explain what's going on. If this is a landmark project for LEED professionals and the green building community, then it's also a great resource for local parties.

Information about this kind of project is really something we're all seeking. We're getting involved in LinkedIn⁵-type networks and trying to talk so we can understand how to approach this process. Everybody's collaborating and sharing their knowledge.

NEW STANDARDS

I think the Chartwell project gave us a roadmap to understand the LEED process. It was LEED 2.1. I'm looking at 2.2, and I'm seeing some differences and changes. Now there is a version 3, and we have one project that might be version 3. Most of our current projects are 2.2. I think we're comfortable with what's expected from us, with what's expected from the contractor. That's put me in a unique position, and I'm able to work with architects on projects even when Ausonio Incorporated is not the contractor. We're working with architects on the New Technology High

School in Napa, California and we're working on projects in Las Vegas that we're not the contractor on, but we can help the architect with things they may not be able to do. They would rather design the project than chase a lot of the documentation, for one thing. They also want to know that they've got somebody with experience working on a Platinum project, someone who worked very closely with subcontractors and contractors to get the necessary documentation. That's very relevant for them.

As we go forward, we're looking at a lot of low-cost and no-cost improvements that we could do on the job site which are just good practices. If we can specify low-VOC paint or use low-VOC adhesives and sealants, why wouldn't we? We're creating a better environment for the people working on the site and, ultimately, for the people who will occupy the building. That's been a big focus, and it's not a very expensive proposition. It makes sense for us to divert our waste so that it doesn't cost us as much to bring it to the dump. We have just adopted some green standards without realizing it, but we're still incorporating those into each job. I see this with a lot of architects, too. They're designing things to LEED standards whether it's a LEED project or not; it's a very exciting time to be on these projects.

CLIENT REACTIONS

We have to let clients know how this process will benefit them. This is most relevant when we talk about indoor environmental quality. You can look at the rent you're paying per square foot. But you could also look at the salaries in that building per square foot and compare that to your rent; there's going to be a huge disparity. If we can eliminate the reasons why people go home and are not productive, like headaches and allergies, then we'll really have an impact. Chartwell School has noticed a decrease in absenteeism and sick days; though it's not yet scientifically verified, they have noticed a decrease during peak stress times when they used to have a lot of absences. The environment does help quite a bit; not every place can be a Chartwell school and take all the indoor air quality measures they've taken, but we can make a difference.

3 VOCs are volatile organic compounds comprised of organic chemical compounds that vaporize and enter the atmosphere under normal pressure. VOCs combine with nitrogen oxides in the air to form ozone. Some VOCs are neurotoxic and carcinogenic.

4 The Division of the State Architect provides design and construction oversight for K-12 schools and community colleges. They also develop and maintain codes and standards used for building throughout California.

5 LinkedIn is a business-oriented social networking site.

<div data-bbox="34 291 61 373">Owner</div> <div data-bbox="34 558 61 676">Architect</div> <div data-bbox="34 837 61 972">Contractor</div> <div data-bbox="34 1136 61 1245">Engineer</div> <div data-bbox="34 1409 61 1543">Consultant</div> <div data-bbox="34 1648 61 1877">Facilities Manager</div>	<div data-bbox="381 184 891 562"> <p>There’s a shift in the way we value quality of life in these buildings, but it comes down to money. I’m a controller, and this has been my hook into the whole thing; it makes sense. As a controller, a lot of times I’m looking at personnel as a dollar amount. If you’re not being productive, or if you miss a day of work, it puts stress on everyone else; that’s unnecessary if we create the right environment. It makes sense. I think people just haven’t really connected the dots enough to realize it, and so it’s up to me to explain that.</p> </div> <div data-bbox="381 667 891 745"> <p>This narrative is based on a video- and audiotaped interview conducted by Kristen DiStefano on July 24, 2009, at the offices of Ausonio Incorporated in Castroville, CA.</p> </div>
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ALLAN DALY

PRINCIPAL, MECHANICAL ENGINEER
TAYLOR ENGINEERING

I. PROCESS

GETTING INVOLVED IN THE PROJECT

The project timeline started in 2000 with design. Scott Shell¹ was the main connection between EHDD Architecture² and us.

Our firm, Taylor Engineering,³ is one of the groups that organizes and runs a number of the classes offered for professionals at the Pacific Energy Center.⁴ We were starting to put together a roundtable discussion about operable windows in commercial buildings and were talking with different people about how to organize it, who should be on the panel, and what buildings we should discuss. We wanted it to be focused around real buildings so there'd be a touchstone for the participants. Scott and I ended up talking for a long time one day about operable windows in buildings. He didn't end up speaking at the roundtable because they didn't have a specific project that was at the right phase at that time, but we hit it off and we both enjoyed our discussion. When the Chartwell project came up, Scott asked if we would be interested in working with them on trying to do an interesting building. He said it seemed like the owner had good sense about sustainability and wanted to take on some interesting issues, and that it was a great project because it was a school for kids with learning disabilities. It would just be a great job. Scott invited us to be part of the team and we presented at the project interview. It really got started with EHDD Architecture, who assembled a team of people they thought would create an interesting mix. I owe it to Scott for getting us involved in the project.



ALLAN DALY, P.E. is a registered mechanical engineer at Taylor Engineering where he specializes in energy efficient and environmentally responsible HVAC system designs that maximize occupant health and comfort. He is an expert in the use of computer programs to simulate buildings and systems to predict building energy consumption, thermal performance, natural ventilation, and occupant comfort.

¹ Scott Shell was the principal at EHDD responsible for the Chartwell School.

² EHDD Architecture is an architecture firm in San Francisco, California, and was the architectural firm responsible for the Chartwell School.

³ Taylor Engineering is an engineering firm located in Alameda, California. They specialize in mechanical systems design and construction, energy conservation, indoor air quality, controls, and system commissioning.

⁴ The Pacific Energy Center, located in downtown San Francisco, CA, offers educational programs, design tools, advice, and support to create energy efficient buildings.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes prepared this narrative. © 2009 U.S. Green Building Council and the University of Oregon. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the permission of the USGBC.

WORKING WITH THE PROJECT TEAM

The first time I met the rest of the team was actually at the interviews; we were there as part of the interview team. The project had some significant environmental goals early on and most of the team recognized that it takes an integrated approach to really make progress. A number of engineers were at the interviews for the project, which is more and more common. It hasn't always been that way, and there are still plenty of jobs that I get involved with where I show up at a design meeting and they're half way through Schematic Design,⁵ (SD) and then I start. On this project, EHDD invited the engineers; the structural engineers were there, and I was representing the mechanical and energy side.

It was really through the interview process that I got to meet Douglas⁶ and the rest of the team for the first time. I remember the interview actually being more like a design charrette where we started kicking around some ideas.

ESTABLISHING PROJECT GOALS

From day one, they knew they wanted to try for some kind of LEED certification. It was definitely in the middle of the design process when Douglas, Scott, and the design team decided the project would go for a very high-achieving Platinum⁷ rating rather than a Certified or Silver-level rating. That changed my understanding of the project. Early on, I thought it was going to be a very nicely designed, but modest, project; it's a private school and the project was going to be cost-focused. I had thought it would be a nice, clean, simple, and small project. When they came back to me with the idea that it was going to be a LEED Platinum project, I knew that they had committed to putting their time, effort, and money into making the project excel. This elevated a very good project to a great project. It was exciting and fun. The LEED rating system gives a lot of weight to energy points, so having a very aggressive,

LEED Platinum goal worked with the project.

In the interview process I remember thinking that maybe this would be a good chance to really tackle a zero net energy⁸ building. Back in 2000, there weren't a lot of people talking about it. Of course, the idea of doing onsite generation and matching it with your demand is a pretty simple concept, but I remember asking at the interview whether it was something that they would consider doing; I asked if they would consider trying to make this a zero-energy building. I think they were a little skeptical. It's a large goal, but they seemed open to it, and it ended up being part of the project in the end. The idea of doing a very aggressive energy design for the project and trying to get to net-zero allowed us to put enough photovoltaics on the project to balance out the demand we predicted. The LEED certification was a big, big part of driving the design in that direction.

II. DESIGN

COLLABORATION AND DESIGN DECISIONS

Since EHDD is in San Francisco and we're in Oakland, our offices are very close. They have a very nice, informal way of running design meetings, and we designed this project by getting together a lot. Our primary method of design-team collaboration was getting together, meeting at their office, and going through sketches and ideas. That kind of collaborative brainstorming was our primary way of communicating. Of course we also exchanged emails, PDFs, and drawings. Primarily, though, we got together face-to-face and made phone calls. The design phase was a very close, collaborative process. We were always going back-and-forth.

The zero net energy goal was pretty aggressive and not easy to accomplish. We didn't end up achieving a zero energy project. We ended up looking at the predicted electricity use and seeing if we could we make their bills zero every year.

⁵ Schematic Design (SD) is an early phase of the design and delivery process.

⁶ Douglas Atkins served as the owner/client for the Chartwell School Project.

⁷ LEED Platinum is the highest rating in the LEED Green Building Rating System followed by Gold, Silver and Certified designations.

⁸ The U.S. Department of Energy Building Technologies Multi-Year Program Plan defines a net-zero energy building as "a residential or commercial building with greatly reduced needs for energy through efficiency gains (60 to 70 percent less than conventional practice), with the balance of energy needs supplied by renewable technologies."

That's how it evolved. In a way, though, that was more of a secondary goal. The primary goal that Scott, Douglas, and everybody on the team really took to heart from the beginning was creating a fantastic learning environment: one that was comfortable, quiet, and had a lot of daylight. EHDD does great designs with daylighting, and of course, they work with Loisos and Ubbelohde Associates⁹ which has fantastic daylighting consultants. Creating a visually and thermally comfortable environment that was quiet and could really help these kids learn was the top goal from day one; everything else slotted in behind that.

The decision to go with a radiant heating system was one which was made in support of making it a very comfortable, quiet environment. Because the project had a small budget, we actually designed a whole scheme around what would cost the least or what was the "plain-vanilla" way to do a project like this. At first we had a little furnace just like one that you'd have in your house. It was a very conventional approach to get things started. Nobody really wanted to have ducts, fans, and all the noisy machinery in the rooms, so the radiant heating system was something we ended up doing. It combines well with the operable windows. Because of the mild climate at Chartwell and in the Seaside area, we knew we wanted to have windows that could open and get fresh air into the building; that is something both students and teachers understand. The radiant heating system was a good match with the windows to make that work.

TECHNOLOGY AND DESIGN

We've done a lot of energy modeling in our office. I used eQUEST,¹⁰ which is a DOE-2 based energy-modeling tool. We built several models and predicted how much electricity the building should use, and then we tried to match the photovoltaic array to create that much electricity. We used energy modeling quite a bit and in a pretty conven-

⁹ Loisos+Ubbelohde Associates is an architectural and energy consulting firm that specializes in daylighting, lighting design, energy modeling, comfort analysis, evaluation of building performance and LEED certification.

¹⁰ The Quick Energy Simulation Tool: an easy-to-use building energy simulation tool that can be used during any phase of the design process, including schematic design.



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Classroom Building Sunshades "Because of the mild climate at Chartwell... we knew we wanted to have windows that could open and get fresh air into the building."

tional way. LoopDA¹¹ was another analysis tool that we used to help refine the design. At the same time this project was developing, there was also a research project at The National Institute of Standards and Technology (NIST) which was trying to develop an advanced design tool to help people look at natural ventilation in buildings. We have some friends at NIST who were looking for some example projects that they could evaluate using their new tool line. They contacted us to see if we

¹¹ A computer program used to implement the Loop Equation Design Method to size the openings of naturally ventilated buildings.



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The Classroom "LoopDA helped guide our selection of the windows, which are down low and up high."

had any projects that could be used as a case study or a test case for this tool they were developing called LoopDA. It was a loop-based analysis method, and "DA" meant that you could do both design and analysis using the tool. We used that to model the building and to figure out, in a pretty coarse way, given the heat loads and the window openings of the building, how much fresh air we could get moving through the building. We actually developed this project using that tool to help predict some of the air flow rates and opening sizes. That tool helped guide our selection of the windows, which are down low and up high. The classrooms are relatively deep, 30-35 feet, and we have operable windows along one side. Intuitively, we knew we wanted to get some cross ventilation. There are skylights in the back of the classrooms, and we were able to show the extra value of having those skylights be operable, in some cases, in order to get some natural cross ventilation.

Some of the benchmarks for this project came out of The Department of Energy (DOE) and The Energy Information Administration (EIA), as

well as The Collaborative for High Performance Schools¹² (CHPS). The CHPS project was starting at about that same time. We were able to use some of those resources to calibrate our energy model in order to figure out where the baseline was and how much better we were going to be. We tapped into the CHPS on this project to some extent. Charles Eley¹³ of Charles Eley Associates, now with a company called Architectural Energy Corporation (AEC), was one of the primary authors of the CHPS guidelines. We asked him to do a peer review of our project to look over everything and see if we were going in the right direction. We wanted to know if he had any ideas for us. LEED required, at that time, and under that rating version, a peer review of each job by

¹² The Collaborative for High Performance Schools is a non-profit organization dedicated to making schools better places to learn. CHPS (pronounced "chips") was founded in 1999 as a collaboration of California's major utilities to address energy efficiency in schools. The program has since expanded to address all aspects of school design, construction and operation.

¹³ Charles Eley is the Executive Director of the CHPS program, and did the peer review for Taylor Engineering.

the commissioning authority. We asked Charles to do the peer review for the project; it was an expanded idea of what a peer review is, and it went further than mechanical commissioning and became more about the whole building. He commented on daylighting, the systems selection, and the way the rooms were laid out. He's an architect as well as an engineer. It was a really interesting and useful way to tap into the CHPS project and Charles' personal history and background; that was a good use of our time. Scott was at that meeting, we were there on the energy side and Charles had some of his engineers there as well. We had a couple of hours of good discussion on ideas and directions for the project.

RESOURCES AND TOOLS

We used the LEED scorecard to track points in the process. Energy modeling tools, such as eQUEST, can be made to give you the information you need to figure out how you're doing on your energy points. We used those kinds of reporting tools. We justified our points and provided our documentation for the LEED process by using the energy modeling that we did for the project. I don't remember submitting any documentation using the LoopDA tool. In a way, though, that work is covered under other LEED points so it wouldn't have needed its own separate documentation. You get credits in LEED just by using the operable windows and giving occupants control over their environment.

When we try to do a building that has a specific energy goal, like getting to zero electricity, it's a very different kind of energy modeling process than one in which you might simply compare Option A to Option B. Instead of doing a relative comparison between two options and figuring out which one is better, we're trying to predict an absolute number of how much energy the building is going to use. That's a much harder calculation to do; you're predicting the future, which is always tough. We tried to find benchmarks for existing school energy-use levels and to calibrate the energy model to figure out whether we were in the range of reasonable, expected demands for the project.

III. CONSTRUCTION

INVOLVEMENT DURING THE CONSTRUCTION PROCESS

This project was procured in a design-build¹⁴ mode for the mechanical, electrical, and plumbing systems. We were not as involved in the day-to-day design of the project because we were handing the design over to the contractors. We took the project through Design Development (DD),¹⁵ but then, beginning in the Construction Documents (CD) phase, the contractors really became the primary designers. I remember thinking that we should keep the collaboration going so I called the contractors and the mechanical engineer and went down to Seaside and met with them. We sat in the room together to figure out what we were trying to do with the project. I let them know I wanted them to understand the design intent behind this so that as they took it forward they could really springboard from what we had done and understand it. It was a nice meeting: lots of shaking hands, lots of cheers and people saying it was going to be great. As I remember, though, it didn't really go much further than that. The collaboration between those designers and me didn't really gel. Maybe it's because we were a little farther away or maybe it's because they hadn't done a process like this before. All-of-a-sudden it became a much more conventional project where we gave information to them, and they were working on it; they gave back drawings, and we reviewed things on paper, but not in person anymore. They picked it up from that point, and I think they did a fine job. There were some Requests for Information (RFI) and the usual Construction Administration (CA) dialogue back-and-forth, but it wasn't a very active, lively discussion between us. That created a bit of a gap, or lag, in getting everything finished and done. For a while it went quiet for us, and then, as we tried to get the job finished up and going again, we got involved in a very serious way in getting things back up to speed. In general, I'm a big fan of design-build; I like getting contractors

¹⁴ In a design-build project the contractor is responsible for completing the construction documents for systems that the design team developed through Schematic Design and Design Development.

¹⁵ Design Development (DD) is a phase in the design delivery process that includes Schematic Design (SD), Construction Documents (CD), and Construction Administration (CA).

involved and I like collaborating because there are more ideas and more experience at the table helping the team figure things out. But the collaboration needs to continue. It can't just be one meeting and then we stop and move on from there. If I could do it over again I would definitely try to set up more frequent, collaborative meetings with the contractors. The process felt disconnected. That was one piece of the construction where I could have done better; I should have tried to make that process more collaborative.

I learned a lot from the challenges during the construction process and liked working with contractors. Though I don't personally have any contracting experience, a number of the engineers in the office do; I lean on them to figure out how things actually get built and how things go together. I enjoy meeting people in the field, talking, and seeing how things get put together. Because of the collaboration on the Chartwell Project, I try to spend a lot of time at the job site getting to know the people who are working on the jobs and the people in the buildings I've drawn. I learn a lot from them, and I try to take the time to explain what we're doing. That's definitely something that has stuck with me over time.

PROJECT SUCCESSES

On most LEED projects, especially ones that go after the monitoring and verification point, getting that to work is always a huge challenge. The person who actually installs the computerized devices that control and monitor the building, the controls contractor, is a critical piece of getting a LEED project to work right, even one as simple as Chartwell. We've got radiant floors and operable windows; it's a very simple project in a lot of ways. Finding a controls contractor you can work with, who understands what you're trying to accomplish, and who is a good collaborator is always the trick. We work in the city with Oakland, San Francisco, and San Jose contractors, and we're used to fighting with them to meet our specifications. Our specifications are very good as far as trying to make it clear what level of performance we expect and what kind of parts and pieces we need and how to put it all together; we're very prescriptive about that. The Seaside market is a little smaller, and it's hard to get the

contractors from the San Francisco area to go down there for a small job. We had the goal, and Chartwell had the goal, to find good people in their own community, who could grow into the project, and who would be good collaborators.

It was a hard job to find the right controls contractor to work on that job. Ausonio Incorporated¹⁶ did a good job helping us identify folks who were in the area who might fit the bill. We ended up finding Chris Jones,¹⁷ of Digital Control Solutions Inc. She's a contractor I've never worked with, and it's a controls product I've never used before. I had concerns about whether it was going to work, but through discussions, interviews, and answering some questions through email, I realized she had an excellent approach to the project and was very committed to it. She had worked in that area before, and she ended up being a superstar. We were trying to get the controls right; as a result, we have all sorts of power monitoring and unusual control sequences for the heating system, to see how efficient we could make it.

That went from being my biggest worry on the job to being one of our biggest successes in terms of getting the job done. Chris was always very helpful in diagnosing anything that might be going wrong, as well as trying to translate. Even as prescriptive as we try to be in our plans and specifications, it always takes another leap to get them implemented for a specific controls solution. She was great about saying what we could and couldn't do. She hired someone she had worked with before who was an expert in using that type of controls system to do some unusual applications. We did some conference calls where the three of us talked together and tried to figure out exactly how to implement what we wanted to do with the controls system. In the end, the monitoring and verification system became a big asset to the project; it's helping us figure out now, after the fact, how close we're getting to our zero-electricity goal, and it's helping us find ways to get even closer to that goal.

¹⁶ Ausonio Incorporated is a design-build construction firm, located in Castroville, California, which led construction on the Chartwell School.

¹⁷ Chris Jones is the owner and founder of Digital Control Solutions, Inc. She was the controls contractor for the Chartwell School.

IV. OPERATIONS

THE COMMISSIONING PROCESS

You have to find a way to have the people who are involved in the design of the project be involved in the commissioning. I don't know if they should actually be out there doing the commissioning or if they should just be a part of the dialogue. Maybe their involvement is just emails and conference calls, or maybe they're doing witness testing to see how things are actually going. You have to have the designers out there in the field to make sure they see how what they drew really gets built, really operates, and how people like it. Then they can understand and improve as they move forward in their work and careers. Perhaps these should be young men and women who are on the design team; maybe it's their first job. My advice would be to work with great teams and be very collaborative. I feel really lucky to have gotten to meet Scott Shell, Michelle Hill, and the team at EHDD. They are just good, interesting people. They're thoughtful people who are very committed to what they do. Finding teams that you really gel with and can collaborate with is a huge part of doing successful projects.

We're definitely involved in the commissioning of projects. On my jobs, I feel like I'm the last person there from the design team in a lot of cases. At Chartwell, we got a round of funding from them to go back and do a study to help with the energy use. We hope to get a bit more funding from PG&E,¹⁸ our local utility, to go back and do a second round of studies so we can try and learn some lessons. We'll look at the data that's there and do a bit more instrumentation; we can try to figure out how to get the energy use down another big notch for them. In a way, I would still call that commissioning; we're still working on it. The project has been open for three or four years now, and we're back in the building. Of course, the architects are still there as well, but the commissioning process could potentially go on forever. We're always checking and trying to make things better; we're always improving the building. It's nice to get to live with your buildings instead of just designing them and then letting them go by

18 Pacific Gas and Electric of San Francisco, CA is the utility company that serves the Chartwell School.



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Electric Vehicle Charger "The idea that you need to capture everything seems simple in retrospect... we're expanding the breadth of what we're trying to model."

the wayside and never seeing them again. To be at the site and have an ongoing relationship with these people is really nice; it gives us a lot of valuable information.

Looking back, Chartwell was the first project I had undertaken where we were trying to get to an absolute energy goal. Even though we used energy modeling tools and found some benchmarking information, it didn't exactly all fit together. We had to make a lot of assumptions and extensions of the data that was there. Looking back now, I realize that we should have done a lot more in order to get a better sense of where



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Building Control Terminal "Chartwell funded us to go back and do a study for them. We used all the data from the building control system."

the project was going to end up energy-wise. As it is we're not getting to our zero-energy goal or our zero-electricity goal for the project. We're falling short to some degree.

The role of commissioning is something that we, as a firm, are trying to adopt very seriously. In one sense, commissioning is just getting out there and making sure the building is working. The real value of commissioning is to make sure the owner gets a building that works. The value to a design firm, like ours, is that you can get out in the field, meet people, talk to people, and see what actually works; you can see what problems are out there and how to fix them. Then, the

next time you go through the design process, you won't make those mistakes again; you'll have a better understanding, and you'll be able to move forward. We like to find engineers who have some field experience in building things. But if they don't, we make sure they get that field experience by being part of the commissioning processes. They get out there, test things, talk to contractors, and fix things. That's a traditional engineering skill that you wouldn't find with somebody who's coming out of school, but it is one that we make sure people get. We find it's extremely valuable in helping people be better designers and thinkers.

LOOKING TOWARDS THE FUTURE

The area where the project could have been improved, from our perspective, would be if we had been more actively involved in the construction. That's the one area where I feel like I could definitely have been more involved and more proactive. I think it's very valuable to be involved through the whole construction process. You learn a lot and you find problems; you talk to people and things go better. It's hard because no one has the fees or the time to do this, but I try to go to my projects that are under construction as much as I can. It just helps. You find that you make friends, find problems, and things go better.

If projects like Chartwell are the kinds of projects we want to move toward, then having engineers who can think in a very broad way is an extremely useful skill. They're not only able to do load calculations and size ducts, but they can think about comfort and the way people are going to use the building; the occupant response. In our office we've got about twenty engineers and only three or four have actual mechanical engineering degrees; it's a very broad set of skills. We've got chemical engineers and physicists; almost everybody has a science degree of some kind. Of course, being able to effectively communicate and collaborate with design teams, owners, and occupants is very important.

GAPS IN RESOURCES

I think a current research gap that would be nice to fill is the need for a better set of building energy use benchmark data that we could use in our energy modeling in a more direct way. That would help with projects like this so we would know how much energy a particular building will use. We can make a reasonable assumption, a reasonable guess, and then see how much better we can get than that benchmark. Those resources are out there, but they're very scattered and hard to find. We can do some Google searches, and look in the research, but it's hard to put your hands on the information. That's a big one; we need to be able to find good end-use energy benchmarking data that we can plug into our energy modeling very easily. On the energy-modeling side, it was sobering to do an energy model exactly how I'd

always done them, exactly how my friends and colleagues do them, and have it be so far off in the real world versus what I had predicted. That was, and still is, a very big lesson learned. I've thought a lot about how to do better at that and how to make that process better and more productive.

LEARNING FROM COMPLETED PROJECTS

The building control system that we have at Chartwell has power meters and gas flow meters. It has a bunch of metering tied into it that records and runs on a continuous basis; we're able to view that remotely and look at the trends. It's a good system, but building control systems are not primarily designed as data-acquisition systems; they're not really designed to do what we're doing with them. It's difficult and a little clunky to get that data into a usable form for real, day-to-day work. It's turned out that some of the meters have stopped working and some of the data doesn't seem like it's right anymore. It just takes time to go and figure out what's going on. There's some inertia there that makes it a little hard to use; there is this emerging idea that we need to spend more time thinking about the building control system or, the term that's being used now, the energy information system. It's not just a building control system, and that is something I've started to think a lot about. How can I do better next time; how can I change things?

We are collaborating with a couple of different companies right now that are more focused on straightforward data-acquisition systems. We're trying to figure out if it makes sense to do a separate system in the building just to collect data. It would be easier to use, and the data would be in a better format, but we're also trying to look at whether we can leverage the existing building control system and continue to make it do something it wasn't necessarily designed to do. It's just one system so you're going to save a lot of money that way. That is an evolving design and process for us and we don't really have a good answer for that yet.

Chartwell funded us to go back and do a study for them. They wanted us to look at the data and then troll through it and figure out some

measures they could implement in the building to get their energy use to go down. We used all the data from the building control system, and we realized a very simple thing: the lights in the parking lot were scheduled to go on all night long. That was using a lot of extra energy that we didn't expect. And we're learning other things. For instance, there's a big, five horsepower irrigation pump that is running to water the sports fields that we never built into the energy model. The idea that you need to capture everything seems simple in retrospect but, at the time, it didn't even occur to us that we should try to capture those things. We're expanding the breadth of what we're trying to model, how we model it, and how we tabulate the information.

OCCUPANT RELATIONSHIPS

I have gone to Chartwell and told people that I designed the building and asked them how it's working. It's always a hard thing to go into your building; it's kind of revealing to say you designed it and then ask how it feels. I do that on a lot of my projects. You get some pretty honest feedback sometimes. Sometimes it works great and some people really like it. I've talked to the occupants at Chartwell, and in general, people are very happy with the building. They did a survey of the occupants, and the project rated quite highly in terms of comfort and how well people liked the building. I remember that there was a comment, somewhere along the line, that the building doesn't have any active cooling. I think one of the teachers wrote a comment that the rooms were too warm. It seemed obvious to me that the right answer would be to open the windows and let some air in from their nice environment, but that wasn't necessarily that person's first reaction to the space. Having that dialogue between the occupants and the designers is an important part of figuring out how to make these buildings better. Would that same occupant then look at a computer monitoring the space and see what the CO₂ level is and what the fans are doing? I don't know. I'm an engineer. I like numbers, graphics, seeing data, and understanding how buildings work, but I'm sure that occupants don't want that level of detail. The right level of detail gives people some informa-

tion to help them understand the building so that they can best use the building. It is a fine line, and you don't want to overload them.

ADVICE FOR FUTURE PROJECT TEAMS

Douglas Atkins, the owner's representative, was really the driving force behind this project. I think everything happened, in the end, because Douglas was committed to it and wanted it to happen. Finding a person who has the leadership to pull a project along is important. As a designer, we're basically hired guns to some extent, but we do have our own agenda: we want to make nice projects. We want to make projects that run well, that are going to go well, and that we're going to enjoy doing; but, in the end, we're doing what the owner wants us to do, and we're trying to give them the building that they want. Douglas had a very clear, let's-make-this-happen attitude and it was his commitment to achieving LEED Platinum from very early on that made this project happen. It was sort of novel for him as well but, when he figured it out and was able to convey it, it made everything much clearer for the rest of us as well. It was very useful in understanding that he was as committed as we were to doing this great building.

This narrative is based on a video- and audiotaped interview conducted by Kristen DiStefano on July 27, 2009, at the offices of Taylor Engineering in Alameda, CA.

GEORGE LOISOS

PRINCIPAL, DAYLIGHTING CONSULTANT
LOISOS + UBBELOHDE

I. PROCESS

PROJECT PARTICIPATION

The Chartwell project was different for a number of reasons, and our involvement was sporadic compared to other projects. Even though it's a very successful project in a number of ways, we're a lot more effective when we're part of the design process from day zero to the very end.

Scott Shell¹ is adept at daylighting design and doesn't need a lot of handholding. In this project, we did specialized analysis to locate the light. There are a lot of questions people don't typically consider. For example, daylight is more than just light coming through a window or a skylight; you have to actually think about what you're going to light. In the case of a classroom, you want to light not only the horizontal working plane, but also the vertical surfaces, and the teaching wall in particular. If the teaching wall is not the brightest thing in the room, then students' eyes tend to wander. They will look outside the window or at a brighter wall, and the teacher will have a harder time keeping them focused.



GEORGE LOISOS, LEED AP, is a licensed architect and a principal at Loisos + Ubbelohde. He was an architectural program consultant for the Pacific Energy Center, and has lead major, university-based research programs in building energy use.

II. DESIGN

DESIGNING FOR DAYLIGHT: PROCESS AND ANALYSIS

We analyzed what we were trying to accomplish with the lighting and what problems we would potentially have to address. That pointed us toward a specific strategy, and at that point, we identified certain issues. For example, glare was understood by the client to be low enough that they decided that instead of buying MechoShades² they would buy flat screen TVs. The contrast ratio³ of the TVs was high enough that it solved the problem the MechoShades were supposed to address. That was not a fantastic idea, though, and I think they've retrofitted the MechoShades

1 Scott Shell is a Principal at EHDD Architecture in San Francisco, California.

2 The MechoShade Corporation manufactures solar shading and interior shade cloth systems.

3 The contrast ratio is the ratio of the luminance of the brightest color to that of the darkest color that a display system is capable of producing.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes prepared this narrative. © 2009 U.S. Green Building Council and the University of Oregon. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the permission of the USGBC.

since. It was an interesting experiment; you could argue that humans are adaptable enough that you could make that kind of substitution, but in this case, it wasn't a strong enough solution to remedy the reflections.

One of the things we did early on was to model a number of fenestration options and look at how they performed throughout the year. We varied the sizes and types of skylights and windows. I think we even looked at glass types, though in this case, glass types were not a huge variable. We settled on the current solution, which is okay, but not spectacular. One of the reasons it suffered is because the contractor mistook the clear dimensions of the skylight for the rough opening dimensions. So the skylights are about half the size they should be; at that size, they're not as effective as we hoped they would be. We had enough leeway in the project that it's good, but it could be a little better.

DESIGN TOOLS AND TECHNOLOGIES

We exclusively used Radiance⁴ in its native form on this project. We don't use Ecotect⁵ or any of the other add-ons that make it easier. One of the problems with using those add-ons is that once you get separated from the code, the solutions may or may not be very accurate. We try to control as much as we can. We control the base sky and all of the parameters, and we use real skies that come from the climate data. For Chartwell we did a lot of false color analysis in order to understand the contrast ratios. This was more important than modeling the actual lighting levels, because with the vertical glass, the orientation, and the climate, the lighting levels vary substantially. In general, it is a fairly overcast environment, but when the sun comes out it gets extremely bright.

When developing daylighting for projects we use physical models to calibrate the architectural models. We also use high dynamic range

photography (HDR)⁶ for some of the same tasks. For example, we will photograph a model with high dynamic range; then we'll compare that to our Radiance predictions. If we have an existing building that we're going to change, we can use high dynamic range photography to create a fairly accurate representational image of the exterior sky condition and the illumination levels.

In addition, we're working on some of our own tools. We're trying to develop a whole-sky calculation tool so that we can directly create a sky file. Then, essentially, we'll create files for Radiance that will closely match reality. We also have problems with how to model dynamic or redirecting glass. There are some light-redirecting technologies that we can model fairly easily, and functions have been written for some of those. For others, it's a lot of hard work. For reflective movers and similar technologies, it becomes complicated. Prismatic glass is very hard, as are the effects of different glazing components. For example, modeling frit in a way that somebody can tell what it's going to look like is not easy. We can try, but at this point we can't do it very well. Things like Mechoshades are unusually complex. Their fabrics allow light to pass through and in the process it gets scattered in complicated ways. They are three-dimensional, and at this point we don't have enough data to model them accurately. We can make approximations, but we don't know under what conditions those predictions might fail. Those are all challenges. What we have to do is figure out where those limitations apply and where they don't. The advantages of the Radiance approach, rather than the physical model, are that it's simpler to do because you don't need a sky simulator, and you can model materials mathematically. We can model almost any time of year in any part of the world if we want to, but when we get into really complicated models, we have to build calibration protocols to make sure we're not making mistakes. We have worked with other people who have essentially sent us Radiance models and said, "Can you tell us what's going on?" It's very easy to screw up.

⁴ Radiance is a suite of computer programs for the analysis and visualization of lighting developed by the Lawrence Berkeley National Laboratory in Berkeley, California.

⁵ Ecotect is a building design and analysis program developed by Dr. Andrew Marsh at Square One Research. Autodesk currently owns it.

⁶ High Dynamic Range photography is used with specific software to compute the average luminance within a space and to identify potential sources of glare.



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Daylit Hallways "For Chartwell we did a lot of false color analysis in order to understand the contrast ratios... with the vertical glass, the orientation, and the climate, the lighting levels vary substantially."

We have done evaluation runs for a lot of our simulations. For example, we've tested our office space and gotten the actual measurements to be within one foot-candle of those predicted. Greg Ward,⁷ who wrote the Radiance software, claims that is too good. The office space has light from three sides, and that makes it easier; being in the space, we have access to light all the time. We can essentially look at the surface reflectances and model them accurately. We are confident with our work.

We're far more confident with our light measurements and predictions than anything else. We can also integrate electric light, and see how the electric lighting and the daylighting work together. For Chartwell, we didn't do that. Another consultant did the electric lighting design; we

had very little interaction with him. Scott was the conduit through which all these pieces came together; the team structure was a more conventional model. We didn't have the grand design of the integrated team; we had a relationship with Scott. What is different in this case is that Scott is like an integrated team; so, it actually works pretty well. Remember, this is a project that had a small budget, so it had very little money for meetings, charrettes,⁸ and the overhead that usually comes with those things. It was difficult to squeeze as much into that building as they actually did, and the amount they accomplished is a testament to the skills of the project architect.

⁷ Greg Ward is the original developer of Radiance software. He started development of Radiance while at Lawrence Berkeley National Laboratory.

⁸ A charrette is a collaborative design and brainstorming session often performed in order to solve design issues or to begin a design process.

DESIGN DEVELOPMENT

We didn't do any energy modeling for Chartwell; Taylor Engineering did that.⁹ Our scope was narrow. It was just daylighting. We got involved after the basic shape of the building had essentially congealed. We did things like identifying good places for skylights. For example, in the corridors, we put skylights at the doors. That way you have pools of light at the entrances, and you make sure people won't run into you. We assisted with refinements but not with the overall building form, which we often do in other projects. We've done a few projects where we did some modeling before the program was even solidified. In cases like that, we essentially just do conceptual models, and lots of them. We do as many as 600 or 1,000 models in order to identify potential site issues.

The Chartwell School's building form is pretty close to what it was before we got involved. We added the skylights in the classrooms, and provided input in the daylighting design of the classrooms. We worked on where to locate the windows and what size they should be. There were issues about which walls would be washed with light. We made changes in some of the classrooms, where we switched the side of the room on which the teaching wall was to be located. There weren't that many challenges, because the bones of the building were pretty good. We have a variety of different clients. EHDD is one of those clients we have worked with a lot and can talk with in short hand. Scott, especially, needs a lot less handholding than many people, because he's done this with us enough that he can do a lot of the conceptual work on his own. He comes to us to fully develop the concepts.

III. CONSTRUCTION

INTEGRATION: DESIGN AND CONSTRUCTION

It's an interesting thing: we talk about integrated design until we're blue in the face, but in reality we do not do it as often as we'd like.

⁹ Taylor Engineering is an engineering firm located in Alameda, California. They specialize in mechanical systems design and construction, energy conservation, indoor air quality, controls, and system commissioning.

Even when we do it, the instincts of most of the people who are a part of the teams make it difficult. For example, many engineers want you to tell them what to work on, and then they will tell you if and how well it works. They're not used to starting from a blank sheet. We end up talking in platitudes; we make lists and charts; then everybody goes back and does the same things they've always done. Integrated design is much harder. You have to relax some of your defenses a bit, and allow yourself to make stupid mistakes and statements as a way of becoming part of a bigger whole.

In this project our fee was limited so our involvement was complete by the end of design development, and we were not involved in the construction phase of the project. When we do daylighting control systems on other projects we usually do have construction supervision roles, such as supervising the sensor location, and we may be part of the initial commissioning process, depending on how that process is set up. We are there to make sure that the system actually works. That wasn't the case at Chartwell. The system is fairly straightforward, and we didn't work on any of the electric lighting components. However, the skylights were a big challenge. Normally we may be asked to look at those things during construction, but in this case, by the time the architect became aware of the issue it was too complicated to fix. I don't think it would have been any different if we were on the project ourselves.

IV. OPERATIONS

LEED CERTIFICATION

Normally on a LEED¹⁰ project we do the LEED documentation, but in this case we didn't. As far as the daylighting is concerned, the LEED documentation falls into two areas. One is the standard LEED spreadsheet, which is relatively straightforward; the other is a computational modeling program. We normally choose to do the spreadsheet when we can, because it's simple;

¹⁰ The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), is a suite of voluntary standards for green buildings.

even if we have all the modeling done, it is easier for the USGBC to approve the spreadsheet.

If you want to do the modeling version, you actually have to model every space, and sometimes we don't do that. The questions we ask about daylight are different than the USGBC. We care about not only the quantity of light but visual performance and glare under multiple sky conditions and different times of the year. LEED 2.1 looks at daylight coverage under one sky condition and one time of the year. As our work is much more complex than that we concentrate on the areas that really matter, where people work as opposed to blanket coverage of occupied spaces. In Chartwell's case, we only modeled the classrooms. We knew that the main hall had enough windows, and the hallways were fine. The classrooms were the critical component, and we had limited resources for modeling on this project. If you're working with people who know what they're doing, it is sufficient. We did another project with EHDD that made the Chartwell budget seem lavish in comparison. There, we basically had just a few meetings and rough calculations, and the building still got LEED Platinum.¹¹ It's possible to do this for little money, but it depends on the complexity of the building, and it depends on how invested the team is in these concepts. It depends on how many times they've done it before; if they've got experience they can predict some of the issues we're going to be bringing up. It's just like anything else. It's like working with structural engineers: you can predict column sizes if you're well versed in the concepts.

The interesting thing about light is that it sometimes throws a curveball, since the number of variables involved is too great for you to do the math in your head. You end up using the rules-of-thumb that you normally have: the size, orientation, and position of the aperture. Then you consider the interior surface reflectances and the exterior reflective components. You look at what's happening inside the space and how many apertures you have. Sometimes you can get situations that are difficult and quite unpre-

¹¹ LEED Platinum is the highest rating in the LEED Green Building Rating System.



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Corner Windows "We worked on where to locate the windows...the bones of the building were pretty good."

dictable. That's when you need to spend time modeling. In the case of Chartwell, these were tiny rooms, and what we were worried about was the quality of light and glare. There was a potential for glare, but it was manageable. We figured that we could limit some of it with a form of a mechanized shade, which would allow the skylights to make up the rest of the light. Now that is in question, because if the Mechoshades are lowered, the skylights are not big enough. However, the electric lighting system is very efficient, and is used so little, that it can make up for that difference.



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Turkeys on the Nature Path "We need to create a situation where we identify what is important to the site."

If you think about the LEED system, there are several problems with it. One is that there's no grand vision. A point doesn't mean anything. A point is defined by a number of people sitting around a table saying, "Yeah, I think we need a point for night pollution; we need a point for clean air." It doesn't compare to a metric. In defense of the LEED system, it's very hard to come up with a metric that crosses from sustainable sites to water reduction and beyond. However, if you look at Malcolm Wells,¹² who wrote *Gentle Architecture* in 1978 he created a metric called "the wilderness index," which compares whatever one wants to measure to wilderness. It has fifteen categories each worth plus or minus 100 points. That was it. The fifteen things are things like: creates food, uses food, creates energy, and uses energy. I can't remember all of them, but there are fifteen. They are actually kind of hard; one of them evaluates beauty. The idea of being beautiful is not to be cute. If what you're building is not beautiful, it's probably not going to last a long time. It is possible to get zero points, and zero's not bad. It is also possible to get negative points, as well as positive points. With a

LEED building, you never get minus points. It's theoretically possible to do a LEED building in a wildlife preserve while making five species go extinct, and still get Platinum. I know it's unlikely, but it is possible. The other issue that I have with this current approach is that it's getting more and more complicated and expensive. What it's missing is what we learned in the energy world a long time ago. In Title 24¹³ or ASHRAE 90.1¹⁴ there are usually two paths: the prescriptive and the performance. In the prescriptive approach you follow a checklist, and then you're done. That's basically what LEED is right now, but it is missing the performance approach. The performance approach is far more nuanced and complex, but it has a much higher possibility for being effective. We don't have that in LEED yet. We're seeing that in fire codes. With fire codes, you can go with the normal prescriptive code of x number of inches of exit width for a given occupancy. Now in New Zealand, Australia, England, and in

¹² Malcolm Wells is an architect, author, illustrator, and consultant best known for his interest in earth-shelter architecture.

¹³ Title 24 of the California Code of Regulations, known as the California Building Standards Code, contains the regulations that govern the construction of buildings in California.

¹⁴ American Society of Heating, Refrigerating and Air-Conditioning Engineers, Standard 90.1 addresses commercial building energy codes in the United States.

the near future here, there will be performance-based fire codes where you model a fire and the ability of the building to survive it with minimal loss of life and property.

We need to create a situation where we identify what is important to the site. As we all know, each site is different, and LEED is struggling with that. Light pollution in New York is different from light pollution in a national park, and that's not the end of it. There are different sources of energy in New York and Arizona. There are different species that you have to worry about, as well as different issues with air quality. The issue of identifying how the USGBC, or any other regulatory agency for that matter, can work with the immediate environment you are working in is important as there may be great opportunities available.

The whole point of sustainability, in my mind, is essentially to use common sense. Instead of just fulfilling a series of items on a list, we need to continue considering the big picture, and the big picture is that the building has to contribute to its environment and its milieu. That's actually a hard thing to do, and few buildings actually manage to do it, but we can attempt to push it to that point as much as possible. That includes using as little electric light and producing as much energy as possible, but we need to look at that larger picture.

RE-EVALUATING COSTS

Normally a sustainable building will cost more than a non-sustainable building. Why? Because it takes more effort to think about it, and usually the equipment is better. You may argue that some of that will be paid off over time, but some of it is not. The other issue is who pays for it. If you take a large office building and you ask, "What's the cheapest building," it will be a square box, 200 feet on a side, with as many floors as you want. However, inside, people won't even know what time of day it is, because they won't have access to light or air. All of the sustainable designers are saying that we need narrow, thin buildings turned on the east-west axis, with shading devices. There's no way you can make those two buildings cost the same. It just doesn't compute. Now, is the second building going to be a bet-

ter building? Absolutely. Is it going to be worth more? Yes. Are people in it going to be more productive? Yes. A lot of people now value this, and they pay for it, but it doesn't make it cost less. There are times when we see buildings become sustainable for very little extra money, and other times when they cost more. The value to the clients also changes. There are some times when it is just insanely expensive, but the client wants it anyway, because they want to do the right thing. That basically describes some of our clients. Our firm attracts those clients, but we cannot depend on this for our society in general, because the number of buildings that our firm works on is a small percentage of the number of buildings built.

SHIFTS IN PRACTICE

In 2008 there were 1,500 LEED certified buildings, out of which we had been involved with 150 of them, or 10% of all the LEED projects in the country. There weren't many buildings when we first calculated; right now there are a lot more. LEED is exploding in a huge way.

In the last ten years, our firm has gone from being just my partner and me to including a lot more people. I would say that the growth is because of the success of the LEED system. So, I'm complaining about LEED, but I complain about it to make it better. The shift also has to do with the market. We have, as a firm, survived three major recessions. With each recession we see the market change radically. For example, we used to do a lot of speculative office buildings, and now we are not doing any. We're doing commercial and institutional buildings. In those days we did more energy efficiency as opposed to sustainable projects, and we couched them in financial terms of the internal rate of return,¹⁵ net present value,¹⁶ and payback period.¹⁷ That's how we justified all of those efforts. Habitat and green space are harder to justify in ways that

15 The Internal Rate of Return is the interest rate at which the costs of the investment lead to the benefits of the investment, not incorporating environmental factors (e.g. the interest rate or inflation).

16 Net present value is the total present value (PV) of a time series of cash flows.

17 A payback period is the period of time required for the return on an investment to "repay" the sum of the original investment.

<div data-bbox="34 291 61 371">Owner</div> <div data-bbox="34 558 61 676">Architect</div> <div data-bbox="34 837 61 970">Contractor</div> <div data-bbox="34 1134 61 1245">Engineer</div> <div data-bbox="34 1409 61 1545">Consultant</div> <div data-bbox="34 1648 61 1877">Facilities Manager</div>	<div data-bbox="381 184 891 357"> <p>benefit the client, in terms of certification or finances. Renewable energy still doesn't pencil out, except in narrow situations, yet we see that all of our buildings have some renewable energy component, and that's extraordinary.</p> </div> <div data-bbox="381 413 891 491"> <p>This narrative is based on a video- and audiotaped interview conducted by Kristen DiStefano on July 27, 2009, at the offices of Loisos + Ubelohde in Alameda, CA.</p> </div>
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ROY WILLIAMS

FACILITIES MANAGER,
CHARTWELL SCHOOL

I. PROCESS

INVOLVEMENT WITH THE PROJECT

I became the Facilities Director in February of 2005. The ground was already broken, the plans were drawn and the specifications had been written. I was very interested in seeing what went underground so that if there were a problem I could find it and make repairs. They have five miles of conduit underneath the slab. Seeing how that was laid out was important; then, if we have future expansions or needs, I know where the conduits are, and where we can run things to accommodate changes and make repairs.



ROY WILLIAMS has been the Facilities Manager at the Chartwell School since 2005. Prior to joining the Chartwell School, he served as Maintenance Director at the Naval Postgraduate School.

II. DESIGN

THE DESIGN PHASE

I lobbied for some changes late in the design phase; I think it would have been nice to be involved a little bit earlier and focus on the maintainability of the systems. There were a few things that I was able to add, but I didn't get everything that I wanted. The air filters are a good example; most of them have an outside intake, and I wanted the filters' housing to be on the outside of the building. That way I wouldn't have to drag a ladder around to each classroom to change the filters. Inside the classrooms, I have to move furniture out of the way to set up the ladder. Outside, the intakes are accessible from the flat roof of the hallway. I was able to add a hose bib¹ up on the roof to clean the solar panels, as well as the ladder in the hallway for drop-down access to the roof.

III. CONSTRUCTION

THE CLASSROOMS

The buildings are aligned on an east-west axis; we have a southern building exposure and a north-facing building exposure. That is great for natural lighting and exposure for the solar panels. The trusses on the inside are exposed, giving the occupants an up-close view of how the structure works. The utilities are exposed, to give you a picture of lighting, heating, and

¹ A hose bib is a spout for a hose fitting that is connected to the water supply.



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The Cistern and Trough "[The water] lasts almost the entire school year...the kids use the trough for science experiments and racing boats."

ventilation systems. There are things happening throughout the facility that are normally behind the wall; here, much of that is within view.

There are self-dimming lights; the occupants are out of the feedback loop. The dimmer reads the light level and tries to maintain a set footcandle² level, and they automatically dim in order to maintain that level for the students. When it's really bright outside, the shades are drawn in order to reduce the glare, and the lights come on. That's one weakness in the system. Having a way of diffusing the light to reduce that glare would mitigate some of that. All in all, I think it's a pretty good system.

THE PV SYSTEM

Our solar panels are thin-film and roll out just like linoleum. They're glued to the roof, and a metal strip covers the wires. The wires are collected

through a wire harness where they are combined into four groups. Those four groups have individual cut-offs and fuses. The four are then combined into two feeds, which go to our Main Distribution Frame (MDF), where they connect to the inverter. We have about 438 square meters of solar panels; our maximum capacity is 30 kW.³

Maintaining the panels consists of keeping them clean and checking the connections periodically. We have a meter that tells us how much sunlight is available. By comparing that against the input side of the inverter, you can tell when the panels need cleaning. When the differential between available sunlight compared to the input side of the inverter begins to widen, it indicates the solar panels are dirty.⁴ The hose bib on the roof makes cleaning easier. We use a general purpose cleaner and water.

² Footcandles are an I-P unit measurement of illuminance (E) per square foot or the density of luminous power expressed in terms of lumens per unit area. The SI unit equivalent is a lux (which is illuminance per square meter).

³ kW stands for kilowatt, derived from the term watt, which is an individual unit of electrical power. Kilowatt denotes 1000 watts.

⁴ Both available sunlight and the input of the inverter are measured in watts.

THE WATER CISTERN

We have a 7,500-gallon cistern. We collect water from the roof, which is gravity fed to a sump.⁵ From the sump, it is pumped into the cistern tank. The water is used for flushing the toilets. There's a booster pump on the backside of the unit to bring it up to proper pressure. Today is July 24th, and we still have about half of the tank of water; it lasts almost the entire school year. Last year, we had about two weeks when the tank ran out of water before the rains came to replenish it. There's an interface for fresh water. When we do run out, we switch over to fresh water. Fortunately, we haven't had to use very much. If the tank is full, the water will overflow and spill into our water feature. The kids use the trough for science experiments and racing boats. It is an interesting visual feature as well.

THE GARDEN

The students come out here and spend time raising flowers, herbs, and vegetables. There's also a cooking curriculum; they take what they've grown to the kitchen to prepare it. They learn about the food cycle, including planting, growing, harvesting, nutrition, food preparation, and composting.

The garden irrigation system was an add-on. I put in a water line and connected it to our irrigation system. The system is connected to the irrigation system, which is why we labeled it as non-potable water. Eventually, we're going to get recycled water here. The City of Seaside has brought recycled water up General Jim Moore Boulevard and plans to bring it to the campus eventually. We have a separate system installed, so we are ready for it. We currently use domestic water for irrigation. We're looking forward to using recycled water, but that depends on the City of Seaside getting the water to us.

SITE IRRIGATION

The irrigation, as a whole, seems to be the one thing that we've had the most problems with. We've had numerous leaks and broken fittings; the layout of the soccer field was unevenly

spaced. The problem was that the installation and the layout weren't good. We've gone back through the entire soccer field and moved all of the sprinklers around so that we have more even coverage. It seems to have been the biggest headache that we've had with the whole school. We ended up fixing it ourselves; the installer was not helpful. We were very disappointed with that. We went out on our own to find a consultant and re-engineered the system. We've spent a lot of effort to reduce our water usage. We have a really nice irrigation control system; it has evaporation and transpiration gauges, so we only water enough to make up for what has evaporated and transpired through the vegetation. We have a rain gauge; if it rains it will cut off the irrigation and account for the rain when it resumes watering.

THE MECHANICAL CLOSET

We have a Munchkin boiler. It's rated at about 94% efficiency. The exhaust pipe is just plastic; 94% of the heat goes into the water, which heats our radiant floor system.⁶ You can touch the exhaust; that's a testament to the efficiency of the boiler. We have two of these units: one unit for each building. They heat the water and circulate it around the buildings. Each zone, which is basically each classroom, has a set of control valves that open and close to regulate the heat. In each of the classrooms there is a thermostat, which allows users a 5-degree variation. The system is set for a temperature of 70° Fahrenheit, and the users can turn the thermostat up or down from 65° to 75° F. In the morning the supply air fans flush out the rooms, then the heat comes on. The system adjusts itself based on temperature inputs from sensors, outside air, inside air, and slab temperatures. Based on these values it varies the start up time to reach the set temperature at the scheduled time.

THE CONTROL ROOM

The MDF is where all our power comes in from the grid and interfaces with the solar photovoltaic system. The 30 kW inverter is in the MDF. A computer monitors the system. The screen

⁵ A sump is a low place that gathers liquids.

⁶ A radiant floor system consists of a series of pipes under the flooring which circulate warmed water to heat the room.

shows a graphic representation of how the system works. At this moment, we have 345 volts DC⁷ coming in at 36 amps,⁸ and we're outputting almost 90 amps and 120 volts. The inverter uses the grid to match the voltage, phase, and frequency. This makes us grid-dependent. If the grid goes down, the inverter shuts down. All three measures must match perfectly in order to interface with PG&E.⁹ We have a time-of-use meter at the PG&E interface near the transformer. The meter logs how much energy we use during peak demand, partial-peak, and off-peak periods.¹⁰ We are billed differently for each time-of-use period. If we produce more than we use, the meter runs backwards. The peak demand period is during the day, and that is when we're producing the most electricity. We have the lowest net use of electricity, if any, during the peak demand period. At the moment we are producing about 17 kW, and the solar index is at 42%. Since it is overcast, we're only getting 42% of the sun's average energy. Throughout the world, the sun generates about 1000 watts per square meter during the day.

IV. OPERATIONS

MONITORING BUILDING PERFORMANCE

There are a number of devices that help us monitor performance in the buildings. We have software for monitoring all of our electrical output, in terms of what we're producing and what we're using. We can even break that down into lighting, plug loads, and equipment loads. You can get a feel for where your utility money is going.

We have two monitoring systems. The solar array came with a system, and we've taken that input and fed it into our HVAC controls system; so, we have one place to look at the data, which works better than switching back and forth between the systems.

⁷ Volts DC refers to the force of direct current electricity provided by the solar array.

⁸ Amps refers to a unit measurement called amperes that is used to measure electricity flowing in a conductor or an electrical current.

⁹ Pacific Gas and Electric of San Francisco, CA is the utility company that serves the Chartwell School.

¹⁰ Peak demand rates are the varying rates charged by utility districts throughout the day, depending on the overall demand placed on the electrical grid.

Almost every day, I come in and make sure the system is up and running, and I check the differential. The computer system graphs our output and matches it against the available sunlight. When the gap between those two gets too big, I know that I need to clean the solar panels. It's a great feedback tool. All of our computer, telephone, fire, and HVAC control centers are in the MDF. Mark, our IT guy, maintains all the computer and communication systems and keeps them updated.

THE COMMISSIONING PROCESS

For the electrical systems, we had anticipated a higher output compared to our usage. Throughout commissioning there was an emphasis on where we were using power and what kind of output we were getting. We found that during the day, on average, we were almost grid-neutral.¹¹ At night, with the security systems, lights, and servers running, we would fall behind. We were able to mitigate some of that; we actually turned off every other light outside, which saved us quite a bit. We had a 52 cubic foot refrigerator in our kitchen, and it was an older model that used a lot of electricity. We traded that in for one that uses one-third the energy of the older refrigerator. We are actually able to see those things, and that information was brought to light through the commissioning process. The only other fine-tuning we did, as a result of the commissioning process, was some air balancing. Commissioning monitors your HVAC system to make sure that it's performing as specified, and it monitors the electrical power; it's very beneficial feedback.

OCCUPANT FEEDBACK

The students that transferred from the old campus to the new campus were really, really excited about it. We've had very few problems with destructive behavior from the kids. There's some pride in the facility; we try to keep it up and instill that in the kids. We had one case of some graffiti that was done in chalk; it was easy to clean up. I think that's a reflection of how the kids feel

¹¹ The term grid-neutral refers to a system supplying the electrical power grid with as much energy as it is taking for building operations.



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The PV Panels "The peak demand period is during the day, and that is when we're producing the most electricity."

about the campus; they have some ownership.

The biggest change needed for the teachers was the addition of shades. There's a lot of reflection from the concrete, and it was a distraction. They have shades now, and since they were installed they seem to be pretty happy.

There's been a learning curve in getting the occupants to understand that they need to participate and anticipate the needs of the classroom. Fall typically has the best weather in Seaside; we have a nice, warm, Indian summer. We ask them to anticipate the weather and open their windows and skylights a little ahead of time to get cross-ventilation going.

Every Wednesday there's a staff meeting at which I give a short presentation on anything new coming up. All of the teachers have an opportunity to say, "This is working," or "This is not working." If there are any specific requests they can email me, and I schedule whatever needs to be scheduled. Most of the time it's a program need; the kids want to raise or lower a desk. I haven't had too many service calls.

CONTINUING RELATIONSHIPS WITH THE PROJECT TEAM

EHDD Architecture has been very responsive if I've had a question. I can email them if I have

Owner	<p>something to ask. I contact the HVAC control person from Digital Control Solutions Inc., frequently for questions, troubleshooting, and ideas; they have been very helpful. Blue Line, the solar array company, has been really helpful when I call them. I can get questions answered right away. I have been in contact with Val's Plumbing on a couple of issues, and they have been very responsive. Other than that I haven't had too much of a need to reach out.</p>	<p>ing; it's very important. If I did this again, I would raise heck about the as-built drawings, the warranties, and the documentation and books that come with the equipment. It is important to make sure that you have a good organizational system for keeping those where you can retrieve them. It's also important to keep up to date with everything that's happening in the trade magazines. There are good resources out there; it just takes some time to find them. You need to be proactive in making sure that you get what you need. The information is there, you just have to dig for it.</p>
Architect	<p>THE LEARNING CURVE</p> <p>The whole campus was different for me, and that was one of the exciting things that attracted me to this job. First was the mission to help these kids and second was the green aspect of the building. Those two things brought me out of retirement; they were the major incentives for me to take this job to begin with.</p>	<p>This narrative is based on a video- and audiotaped interview conducted by Kristen DiStefano on July 24, 2009, at the Chartwell School in Sea-side, CA.</p>
Contractor	<p>Part of the contract was a training element; it was probably the best thing to help me get up to speed. Even with all of the training, there are always a few things that you're not sure about when you are running a building.</p>	
Engineer	<p>The training came fairly late in the process. Sometimes they would come here for a presentation. In one case, on the HVAC system, we went to their facility in Gilroy and went through a bunch of simulated exercises. It's all computer-driven; the simulation was mainly to show us how to access the system and where things were. In the computer, they have a naming feature for all of the different components; we became familiar with what they called each part.</p>	
Consultant	<p>LESSONS LEARNED</p> <p>I was disappointed in our as-built drawings; they left a lot to be desired. In the contract we had specific line items for providing them, but, apparently, the language was not strong enough. I would suggest that you have strong language and maybe even penalties for not providing good, professionally drawn, accurate as-built drawings for the maintenance of the building. I also would like to have been able to edge in a few things a little earlier, before the design was locked down.</p>	
Facilities Manager	<p>It was a good idea to take advantage of the train-</p>	

APPENDIX A: IMAGES



Classroom Section



Diagrammatic Section



Elevation



Elevation



Elevation



Site Plan



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“The vision for the Chartwell School was to create an exceptional, high-performance learning environment for children with learning differences, such as dyslexia. The result is a pleasing, durable campus that integrates daylight to improve learning rates, and uses its site overlooking Monterey Bay as a sustainability teaching tool.”

– AIA San Francisco Chapter Website

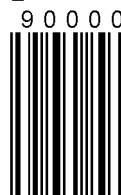
Prepared for the U.S. Green Building Council by the Case Study Lab of the Center for Housing Innovation at the University of Oregon, this book documents the visioning, design, construction, and operation of the Chartwell School in Seaside, California.



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