FINAL REPORT

to

American Institute of Architects

Upjohn Research Initiative 2007-2009

Case Studies of Carbon Neutrality

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PROJECT ABSTRACT: In 2006, recognizing the impact of buildings on global climate, the American Institute of Architects adopted the 2030 Challenge — an initiative to reduce the building sector's dependence on fossil fuels and mitigate greenhouse gas emissions. The AIA also initiated a program (2001) to develop case studies of recently completed and ongoing projects. The case study initiative was intended to expose students to specific issues of professional practice, and simultaneously provide opportunities for practitioners to reflect on their design approach for their next project.

This proposal addresses both AIA initiatives, relates to domains of architectural knowledge, design, and building performance; strengthens research links between academia and practice, and addresses the goals of the 2030 Challenge.

The Case Studies of Carbon Neutrality Project will catalog the design and delivery process for carbon-neutral buildings through a series of case studies that describe design intent and actual performance. Research methodologies will include interviews with selected practitioners from architectural firms on the West Coast on the design process and strategies that delivered buildings that meet the 50% target of the 2030 Challenge. Performance outcomes will be measured by using a nationally implemented set of investigative protocols that focus on particular design strategies. By documenting the delivery process for carbon neutral buildings, the barriers to sustainable practice will be better understood — the issues faced by design teams during the design process and the role of clients, consultants, and contractors. Examining the results of post-occupancy performance will offer practice a means to "close the loop" of design lessons learned in building design.

Introduction: The AIA Upjohn Award was awarded in November 2007. During this time period, we adjusted the budget to meet the needs of the project with the reduced funding from our proposal. We also began researching and reviewing suitable digital transcription equipment, costing out transcription services vs. having student assistants complete the tasks, filing a Human Subjects Protocol with the University of Oregon Office for the Protection of Human Subjects, meeting with consultant, Nicholas Rajkovich to refine interview process, and contacting four firms for the initial interviews.

Nick Rajkovich from Pacific Gas and Electric in San Francisco, was the primary consultant for the project, advised on all aspects of the narrative development, conducted interviews, developed the format for the narratives, and presented the project at several conferences.

Britni Jessup, Graduate Research Assistant from the UO Center for Housing Innovation and the principal research assistant for the project from its inception. Britni has purchased equipment, conducted interviews and followup building walk throughs, transcribed all interviews, provided exhibits, and worked on final edits. Britni graduated in March 2009 and I have hired her as a research assistant using my university research funds to finish up this project

Christopher Neilson, Graduate Research Assistant from the UO Center for Housing Innovation, came onto the project on April 1, 2009 and has assisted with the final edits, calculations, and updating case study information.

The firms invited for this project are shown on Table 1. Principals at the firms were sent a letter of invitation, asked to select a recent project that meets or exceeds the Commercial Buildings Energy Consumption Survey (CBECS) energy consumption performance standard of 50 percent of the regional average for that building type. Some firms selected buildings that were designed

early in the USGBC's LEED process (or before) and other firms decided to select buildings that were designed more recently. Our criteria for the project were that it had to have been in operation for at least one year. One firm, SERA Architects, insisted on using the East Portland Community Center which is still under construction; we may or may not include it with the final case studies depending on the balance of information. Interviews with the mechanical/energy consultants are also included on Table 1.

Table 1: Architectural Firms and Consulting Engineers Participating in the AIA Upjohn Project

CASE NO.	BUILDING	FIRM	ARCHITECT/ENGINEER
2009-001	Chartwell School Seaside, California	EHDD	Scott Shell
		Taylor Engineering	Gwelen Pagliaga
2009-002	Tillamook Forest Center Tillamook, Oregon	Miller Hull Partnership	Bob Hull Teresa Russell
		PAE Engineers	Paul Schwer
2009-003	Orinda City Hall Orinda, California	Siegel and Strain Architects	Henry Siegel Burton Peek Edwards
		Taylor Engineering	Allan Daly
2009-004	Portland State University Stephen Epler Hall Portland, Oregon	Mithun	Ron van der Veen, Roger Gula Steve McDonald
		Interface Engineers	Mark Heizer
2009-005	The Gerding Theater Portland, Oregon	GBD Architects	Craig Mendenhall
		Glumac Engineers	Bob Schroeder
2009-006	East Portland Community Center Portland, Oregon	SERA Architects	Lisa Petterson Eric Ridenour
		Interface Engineers	Mark Heizer

Interview Protocol: We developed a series of questions for the interviews with the intention to draw out a discussion and conversation. The questions are organized in the categories of: team building, goal setting, technology, process, management and relationships, barriers, and future work. An Olympus digital recorder recorded the interview, during which time the interview team could focus on the interview and not be distracted or slowed down by taking notes. The interviews took place in the firm's office, usually in a conference room. We encouraged the architects not to use any drawings or handouts, so that the story could be told verbally. Each interview takes approximately one hour. Most firms had two people sitting in for the interview: the project architect and the design architect; they were able to refresh each other's memories and discuss the project from different perspectives. The interview protocol was also used when we contacted the engineers associated on the projects. We developed a similar protocol and set of questions for the facility managers.

- ***All interviews were completed by February 2009.***
- ***All transcriptions were completed by March 2009.***

Transcriptions and Narrative Development: The transcriptions from each hour-long interview took approximately 5 to 6 hours to transcribe. The development and editing of the narrative (from the transcription) took approximately 10 hours. Correspondence, further editing, and formatting by the architects and engineers took approximately another 15-20 hours spanning over three weeks, depending on their schedules. We severely underestimated the amount of time that it would take to get the narratives to the end product. There was also the delicate balance of the firms wanting the narratives to read as a promotional pieces (and to edit the "voice" or clarity of speech) and our intention to have their voices tell the story of the design and delivery process. Anticipating the time (see December interim report) needed to complete the narratives, we requested a no-cost extension to the end of May.

- ***No-cost extension requested on April 8, 2009. Richard Hayes approved April 13, 2009.***
- ***All narratives were completed by early May 2009.***

Equipment and Supplies: We purchased the Olympus DS-40 Digital Voice Recorder, ME30W Stereo microphones, and AS-2400 footswitch, headset, software, cases for cameras and equipment. We also had the opportunity to examine several carbon metrics and requested half sized drawing sets and specifications; this incurred unbudgeted expense. We purchased additional recording equipment, a video camera and 4 large screen monitors to facilitate the editing process.

- ***All equipment purchases completed by April 2009.***

Building Visits: Following the interviews with the architects, interviews and building walk-throughs were scheduled with the Facility Manager. A modified interview protocol was developed for the interview with the Facility Managers about the operations of the building, covering similar topics (team building, goal setting, technology, process, management and relationships, barriers, and future operations), but focusing on building operations and maintenance. The intention is for students to take the lead in the Building Visits portion of this project and to give them first-hand experience in the protocol because it is an activity that students frequently conduct during studio. During the building walk-through, students take notes, make observations, sketches and photographs about the functioning/operation of the building: e.g. occupancy and behavior, lighting use/control, clothing, fans, positions of blinds, diffusers. Most importantly, they are asked to develop questions as they walk through the building, covering almost any issues that they find interesting and related to energy use, thermal response, thermal comfort and/or climate control, ventilation, lighting control, number of computers used, plug loads, etc. These questions may be followed up later or developed into a case study project on a building performance topic. Successful strategies are to be recorded.

- ***Four of the six building walk throughs are complete by December 2008; however due to time constraints, we focused on the transcriptions and architect-engineer stories/***

Dissemination: On Nov. 16-19th, we presented the project at a national conference, Behavior, Energy and Climate Change, in Sacramento, California home to more than 700 participants for the second conference on behavior, energy and climate change, Nov. 16-19, 2008 at the Hyatt Regency Hotel. Convened by the California Institute for Energy & Environment (CIEE), University of California (http://ciee.ucop.edu), the Precourt Institute for Energy Efficiency, Stanford University (http://ipiee.stanford.edu) and the American Council for Energy-Efficient Economy (ACEEE) (http://aceee.org), this conference focused on understanding behavior and decision making of individuals and organizations and using that knowledge to accelerate the transition to an energy-efficient and low carbon future. International participants from utility organizations, policy institutes, communications and marketing companies, and academics (few architects) gathered around concurrent behavior tracks. The project levered other dissemination activities and we conducted two Zero Net Energy Design Charrettes; one in Portland, Oregon for 25 architects and 25 engineers, and one in San Francisco for architects only. Response that these presentations generated emphasized the need for more case studies and information about the design process of buildings.

- ***Behavior, Energy and Climate Change, Sacramento, CA Nov. 16-19,2008***
- ***Zero Net Energy Design Charrette, White Stag Building, March 21, 2009 (50 architects, engineers), Portland, Oregon***
- ***Zero Net Energy Design Charrette, AIA National Convention, April 29, 2009, (50 architects), San Francisco, California***

Summary: As pdf documents, we hope the AIA will place these narratives on their website for further dissemination. These documents represent narratives about the design and delivery process by the firms that has a unique place in the market as an architectural resource. We plan to continue the development of these kinds of narratives in the near future.

2009-001-01
JUNE 01, 2009

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Chartwell School Case Study

Project Description

"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. The design dramatically reduced environmental impacts, achieving zero net electricity use, and potable water reduction by 70%."[1]

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

Project Awards

- 2009 American Institute of Architects Committee on the Environment Top Ten Green Projects Award
- 2008 LEED NC v 2.1 Platinum, U.S. Green Building Council
- 2007 Green Apple Award from the Collaborative for High Performance Schools
- 2007 Honor Award—Energy & Sustainability from the American Institute of Architects San Francisco Chapter
- 2007 Environmental Award from the U.S. Environmental Protection Agency

Project Data

Completion: October 2006

Cost: 9,000,000 U.S. Dollars (2006)

Area: 21,000 ft²

Location

City: Seaside, CA

Latitude: 36.38 North

Longitude: 121.48 West

Climate[2]

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 EUI:

30 kBtu/sf/year (2007)[3]

27.9 kBtu/sf/year (2008)[3]

[1] AIA San Francisco Chapter website at www.aiasf.org
[2] National Oceanic and Atmospheric Administration website at www.noaa.gov
[3] EUI: Energy Utilization Intensity onsite estimate. Based on electricity only from report by Pagliaga, Gwelen, *Chartwell School Electricity Use and PV Production*, Taylor Engineering March 26, 2008 and Allan Daly, Chartwell Presentation (ppt) to PG&E, May 13, 2009.

2009-001-02
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Chartwell School Narrative: Architect Scott Shell

Getting the Project

We were invited to submit for the Chartwell School project, first a proposal phase, and then an interview phase. As I recall, it was our firm and two other firms. One of the other firms was Sim Van der Ryn's.[1]

The school had been working with an architect and they had set an unrealistic budget. This happens all the time. You go to the interview and they tell you what the budget is. Do you tell them their budget doesn't match what they are asking for? Or, do you say, "Oh sure, we can do it for that." It's a real dilemma.

Although they had a number of developers and people who were knowledgeable about construction on the board, they didn't have experience with the quality of learning environment that Doug Atkins[2] had in mind. They also didn't have experience with sustainable design. The board's background was more in terms of building something quickly and inexpensively, in lower cost locations.

It's funny because Monterey, where the school is, is by Pebble Beach and Carmel, very pricey stuff. But, just a few miles away in the valley is Salinas. Chartwell spans both communities. Some people said, "People are building schools in the valley for so cheap!" But, that's not what you get when you build in Monterey, and that's not what you get when you hire our firm. There was definitely a disconnect. We still got the project and Doug was very astute about bringing his board along and helping them understand his vision.

Plus, it's their kids. Everybody loves their kids more than anything in the world. They want to make sure they get the best education. When you make the argument, "Kids learn better with daylighting," what are you going to say?

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 including two LEED Platinum certified buildings, an AIA/ COTE Top Ten Green award winning laboratory, a zero net energy/ zero net carbon office building, and the zero net energy Chartwell School.

[1] Sim van der Ryn is the former president of Van der Ryn Architects in Sausalito, California.
[2] Douglas Atkins is the Executive Director of the Chartwell School.

Selecting the Project Team

Selecting a design team is something I spend a lot of time on; finding the very best team because they can make us look brilliant or like a bunch of idiots. From our firm's perspective, we have to think about it a little more globally than just project by project. What are our longer firm goals and vision? We can't put all our eggs in one basket and go with a single firm or person for all of our projects. What if they got hit by a bus or went out of business? We try to keep our options open and keep a variety of top firms as consultants. Different firms have different strengths.

I think this was the first project where we used Tipping Mar[3] for the structural engineering. I had followed their work because I had been very frustrated with some larger engineering firms not pushing sustainable design. In selecting our internal team, you really want one principal plus one strong person who does most of the day-to-day work for the duration of the project. This strong person is a project manager and a project architect, and they might work with a junior person to assist them.

Setting Goals for the Project

It's funny looking back at your own personal evolution. It was not that many years ago that I just thought PVs[4] were not a realistic alternative. Something just switched at some point—you do a calculation and say, "OK, what would it cost to put PVs on this project?" If you're expecting a really big number and it comes in smaller the possibilities just open up. It's a whole new mental model.

On this project, our general strategy was to do daylighting; we wanted people to be able to operate this building without the lights on for most of the school year. Sure, on a rainy day in the winter it's not going to be daylit all the time. In our energy model at the very beginning of design, we saw that lighting was by far the biggest load, and with daylighting we can eliminate of most of that.

Then what else do we have left? A little gas for heating, some plug loads, but we don't have much else. Then let's see how many PVs it takes to offset the remaining energy and it was 1.6 percent of the construction cost. I was shocked. If you would have asked me a few years ago I would have said that it would increase your construction costs by twenty or thirty percent or more. If you really go after the loads and get them down then you can do it. It became a personal goal that just evolved over the years, "Let's daylight it, the whole thing, every space." I talk about daylighting the toilets and janitor's rooms because then people get the point.

We're always looking for good people to work with. We work with George Loisos[5] on daylighting a lot and we share these goals with them, and then they help make sure we get there. For example, on Chartwell that's why the windows wrap the corners. It's to get light back on the walls to reduce the contrast. It's not just a bright, punched opening in a dark wall. George did some Radiance[6] studies about where the skylights should go to balance the light.

He always wants to do a bunch of Radiance models and I'm always saying, "This is a little project and it can't afford you doing Radiance models." I really trust his intuition on these smaller scale projects. But, he did some modeling of a typical classroom anyway with three different skylight options.

[3] Tipping Mar + Associates are a structural engineering firm in Berkeley, California.
[4] Photovoltaics (or PVs) are a technology that converts solar energy into electricity.
[5] George Loisos is a principal at Loisos & Ubbelohde in Alameda, California.
[6] Radiance is a suite of computer programs for the analysis and visualization of lighting developed by the Lawrence Berkeley National Laboratory in Berkeley, California.

Jim Benya[7] was the electric lighting designer and he did a Lumen Micro[8] model to analyze the electric lighting. I told him about our daylighting goals and that this is where we are trying to go with our practice. After the school opened, he went out to the site and measured the lighting. It was right around the winter solstice and it was something like thirty-five footcandles at the desk level. He said that teachers wanted it a little brighter, but the students were fine.

Selecting Technologies for the Project

I always ask the energy guys on my team what they think the energy pie is going to be. Allan ran an energy model for Chartwell and gave me what I call the "energy pie." We then decided to go after the biggest slices most aggressively, and the other slices next."

I know this is basic good design. A lot of times you have a pretty good idea of where the energy use is going to be just based on the occupancy type and the geography. On this project we didn't have AC,[9] but we had lighting, plug loads, and heat. There's little hot water for hand washing. They have a kitchen that's not used everyday. It's just more for events or for teachers so it's very light use. It's really very simple

Eliminating AC was a major design goal and to do that and keep people comfortable, you have to watch out for heat gains, shade, your windows, use the right glass, get the orientation right, all the basics must be done well.

Project Tax Credits and Incentives

We used "Savings by Design."[10] Those rebate numbers are always small in the end. It was a fair amount of work to go through that process for Taylor Engineering.

You know when people are giving money away they want to not give it away too loosely and so they want to see things in a certain format and be able to check things. There are all these rules that go with Title 24 then you're always saying "Well, we don't have air conditioning. Does that apply when we apply for the incentive?" It always takes some back and forth.

Methods and Tools Used on the Project

So you've got these different goals from the different energy models. When you ask a different question of the model you get a different answer.

If there's one thing we've learned it's to forget about the energy models, look at the real performance. Show me measured data, one with everything in, not just the predicted energy use. With Chartwell School we were way off.

I really try to trust my energy team. I used to try and do everything myself and I realized at some point that these guys know so much more than I do. It's not just ten percent, more like five hundred and ten percent. I challenge them to do their best work, and they usually exceed my expectations.

Doug wanted the LEED[11] Platinum. But I've been focused on climate change, in part because of some clients we've had. I was less focused on indoor air quality, which I think are fairly simple and straightforward. So we really focused on daylighting and energy, striving for the net zero electrical goal.

I've found that if you really nail the energy issues, if you get all 17 of the energy credits—LEED is really not that hard. The indoor air quality points

[7] Jim Benya is a principal at Benya Lighting Design in West Linn, Oregon.

[8] Lumen Micro is a computer program for the analysis and visualization of lighting developed by Lighting Technologies, Inc.

[9] "AC" is an acronym for air-conditioning.

[10] "Savings By Design" is a new construction incentive program offered in the State of California.

[11] 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.

are easy–add the energy points, and you're already well into the gold.

Doug wanted to get LEED platinum.[12] I was terrified of falling one point short on some technicality, but we ended up with several extra points in the end. Whew!

The energy use, particularly the carbon component of that energy, was very important for me. On the Center for Global Ecology[13] when we did our carbon calculations we learned that even though the natural gas was small from a cost point of view, from a carbon point of view it was significant. I just keep running into that over and over so we have to address natural gas and heating and strive for zero energy not just zero electrical. It just blows me away. Three years ago I didn't think it was feasible to do zero net electrical, and all of a sudden now we've got a handful of projects that are going for zero net energy.[14]

I remember looking at mechanical options with Gwelen and Alan.[15] We sat in the conference room and did a matrix for all these different types of mechanical systems. We scored every system, and we weighted the scores and we ended up with a very conventional system. But the answer didn't seem correct. As we looked at it, we began to question our weightings–our fundamental priorities, really.

It's really hard to know how to weight things. Are tools like decision matrices a self-fulfilling prophecy or, do they really help clarify your thinking? I think the latter, to make explicit your assumptions.

The students at Chartwell arrive there from conventional schools where they have had a very frustrating learning experience. Douglas's vision was just to get rid of every possible distraction for the students, so excellent indoor air quality, good acoustics and not a bunch of mechanical noise. So the radiant flooring was a key part of that, and was seen less as a sustainable strategy and more as a thermal comfort, acoustic and indoor air quality strategy. I had worked on a number of schools before, and I knew that you could have air quality problems in the winter when the windows are closed. We debated endlessly how to deal with that and ended up with CO_2 controlled fans that the teachers could also control.

I've asked Douglas, "How do the teachers use it, how do they like it, do they keep it running, is there a draft in the winter?" We finally got detailed CBE POE[16] survey results in. We scored in the 99th percentile for air quality and the 98th percentile for thermal comfort.

I always have a lot of sympathy for anybody who has problems with a building. I know how easy it is to have a good design and then something changes or gets VE'd[17] out. You can't just go back mentally and reconstruct all of the ricochet effects that is has on the project. Or the contractor submits something different, a subcontractor installs it does it a little bit different and so on…

Managing the Project

Doug is a visionary and that vision is always learning, growing, and evolving. Every time he gets a new idea it adjusts his vision. While I admire that greatly, from a business point of view it's challenging. You have to be careful you don't

[12] LEED Platinum is the highest rating in the LEED Green Building Rating System.
[13] The Carnegie Institute for Global Ecology is a building designed by EHDD for Stanford University in Stanford, California.
[14] 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."
[15] Gwelen Paliaga and Alan Daly of Taylor Engineering in Alameda, California.
[16] CBE is the Center for the Built Environment at the University of Cal, Berkeley, an industry/university collaborative research organization. The post occupancy evaluation (POE) refers to CBE's Occupant Indoor Environmental Quality (IEQ) Survey
[17] "VE" is an acronym for "value engineering."

quash an idea. You can't say no too often to a powerful visionary—that's not our style. Our style is to get excited about it and keep changing the design. But at a certain point it's just really counterproductive to we have to get the project built and not lose our shirt.

Doug was wonderful to work with. He was a Naval officer on a nuclear sub. He was the disaster recovery specialist so he had to know how everything worked and how to get to every piece of equipment. He could understand all this; he could articulate it, he could tie it back to education, and that's the key point of the sustainability strategies in this project. When you're asking parents to donate big dollars for something, they don't want to hear about architecture, they don't want to hear about design, they don't want to hear about how pretty it's going to be, they want to know about how it's going to affect their kids. Doug can make that connection for them.

It was much more powerful of a message coming from the head of the school to hear how to inspire kids to learn, than an architect talking about design. It's coming from an educator rather than an architect; he was very adept at translating between those two worlds, and a very effective spokesman for sustainable design in learning environments.

For LEED you have to do a peer review. So I said we should get Charles Eley,[18] the guy wrote CHPS[19] and has a wonderful understanding of schools. What a privilege it is to have access to people like that. I was back at home in Pensacola, Florida would I have access to colleagues like this?

I've got Charles Eley over there who's looking for interesting projects to feature, I've got clients like Douglas, I've got an entire infrastructure of sustainable design expertise here in the Bay Area. From Tipping Mar doing all this stuff on structures, to Eco Timber,[20] Hayward Lumber,[21] great mechanical engineers like Allan and great daylighting people. It's just an incredible set of resources here in California. So we really learned from Charles' peer review and Charles got a case study for CHPS.

Lessons Learned

Certain things you know intellectually but it's completely different to experience them viscerally. When we turned on the rainwater pump in the winter and let it spill out into the sloughs—the kids just went wild! They were having so much fun. I see it now with my kids, you give them water and they're having so much fun. Conceptually you can talk about, "It's collecting water and flushing toilets and sometimes in winter you have more water than you need so you can use it for play or for learning about hydraulics, or water flow, or whatever. But when you see it happening and the kids' excitement, it is really something.

The Unisolar[22] Peel & Stick PVs on that metal roof are so clean, beautiful really. I was really surprised by that.

I'm constantly reminded how hard it is to do daylighting well, especially to illuminate surfaces like the underside of the ceiling, so that spaces not only have adequate light, but feel bright and cheery.

The skylights—this is one of those million in and one ways things can go wrong. We had a two foot by two foot clear skylight well. We ended up with a two foot by two foot skylight less the curb. You take out three inches on four sides of a skylight

[18] Charles Eley is the Executive Director of the Collaborative for High Performance Schools.
[19] CHPS is an acronym for the Collaborative for High Performance Schools.
[20] EcoTimber sells sustainably-harvested and reclaimed wood products. They are headquartered in Richmond, California.
[21] Hayward Lumber is a environmentally conscious lumber supply company. They are headquartered in Monterey, California.
[22] Unisolar is a manufacturer of amorphous silicon photovoltaic (PV) solar panels.

and suddenly it's undersized by thirty or forty percent.

The contractor didn't have any experience with sustainable design and really had to stretch themselves on the project. In the end the workmanship looks pretty good but some things like the skylight were a problem.

We were constantly battling with cost issues and endless value engineering. Unfortunately this seems like it's just become part of our business.

A huge percentage of our time and energy goes into trying to meet a budget and a lot of times that budget wasn't set properly to start with. So, one of the games that gets played is you move things from the building budget to the furniture budget. The interior Mechoshades[23] were put into the FF&E[24] budget and they didn't get installed when they first moved into the building. And they were having terrible glare problems on the south side until they got the shades installed.

Another lesson learned is that when you take paving right up to building on the south side, heat really tends to build up there. You might start out with reflective concrete paving and think it's not a problem. By the time you get done with VE you've got a lot more asphalt than you expected. Then it's even hotter than you thought. Especially if breezes come from the northwest then the south side can get warm.

You read about these guys in the Alps that are growing grapes by putting south facing rocks in a vertical wall and growing something in front of that. "Well, that's kind of what we did with our building unintentionally!"

We actually have a school project in Salt Lake City where I'm really interested in creating different outdoor microclimates, especially for shoulder seasons when it's really cold but you want to be outside. So we're making a kind of hot pocket, like what happened at Chartwell, and in other places you make cool pockets for summer when it's quite hot. The heat island on the south side of Chartwell was a little bit of a surprise for us.

I think one challenge for our profession is that people in the green building community say, "Look what I did!" but don't have any real data to back it up. Real energy use numbers, comfort surveys, things like that. We are trying to shift toward measureable benchmarks and trying to be honest about lessons learned.

I've been doing this for 20 years or so and how many buildings have I finished? Not that many. As architects, our product cycle is so long from start-to-finish is often, four years or more. You learn a lesson for a project you are working on that will take another four years to get completed. We've got to get better at sharing those things with our peers and learning those lessons.

You can't just layer in sustainable design later in the process. At some unpredictable point the design resonates with the team, they instantly like it, and get locked in. Once the client sees it and they like it, and the design team sees and they like it, at that point it's very hard to change. You don't know when that point's going to be, you could go along for months and then all of a sudden it happens. Or, sometimes you hit it in the interview.

Once that happens, if you don't have daylighting in there, then you're fighting an uphill battle. You're trying to sidelight[25] a distance that is unrealistic. For instance on the Packard Foundation building we said, "Hey, this is the building width that we can reasonably sidelight, and that's how we set our building width." That drives the whole parti.[26]

[23] The MechoShade Corporation manufactures solar shading and interior shade cloth systems.
[24] Furniture, Fixtures, and Equipment.

[25] "Sidelight" is the daylight coming in from the side of a space, typically through a window. "Sidelighting" is a strategy to bring in more daylight from windows deeper into a space.
[26] "Parti" is an architectural term which means the basic scheme or concept of an architectural design.

Hiring New Staff

We have a big, diverse practice, and we need all kinds of talent. In general, a lot of people come to us because of their interest in our sustainable expertise. A lot of those people are really bright, really talented and we'll hire them because they have a great range of skills. We rarely hire somebody with just sustainability as a skill because it's just not broad-based enough.

Last summer we hired Janika McFeely[27] who was Ray Cole's[28] research assistant and she's been great. Even then, we don't want to pigeon-hole her just into doing LEED because she needs to also develop as an architect to understand integrated design. You can't do that in isolation without understanding how it fits into what we do.

So we get a lot of people interested in sustainability, and we have some really strong staff on that. But we also need people with fantastic graphic skills, or really strong technical skills, or somebody at an intermediate level who can really put together a sixty million dollar lab project.

Those people are really hard to find who have first the sustainability expertise, plus these other skills. They know what they are getting into when they come here; a serious effort to integrate great design, technical performance, and sustainability.

Among our principals there is broad and deep support for sustainability; it's a part of our firm culture and goes back to Joe Esherick and all of the original partners. The level of sustainability does vary among our projects, but we're always trying to raise the bar.

This narrative, part of a larger case study describing the Chartwell School, was supported by a 2007 AIA Upjohn Research Initiative Grant.

[27] Janika McFeely is a designer at EHDD.
[28] Dr. Raymond J. Cole is a Professor at the School of Architecture, University of British Columbia.

This narrative is based on an interview with architect Scott Shell at the EHDD Architecture office in San Francisco, California on March 25, 2008. University of Oregon graduate student, Britni Jessup, transcribed a digital audio recording of the interview. The interview was conducted by University of Oregon Professor Alison G. Kwok and Nicholas B. Rajkovich, Pacific Gas and Electric Company (PG&E).

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JUNE 01, 2009

ALISON G. KWOK
BRITNI L. JESSUP
NICHOLAS B. RAJKOVICH

Chartwell School Narrative: Engineer Allan Daly

Getting the Project

I had done some work with EHDD[1] at Arup[2] but we hadn't really done a lot of work with EHDD at Taylor Engineering.[3] Scott Shell[4] and I had crossed paths a number of times, doing things like natural ventilation seminars but we had never gotten a chance to work together. If I remember correctly, Scott just called up and said, "Let's try working together on this one."

Selecting the Project Team

I mainly was the one who worked on this project. Gwelen Paliaga[5] was hired when the job was half to three quarters done. So, I did most of the preliminary work and the energy analysis and Gwelen came on near to the end of it, and helped finish it up and get it built.

Setting Goals for the Project

Right off the bat, the goal was to be zero net energy. I remember going to a LEED[6] workshop down in Seaside or Monterey and there being a lot of discussion about trying to go to zero net energy[7] on the project. So it was always meant to be very aggressive, it was

Allan Daly, PE 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] EHDD Architecture is an architecture firm in San Francisco, California, and was the architectural firm responsible for the Chartwell School.
[2] Arup is an international consulting engineering firm with an office in San Francisco, California.
[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] Scott Shell was the principal at EHDD responsible for the Chartwell School.
[5] Gwelen Paliaga is a senior mechanical designer at Taylor Engineering.
[6] 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.
[7] 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."

always LEED Platinum[8] from day one. That's what the architect and client wanted.

There was certainly some discussion of goals back then, but it was scaled back from the energy independence, zero energy goals. I am not exactly sure if I remember all the reasons why, but it basically came down to a budget decision reacting to when we proposed, "Let's go and have it be a zero net energy building.

Tracking Progress on the Project

Just to give you a sense of history, as the design evolved we updated our energy models and tracked how we were doing. We were tracking a PV[9] array as the way to make up for a good chunk of energy use of the building to get to zero net electricity. Sizing that array was part of the design process, "How big does it need to be to get to zero," we always had that design parameter in play. In our office we are mechanical engineers; we do the ducts and pipes and all that stuff. We're working with electrical engineers who are sizing the PV array, and specifying the PV array, so we were collaborating in that way. We weren't actually doing the PV design.

There was a LEED brainstorming charrette[10] kick-off and there were some discussions, mostly with the architects. Scott was more in tune with the goals of the owner and brought those things to the project.

Selecting Technologies for the Project

We looked at energy recovery ventilators, we looked at a number of different insulation levels and glass types, and effective daylighting. The effective daylighting controls and a whole series of options were under consideration.
We take a pretty analytical approach to these things, trying to figure out what makes sense and what doesn't make sense. The process was that we were generating ideas and then analyzing them and trying to figure out, "Is it logical, can we pay for it?"

Some jobs, it seems like the design team is much more interested in doing sustainable, low energy, interesting work than the client is. In those cases you're trying to persuade, not really fight with the client, but no natural connection occurs.

That was not the case at all on this job. They [Chartwell] were so into all these ideas but the biggest issue for them was just to figure out the budget. It's a school, it didn't have an unlimited budget, and anything they wanted to do they had to raise money for it. So they had some degree of having their desires tempered by that, but it was an easier discussion than usually occurs on a project.

Project Tax Credits and Incentives

I think that we were tracking and trying to get some money for the PV array, and we also were participating in the energy incentive program, "Savings by Design."[11]

Methods and Tools Used on the Project

We primarily used eQuest[12] which is a DOE-2[13] modeling tool. Early on in the project we also used a program from NIST[14] that they were developing,

[8] LEED Platinum is the highest rating in the LEED Green Building Rating System.
[9] Photovoltaics (or PVs) are a technology that converts solar energy into electricity.
[10] A charrette, often Anglicized to "charette", and sometimes called a design charrette, is defined as an intense period of design activity. Charrettes often range from one day to several days of meetings to kick off a design project.

[11] "Savings By Design" is a new construction incentive program offered in the State of California.
[12] eQuest is a building energy use analysis tool based on the DOE-2 algorithms provided free of charge by Energy Design Resources: http://www.energydesignresources.com/.
[13] DOE-2 is a widely used freeware building energy analysis program sponsored by the U.S. Department of Energy (USCOE) that can predict the energy use and cost for many types of buildings.
[14] "NIST" is an acronym for the National Institute of Standards and Technology.

and actually we got some money from them to use Chartwell as a case study.

It was called a very horrible name, LoopDA,[15] and it was supposed to be a tool to help size natural ventilation openings. It was was a little hard to use, but did provide some useful design guidance.

It was a professor on the East coast somewhere, who came up with an inverse method for looking at bulk air flows through buildings. They call it an inverse method because it's for design, you don't know what the building geometry is to plug into your analysis, you're trying to figure out what the building geometry should be. You're going backwards, what airflows do you want, so how big do your openings need to be?

So, for them, that was a huge breakthrough of to figure out that you need to go backwards. It seems silly, but they're all researchers. That's what we do every day. It was just one of these things that wasn't really connected to the real world particularly well.

One question is, do you do a CFD[16] analysis? There's so many unknowns and it takes so much time. You try to use more simplified tools that have a rational basis and then use your judgment a lot; that's my preferred approach.

Project Challenges

There was always the desire to not have air conditioning, but that was always easy because Seaside is a very mild climate. I think that the only special challenge as far as the design went was when you do a naturally ventilated building, you don't really need any ducts or fans, it can just be naturally ventilated.

But partly because of the work Alison Kwok[17] did with her dissertation,[18] we knew there may be reasons that they would want to have windows closed, besides ventilation reasons or temperature reasons. So one challenge that we took on was how to provide, how to create a really high quality environment using a natural ventilation scheme even though we understood the dual motivation behind why people may open or close windows.

We ended up putting in these small little ventilation fans that were in some ways completely redundant with the windows to allow there to be situations when the windows are closed, but you are still getting fresh air in the room.

I actually think it's a very clever, very simple thing to do to put in little supply fans up high in each room, which don't have any air conditioning at all. They're not heated; they're not cooled. We're just dumping fresh air indirectly into the room, we just provided enough fresh air for each of the students plus the teacher, 15 CFM[19] per occupant.

In heating mode, we dumped that air into the room up high, thinking that it would be warmed up already and would mix around and be tempered. In cooling mode, we only cared because we're not providing any air conditioning, we're just bringing in fresh air, and that was a way to guarantee that people would be getting fresh air in the room.

We put a CO_2[20] sensor in each room. Those are there to control the fans, so if it ever goes past a CO_2 high limit, then the fans come on to bring in some fresh air. There's a louver on the outside of the building and it's ducted up to the one of these fans, and we chose the kind of fans that are very

[15] A computer program called LoopDA was developed by NIST to implement the Loop Equation Design Method to size the openings of naturally ventilated buildings.
[16] "CFD" is an acronym for Computational Fluid Dynamics.
[17] Alison G. Kwok is a professor of architecture at the University of Oregon.
[18] "Thermal Comfort in Naturally-Ventilated and Air-Conditioned Classrooms in the Tropics," University of California, Berkeley, May 1997.
[19] "CFM" is an acronym for Cubic Feet per Minute.
[20] CO_2 is the chemical symbol for carbon cioxide.

quiet, small, residential style. So they're pretty quiet in the rooms.

It was relatively inexpensive because it was just a fan and a couple of ducts with no heating or cooling, the controls are pretty simple. Plus, we did radiant heating which is really quiet and was certainly a premium over forced air. It makes for really nice spaces for the kids and for the teachers.

There weren't many design challenges, but construction-wise it was actually an incredible challenge to get this building built because they decided to go with a local contractor. This contractor totally unprepared to do a project that was so out of the ordinary.

Somewhere along the line the contractor had gotten another job that was going green, and there was a little shift at some point where he started to perk up about really understanding it more.

It was a fight; it was one of these jobs that was a fight. They didn't read any of the specs, they didn't want to follow any of the rules.

It was always a job where there were very minimal fees design-wise. This job was a design-assist job where we took it through DD[21] and there's a lot of work for the contractors to do when they get the drawings. But, the general contactor didn't understand that, they thought it was a plan and spec job.[22]

There was a disconnect between what our specs say called for and how to go forward with what we designed versus what they had priced.

I think it would be good to get the contractor to be a part of the design team. They weren't ready to be a part of the design team, they were just ready to build it, and they didn't understand that when they read the specs that they needed be thinking, not just building. [Scott Shell: We worked with another contractor and their design build sub to to coordinate our efforts. But when their bid came in higher, Chartwell switched to a different contractor, losing some of this coordination.]

Lessons Learned

For small jobs, for green jobs, jobs that are aggressively green like this, I really feel like we need to be involved as much as possible and not hand it off and try to explain what needs to be done to someone else.

We just don't do a lot of school work, they're really small and they take tons of time, tons of passion and energy. As far as the business, just trying to keep our doors open and things, it's a small job so it wasn't like it was a huge black hole or anything. But, it's a job we didn't make any money on which is not sustainable from our standpoint. From our side of things, it certainly has affected our perception of what these jobs take to get complete.

Hiring New Staff

Taylor Engineering is an unusual organization. We pick our employees very carefully.

Gwelen was a new employee who came into our office and worked on Chartwell. He's not a mechanical engineer, he doesn't have a mechanical engineering degree. He's not really an architect, he doesn't have an architectural degree. But Gwelen understands building science -- all of the issues related to comfort and thinking about energy flows in buildings.

Being able to think critically about what might make sense and what might not make sense, and to think analytically about how to figure out those answers, those are the skills that are really useful and really valuable.

I think a lot of engineers, we do it too, when we look for a new hire we say, "Are they

[21] "DD" is an acronym for Design Development, a phase of the architectural design process.
[22] A "plan and spec" job is a delivery model where the design team develops detailed design drawings and specifications for the building systems.

experienced? Do they know our business today, can they do load calculations[23] and all these things?" Those are great skills to have when you are just trying to get work done and make a profit, but when you start doing green projects like this, you're constantly faced with all these new science challenges. You're doing something new for the first time and how do you determine when the technology or when the system approach is ready for prime time? When do you go with it?

One current example is that people are all excited about chilled beams[24] in the design world, the HVAC[25] world, because it's the new thing and they're cool and sexy and different. So how do you, as a professional, stand behind something and say yes to the owner, it's worth spending money on this? It really takes a lot of critical thinking, and a lot of analytical thinking to decide if the manufacturer's claims hold water.

It's much more about just having good critical thinking skills that are, in my mind, more in the liberal arts training. Engineers are trained to be able to solve problems in a linear fashion. They're not really trained in the way problems are formulated in this kind of design. How do you teach people to be good thinkers? That's the biggest question.

At the heart of it, it's someone with passion for what we do that's interested in low-energy buildings and broader environmental goals.

Closing Thoughts

I've done some teaching along the lines of zero net energy and carbon neutrality.[26] I'm an engineer; I come at these things very analytically. I like the whole energy modeling structure of thinking because it makes one analyze the components and then how they interact as a whole. The models also interact with the weather, and the building's climate, and the building's form.

This narrative, part of a larger case study describing the Chartwell School, was supported by a 2007 AIA Upjohn Research Initiative Grant.

This narrative is based on a phone interview with engineer Allan Daly on July 15, 2008. University of Oregon graduate student, Britni Jessup, transcribed a digital audio recording of the interview. The interview was conducted by University of Oregon Professor Alison G. Kwok.

[23] Load calculations determine the maximum expected heating or cooling load for a building in a given climate.
[24] There are three types of chilled beam systems. They are chilled ceilings, passive chilled beams, and active chilled beams. Chilled beams are a water based system designed to remove heat from a space.
[25] "HVAC" is an acronym for Heating, Ventilation and Air-Conditioning.

[26] A carbon neutral building is a zero net energy building that uses emissions, especially carbon dioxide, as the accounting method.

Exhibit: Chartwell School

Fig. 1. The approach to Chartwell School in Seaside, CA

Fig. 2. The cafeteria and theater off the main courtyard

This exhibit, part of a larger case study describing the Chartwell School, was supported by a 2007 AIA Upjohn Research Initiative Grant. University of Oregon Professor Alison G. Kwok and Britni Jessup with Nicholas B. Rajkovich, Pacific Gas and Electric Company (PG&E), prepared the associated narrative.

Fig. 3. Student entrance on the north side

Fig. 4. Covered walkways between buildings

Fig. 8. Integrated roof-mounted photovoltaic panels

Fig. 9. Southern shading system and recycled wine-cask siding

Fig. 10. Dew collection system

Fig. 11. Rainwater retention cistern with external display

Fig. 12. Student garden on the north side of the courtyard

Fig. 13. Interior of cafeteria, theater and entry

Fig. 14. Top lit circulation spaces of interior hallways

Fig.15. Top-lit entrance and student storage

Fig. 16. Daylit classroom

2009-006-01
JUNE 01, 2009

ALISON G. KWOK
BRITNI L. JESSUP
NICHOLAS B. RAJKOVICH

East Portland Community Center Case Study

Project Description

"The East Portland Community Center Aquatics addition, which adds 22,000 sf to the existing community center [will] create a full service complex that provides all recreation needs for the citizens of East Portland. The addition will include a new 4,500 sf family leisure pool (with water slide, a lazy river, warm water lap lanes, and play features) as well as a spa and a 4-lane, 25 yard lap pool. As designed, the building will significantly reduce energy consumption. The project, which is targeting LEED Platinum certification, has documented exemplary performance in daylighting, energy efficiency, and material reuse."[1]

Architect:	Sera Architects, Portland, OR
Landscape Architect:	Mayer Reed, Portland, OR
Structural Engineer:	ABHT Structural Engineers, Portland, OR
Civil Engineer:	Roberts Consulting Engineers, Eugene, OR
MEP Engineer:	Interface Engineering, Portland, OR
General Contractor:	Lease Crutcher Lewis, Portland, OR
Green Consulting:	Brightworks NW, Portland, OR
Aquatics:	Water Technology Beaver Dam, WI

Project Data

Completion: December 2008
Cost: $12,000,000 U.S. Dollars (2008)
Area: 22,000 ft²

Location

City: Portland, OR
Latitude: 45.31 North
Longitude: 122.33 West

Climate[2]

HDD65: 4522
CDD50: 2517
Annual Precipitation: 36.3"
Solar Radiation: 377 kBtu/sf/year

Energy Metrics

Energy Code: Oregon Non-Residential Energy Code

Predicted % Below Code: ~60%[3]
Measured EUI: Not Available

[1] From the SERA Architects website at www.serapdx.com
[2] From the National Oceanic and Atmospheric Administration website at www.noaa.gov
[3] From the Portland Parks and Recreation Green Initiative Fund Application

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ALISON G. KWOK
NICHOLAS B. RAJKOVICH
BRITNI L. JESSUP

East Portland Community Center Narrative: Architects Lisa Petterson and Eric Ridenour

Getting the Project

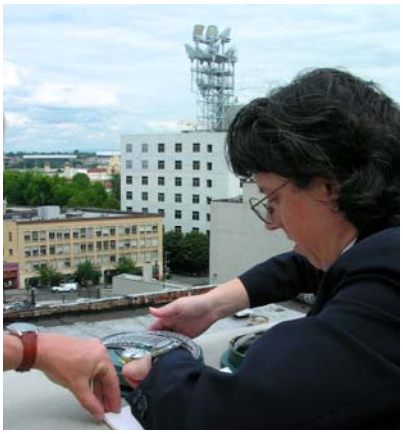
Lisa Petterson (LP): We got the project through an RFP[1] process. It was a publicly advertised project that we submitted for and were selected as the top candidate, without an interview. That was primarily because Kurt Schultz had done the existing building, which gave us an edge and knowledge of the existing infrastructure.

I was involved as the project architect at that time, Clark Brockman was project manager, and Kurt Schultz was principal-in-charge. Over time, I became the project manager and Eric Ridenour was added as the project architect. Clark stepped out of an active role on the project. The roles evolved as the project evolved.

Eric Ridenour (ER): We've continued those roles through the construction process as well. I've been doing the regular, daily contact with the contractor and Lisa has been the project manager of that component as well.

LP: It started in 2004. The levy was passed in 2002 and there was funding set aside for this particular project. EPCC was the biggest project that was part of the levy so it was put off until the end of the cycle. We did do some initial schematic sketches for them even as early as 2003. It was a long process. We did everything from working with a sports management group to figure out what the program amenities ought to be, including what the revenue would be and what they should be charging, to looking at the demographics of the area. Also we went through land use process that was fairly extensive..

LP: Neither Eric, nor I had previous experience with natatoriums, although I had a lot of experience as a swimmer and as a lifeguard.



Lisa Petterson, AIA, LEED AP, NCARB was both project Architect and project Manager for the EPCC.

Eric Ridenour, LEED AP, RA was the project architect for the EPCC. He was a founding member of the Cascadia Region Green Building Council.

[1] Request for Proposal is one process for hiring an architect.

Kurt and Clark both had previous experience working on the Mount Scott pool in Portland and the Osborne Aquatic Center in Corvallis. The initial team gelled with Clark staying on as our consultant for all things aquatic and to help the team out.

Selecting the Project Team

LP: Interface was selected because of their previous experience with Portland Parks and Recreation, because of their previous experience working on pools. Pools are very big energy hogs We knew that the natatorium was going to be a pretty tough nut to crack in terms of its energy use. We wanted someone with previous experience, but also someone who was really well known for their cutting-edge design and Interface really fit the bill and they're local. We had done lots of work with Interface before; we had worked with them extensively.

ER: They were familiar in that we knew that they would be up to the challenge.

LP: Mark Heizer is was our main engineering contact. I hadn't had previous experience working with him but I had worked with Omid Nabipoor, [2] the principal-in-charge of the project. We have done ten projects together; we definitely trust him implicitly.

Water Technology is a pool design firm that we've worked with extensively. They're out of the Midwest. We knew, based on their experience with recreation facilities, that they would fit the bill from the Parks side.

Barbara Roberts of Roberts Consulting was our Civil Engineer; from Eugene. I had previous experience working with her when she was with Balzhiser Hubbard Engineers. We were looking for minority and women-owned businesses and she fit that bill, which was the same with Mayer Reed, our landscape architect. Again, it was the combination of previous experience and the fact that they are woman-owned firms that led us to them.

APHT[3] is an up-and-coming structural engineer. We had tried them on a previous project and had good success. They are also a minority-owned business. We were looking for a diverse team.

Brightworks[4] was one of the consultants on the project. They helped with a lot of the nitty-gritty paperwork in the LEED process, as well as through their consulting and advice on different strategies. They were part of the team from the get-go. We have done LEED services probably more than a lot of architectural firms and we've done a lot of in-house documentation work, but they were instrumental in terms of keeping track and managing the LEED process.

LP: Eric is one of our premiere LEED people in the office.

ER: But it's been a very collaborative, iterative process where we're always bouncing ideas back and forth about different strategies and how they work.

LP: The Energy Studies in Buildings Laboratory[5] was also consulted on the project and were involved early on. They did energy programming with us in the initial design phase and worked with us on daylight testing to see at how we could bring more daylight in the facility. Of course we did their usual checking of our drawings and that type of thing.

[2] Omid Nabipoor, LEED AP is the president of Interface Engineering, a five-office multidiscipline consulting engineering firm.

[3] APHT Structural Engineers is located in Portland, Oregon.

[4] Brightworks provides strategic and operational planning and facilitation for LEED programs. SERA worked with Brightworks Northwest located in Portland, Oregon.

[5] Energy Studies in Building Laboratory (ESBL) at the University of Oregon provides design assistance in daylighting, natural ventilation, and energy efficiency.

Setting Goals for the Project

LP: The City of Portland has a LEED[6] Gold Plus mandate now and we were actually the first project under the new mandate. In addition to mandating the LEED Gold, the City of Portland has said, "You must do these other five things as well."

ER: The mandate states that you need to perform 30% better than baseline standard and you need to have at least 30% stormwater management on site. It was a separate mandate to do 100%, in our case, because of the local infrastructure near the project, and then 30% water efficiency relative to the EPA, the Energy Policy Act of 2000. The energy policy had a baseline, which is the same baseline that LEED uses, and we needed to perform 30% better than those in addition to attaining the LEED Gold certification.

LP: The LEED Gold plus policy also mandates construction waste management recycling hit the 75% mark.

ER: The last one is that you need to get, is the commissioning credit under LEED. They said LEED Gold, but they micromanage which LEED credits you are required to get. It's LEED Gold plus those five categories. That's why they call it LEED Gold Plus.

LP: The concern from the transportation side is the facility really just for the neighborhood that it served. There's a real concern about being able to show that we weren't going to be over-parking the area and disturb the residents. From that extent, we needed to investigate what transportation strategies were already put in place because it is an addition to the existing community center. They already have a really good ride-share program. We looked at the bus lines and other similar options, but it wasn't really an active part of our project as much as showing that we were providing adequate parking.

ER: Although, we did, in the end, wind up implementing a few strategies associated with the addition. Four of the parking spaces in the expanded parking lot will be dedicated to fuel-efficient vehicles, meaning that there's no LEED credit. It is for fuel-efficient vehicles that are on the ACEEE[7] list: Hybrids plus the other really efficient cars on the market are allowed. When you are trying to do that you get into great discussions about how much signage to put. Do you put the whole list of cars out there? Or do you just put something general and educate people through other means? The intent is to encourage people to use more efficient vehicles.

LP: Another goal that was added after the project's inception, was an idea about having the project be photovoltaic-ready. We were looking at a third-party financing system to get a large, somewhere in the neighborhood of 80-85 kW, array on the edge of the building. We're still working on that and we're very, very close.

ER: We can definitely say we are delivering it PV-ready. It's very ready down to locating the roof clips, the right places to attach everything later, and adding electrical conduits to where you would want to punch through to actually wire in that PV later. It also means leaving space in the appropriate mechanical rooms for the inverters, or other meters or systems, that will need to go along with it. In our case, actually, our inverters could go on the roof, so it meant adding some additional steel to support them by looking at the inverters that are likely to be used. Structurally it means that, at a minimum, making sure that the basic roof structure is strong enough to support the loads. We've taken it beyond that to the point where we've told the roofing supplier exactly where to put the roof clips so that if we need to locate the clips that hold the panel directly above the clips that hold the roof on, we should be able to do that. We have it down to a fairly refined

[6] Leadership in Energy and Environmental Design (LEED) Gold is a classification given by the United States Green Building Council representing that the project has earned sufficient points to satisfy Gold status.

[7] American Council for an Energy-Efficient Economy.

level of detail. We had the benefit of talking to a third-party installer for the photovoltaic panels throughout this process. We could anticipate their design in a very detailed way.

Tracking Progress on the Project

LP: ESBL was instrumental for us to evaluate the daylighting design that we were proposing, to make changes, and to perfect it.

We relied, on our mechanical consultant, throughout the energy modeling process, to help us evaluate different items like the wall insulation. We ended up settling on two inches of rigid insulation. We modeled the energy savings for three inches of rigid insulation and did a cost-benefit analysis throughout the modeling and, ultimately, two inches is what we settled on.

We also looked at the building from an energy-programming standpoint because pools areas are high, in terms of the overall temperature. We looked at how we could best place openings relative to other spaces in the building to take advantage of that heat transfer. It turns out that, because we were doing an addition, we weren't able to use as much of the heat in that way as we would have liked to, so we re-directed it and, instead, are using the waste heat off the mechanical system to help heat the pool water. A lot of people ask, "Why aren't you using solar thermal for the pool?" It turns out it is not needed because we can essentially heat the majority of the pool water with the waste heat off of the mechanical system because there's just such high energy requirements. We are doing a little bit of solar thermal for the showers. In the overall scheme of what we were looking at it's just a small, little array of six panels that will provide most of the shower heat for the hot water.

ER: To make the bathers comfortable you want to do two things. First, you want to provide nice, warm air. It's about 86 degrees Fahrenheit so the people that are running around in bathing suits and are wet are going to be comfortable. That's a primary programmatic need. The second programmatic need that is associated with this building type is fresh air. Think about the fact that these are chlorine-treated pools. Chlorines and other contaminates are going to build up in the air. You need a lot of air changes per hour. You have to consider what that means for energy-use when you're taking a lot of really warm air and trying to dump it out of the building. Working with Interface, we came up with the idea of capturing that heat and air as it is being exhausted and then using that to pre-heat the pool water. It does most of the heating of the pool water, really.

LP: We have a site that is oriented incorrectly for daylighting. There is only one place on the site where we could put the addition. We looked and struggled with it and tried to see if there was any other way that we could achieve a better daylighting design for the natatorium from a strictly building-orientation stand point and we couldn't. Then we looked at building form and how it could inform the daylighting design when its orientation really wasn't going to be able to. That's where the shape with the clerestories, the lower-angled roof, and then the additional clerestory, came from; it came out of the process of trying to get light. We were designing, really, from the daylighting perspective and, after that we were looking at how we could integrate with the rest of the buildings and form the rest of the facility.

Project Tax credits and Incentives

LP: We are going to be looking at all of the funding that's available through the BETC[8] program. One of the interesting things about our project is that we're going to be achieving LEED Platinum, or we hope so, through the addition of the solar array. There are separate tax credits provided from the solar side versus the LEED pathway so we'll essentially be applying for our LEED Gold target for the BETC money for the building itself and then we'll be looking at BETC

[8] The Oregon Department of Energy offers the Business Energy Tax Credit to those who invest in energy conservation, recycling, renewable energy resources and less-polluting transportation fuels.

money for the solar array as separate funding. ETO[9] is also providing a significant incentive because of the high energy savings that we are achieving. ESBL gave us a grant for parts of their work. We actually did win a City of Portland Green Investment Fund (GIF) grant but we ended up getting it too late in time to be able to implement it. We were going to install a spa water reclaim system, where we would use the spa water to flush toilets. We were not able to implement the idea as we did not receive approval until we were over half way through construction and the costs turned out to be too high, so we had to give the money back.

ER: When it's a public sector project using state tax credits, you have to take advantage of the pass-through option that the State of Oregon offers. They need to have a partner that can take the tax credits and give it ahead of a tax liability. There's a formula reached through the Energy Department for how much goes to the pass-through partner and how much goes to the project owner. It's part of the standard rules of the tax credit.

LP: One of the things that SERA has really been instrumental in is looking at how we can help clients understand that incentive process. In Oregon, we're uniquely situated and have really good funding sources with both Energy Trust and BETC. They incentivize different things; one is very broad and shallow and the other is very pointed and deep. Not all clients know how to take advantage of that so we try to help guide them through that process. We help them navigate through the process and decide on the track that will get them the best incentives. We often look at it in multiple different ways. For this project, because it already was mandated to go LEED, and the LEED track is generally the highest incentive, we knew from the get-go that we were going to follow that track.

Selecting Technologies for the Project

LP: At SERA, we're working on energy and water tools that were not developed for this particular project, but we retroactively used them to look at the spa water reclamation. At that point, though, we were already in construction and were just using it to figure out how big of a tank we would have needed to flush the toilets.

ER: It's worth going into a little more detail about the process, especially in the early stages. We have acquired a lot of basic tools that not every firm necessarily has, like a solar pathfinder, for example. Very early Lisa went on site with a solar pathfinder making sure that we knew when the sun was going to fall on different parts of the site to help with those early, early orientation decisions.

LP: It was interesting because ETO doesn't come out to check until we were actually already under construction. The walls were up and if we'd got it wrong, , it was would be too late.

ER: They had it down as perfect. It was south facing as much as you could ask for. Communicating our data and proving it, because we all have an intuitive level of understanding, becomes really important. When you pick up those tools it changes everything. Even an experienced designer will have little surprises on each project of exactly how the sun's moving in that particular site.

LP: I have been involved with the daylighting lab, for a long time and know the process. We made sure that testing was built-into the schedule and happened at the right times where we were still at the point where we could change the building form and adjust as needed. We also looked at the window U-value because it's so important; you need to worry about the interplay between daylight and heat loss when you're heating the air to 85.

ER: This was one of the earlier projects in our firm after we had made the firm-wide commitment to

[9] Energy Trust of Oregon

use 3D modeling as our production software. We use Revit, which is a 3D modeling software tool that instead of developing 2D drawings, you are developing a 3D model. It has all kinds of benefits, but one of them in this projects was that it was very quick, since we already had the 3D model, to just add different solar arrays and, to some extent, test out different lighting options and see how they were going to work within the space. We didn't do a full lighting model of this electronically, but we did have the ability to test different openings in the clerestories as I mentioned and to test different PV arrays and to resize them because we had already invested in a 3D model Since it was now part of our production approach, the added time of doing those quick studies wasn't that much.

Tracking Progress on the Project

LP: We had lots of meetings!

ER: One of the things that Parks and Recreation really did well in this project was bring the right people to the room at the design sessions. The head of maintenance was there for key decisions, and also the people who were going to and who currently operate this building as a community center, as well as the people who run aquatics programs for Parks. We had direct access to the right decision makers. In terms of our consultant team, there were lots of iterations, testing, and back and forth. They were often meetings with the big owner team and so the consultant team would bring in relevant consultants for the agenda.

LP: For this particular project, we didn't have a regular schedule of meetings other than our in-house team meeting, but we did have regular meetings that were set up. From the beginning of DD[10] we said, "We are going to need these meetings," and we set them up. There were a couple that popped up that needed to happen that we didn't anticipate, but we kind of ran with it and gathered the meetings as we needed them.

ER: Whenever you are in construction there are unexpected surprises, of course, especially when you're connecting to an existing building and trying to do it on a site that has unpredictable soils.

Lessons Learned

LP: There's no question that this project has affected our process, particularly in any other natatorium projects that we would do. We would definitely be looking to this as a model. There are so many different things that we tried. One of the things that got brought to the table early on through our aquatics consultant was, when they heard that this was a LEED project, they said, "well, there's a new kind of filtration system that's out there that's called the Defender Filtration. The result from it is that it will end up saving about 1.5 million gallons of water a year. It is a different way of treating the pool water to get rid of the excess body oils and things that you normally need to filter from pool water.

ER: In a nut shell, filtration systems either use a natural diatomaceous earth or a synthetic particle that's like diatomaceous earth. Water goes through it and it bonds and extracts as it filters. What that means operationally, with the conventional sand filter which is sort of the default technology, is that you have to run it through the sand filter and then, fairly often, you have to run that water backwards through the sand filter to effectively clean it. Of course, when you are running that backwards, you don't want to dump that into the pool so you have to dump it into a sanitary drain because it's pool water. In our case, with the added complexity of limited pipe capacity in the ground for the combined storm and sanitary sewer, we didn't have the option of directing that flow of water, that volume, in real time. We were looking at having to add a large storage tank that effectively takes the backwash water, stores it, and then releases it more slowly to the public sewer system.

[10] Design Development is a phase in the architectural construction and design process.

By going to the Defender pool filter system[11] we did two things: one, we eliminated the need for that backwash water at all because the Defender, with the diatomaceous earth filter, doesn't need to be backwashed in that way and, two, we eliminated the capital cost of that large tank and the follow up that is involved, such as where to locate the tank.

It saved the project a lot of money and led to this 1.5 million gallon water savings. To clean itself all you need to do is turn a valve. It does periodically need to have clean water just run through it, but that doesn't return to the pool. Basically you self-clean with a much lower flow and it doesn't need to be backwashed. It has a cleaning cycle where, instead of directing the water coming out of the filter back to the pool, you direct it to the sanitary sewer, but it's a much, much lower quantity and it doesn't need to be in a big holding tank.

LP: It happens at a lower frequency, too. Parks has a high use of their pools and a high standard for filtration.

Typically, in the summer, they would do the backwash process maybe twice a week. We're predicting, based on our aquatics consultants experience that we will need to use the Defender system once every two weeks. Frequency is one huge benefit and then the fact that we're using about half the water each time. That's where the multiplication happens. We've actually been pretty conservative in our estimates and we're saying, "What if we use the same amount of time and just look at the water savings, how much do we actually save?" We're hopeful that we'll be increasing from our multiple of 5 gallons to even greater water savings.

ER: That's a nice annual number

LP: That's a success that we hope to document down the road. One of the great things about working with the Parks team is that they were willing to try the new technology. This is a technology that's out there, but it's not tried and true in a lot of different facilities. We were working with them to find as similar a facility as we could that had used this. I don't think they actually ended up going to see it, but they talked to some people that are using it and got testimonials.

ER: The City is open-minded and willing to build in a responsible way. They wanted to know that the system had been done somewhere else and in a pool that had similar use patterns. Just like their use of the Defender system, they didn't want to take just anyone's word for it. Here was a great system that they had never heard of before so they wanted to kick the tires. They were responsible in that way. There were times they said no to a system because they didn't get to that level of comfort but, in general, they were open-minded to test new ideas.

We also are employing a liquid pool cover which is another technology that you don't hear about very much. It's an alcohol-based solution that they put into the pool water and what it does is form a film on the top when the water isn't disturbed. So, when people are no longer splashing in the water, the alcohol rises up and it forms a film that stops a lot of the evaporation and, thus, heat loss. It's not as good as a pulled pool cover, but if you think about what these pool shapes are like, with the leisure pool, there's no way you could get a pool cover on. Again, Parks was willing to look into it. We had previous experience with another facility in Corvallis, so we hooked those people up together. We also had to work with the Building Department to make sure that that was an approved pool cover because it needed to meet a requirement of the Energy Code. To show them that this actually has worked in places, that is a relatively new piece of the energy code, was an additional requirement.

[11] Defender filter system is produced by Neptune-Benson, Inc. differs from a sand filter by utilizing depth filtration while the Defender functions with surface filtration and saves approximately 90-95% of waste water associated with sand filter backwashing.

Parks and Rec designs their buildings, or asks for their buildings, to be designed for very high demand. The term they use is "bather loads," which are some of the highest loads they know of. Even though it's a set of municipal pools, partly because of their strong standards and strong operational standards, they're popular. If you look at Southwest,[12], or Mt. Scott,[13] they all get a lot of interest. It's because they have the big slides and family-friendly things, but they also have lap pools and swim lessons. They are planning for this pool to be very popular, very busy, but I don't know that they could staff it, literally 24-7.[14] I think that would be a constraint before the actual technology would.

LP: The hours of operation that we're planning for are from 5:30 or 6 in the morning until 9 to 10 at night, seven days a week.

ER: One of the details that are very, very important in a building like this is how to protect the steel in a building that has a bunch of chlorine in the ambient air. There's a term called, "high performance coatings," that is basically paint that has some other kind of mineral added to it to keep the rust off the steel. Clark was a great resource, in-house, on those high performance coatings and how they can be specified correctly and he gets them chased through the whole construction process. That just came out of experience with these kinds of buildings.

LP: At the same time we were looking at the LEED criteria in terms of VOCs[15] that are in a facility. What we were looking at is how we could achieve the high performance coatings without jeopardizing the VOC budget. That led to a more superior coating. We were applying it outside of the facility using a combination process that's both dipping and spraying. All that will be left are some minor touch-ups.

ER: It was all done in Vancouver, WA and it was a lot more detailed than you would think. It was a very precise process where you have to sand blast the factory oils off and, within a matter of about four hours, you have to put the first level of coating on. There is a lot of process that needs to be managed both on our end and on the general contractor's to make sure that all happens. If you have a bunch of factory oils and the coating doesn't apply and you get voids, then you've got rust gaps and all the things that you were working so hard to avoid. What that translates into is building durability. The reason to do that is that you want a building that is going to be around for decades and decades, not just years and years.

LP: The ventilation and air quality has continued to be the most important driver of the mechanical system. We were, of course, looking at ASHRAE[16] which publishes standards. The ASHRAE standard for air changes for a natatorium environment is really six to eight air changes per hour. Portland Parks felt that they had to be at the high end of that spectrum. Eight air changes per hour were what we were looking at meeting. They were also going to make sure that, as we were looking at this mechanical system, we were, at the same time, not sacrificing air quality. We had many, many discussions with the maintenance folks to make sure that we weren't giving up comfort and people's ability to enjoy a quality environment for our energy efficiency.

ER: We already talked about the specifics with the heat recovery system, but another aspect of that is how Interface laid out how the air was supposed to move through the space. Along one side of the building there are a whole bunch of return air louvers that go quite low down to the deck of the pool. What they do is to help pull the lowest air in the room across the floor and across the surface of the pool because chloramines, the chemicals they are trying to get out of the air, tend to sink and stay low in the space and not rise. You really want to pull that low air and keep it moving, but you

[12] Southwest Community Center & Pool is located in Gabriel Park at 6820 SW 45th Ave in Portland, Oregon.
[13] Mt. Scott Community Center & Pool is located at 5530 SE 72nd Ave in Portland, Oregon
[14] 24 hours a day, seven days a week.
[15] Volatile Organic Compounds
[16] American Society of Heating, Refrigerating, and Air-Conditioning Engineers

don't want it moving so fast that it becomes a comfort issue. There's a real design fire point there. Basically, the louvers are pulling all the air out of the room and it's being delivered high, dropping down from the ceiling, along both of the walls, and all the way around. The intent is to get the fresh air dropping down and to get the worst air moving off and do it at a low enough velocity and a high enough volume that you're balanced and not creating a wind storm, yet still moving eight air changes per hour out. That was energy modeling telling us what was happening and also basic mechanical design looking at ventilation rates and making sure there's not too much air speed.

Parks has a standard DDC, Direct Digital Control system. They actually have their own separate consultant that has been doing the Building Information System work. Part of our job has been to integrate their work with our general contractor's work. They have a standard across all their systems so that, in theory, most of their systems can be run off site from the main supervisor's office.

Hiring New Staff

LP: We're always looking for people with the right attitude and aptitude. You can always teach people skills, but what we're looking for is people who are curious, who want to explore, who have energy and who initiate; that's always important. We don't get many people who have Revit skills; that is our primary software. There just aren't qualified people out there, so that automatically takes places them in production right away. So we look for people with other qualities. It is really important to us to find the fit between the person and the firm. Typically, we'll do at least two interviews with each candidate and usually there are at least four or five of us who are participating in the round robin. I would say, also, it goes the other way. We want to make sure that the candidates feel comfortable at SERA. We try to make sure they understand the culture and the team process, and give people an idea of who we are.

ER: If we found someone who had a great set of aptitudes, was interested in the quality of work that we do, and had a very beginner's interest and curiosity about sustainability, I think we'd not care about LEED or NCARB. We like it when someone walks in and says they've heard about sustainability and they really don't know what that means, but it's one of the attractive things that about coming to SERA, to educate themselves.

LP: Most people that come to us either already have developed an interest or know that it is an interest of theirs because SERA is definitely associated with sustainability. I don't think we see a lot of people seeking us out that don't already have that curiosity. We're looking at people with that in mind even outside of the architectural discipline; we're looking at admin hires and people come to us that already have those interests and skills. It's amazing what can happen; Robin, our purchasing agent, found pens where the cartridge comes out and you can recycle it and then keep the casings. We dig through our trash to figure out what we are throwing away.

ER: We don't have trash cans at our desk, but we do have recycling. You have to work harder to throw something away then to recycle it. SERA is getting as many if not more commitments to our in-house practices and how we do our business as we have to how we run projects. It is partly because, when you make good projects, you can only go as far as your clients are willing to go, but when you are your own client or you are making your own decisions, you can go as far as your budget allows you.

LP: We really invest in the process of finding good people.

ER: And if we've done that, then we can invest in their software skills. Every business is going through new software, buying bases anyway, so there's always going to be training in this day and age. You kind of expect that you're going to need to train them, at some point, with specific tools.

Closing Thoughts

LP: We've been working a lot on the Living Building Challenge. I feel like we're at a point where we don't even know what we don't know yet. For example, in terms of the materials category, what are the toxic materials? Where do they show up? We need to incorporate research and many use university students to help us understand a lot more about what goes into our building materials and what the right choices are. We know already that vinyl flooring is probably going to be the next asbestos. What else is out there that we regularly put in buildings that we don't' even think about in even our best green buildings?

ER: I think academia is well placed to do that because they aren't in the role of specifying those materials and needing to work with the realities of putting buildings together. You can take that slightly more distant view than practitioners can. Another place that that distance helps is in post occupancy studies. It's appropriate, but tough, for us to arrange our projects in a way that we can go in and do a POE,[17] though it's not in client's budgets. There's a definite value in knowing what's actually working a year or two years down the road and doing it in an un-biased way so that you don't have to worry about if it was a SERA project or someone else's project. You can just say, "This is what's working," or, "this isn't working," and bring out all the realities.

For example, this was a public-sector project or it was a budget-constraint project or whatever it may be. That shapes the way that the sensitivities are met and focuses on the choices that had to be made in the real world of putting a project together. It would be helping the whole industry if, in a more objective way, you can understand what's working and what's maybe not the right place to spend as much energy.

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This narrative is based on an interview with architects Lisa Petterson and Eric Ridenour at the SERA office in Portland, Oregon on October 2, 2008. University of Oregon graduate student, Britni Jessup, transcribed a digital audio recording of the interview. The interview was conducted by University of Oregon Professor Alison G. Kwok.

[17] Post-Occupancy Evaluation

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East Portland Community Center Narrative: Engineer Mark Heizer

Getting the Project

We were a part of the design phase and were selected as a part of the design team with SERA,[1] the architects for the project. We had been doing a lot of work with the City of Portland Parks and Recreation,[2] including a few pools, but this was the first time we partnered with SERA on a project of this size.

We had worked well with SERA on a few smaller projects, and we were familiar with Parks work. SERA was very good at doing recreation projects and has a good reputation for sustainable design. We also showed an interest in sustainability with that building type so it was a natural partnership.

Selecting the Project Team

On this project, we took a design group from Interface who had previously worked on a Parks projects or had already worked on an indoor swimming pool. We tried to get a group that was familiar with the quirks, and pitfalls of a pool project. Of the four design teams in the office, I was on the team that was selected. I had done a bit of work for the Parks so I wound up being the "pool person" in the office.

The swimming pool building type has a lot of challenges since the pool itself is a big energy hog. The HVAC[3] becomes a critical part of the design, along with some of the plumbing and lighting. This includes meeting safety regulations without overlighting the space.

Mark Heizer, PE, LEED AP is an associate with Interface Engineering. He has experience with multiple LEED projects including the recently completed East Portland Community Center with SERA Architects.

[1] SERA Architects are located in Portland, Oregon.
[2] Referred to as "Parks" in the rest of the narrative.
[3] Heating, Ventilation and Air-conditioning.

University of Oregon Professor Alison G. Kwok, graduate student Britni L. Jessup, and Nicholas B. Rajkovich of Pacific Gas and Electric Company (PG&E) prepared this narrative.

Setting Goals for the Project

Our goals were to try and lower the energy use as much as possible. The biggest challenge was working with an owner that was very comfortable with "tried and true" methods that were commonplace when energy costs were much lower. New methods and materials had to pass multiple reviews by the owner's staff. That approach would waste a lot of energy.

My personal goal on all pools is that when you walk into a building, you shouldn't know that there is a pool. You shouldn't smell chlorine when you enter the building. That's a challenge to do without wasting a lot of energy. You can overdo ventilation in a place, but to have optimal indoor air quality conditions and still save energy, that's a challenge.

There's so much energy that's wasted all the time in pools. We knew that we were going to reduce our loads as much as possible and we knew that there were areas that could be cut. We knew that there was a huge opportunity there. We didn't know where it was going to wind up on the scale of 20, 30, 40, or 50 percent better than code.

There's also a need to control humidity from the pool water evaporation, which is taking energy from the pool. All of that energy must then be put back into the pool to keep it warm. At the same time you don't want that humidity in the building any more. It's a never-ending cycle to find ways to take heat from point A to point B and do it in a creative, energy-efficient way.

Tracking Progress on the Project

We did a preliminary estimate of the actual amount of energy savings, but some of the things that we were doing were new and very difficult to model. We had to find a method that everyone would accept and believe.

We were looking at ways to improve the envelope, the lighting, and the daylighting. We weren't only looking at the HVAC system, but also the rest of the building. We were going back and forth with some of the energy measures and not only saying, "What is the payback?" but also working with the client to show them that it's not just one strategy that can save you money.

It's going beyond payback and not just looking at the dollar savings, or the costs of an individual measure. It's difficult to explain to clients that saving $5,000 a year might initially cost $20,000. Some people say, "Well, it costs $20,000, what do I get for it?"

This project was different because there were many different decision-makers. The maintenance crews didn't want anything new, so we tried to make things familiar for them. Even after presenting them with many iterations, showing how simple it is to use, describing that it costs less and is easier to maintain, and showing them existing installation locations, they were still resistant to change.

Sometimes it is a matter of getting them together with an owner that is using it and showing them that we're not making this up. It was also a challenge because the people at the top wanted to make this a green, energy-saving building, but didn't want to spend money on the energy savings.

Selecting Technologies for the Project

On past projects, we came across a new way of doing pool projects in our Pacific Northwest climate.

Typically, pools in this region control humidity through compressor-based refrigeration systems and the re-circulation of air to reduce energy use. Another method is to use a varying amount of outdoor air to control the humidity. You then recover that energy with a heat wheel or flat plate heat exchanger. The owner didn't want to have anything to do with compressor based technology. They just said, "No, it doesn't work, we tried one of those 15 years ago and it failed and we'll never

use one again." They didn't understand that the technology has improved in the last 15 years.

So what this technology did was to take a standard heat exchanger that varied the amount of outdoor air to control humidity, and coupled it with an exhaust air stream and a refrigeration coil. We have to try to get that moisture out of the building because it is damaging. The exhaust air still has a lot of the latent water that has evaporated out of the pool in it.
That exhaust air has loads of embodied energy in it. This compressor we specified essentially refrigerates that air to wring out the moisture and puts the additional energy back from the other side of the compressor into the pool water itself; it's above and beyond basic code requirements to recover the moisture and warm the pool simultaneously. It's really just a heat pump.

It takes very little compressor energy to heat the pool water; it's a very simple and easy heat pump, and there's an amazing amount of energy that you can get back out of both sides of the system. At first glance, it's like you're creating energy because you're using both sides of the compression cycle.

We talked with a few manufacturers about the product. One of them said that they wouldn't sell us anything other than this particular system. We looked into it and compared it to every other way of doing this building, and it was head and shoulders beyond anything else we could have done. We were fortunate to have the right climate, because we couldn't have gotten to the level of energy savings if this building was in Atlanta, Minnesota, or Poughkeepsie.

We were fortunate that we came across something that was a little new. But we also looked at all the other systems, such as the windows and the pool filtration system. We had to be sure that all the systems could work together.

The whole process was collaborative and it kept building on itself. We kept coming up with something else that we could save on, and, finally, we came up with where we'd really like to be with the project.

We would have liked to go with triple or quad-glazed windows since it's a building who's interior temperature is kept 10 -15 degrees warmer than the average building, 24-hours a day, 365-days a year. When people in the building are wet, the evaporative cooling has a cooling effect on their skin. We knew that having a better radiant feel within the building would be truly important and the glazing would have helped, but in the end the glazing didn't make it in the project.

We used eQUEST[4] as our DOE-2[5] modeling software for this project.

The control schemes for the primary HVAC system for the pool are proprietary and are the manufacturer's control scheme. Getting that information from the manufacturer took a lot of negotiation and a lot of time. Every manufacturer can claim that their unit will perform a certain way, but we have to find a way to model it accurately.

We went through the same thing with some of the new refrigerant systems. The manufacturer gave us a housing development, as an example, and told us what they expected the efficiency of the units to be. That doesn't work for every building. It depends on the building type.

We had to ask for more information, in order to fit it with our building. We can't just say that it has an energy efficiency ratio of 17, or a heat pump COP[6] of 4 and leave it at that! We have to see how it's really working. Since it's not something that

[4] eQuest is an building energy use analysis tool used to compare building design and technologies and uses a DOE-2 engine to run the building energy use simulation program.
[5] DOE-2 is a widely used freeware building energy analysis program sponsored by the U.S. Department of Energy (USCOE) that can predict the energy use and cost for many types of buildings.
[6] COP stands for the coefficient of performance and describes the ratio of useful heat movement to total work done by the system.

has been modeled before, it took some digging on our part too.

Our models on some of these previous projects reflected pretty closely what happened in the field. Some of our assumptions were clever work-arounds because of the limitations of the software. Swimming pools aren't something that is easily modeled.

Shawn Henry, our energy modeler for this project he did a great job figuring out ways to work through it. We kept trying to be conservative on our energy modeling decisions. We pulled back a little bit from what we thought could happen and made it so that we were not over-shooting what could be expected.

This project followed our standard project flow. There were a few more steps we took during SD[7] and DD[8] phases that we normally do on any LEED project, including going through basics of design, looking at the owner's requirements, and trying to reconcile the requests of the owner. The Parks Department management wanted an extremely efficient building. The maintenance department, who had very strong influence, didn't want anything new. Working through that was a challenge.

The capital expense group of the Parks Department was another team with input on this project. We had to make sure that we were on target and on budget. If we did something innovative with the electrical or mechanical systems, would we actually save on the building construction cost? We tried to get the whole budget to work together. It's a matter of looking beyond the price tag for only one piece of equipment.

This project started looking as if it was going to be a much higher-level LEED project, and as people were seeing that we might get to a higher goal, and it could bring in additional incentive funds, the DD phase became more intense than normal. We asked ourselves, "If we could get to the next level, what would the compromises be?

There was a lot of give and take. A few of the things that we were given the go-ahead on were later retracted. There were times when we heard, "We did agree on that during a previous meeting, but now we don't want to go in that direction." So, we pulled back and discussed things. It takes following through and showing what the impacts are for their employees in order to get a sign-off from all of the decision-makers.

It is a big challenge even to have the right people there. On projects where the people that make the decisions are at the meetings, the decisions are final. It works a lot smoother. You have to look at how your client is set up.

EPCC[9] was one where we had a lot more decision-makers to answer to than the typical project. When you've got a focal point on the owner's side it really helps to have definitive answers and responses, "Give me what I need to take back to my people so we can make an informed decision." It is a challenge and it requires a lot more documentation, especially when you are tracking a LEED certification.

Expectations are different in a building that will potentially save 50 percent on energy. We have to do things a little differently than we do today. As a society, we have come to expect a specific temperature at any time. We expect the lights to be exactly how we want them, not how the person sitting next to us wants them. We expect certain things of how the air moves and how plumbing systems should operate.

A lot of what we're moving towards in sustainable design is what our grandparents and great-grandparents did as a matter of course. In some ways it's as if we're taking the step back in time.

[7] "SD" is an acronym for Schematic Development, a phase of the architectural design process.
[8] "DD" is an acronym for Schematic Development, a phase of the architectural design process.
[9] East Portland Community Center

Project Tax Credits and Incentives

The owners are applying for State incentives for the overall energy savings on the building. They have an energy program based on the LEED[10] scorecard that they are going through with the Energy Trust of Oregon. [11] Those incentives helped the owner to look at some of the things they normally wouldn't have looked at.

The owner looked at incentives for the 70-85 kW[12] solar PV[13] panels on the south-facing roof slope. It's a huge array on a big recreational pool on a perfectly sloped, south-facing roof. This was done through creative secondary financing, as a lease-to-purchase model. It's really outside of the budget for the building project, but we took into account the energy as part of the overall energy savings for the building.

Lessons Learned

We would definitely use the HVAC technology again, because payback is just so quick on the heat recovery system. For buildings that run continuously, we need to take advantage of that. The return is not as quick if you just use the latest pool cover to cut down on the evaporation during the night. You have to put the heat back into the water somehow.

The new pool filtration technology was unbelievable. It was presented to the owners and they were debating implementing it. Using the old sand filter technology they had to backwash their filters twice a week, dumping 7,000 gallons of water down the drain each time. The new pool filtration system probably would need backwashing only once every two weeks and looses only 500 gallons per backwash cycle. That adds up very quickly and the new, fresh, cold water doesn't have to be heated up to 82 or 84 degrees every time the water comes in.

We received other benefits from looking at this new system. The site was overloaded in terms of the amount of water discharge that the sewers can take at any given time. They can't take high flows, so this filtration system allowed us to reduce the amount of water used on-site and eliminated the need for storage.

There were a lot of meetings to determine which filtration system they wanted to use. It was a collaborative effort in researching who has done it and talk with people around the country to see if they are happy with it. We had to find out if this was going to be something that our technicians could actually work on and if there was local service available. Getting over those hurdles with the client took a bit of work and time upfront. There was a lot of time during the DD and SD phase of going through these options and looking into them. Some went through, some might have gone through, and some didn't go through.

On sustainable projects things are a little different. Our role in the various parts of a project, for example: owner expectations, owner requirements, how to develop a better picture for that owner, what the end product will be, and knowing that they understand what that end product will be, is shifting. Our job is to really make sure that from the very beginning clients understand what the give and take will be to deliver a more sustainable building.

We know that the more everyone gets involved the more opportunities that you may be able to find out there. Giving the client more information opens up possibilities and opportunities.

[10] Leadership in Energy and Environmental Design is a designation given by the United States Green Building Council.
[11] The Energy Trust of Oregon is charged by the Oregon Public Utility Commission (OPUC) with investing in cost-effective energy conservation, helping to pay the above-market costs of renewable energy resources, and encouraging energy market transformation in Oregon.
[12] "kW "is the basic unit of electric power equal to 1000 Watts.
[13] Photovoltaics (or PVs) are a technology that converts solar energy into electricity.

Hiring New Staff

We've been looking for people who appear to have a passion to do new design, people that show a passion for wanting to save energy, a passion for sustainability, people who want something more than earning a paycheck. We are looking for people who want to feel good about the product and results. That can make a difference in how much energy a building uses and what the impact is for future generations. We're seeing that fire in the people who want to work for us. And the people we've hired still have it today.

Closing Thoughts

Something that will need to shift is client expectations about space temperature. In Portland I am an advocate of our design temperature being 92 to 95 for summer. We can keep a well-designed, naturally ventilated building just barely within the acceptable temperature range, if you're dressed appropriately and can use a fan.

Why not create the equivalent of a snow day when it hits 105? It reaches those temperatures now and then; on those days we should go home early or work from home that day. You're already going to be running your air conditioner at home, so we shouldn't be running it here at work, too. Why come here and be miserable when you can stay at home and be miserable?

It's all about getting clients to understand that a sustainable building is going to have different temperature swings. In winter and in summer occupants will need to wear layers and understand that if it is going to get extremely hot they shouldn't run the building. Tell their employees not to come in or understand that it's shorts and t-shirts day for everybody.

The one portion of the building energy pie that's not getting any smaller is glazing. I see that as a challenge for everyone. There aren't systems out there that are affordable and meet client and architect expectations for appearance that aren't horrible insulators. Technology is not keeping up.

Highly insulated glazing is only being seen in the most northern climates like Minnesota, North Dakota, or upstate Maine. Those are some of the few spots where you're seeing people purchase this technology. Those aren't exactly the population centers that can start to influence design.

The early mantra of the USGBC[14] was about changing the way people do business, making it part of a market transformation. They have done a lot toward that, but to get down to a 50percent reduction in energy for your average building and to head toward net zero, the glazing business is the one that has miles to go. Until they come up with that, whether it's the air gel glazing that doesn't distort vision, or something else, you're looking at heading beyond double pane glazing.

Somehow that last little bit of market transformation needs to start happening so that contractors are familiar with it. Then manufacturers can start bringing down their costs so that the window systems are acceptable and don't short circuit the efficiencies of the building.

This narrative, part of a larger case study describing the East Portland Community Center, was supported by a 2007 AIA Upjohn Research Initiative Grant.

This narrative is based on an interview with engineer Mark Heizer on February 18, 2009 at the office of Interface Engineering in Portland, Oregon. University of Oregon graduate student, Britni Jessup, transcribed a digital audio recording of the interview. The interview was conducted by Nicholas Rajkovich of Pacific Gas and Electric Company (PG&E).

[14] USGBC = United States Green Building Council

Exhibit 1: East Portland Community Center

Fig. 1. The exterior of the East Portland Community Center addition with the original center visible in the distance

Fig. 2. The exterior of the East Portland Communicty Center aquatics addition

This exhibit, part of a larger case study describing the East Portland Community Center, was supported by a 2007 AIA Upjohn Research Initiative Grant. University of Oregon Professor Alison G. Kwok and Britni Jessup with Nicholas B. Rajkovich, Pacific Gas and Electric Company (PG&E), prepared the associated narrative.

Fig. 3. Outdoor courtyard

Fig. 4. Exterior of pool addition

Fig. 5. Exterior of pool addition

Fig. 6. Original East Portland Community Center

Fig. 7. Daylit interior view of pool

Fig. 8. Daylit interior view of pool

Fig. 9. Daylit interior view of pool and clerestory

Fig.10. Daylit interior view of pool and sidelighting

Fig. 11. Daylit interior of pool and clerestory

Fig. 12. Daylit hallway

Fig. 13. Daylit interior

2009-005-01
JUNE 01, 2009

ALISON G. KWOK
BRITNI L. JESSUP
NICHOLAS B. RAJKOVICH

The Gerding Theater Case Study

Project Description

"A dedicated team of architects, artists and designers has worked together to create a most unusual theatrical experience at the Gerding Theater at the Armory. But what makes it even more unique is that this design also embraces the highest standards of historic preservation and green building design and is imbued with a casual and inviting atmosphere that gives visitors a range of compelling reasons to come inside, to linger and to return time and again."[1]

Architect:	GBD Architects, Portland, OR
Historic Consultant:	Heritage Consulting, Portland, OR
Structural Engineer:	KPFF Consulting Engineers, Portland, OR
Geotechnical:	Geo Design, Portland, OR
MEP Engineer:	Glumac International, Portland, OR
General Contractor:	Hoffman Construction, Portland, OR
Green Consulting:	Green Building Services, Portland, OR
Theater Design:	Landry& Bogan, Mountain View, CA
Experience Design:	The Felt Hat, Portland, OR

Project Awards

- 2007 Award: The America's for Excellence from the Urban Land Institute
- 2007 ARC Grand Award for Engineering Excellence
- 2007 Honorable Mention American Institute of Architects' Committee on the Environment Top Ten Green Award
- 2006 LEED NC v2.0 Platinum, U.S. Green Building Council

Project Data

Completion: October 2006

Cost: 28,000,000 U.S. Dollars (2006)

Area: 55,000 ft^2

Location

City: Portland, OR

Latitude: 45.31 North

Longitude: 122.41 West

Climate[2]

HDD65: 4522

CDD50: 2517

Annual Precipitation: 36.3"

Solar Radiation: 377 kBtu/sf/year

Energy Metrics

Energy Code: Oregon Non-Residential Energy Code

Predicted % Below Code: ~35%

Measured EUI: 61 kBtu/sf/year[3]

[1] From the Portland Center Stage website at www.pcs.org
[2] From the National Oceanic and Atmospheric Administration website at www.noaa.gov
[3] EUI: Energy Utilization Intensity estimate for onsite usage. EUI calculated from gas and electric bills; excludes energy used in chilled beam cooling system

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JUNE 01, 2009

ALISON G. KWOK
BRITNI L. JESSUP
NICHOLAS B. RAJKOVICH

The Gerding Theater Narrative: Craig Mendenhall, GBD Architects, Inc.

Getting the Project

Craig Mendenhall is a designer with GBD Architects who worked on the project along with architect and firm director Steve Domreis and project architect Dick Kirshbaum.

Craig Mendenhall: The project came to GBD through Gerding Edlen Development.[1] Bob Gerding[2] of Gerding Edlen is very involved in the arts community and is on the board at Portland Center Stage[3]. Prior to the involvement of Portland Center Stage we had done several schemes for the Armory Building through Gerding Edlen. We had looked at converting the Armory into an REI retail store, an LA Fitness Center and had considered several housing options in 2002, but programs didn't work out. Around that time, construction of the Henry Condominiums was nearly complete, and, in order for The Henry to get their certificate of occupancy, the roof of the Armory had to be replaced with a two-hour fire rating. That happened before the Armory got put on the National Registry of Historic Places.

Meanwhile, Portland Center Stage was looking for a new home. They were sharing space in their former building with several other tenants and it wasn't ideal. Portland Center Stage had recently brought in a new artistic director, Chris Coleman. Chris was instrumental in identifying the Armory as a suitable home. Its interior Douglas Fir bow trusses span 100 feet across the width of the building making the Armory ideal for space planning a theater. Bob Gerding, being on the Board for Portland Center Stage and the owner of the Armory building, decided at that time that a performing arts theater was the right fit and was determined to make it happen. They began to look into the finances.

GBD started doing the conceptual programming in 2001. The contractor Hoffman Construction quickly dubbed the Armory space plan a "ship in a bottle" because of the immense program within the existing barrel vaulted structure. How do we put the original 72,000 square foot program into a 20,000 square feet existing footprint? That was one of the biggest challenges.

[1] Gerding Edlen Development Company, LLC
[2] Bob Gerding is the retired co-founder of Gerding Edlen Development and is currently a member of the executive team.
[3] Portland Center Stage is a theater company based in Portland, Oregon.

Selecting the Project Team

The design had to be an integrated process. The Armory was slated to be the first LEED platinum certified theater, and the first LEED platinum certified building on the National Registry of Historic Places. Prior to this experience GBD hadn't designed a theater. We simply had a good relationship with Gerding Edlen Development and they asked us to begin making the dream a reality. We said, "surround us with consultants that know all of the things we don't, and we would love to work on the project."

Portland Center Stage had done their research and knew the kind of theater they wanted. They wanted something small. At the time their main stage theater was too large and they were not selling out to a full house. Portland Center Stage wanted a 600-seat main stage theater, similar to the Bowmer[4]in Ashland, so they went to Landry & Bogan[5] out of San Francisco and asked them to be the theater consultant on the project. Landry & Bogan were the theater consultants on the Bowmer. GED and GBD chose Green Building Services[6] for the sustainability consulting, KPFF[7] for the structural engineering and Glumac[8] for the mechanical engineering. These are all consultants we work with regularly and on LEED projects. We would meet with this group every week or two and there would be 25 people in a room making important decisions early in the design process. That was a big part of making this project a success.

Steve Domreis, a director at GBD, was the design principal in charge of the Armory project. He worked with Bob Gerding on project feasibility early on and brought the project into the office. I was new designer at GBD and working with Steve at that time. That's how I started working on The Gerding Theater. Dick Kirshbaum, who was the project architect, worked on a lot of the other Brewery Block[9] buildings. He was really good with the construction process and making changes in the field when things didn't quite fit as intended. He is very good at problem solving in that way. We then brought on the production team as needed.

This was a great experience for me because the Armory was my first design project out of college. I didn't have the experience to realize the design team was structured in a way that was different from past projects at GBD. The design process was much more integrated and each person on the team had to step outside of their specialized role to make the project a success. It takes a lot of bending on everyone's part to make innovative ideas work when you are doing something that hasn't been done before. I have been told that The Gerding Theater is one of the most complicated buildings in GBD history.

To put it simply, there are three reasons why this was a complex project:

1. PCS is a non-profit organization. This meant they required multiple sources of funding in order to make the project happen. Each of those funding sources were potential owners of the building with a different opinion as to what the final product should be. In the end the solution was to make all decisions thru the eyes of the theater.
2. We were working with a large program to be placed inside a historic building and on an extremely tight budget. This meant the design needed to be minimal, cost effective and expressive.
3. We were to exceed the highest level of LEED certification on a fast pace schedule. Complex problems needed to be solved quickly.

[4]The Angus Bowmer Theater is located in Ashland, OR and serves the Oregon Shakespeare Festival.
[5] Landry & Bogan is a theater consultant group located in Mountain View, CA.
[6] Green Building Services is a sustainability consultant with various office locations including Portland, OR.
[7] Kelly, Pittelko, Fritz and Forssen is a consulting engineer firm with various office locations including Portland, OR
[8] Glumac Engineers have various office locations including Portland, OR.

[9] The Brewery Blocks are a series of blocks developed within the Pearl District that house a variety of uses.

Setting Goals for the Project

Gerding Edlen's mission was to design a highly sustainable cultural center. The highest level of sustainability was also a requirement of the funding package put together by PDC and Portland Family of Funds.[10] From early on the goal wasn't, "Let's design a building and make it as sustainable as possible." The goal was to make the Armory a LEED Platinum certified building. They said, "What do we need to do to make that happen?" And then, how do we need to organize the financial structure to make that happen? We knew the building was going to be LEED Platinum very early on. All other decisions were based on what it took to make that happen.

All design strategies had to do with the building performance. We worked with PCS, GED and our consultants group to create a concept design. We then passed that concept on to Hoffman Construction to price. If the price came back too expensive we went through that exercise again and again until it all made sense.

Early in the design process we did something called an eco-charrette. Economics play a big role in the decision making process. At one point the decision had been made to place a large photovoltaic array on the roof of the Henry Condominiums next door. Ultimately this was not a cost effective decision. There was a $600,000 cost savings in switching to an under-floor air plenum in concert with a chilled beam in all regularly occupied office areas. This was a major cost savings and we maintained the same number of LEED points.[11]

The Gerding Theater tapped into the centralized utility plant on top of Whole Foods[12] in the Brewery Blocks for its cold water supply. This is a chiller plant that provides cold water to the neighborhood and prevents each building from needing to have a cooling tower on the roof. The C.U.P. is not nearly at capacity as it was originally intended to serve a much larger area that just the Brewery Blocks. The cost to get infrastructure to the potential nearby projects has outweighed the benefits in some cases.

Tracking Progress on the Project

Our first couple LEED certified buildings had what I would call "green curtains" meaning, the decisions necessary to create a LEED building were made too late in the design process. We then had to scramble late in the game to reach our sustainability goals. The design process for creating sustainable buildings continues to evolve. Most people in our office have now taken the LEED exam and have become LEED accredited professionals. GBD typically assigns a LEED "cheerleader" to each design team to document and double check decision making during the design process. At this point, LEED has just become a part of what we do at GBD. We no longer rely as heavily on consultants such as Green Building Services however, they are still regularly apart of the design team on most large scale projects.

Since I started working at GBD six and a half years ago, every project I've worked on has had a goal of being LEED gold certified or better. Recently, we've started doing a lot of master planning because the market has been shifting away from condominiums. We've gone from designing LEED-certified buildings to LEED neighborhoods and communities. Now we're working on several LEED neighborhoods across the western United States as well as The Oregon Sustainability Center, a 12-14 story net zero building downtown Portland. The Oregon Sustainability Center is

[10] Portland Family of Funds Holdings, Inc. is a mutual benefit corporation for economic development activities.

[11] LEED designations are based on a point system. The number of points earned correlates to the LEED status. In the case of Portland Center Stage, enough points were earned to achieve Platinum status. (The ranking from least to greatest: certified, bronze, silver, gold, and platinum)

[12] Whole Foods is an adjacent grocery store and part of the Brewery Blocks in the Pearl District.

requiring us to look way outside the box in our exploration for potential design strategies.

Selecting Technologies for the Project

We used a complex energy model to verify the daylight requirements for LEED of 75% and 2%.[13] This was difficult to accomplish because we were working inside of a Historic Armory with small windows. To achieve the 75% and 2% requirement we had to negotiate the design of the 42 skylights to be placed in the roof of the Armory with the National Historic Preservation Office back in Washington D.C. New exterior windows would not be allowed by the NHPO. The new skylights were very difficult to get approved. This is a good example of two organizations (USGBC and NHPO) operating a bit like oil and water. I hope that in the future these two organizations can find a way to work together to establish a criteria for the design of LEED certified historic buildings.

The design and implementation of the mechanical systems were a huge challenge due to the immense program within the Armory. Not to mention the fact that we have very few finished ceilings in the building. Everything is out there for you to see.

After configuring the mechanical systems to fit the design and evaluating the budget, ultimately we had to sacrifice and cut out a full floor of the program which brought the overall square footage down to about 55,000 square feet, from 70,000 square feet. Putting 55,000 square feet in a 20,000 square foot existing building meant that much of the program had to be below grade. This could have had a major impact on our ability to reach platinum. However, it was to our benefit that this was to be a performance theater which allowed for below grade occupied spaces.

Being that they were a major funding source The Portland Development Commission (PDC) required that the lobby for the theater be a "living room" for the city of Portland. The lobby is intended to be a multi-functional atrium. The lobby is used for anything from grabbing a cup of coffee and hanging out, to weddings and receptions. The design is about seeing and being seen. It's supposed to be a cultural hub for the neighborhood. I was at an after party on the lobby mezzanine not too long ago and Storm Large was singing at this event. All the while a performance was ongoing on the main stage. The two did not disturb one another. I guess that is the point of being multi-functional.

Landry & Bogan (the theater consultants) had stringent requirements. They needed 30 feet of backstage behind the main stage for PCS productions work properly. From an architectural design standpoint, we needed at least need 30 feet for the lobby space. And sandwiched in between was the theater box. So we ended up with a concrete theater box within an unreinforced masonry exterior box. Structurally we were able to meet seismic upgrade requirements by tying the two together through the floor slabs. This allowed for a maximum exposure of brick and basalt on the interior of the building.

As it turned out, everyone had to compromise including Portland Center Stage. In order to maintain the buildings historic status we could not place large pieces of equipment on the roof. Therefore, PCS could not have a traditional fly loft, because they didn't have sufficient height below the existing roof trusses. The result is a truncated fly loft and a slightly shorter proscenium on the main stage.

Other compromises were made. We could only dig down to 27 feet as opposed to 30 feet or more below the sidewalk level. Each additional foot compounded the budget issues related to the project. The black box theater and the large mechanical room that is the engine that runs the yacht are located on the basement level. The building as a whole requires low flow air distribution so that the air cannot be heard as it is supplied to the performance spaces. The reduction

[13] Environmental Quality credit for daylight and views states that a minimum of 75% of all regularly occupied areas should achieve a minimum glazing factor of 2%

of the height in the basement level meant that we would have a raked ceiling in the black box theater mimicking there slope of the seating in the main stage theater above. This is not ideal for lighting the black box theater. The large duct work is distributed from the mechanical room to various shafts leading up to through the building. This large duct work further compounded the height reduction in the ceiling limiting the size of the props that could be transported to the black box theater from the freight elevator on the far east end of the building. The design became more complicated as decisions compounded one another.

The coolest thing about the main lobby is the ceiling. We decided early on we wanted to keep as much mechanical equipment out of the ceiling as possible. One of the only things you see other that the lighting is the pipe that captures the rain water from the roof and takes it down to the tank under the sidewalk. The grey water is then reused for irrigation and toilet flushing. The decision to keep equipment out of the ceiling led to the use of a radiant floor heating system combined with a "finger duct" at the floor levels which are the supply air for the space. The heating and cooling for the space are introduced at the level of the occupant therefore, requiring less energy to keep people comfortable.

Vera Katz Park[14] runs along Davis St. between 10th St. and 11th St. The park is about telling the sustainability story. In the past Davis St. has been susceptible to vandalism. We choose to use a portion of our budget to pay the city to remove a few parking stalls from Davis St. and widen the sidewalk to 20 feet. There's the 12,000-gallon rain water cistern below the sidewalk at 11th and Davis. The cistern collects water to be reused in the building. The cistern is small relative to the amount of rain water we get in Portland. The excess water bubbles over into a fountain and runs down the sidewalk and eventually into a bioswale where it is filtered before being released into the storm-water system. The grey water story, or the water reuse, seems to be the thing that people who aren't architects, or that don't necessarily know a lot of architectural terminology, grab on to. The idea that you flush the toilets with water that you have collected off the roof seems to interest people. The topic creates interesting conversation.

A lot of people ask now that the project is complete if I feel as though the project is a success. I am increasingly satisfied with the success of the project. Simply the fact that people like you are still asking me questions about the building means success in my mind.

Project Tax Credits and Incentives

We earned Business Energy Tax Credits (BETC), which played a role in choosing the varied strategies to get the different points, mostly in the Energy and Atmosphere category of LEED.

The historic tax credits came in and those were huge. We received somewhere in the neighborhood of $5 million from the Federal Government for being on the National Registry of Historic Places and meeting all the historic criteria that the Secretary of Interiors sets. Money came from all over, but we still have a bit more to raise. Out of the $39 million, which was approximately the overall project cost, we are probably a couple of million away from raising it all. They still have ten years to raise the full amount.

Lessons Learned

Designing for LEED platinum has become the norm. Now they want to go carbon-zero or net-zero and to create a carbon-neutral building in a city. I think as a city Portland is moving in the right direction.

Portland is 10 years or more ahead of most other major cities in the country in terms of sustainable design. Most clients have heard of LEED but may not be familiar with how the process works. We've been able to get them to jump over those hurdles

[14] Vera Katz Park is adjacent to the Armory building and is a sculpture and rainwater harvesting element.

and go to the full extent of creating a sustainable project. It's not something we charge extra for.

Hiring New Staff

Even in the toughest economy we still keep our eye out for design talent. We have recently gone as far as to open up a portion of our office space to freelance designers. What we are looking for, and what I think Oregon[15] does a good job of teaching, are people who know how to design great spaces. We are looking for people who can think in three dimensions who are strong conceptual designers, who are able to graphically represent ideas, and can communicate the ideas. Everyone at GBD is always learning and at different levels.

We work in a studio setting. Teams move around and sit together and are able to talk back and forth, get ideas, and talk about different strategies. The person next to you might know something that you don't and vice versa. Being excited about design and wanting to work for a company that shares an interest in sustainability goes a long way.

I've sat in on several interviews and it seems that people feel like they are going to work for a corporation and will be the person who is doing AutoCAD.[16] They assume they are going to work their way up the ladder, but that's not necessarily the case. I came in and was able to do fun stuff from day one. GBD is able to take the new employee and steer them towards wherever they're of the most benefit. If you have the mentality that you're going to be a production person, it's probably what you'll end up.

Every new person that comes into our office feels like they get out of school and now they're really starting. There's just as much to learn once they start working in an office as they did in 5 years of school.

The work done over two quarters in school is comparable to what we do in a week in a many cases. It's very fast paced, but we do this 8 hours a day, every day. Do it long enough and you know how you like to work.

Not only is it important to create compelling graphics to express an idea or concept. You must be able to tell the story to capture someone's interest. Sketchup[17] wasn't available when I was in college, but it's popular program in the office today. Sketchup has helped me to solve problems quickly but I don't think it's a great presentation tool unless you are very good at it. Sketchup will make you think in 3-D.

Closing Thoughts

The Armory has a lot of imperfections and is the result of the work of a whole lot of people. The imperfections are what make the building unique to Portland. I have gained valuable experience in working on The Gerding Theater and hope to bring this experience to my future projects.

This narrative, part of a larger case study describing the Gerding Theater, was supported by a 2007 AIA Upjohn Research Initiative Grant.

This narrative is based on an interview with designer Craig Mendenhall at the GBD office in Portland, Oregon on October 11, 2008. University of Oregon graduate student, Britni Jessup, transcribed a digital audio recording of the interview. The interview was conducted by University of Oregon Professor Alison G. Kwok.

[15] University of Oregon

[16] A computer-aided drafting (CAD) software.

[17] Sketchup is a 3-D modeling tool by Google.

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The Gerding Theater Narrative: Engineer Bob Schroeder

Getting the Project

Bob Schroeder: We had been doing the work with GBD Architects on the Brewery Blocks,[1] which is a complex project with multiple uses and this ended up being the last building. The Armory building is on the historic registry so it was natural to develop that piece of property into a showcase project.

Bob Schroeder, PE, LEED AP is a principal engineer with Glumac and is based out of the San Francisco office. He was the project manager for the Gerding Theater project.

Selecting the Project Team

We did the mechanical, electrical, plumbing and the commissioning. We had a traditional structure for an engineering group. Internally we had a principal-in-charge and I was the project manager. I also had a focus on HVAC and sustainability. We had electrical, plumbing and HVAC engineers and a separate commissioning group within the firm. The commissioning group's role ramps up toward closure, to get the building up and running. It was a large team.

Setting Goals for the Project

It was simple: this is going to be Platinum,[2] that was goal one. Goal two was to preserve the historic nature of the building. The third goal was to make everything fit with new technology. The theater, in essence, was a box within a box and so the corridors around it became highways for mechanical, electrical and plumbing systems. It was a challenge.

We kept having LEED[3] charrette meetings to assess credit feasibility. The goal was to make sure we hit all the points because with platinum there are no "maybes." It's "yes" or it's "no" and it's only "no" because it doesn't fit the building and those credits drop off the table right away. The "maybes" have to, for the most part, get into the "yes," category. That process took quite awhile to resolve.

[1] The Brewery Blocks is a 5-block retail and office area located at the site of the Blitz-Weinhard Brewery within the Pearl District neighborhood in Portland, Oregon.
[2] LEED Platinum is the highest rating in the LEED Green Building Rating System.
[3] Leadership in Energy and Environmental Design is a designation from the United States Green Building Council (USGBC).

We were eco-charetting, then designing. The major goal was to get everything to fit. We cut sections everywhere and focused on the layers. Then everything was about aesthetics. It's a really fabulous building because everything is exposed. The placement of each element was really important and choreographed. There were a lot of meetings with the architect to organize it all.

Tracking Progress on the Project

The Platinum goal drove everything. I think that the main success was when we finally said, "Okay, Platinum is within reach here; we can get there." It was like climbing the mountain. Then it was a matter of finishing up the design elements and documentation.

The HVAC system used sidewall displacement and underfloor air distribution. Using stratification, because of the displacement systems, allowed the system to work really well due to the fact that we were focusing on the loads in the occupant zone and letting the return air stratify. It was an elegant and simple solution. We eliminated the need for a lot of returns. We have very large displacement diffusers in the lobby. Six hundred people can exit into the lobby and stand right next to the diffusers without feeling any air movement because of their low velocity.

It was a long design process, and an even longer construction period. The key was having a core team with the same goals. Having meetings on a regular basis to focus on the issues and to make sure things are getting done, was a key to our success.

An open dialog with the entire team was the first step. First it is the "what ifs," then figuring out what it looks like, what is the cost, and finally, back to the budget. As we got further into the project, we got to a point where everybody came to the consensus that this is what we have to do here! At that point we had explored everything and moved forward. Some elements were changed all the way into mid-CDs,[4] which caused the schedule to shift.

Selecting Technologies for the Project

Some of the technologies were straightforward and didn't change from the beginning, since we were really focusing on energy-efficiency. We looked at PVs[5] on an adjacent building since they couldn't be placed on the historic roof. We looked at other technologies as well, but none of them worked out. It just got too expensive. We had to steer our focus in other directions.

We shifted to the administrative[6] areas and how we could transform those spaces (and help with a few of the LEED credits). The major aesthetic issue was the exposed barrel vault. We solved this issue by utilizing raised access floor and chilled beams. Both technologies helped with the energy use because they are low-energy systems.
The chilled beams and the raised access floor were very successful. The staff really like that environment. Displacement ventilation and radiant floors were successful in the lobby. Fan-wall technology allowed us to reduce the size of the air handling units. We didn't have a sound trap in the entire building and that was with stringent noise criteria levels. The theater works fabulously with the under floor displacement ventilation.

There was also a focus on reducing water consumption in the building. The first step was installing low flow fixtures to reduce demand, and then collecting rainwater for storage and distribution to water closets and urinals.

Project Tax Credits and Incentives

There were tax credits and incentives, however, we weren't involved with that aspect of the project.

Lessons Learned

Many of these technologies are sound and we have carried them forward on other projects. We had been doing many access floors, so that one wasn't new, but the chilled beams were. This approach saves on fan energy because you do not

[4] Construction Documentation, a phase of the design and construction process.

[5] Photovoltaic panels which generate power from the sun.

[6] Administration or the office component of the program.

have to push large quantities of air around the building.

Rainwater harvesting, for reclaiming water, was appropriate and we continue to utilize this technology.

The process required more time for the charrette process and exploring ideas while you are designing the building. The complexities of the project and level of sustainability can take some effort.

As the construction was progressing, transition occurred to the commissioning. Commissioning involves a high level of intensity because when the project ends and contractors start to finish their tasks, the commissioning agents have the bulk of work to do.

In this case, the commissioning work was really pressured because of the move-in deadline. In addition to normal occupancy, the owner was getting ready for opening night performances. Dress rehearsals occurred with full audiences so we didn't have a lot of time to test the systems. We had to have chilled water and everything working for opening night. We would have liked to have had more time to tinker with the system. The last thing anyone wanted was to have a dress rehearsal for 600 people with the systems not working.

There are always issues with start ups, but we didn't have the luxury of having any leeway. You don't want to be the mechanical engineers on the first night and have it be too hot, especially when you're invited.

Hiring New Staff

We're looking for energetic people with sustainability as a focus. As engineers working on new technologies and higher-end sustainable projects, it is about designing around the table. You have to have people that can be thinking and making good decisions.

Closing thoughts

We need to do research on new technologies that are being developed and keep pushing the envelope. The best goal is to work with the architect early on to improve the facade. Then, try to reduce the internal loads, downsize the systems accordingly and use passive approaches when possible. It's definitely an interactive process that everybody buys into.

The vision was to make Portland Center Stage an inviting place that gives a sense of community. People could come and learn about what is happening in the neighborhood and in the theater. The project succeeded and transformed a historical building into a sustainable showcase while meeting the needs of the community.

This narrative, part of a larger case study describing the The Gerding Theater, was supported by a 2007 AIA Upjohn Research Initiative Grant.

This narrative is based on an interview with engineer Bob Schroeder at the Glumac office in San Francisco, California on March 4, 2009. University of Oregon graduate student, Britni Jessup, transcribed a digital audio recording of the interview. The interview was conducted by Nicholas B. Rajkovich of Pacific Gas & Electric (PG&E).

Exhibit: Gerding Theater

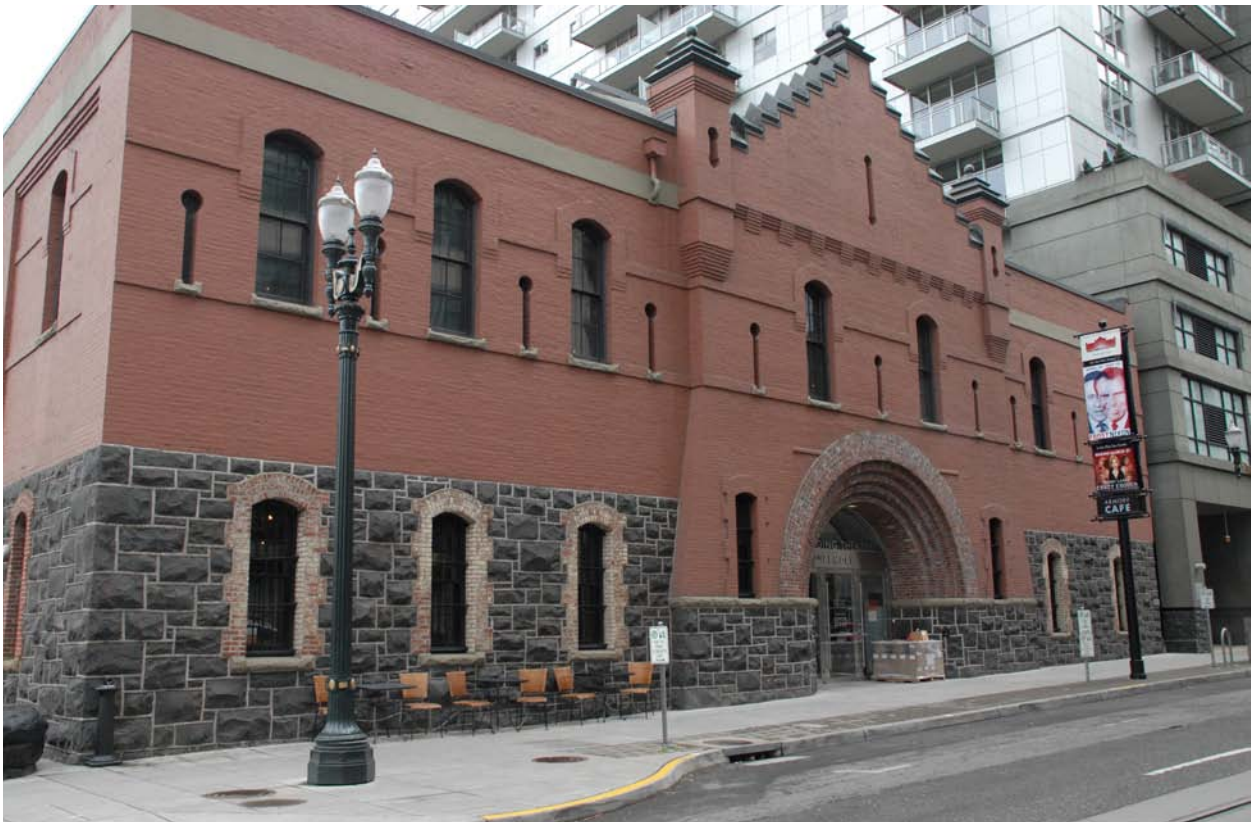

Fig. 1. The exterior of Gerding Theater on NW 12th Ave. in Portland, OR

Fig. 2. The exterior of the Gerding Theater on NW Couch St.. in Portland, OR

This exhibit, part of a larger case study describing the Gerding Theater, was supported by a 2007 AIA Upjohn Research Initiative Grant. University of Oregon Professor Alison G. Kwok and Britni Jessup with Nicholas B. Rajkovich, Pacific Gas and Electric Company (PG&E), prepared the associated narrative.

Fig. 3. Vera Katz Park on NW Couch St. next to Gerding Theater

Fig. 4. Vera Katz Park stormwater collection system

Fig. 5. Vera Katz Park on NW Couch Street

Fig. 6. Vera Katz Park stormwater retention system

Fig. 7. Vera Katz Park

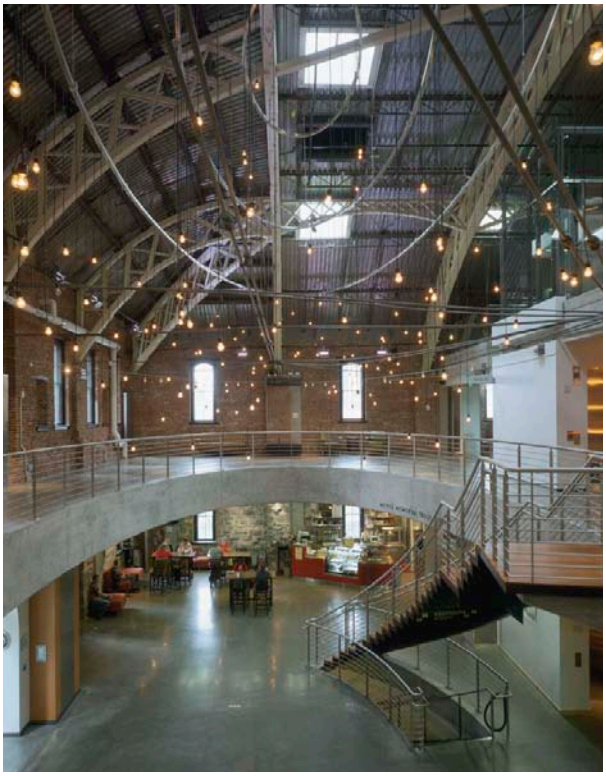

Fig. 8. Gerding Theater lobby from the mezzanine

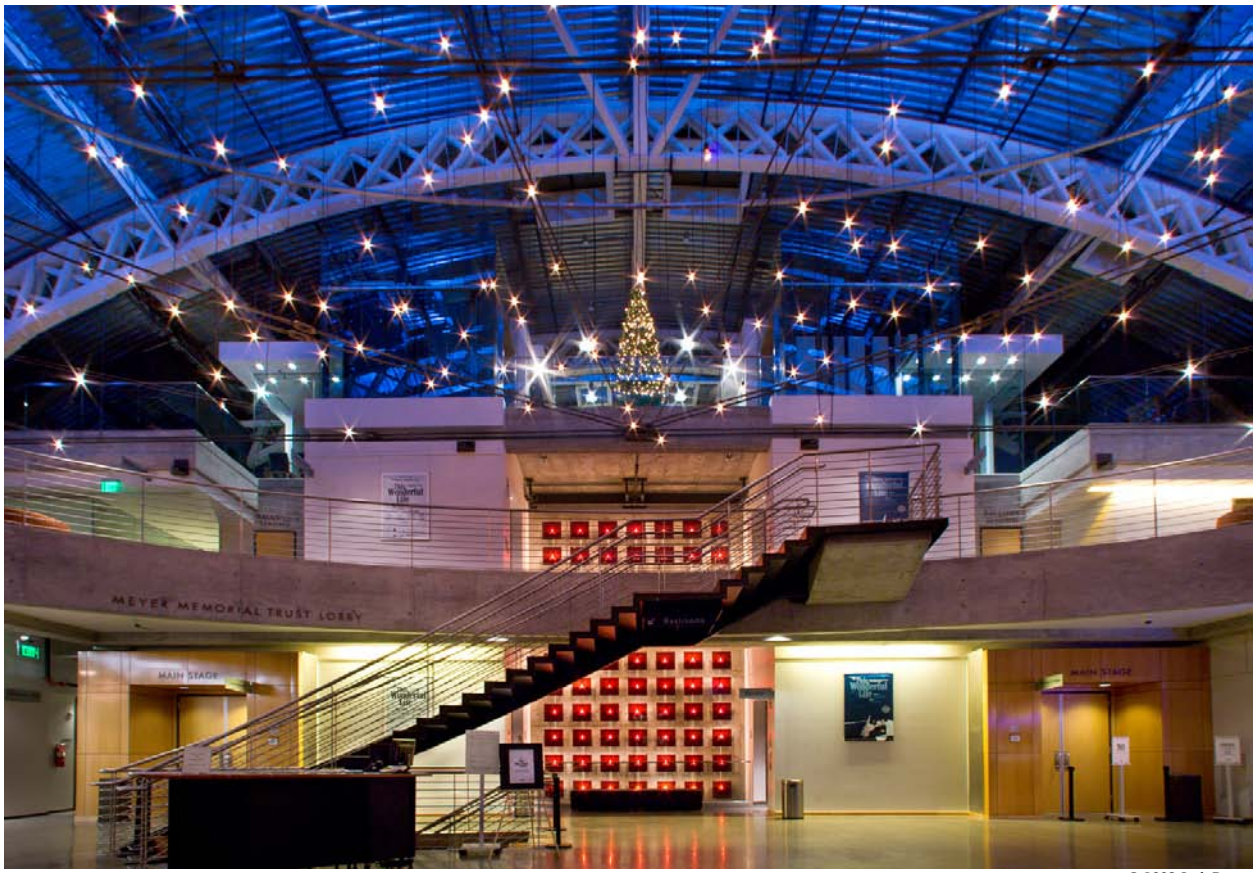

Fig. 9. Gerding Theater lobby

Fig. 10. Main Stage

Fig. 11. Main Theater

Fig. 12. Studio Theater

Fig. 13. Visible mechanical system “highway”

Fig. 14. Mechanical system

Fig. 15. Visible systems travelling through the back of the house

2009-003-01
JUNE 01, 2009

ALISON G. KWOK
BRITNI L. JESSUP
NICHOLAS B. RAJKOVICH

Orinda City Hall Case Study

Project Description

"Orinda's new City Hall showcases the City's commitment to civic buildings that strengthen the community fabric, protect the environment and provides a much-needed home for City staff. The covered outdoor lobby brings nature into the heart of the building, providing significant community gathering space and linking residential areas above the site to the village and civic buildings below. The building balances daylighting with heat gain, integrates natural and mechanical ventilation, makes the most of ground-coupled thermal mass, combines good shading with a high performance building envelope, and provides a high measure of occupant control."[1]

Architect:	Siegel & Strain Architects, Emeryville, CA
Energy Engineer:	High Sun Engineering, Guerneville, CA
Structural Engineer:	Tipping Mar + Associates, Berkeley, CA;
Civil Engineer	BKF Engineers, Walnut Creek, CA
M&P Engineer:	Taylor Engineering, Alameda, CA;
Elec. Engineer	After Image + Space, Oakland, CA
General Contractor:	Richard Larsen & Sons, San Mateo, CA
Landscape Architect:	Merrill Morris Partners, San Francisco, CA
Acoustic:	Wilson, Ihrig & Associates, Oakland, CA
Lighting:	After Image + Space, Oakland, CA

Project Awards

- 2009 LEED NC v2.1 Gold, U.S. Green Building Council
- 2008 Honor Award, AIA San Francisco, Energy and Sustainability Awards
- 2007 Energy Star Challenge Award from the Environmental Protection Agency

Project Data

Completion: June 2007
Cost: 7,900,000 U.S. Dollars (2007)
Area: 13,900 ft²

Location

City: Orinda, CA
Latitude: 37.52 North
Longitude: 122.11 West

Climate[2]

HDD65: 3278
CDD50: 1196
Annual Precipitation: 25.4"
Solar Radiation: 608.2 kBtu/sf/year

Energy Metrics

Energy Code: California Title 24
Predicted % Below Code: ~72%
Modeled EUI: 59.6 kBtu/sf/year[3]

[1] From the Siegel & Strain website at www.siegelstrain.com
[2] From the National Oceanic and Atmospheric Administration website at www.noaa.gov
[3] EUI: Energy Utilization Intensity estimate for onsite usage. Paliaga, Gwelen, *Orinda New City Offices: Energy Analysis Report, Savings by Design Report, LEED Application Documentation*." July 11, 2006, 27.

University of Oregon Professor Alison G. Kwok, graduate student Britni L. Jessup, and Nicholas B. Rajkovich of Pacific Gas and Electric Company (PG&E) prepared this narrative.

- 2007 Excellence in Structural Engineering Award, Structural Engineers Associations of California
- 2006 Design Excellence Award, National Council of Structural Engineers Associations
- 2006 Excellence in Structural Engineering Award, "Best Use of New Technology in New Construction," Structural Engineers Association of Northern California

2009-003-02
JUNE 01, 2009

ALISON G. KWOK
BRITNI L. JESSUP
NICHOLAS B. RAJKOVICH

Orinda City Hall: Architects Henry Siegel and Burton Peek Edwards

Getting the Project

It was a public RFP process. The City of Orinda asked for LEED Silver[1] as part of the RFP. There was a short list of five; I don't remember everybody that was on that short list. It came down to us and Leddy, Maytum Stacy Architects[2]. The real surprise about getting this project was that we had never designed an office building before, so we had to convince the client that we were capable of doing that.

Selecting the Project Team

We have a usual group of consultants that we work with on green projects, and we basically went straight to them. It wasn't hard, we had our first choices as to who we wanted to work with and they were all interested in it.

It was a debate for us on the mechanical side to use Rumsey[3] or Taylor Engineering. We ended up with Taylor Engineering[4] just because they had so much office experience. More than Peter,[5] who's got more diverse experience, and is maybe a little more experimental than Taylor Engineering is at times.

With all that office experience, we felt like we needed to use Taylor Engineering because we didn't have the office experience. It's just sort of the politics of how you go after a project. And Tipping Mar,[6] the structural engineers, they're just great engineers. After we got the job, we asked Gail Brager who teaches Building Science classes in the architecture program at UC Berkeley if her students would like to take on Orinda as a class project. She also lives in Orinda, so there was an interest in her home town.

Henry Siegel, FAIA, LEED AP is one of the founding partners of Siegel & Strain Architects. Since the early 1990s, Siegel & Strain Architects has won over forty local, state, and national awards for design excellence, sustainability, historic preservation, and research.

Burton Peek Edwards, AIA, LEED AP has been with Siegel & Strain since 2000 and has 28 years of experience in architecture, historic preservation, and project management. Burton was the project manager for Orinda City Hall.

[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. LEED Silver is the third highest rating in the System.
[2] Leddy, Maytum, Stacy Architects in San Francisco, California.
[3] Rumsey Engineers in Oakland, California.
[4] Taylor Engineering in Alameda, California.
[5] Peter Rumsey of Rumsey Engineers in Oakland, California.
[6] Tipping Mar + Associates are a structural engineering firm in Berkeley, California.

She was actually on the selection committee and was pretty adamant that there be someone with solid green background as the final candidate for the project.

We actually went out and added to our team a couple of guys who had their own firm and who used to share space with us. They did nothing but T.I.[7] work. They helped us in the initial programming and the interior office programming.

One of the biggest issues for the project was siting of the new building. We had probably three meetings on how you access parking on this site. We tried lots of different schemes, and we would go to these meetings with lots of alternatives to show. The City had a design review group made up of city council people, planning commissioners, and a couple of local residents who were architects. We'd go to these meetings and make sure we were so well-prepared that when somebody would say, "Well, did you think of doing it this way?" We'd pull out the next board that showed it "that way." There would be a line of ten boards behind our presentation with every option.

Political and financial decisions were a constant throughout the process, even down to losing features like the solar panels. There was a lot of client turnover during the course of the project, we had three mayors, three city managers, and four project managers. The city manager who first hired us, along with his assistant, were both strong supporters of the environmental goals. They left. There was in an interim city manager and project manager who just wanted to get the project done and at the lowest cost. Then, there was the new City Manager who was actually going to occupy the bulding but who hadn't participated in any of the design process discussions and so didn't necessarily understand the reasons for earlier decisions. She ultimately became a strong supporter of the project.

[7] TI is an acronym for "tenant improvement."

Setting Goals for the Project

We did not set specific energy goals in terms of percentages. The City had set a soft goal of LEED Certification or Silver. We thought that was a pretty low bar. We wanted to see how far above that we could take it. We thought it was unlikely that we could get to LEED Platinum,[8] but given the budget and the constraints we might be able to get to LEED Gold.[9] We expect it will, though it's not quite done yet.

There were so many other issues, particularly site-related issues. We knew we had to solve those first to make the building function. The steepness of the site and then narrowness of the actual building, it was very limiting. The building had to be a long rectangle. But when we broke it in two, we found we could improve it vastly.

We went back and forth with Gwelen[10] over the sun shades and light shelves. We also went back and forth on the amount of glass, where we were going to put trees, and the height of the building. We worked on tiny incremental changes from beginning to end.

Tracking Progress on the Project

We started out asking, "Can we only naturally ventilate this building?" Could we actually get away with something like that? We initially proposed ventilation towers and all those sorts of strategies. Basically the conclusion we reached pretty early on was, no, we can't do that. It's a little too hot here and we need air conditioning in some form. So the fall back position was if we can't eliminate air conditioning, can we do non-compressor cooling? We thought we might be able to. When we did our first iteration using evaporative cooling, we were aghast because the size of the cooler that Taylor came up with was

[8] LEED Platinum is the highest rating in the LEED Green Building Rating System.
[9] LEED Gold is the second highest rating in the LEED Green Building Rating System.
[10] Gwelen Paliaga of Taylor Engineering in Alameda, California.

gigantic. It was like a railroad car parked next to the building.

That's when we started to work really hard on the sun shading, and the orientation, and the glazing. We tweaked everything we could.

The evaporative cooling units are all custom made by three or four companies. They're not very widely available for the size needed for Orinda. They are sized by the companies in a very constrained way. By continuing to work on the envelope and shading we were able to down-size the final unit.

We re-designed the equipment yard more than any other portion of the building. The physical space available on this narrow strip of site was so limited. It's outside, and it's on the worst real estate. It's a slide zone, so we had to make it smaller and smaller and smaller to try to make it fit.

Methods and Tools Used on the Project

Most of the computer modeling was by Taylor Engineering and we didn't really have the budget to do extensive computer daylighting models. We did most of the daylight analysis on the heliodon at the Pacific Energy Center[11] with Bill Burke's[12] help.

When we did our initial presentation to the City Manager it was August. The city offices were located in temporary trailers on a hill. The project manager was from the East Coast. He had his tweed wool jacket on and he walked into the room and took off his jacket. We said, "That's it, that's exactly what you are going to have to do to make this building work." You are going to have to be flexible and understand that there will be a few hot days. In the extreme there may be four afternoons a year where it's so uncomfortable you can't work, but the rest of the hot months, you wear short-sleeved shirts, you don't wear a jacket. He got it, right then and there. He said, "Let's go ahead with the evaporative cooling."

By the time the building was under construction there was a new police chief, and despite the fact that Orinda has a very low crime rate, the officers now wear bullet-proof vests—all the time. They have complained about their section of the building being too warm

The chief we worked with during the design process didn't require this. He was more concerned about the evidence lockers and the closed circuit TV.

Selecting Technologies for the Project

It's common sense. We started intuitively, and then we modeled it, and then we used the computer models to tweak it. The computer models were used to refine, to test rather than design.

By the time we got to computer models, it was the kind of thing where Gwelen would call up and say, "This one window is really hurting us, can you do something about it?" And we would do something about it.

It started with intuition. Since we have been doing design with climate for a long time, we know the effects that shape and shading will have. We started with intuition and then worked back and forth with the computer model and the daylighting model to refine it.

Our first pass at the models said that we were going to beat Title 24[13] by 75 percent. We were

[11] The Pacific Gas and Electric Company Pacific Energy Center (PEC) offers educational programs, design tools, advice, and support to create energy efficient buildings and comfortable indoor environments. The PEC is funded by California rate payers under the auspices of the California Public Utilities Commission.

[12] Bill Burke is a Senior Program Engineer at the Pacific Gas and Electric Company Pacific Energy Center in San Francisco, California.

[13] California Title 24 is the applicable building energy code for this project.

really excited about that. We ended up at seventy-two percent after later corrections were done.

There was a moment of amazement at the Pacific Energy Center when we were looking at the daylighting. The scheme for the sloped ceiling, the skylights on the back side, it actually worked! We went into the PEC, and in this controlled situation we're twisting it around and we could actually see the light bounce off of the model ceiling and light up the very back of that space. We all thought, "Wow!"

We just thought that the skylights in back were a good idea even though we had not tested that in any other project. It really did provide light. The main thing was that this light creeated a balanced light over the entire space. There were no really uncomfortable glare spots, and that's pretty evident when you walk through the building today. When you go into some of those back conference rooms set against the retaining wall it looks like the lights are on, but they're not on. It makes a big difference.

Project Tax Credits and Incentives

We used "Savings By Design."[14] The city ended up getting a big check back, and we got a smaller check back that really just covered Taylor's time. It wasn't that much effort for them to actually do the application. But, it didn't end up being much of an incentive for the design team.

Managing the Project

There was lots of back and forth with Taylor Engineering. We were both learning from it, we were both contributing to the process, and we listened to each other really well. So, when Gwelen said, "You know, can you take out this window? We looked at and we said, "Yeah, we can take out that window."

In designing the sun shades, we would be able to say, "OK, this is what we think it might be, and this is the material we might want to use." Gwelen would stick that information in the computer and figure out that the spaces between the shading devices are too far apart, that you need more of them, that they can't be that tall. We went back and forth and it was a very open and cooperative arrangement. We never felt that he was telling us, you have to do this.

The main discussion with the client was to explain the comfort model analysis and that they will have 12 hours a year where it might be uncomfortable in this building. They accepted this, though the people who accepted it are no longer working there.

There were also certain issues that were important to the neighboring church – they sold the property to the City with conditions. They insisted that there be no front door to the building -- that the façade facing the street was no more important as an entry than the façade facing the opposite way, towards the church and downtown. They really wanted people to enter the building by walking between their two church buildings and coming up to the site from below.

Lessons Learned

The special challenge for this project was the site, it was highly constricted. Both where the building could go in plan and just how steep the site is in section. We ran into big soils problems because there is an area of fill and a seasonal creek just north of the building.

We had a meeting late in the design process where we got the project manager for the city, the structural engineer, and the geo-tech together in a room. They were able to collaborate and talk about the soils rather than have the structural engineer just react to them. Together they redesigned the foundation system for one end of the building.

That meeting produced a redesign that probably saved several hundred thousand dollars because

[14] "Savings By Design" is a new construction incentive program offered in the State of California.

they were able to lighten up the foundation. That was a really nice piece of collaborative teamwork.

The other challenge really had to do withkeeping the LEED pocess in the project. Their original RFQ statement they had said that it was going to be LEED silver. Since the construction manager did not support LEED we had to ask the City at a certain point, "OK, you had originally said minimum LEED silver, we need you to confirm that." They wanted to do the right things, most of the council people wanted it to be a green building, they wanted it to be an example.

There was a combination of issues about materials because they wanted the exterior to be pretty durable. So what is now tile on the building, was once wood. Nobody wanted to maintain wood. There was lots of discussion about what the building looked like, trying to make it a civic presence, but also pushing to keep it more modern. The City has this notion of "village character" and we wanted to honor that. We wanted to provide village character, but we didn't want to make it a corny nostalgic building to give them village character. So we kept it as a more modern building that reflected the scale of that community and the materials of that community.

The other take-away part was how well we did on energy points and the mixed-mode nature of the building. It's a social experiment to have people open the windows, and we're curious to see how that's going to work. It's not a take-away yet.

It may never be a take-away, but hopefully, this is really going to work. Are people going to use it in the way it's intended? We were able to get so far with the mixed-mode aspects of the building, convincing the users that they were going to have to interact with the building more. There may be a few days where the building was going to be uncomfortable, and having them understand that and accept it was pretty great.

It really does start off with intuition and a very careful inspection of site conditions. We see how we can respond to that and then try to incorporate our design aesthetics which are quite a modernist approach. If we presented a fake adobe that would have been pretty popular. The curved roof—we looked at a variety of forms and we thought it was a good design move because this roof was going to be very visible from above. There's no equipment on the roof, so it is very important how it looked. There was a newspaper article in the local paper that praised our response to the rolling hills of Orinda in the roof form.

It's more of a validation of just how we approach things in general, which is we start with how do we make the building work the best it can without any systems, or how do we minimize systems, and how do we do that just by designing the envelope, how you lay out the building, the orientation, and the section and see how far we can get with it?

We got pretty far on this particular project, given the constraints that we had. It would have been nice to have kept our PVs[15] which would have pushed our net energy down even further. But the nice thing about not having the PV's is that the solution doesn't depend on a particular technical solution.

Hiring New Staff

We have to be flexible about who we hire. We want people who are somewhat knowledgeable and passionate about green. They can't just be somebody who is green but doesn't have very good design skills because that doesn't work. And, they can't be somebody who only cares about being the star designer and cares nothing about green, that doesn't work. We look for people who are really well-rounded, that's important to us. They need to be willing to do a little bit of everything. We're a small enough office where everybody does everything. That also reflects the principals who are all generalists, in some sense.

[15] Photovoltaics (or PVs) are a technology that converts solar energy into electricity.

Closing Thoughts

All of these principles need to get integrated into studios. That's the shortest way of putting it. It can't just be siloed into building science courses and not spread out. It really is a design agenda, it's not purely a science agenda.

It's really about expanding the definition of what good design is. It can't just be about making things pretty. Buildings have to be beautiful, and the have to perform well, and architects have to learn how to be comfortable talking about BTUs and lumens. That has to be integrated into the design process, it's left brain and right brain, you have to be able to do both. Architects have to honor both.

Next year's AIA[16] honor awards will have 2030 metrics that everyone will have to fill out. It is one of the things that COTE[17] has been working on this year, so we're hoping to keep pushing that and get it into all the AIA awards programs around the country. AIA is also putting up a new requirement where sustainability is part of the annual CEU[18] requirement, parallel to health, safety and welfare.

This narrative, part of a larger case study describing the Orinda City Hall, was supported by a 2007 AIA Upjohn Research Initiative Grant.

This narrative is based on an interview with architects Henry Siegel and Burton Peek Edwards on March 24, 2008 at the office of Siegel & Strain Architects in Emeryville, California. University of Oregon graduate student, Britni Jessup, transcribed a digital audio recording of the interview. The interview was conducted by University of Oregon Professor Alison G. Kwok and Nicholas B. Rajkovich of Pacific Gas and Electric Company (PG&E).

[16] AIA is an acronym for American Institute of Architects.
[17] COTE is an acronym for the AIA Committee on the Environment.
[18] CEU is an acronym for Continuing Education Unit.

2009-003-03
JUNE 01, 2009

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Orinda City Hall Narrative: Engineer Gwelen Paliaga

Getting the Project

Gwelen Paliaga is a senior mechanical designer with Taylor Engineering, specializing in low energy buildings and HVAC systems. He was involved in the design of Orinda City Hall and Chartwell School (see narrative 2009-001-03). He has worked on various projects with a focus in passive systems and occupant comfort.

Gwelen Paliaga: The project came to the firm right before I got involved. When I came to Taylor the project was still in the schematic design phase. I would say that our involvement at that point was much higher than usual on most projects, and the best early collaborative design that I've seen on green projects. It was partly because Siegel and Strain had taken a stance from the very beginning that this building would be naturally ventilated, at least to some extent, and had done their initial site plan, massing, and programming studies to accommodate that. Right when I got involved we were working with them on designing, developing, and testing the natural ventilation. Because of our connections to UC Berkeley, what they teach there, and I had graduated, we got involved with Gail Brager's[1] natural ventilation class. They did some wind-tunnel modeling and our role, as mechanical engineers at that point, was to facilitate. We took a lot of the natural ventilation modeling that the students were doing and the interpretation of it, to give some more detailed guidance to Siegel and Strain for window openings and massing.

The initial moves for the form of the building and the orientation had been pretty well decided when we came on board or, at least, when we got more involved. They had made all the right decisions. This was partly based on their experience and knowledge and some fortunate things about the site. There's a side of the building with orientation that was west-facing that allowed for natural ventilation. They knew all of the rules of thumb; the things you should do, they've done. There wasn't a lot of need for us to push the building in a different direction. The wind tunnel analysis was more of a refinement rather than a discovery that it doesn't work. A lot of projects modeled in a wind tunnel are part of an initial schematic design analysis and is a part of the process of educating the architect and illustrating that the scheme actually doesn't work physically in terms of heat flows, for example.

[1] Gail S. Brager, Ph.D., is Professor of Architecture at UC Berkeley.

Setting Goals for the Project

The primary goal was to be a LEED[2] project and to get as many energy points as was reasonable in comparison to the other points. That drove us through the process. There was a LEED target of either silver or gold but no specific number of points. We actually came in and added to the goal setting. We had been asked by Siegel and Strain to have a very energy efficient building and to do some natural ventilation. We'd also been asked if we could do the building without compressors and without refrigerated cooling. That is not only an energy efficiency measure, but it also has the other green, environmental benefits of not having refrigerants. It became a demonstration that this is possible; you can have an office in a hot climate, or a medium to hot climate, without a compressor. Those were all challenges that related to the energy goals that they gave to us: natural ventilation or mixed- mode, no compressors and energy efficient.

What we brought, in terms of the goals, was that I had just finished graduate school with a focus on mixed-mode buildings and natural ventilation. This project was the perfect case study. We said that we wanted to take this as far as we could and make a mixed-mode building that really worked and really saved a lot of energy. We discovered, in the process, that we could potentially get ten LEED points and be more efficient than code, but that wasn't necessarily the goal right off. The goal was to demonstrate these technologies or see if we could make everything integrate together in terms of natural ventilation, evaporative cooling, and so forth.

Some projects have really clear goals. Usually we just try to meet them. In this case, the goal emerged as we went through the design process.

[2] 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.

Tracking Progress on the Project

I think about the project in three separate pieces: one was the mixed-mode building, the second is evaporative cooling without compressors, and the third was being very energy efficient. In terms of the energy efficiency, tracking was done with simulations and energy models. We used eQUEST[3] as our DOE-2[4] modeler and to get feedback on how much we were beating code by, how many LEED points we were going to get, and to keep track of the potential for utility rebates from PG&E[5] and Savings by Design. [6] The owners were going to get money and the design team was going to get an incentive; that's the energy piece.

The most interesting part was the indirect-direct evaporative cooling. The challenge was to have no compressors on the project. That's something that was actually tracked through the entire design process. We had been asked to do that, but it was very challenging and required that the loads in the building be incredibly well-controlled. From the point of view of the envelope, the internal loads, and all aspects of programming, we just couldn't get cold enough air off an indirect-direct evaporative cooler so we needed larger air quantities, which meant larger ducts. There's a trade off.

In early design development, we were doing simulations and load analysis to measure the feasibility of evaporative cooling and we came up with some break points that we needed the loads to be below to eliminate the compressor all together. Throughout the design process we kept a back-up compressorized cooling system in the design, since we had a space for it. For each major design change we'd look at it and evaluate how it fed back into the design, like the glazing or the

[3] eQUEST is a form of DOE-2 software used for energy analysis.
[4] DOE-2 is a modeling form of software used in energy modeling.
[5] PG&E is Pacific Gas and Electric Company, based in San Francisco, is one of the largest combination natural gas and electric utilities in the United States.
[6] "Savings By Design" is a new construction incentive program offered in the State of California.

shading design. We can determine how each affected the loads. Because it had a western orientation we had a problem controlling solar heat gains on the west side. That was really the driver in the end for pushing Siegel and Strain to decrease the loads on the west façade so that we could meet our goal for evaporative cooling. They looked at re-sizing the windows, lower transmission glass, or relocating windows so the way that they were oriented wasn't as problematic. We worked very closely together to develop external shading. The cooling system we ended up with is an indirect-direct evaporative cooler.

Our standard tool we use for load calculations is the Trace 700[7] software that is made by Trane Company. It is used by a large portion of the engineers in the commercial industry. We used that in a somewhat unconventional way to complete the feedback loop and to make the loads low enough so that we could do evaporative cooling. We actually weren't using eQUEST for that because there's a difference between the annual energy prediction and the peak load prediction, so for peak loads we used Trace. To make evaporative cooling work we had to allow warmer temperatures at peak conditions in the space but we wanted to maintain comfort. We actually have a fairly creative comfort system that uses air movement for additional cooling during peak conditions.

For the comfort analysis we used the ASHRAE[8] comfort software and some of our own spreadsheet analyses. One of the things that we had to do that was fairly unique was to figure out how ceiling fans work and how the air movement works. We were trying to predict what kind of air movement the fans produce so that we could fold effective air movement back into the comfort analysis. There is no standard test or literature on the air movement that is created from a ceiling fan in an occupied zone. We had to do some research into some of the fundamental studies that Florida Solar Energy Center[9] did and then do some of our own hand calculations to come up with predictions. We came up with a rule that you could only get effective air movement two blade diameters away from the center of the fan. If it is a 60" fan you would get about a 120" diameter circle where there was enough air movement. We came up with 100 feet per minute as a target air speed, which was based on how much cooling effect we wanted. This would allow the temperature in the space to rise. What we ended up doing was creating a dimension that Siegel and Strain could use for laying out ceiling fans. In private offices they could put just one fan, but there are a lot of open plan spaces. They put the fans two blade-width diameters apart, which is a high density of ceiling fans, compared to how you would normally lay out fans. Normally, you would just throw in a couple per room. We ended up using twice as many as you would expect. We also did an unusual amount of comfort analysis.

As far as educating the public about the building, we have a sign that illuminates when the windows should be opened for natural ventilation. It has a green background that gets brighter green when it turns on, like an exit sign. Based on my experience in adaptive comfort, doing research, and working with Gail Brager, I told Siegel and Strain repeatedly that this building was not going to work and might actually be a problem building compared to a conventional building if we didn't make it very clear what was happening to the occupants. I recommended putting in some systems to educate the occupants. They wanted to do that, too. The primary way of doing that is with the lights.

The other major thing was to realize that a huge challenge in mixed-mode buildings is switching over, especially from air conditioning to natural

[7] Trace 700 is a load analysis software produced for professionals in the Heating, Ventilation and Air Conditioning (HVAC) industry by Trane Commercial Services and is an accepted method used in LEED documentation.

[8] American Society of Heating, Refrigerating and Air-Conditioning Engineers.

[9] FSEC based in Cocoa, Florida was created by Florida legislature in 1975 for testing and analysis of solar energy systems as well as the development of educational programs.

ventilation. Most people, if they are in an air-conditioned building and temperatures are controlled, they just stop engaging and are not operating the building in a way that is maintaining their comfort; they just let the building do its job. When you switch over you need people to start using their windows. We were worried about that, and that's the reason for putting in the indicator lights. We also decided that we could turn off the air conditioning system when we were in natural ventilation mode if we put the lights in. It was kind of a subtle issue.

Code in California requires that you ventilate spaces with outdoor air if they are farther than 20 feet from the perimeter. Most of the spaces in the building are 20 feet from the perimeter, so we didn't have to provide outside air. In an air-conditioned building, since the windows are not operable, most people do not expect outside air to not be coming in through the windows. In air-conditioning mode we are bringing in fresh air for ventilation. When a building goes into natural ventilation mode, what most mixed-mode buildings do is reduce the air flows to minimum ventilation, but they keep the system on. The thinking is that we want to make sure that we bring fresh air because people might not open their window and, because it's a mixed-mode building we weren't sure what people would do. We felt that if we put the natural ventilation light in we'd have a way of telling people, "Hey, we're in natural ventilation mode. You're not going to get outside air ventilation or fresh air unless you open your window." In all of the perimeter zones, which is most of the building, we completely turn off the air flow when we are in natural ventilation mode. That way we are saving more energy. We put a bunch of work into writing the design intent that went into our design documents.

Siegel and Strain did a section through the building that shows the energy strategies. We wrote the text that describes how the system and natural ventilation work, and we try to be very clear and, in as few words as possible, say that you need to use your windows for fresh air when the lights are turned on. We also describe that when the light is on a lot of energy can be saved by opening windows, opening internal doors, and making sure that they get cross-ventilation. The way we end up operating the system is if any zone actually gets too hot, even if it's in natural ventilation mode, the system will turn on and provide air to that zone. We turn on the light to say, "There are good conditions outside, open your windows and naturally ventilate your space." If either the loads are too high and the space gets too hot, or people fail to do that, the system will come on and start to cool. It gets incredibly complicated.

I have to say, it's a real challenge to come up with control sequences and the intersection between the control sequences, the HVAC system, and the way to communicate with occupants. We have some expertise in natural ventilation and mixed-mode and we've done some mixed-mode buildings in the past. Our firm does a lot of control work and we wrote the ASHRAE control handbook. We found that just to get the programming to turn things on and off, to get the sequence of operations correct, was really challenging. It still presents problems. It made us realize that most of the mixed-mode buildings that are out there are not really what they are chalked up to be because there's no way that they're operating in a way that saves energy. What we realized is that almost all of them are air-conditioned buildings that happen to have operable windows, because it's really hard to have this mechanized system with all these controls that somehow turns off or switches off. How does it turn back on? When does it know to turn back on?

We have some anecdotal feedback and it's been varied. A number of people have said it's a fantastic space. There's a lot of love for the daylight and there's an appreciation for having operable windows within their control. We had some feedback that the wind coming through the windows and blowing papers and the blinds around is a challenge. We also had a lot of challenges and some negative feedback from the police department because their clothing levels and their metabolic rates are high. They also

apparently had some equipment react with the humidity of the evaporative cooling system. This is one of those things where no one ever told the design team that the police would be wearing their flack jackets[10] all the time, so the space needed to be 60 degrees all the time. They wear the jackets that so they can be ready rush out and go immediately to an event. So the space was modeled as an office space instead of a super-cool space.

Project Tax Credits and Incentives

For Taylor Engineering, when we do a Savings by Design project, which is often, we do all of the analysis ourselves and then submit the report with the rebate application at the end. For this project we did a life-cycle cost analysis of different system operations early in the design development[11] phase and then we did the simulations and report for Savings by Design at the end. If you include a life-cycle cost analysis it's on a certain track for Savings by Design and that resulted in a rebate to the owner of about $60,000 and a design team incentive of around $25,000. That was outside funding that came through the utility rebates. It certainly made us more willing to invest more time for energy modeling because we expected to get some money back. It turns out we spent something like $15,000 or $20,000 worth of our time in simulation and modeling because it was a real challenging project. The design team rebate helped pay for that because we did it on our own time.

The other outside assistance we got was Gail Brager's natural ventilation class. They put in hundreds of hours that were focused on the project.

Tracking Progress on the Project

We did take a role that was more pro-active especially with the massing, the fenestration and the shading. We had decided, or everyone had wanted, to use evaporative cooling and we knew what it would take. Siegel and Strain was in a response mode where they would ask, "What about this?" and we would come back with comments saying," No, you need to do better," or, "Maybe this change or that change." We actually were, in some ways, the lead on some aspects of the façade, in terms of having some input. For example, the placement of the interior partitions blocked air flow and affected the detailing of some of the private offices. They wanted acoustic privacy and, in the end, we worked out a situation where the top ten inches of the wall is cut away so that it is always open to air flow. We were the advocates of that.

The architects had to think about more issues and other parts of the design and were often distracted by those things. We always stayed focused on making sure there was air flow through the building and that loads were low enough. We also interacted with the client on comfort and evaporative cooling. We never want to force something that's innovative, risky, or challenging on the client. We were clear that this was going to be a system that didn't operate conventionally and air temperatures would vary more. We let them know that there are going to be times of the year that they would absolutely have to use ceiling fans to stay comfortable and it still might be warm for a certain number of hours per year. We actually put together our comfort analysis and went to the City Manager[12] with Henry[13] and Burton[14] for an important decision-making meeting where we told them very clearly what the risks were, how the temperatures would vary, and what it meant to go forward with this. Then we also told them what the benefits would be and made sure that that direction was the way the City wanted to go.

[10] A flack jacket is similar to a bullet-proof vest and provides protection for the police officers and is worn under their police uniforms.

[11] Design Development, or DD, is a phase in the design and construction delivery process.

[12] The City Manger of Orinda, CA.

[13] Henry Siegel of Siegel and Strain Architects.

[14] Burton Peek Edwards of Siegel and Strain Architects.

There was one very important meeting with the City that we were involved with. I know that Siegel and Strain had many, many, many meetings with the City and they went over these same subjects with them. We were only involved in one really important meeting on developing the architecture of the building.

There were hundreds of meetings and lots of times where I went to Siegel and Strain's office. Shading was one particular topic that comes up repeatedly on every project, despite the fact that architecture students study sun paths and shading masks in school. Some of them really believe in it and want to do it in practice, but they don't do it enough and aren't up to speed on the geometries to make shading devices work from the point of view of energy and comfort that I am coming from. This was a classic example where Siegel and Strain had great intentions and was working hard to develop the shading, but it didn't work from my point of view. We had to step in and help do the analysis, go through the iterative process, and provide sun path diagrams and sun shading masks. We helped them start by making a egg crate overhang so that the sun doesn't come through it at peak or at the wrong times. It is actually porous at some times of the day. They had the aesthetic input on the way that these were arranged and what materials were used. We contributed the geometry and the shading mask analysis. We worked together.

Lessons Learned

We definitely learned a lot on this project. We realized that we can't do buildings this innovative on a conventional budget. We lost a lot of money. By the time we were into it, we obviously wanted to complete what we started, and turned a blind eye to the budget. It became more complex than we thought and took a lot of time. A lot of it was in the collaboration I was talking about.

We've changed the way we bid and talk to owners and architects about what it's going to take to do a super-innovative building, especially a small building like this. We also learned that, in terms of the police department, we should have received more user information and there should have been more user discussions.

The controls have been a real challenge on this project and it's one of the reasons it's not closed. Because we have a really complex sequence of operations for everything to work, in the future, we will take a more proactive role in the controls. We need a certain type of controls contractor and a certain type of process to get to a functioning building. This project was difficult terms of getting the programming and the controls squared away.

Hiring New Staff

Since I've been here most of the people that we've hired have some unique skill or experience. We hired Molly McGuire from MIT who had studied building technologies and done a lot of daylight modeling and daylight redirecting for her research. We hired Hwakong Cheng from the University of Colorado. He studied building technologies and had done a lot of simulation using thermal mass for night pre-cooling. We tap into those skills. We ask each other questions. Most days, we work on more conventional things that we do over and over again. Having the collective knowledge is part of the goal here. The way that Taylor Engineering works is that we're totally horizontal and everybody is their own project manager. Another thing that is required to participate here is to be capable of the whole design process and the whole role of an HVAC engineer, including doing the analysis, the CAD, and the drawings. Quite a few firms would probably be looking for specialists and people that can really do specialized analysis, but that's not what's happening here.

Closing Thoughts

It's great that these buildings are out there and being talked about. I've been doing this for a little over four years now, and started out pretty green, meaning inexperienced and got experience working on some of these exciting projects and also some conventional projects. Finally I'm getting to look back and see completed buildings

and tell these stories and it's exciting. All of these parts are part of closing the feedback loop and we're learning from them.

This narrative, part of a larger case study describing the Orinda City Hall, was supported by a 2007 AIA Upjohn Research Initiative Grant.

This narrative is based on an interview with designer Gwelen Paliaga over the phone on April 10, 2008. University of Oregon graduate student Britni Jessup transcribed a digital audio recording of the interview. The interview was conducted by University of Oregon Professor Alison G. Kwok and Nicholas B. Rajkovich, Pacific Gas and Electric Company (PG&E).

Exhibit: Orinda City Hall

Fig. 1. From below the outdoor lobby

Fig. 2. Sunshade detail

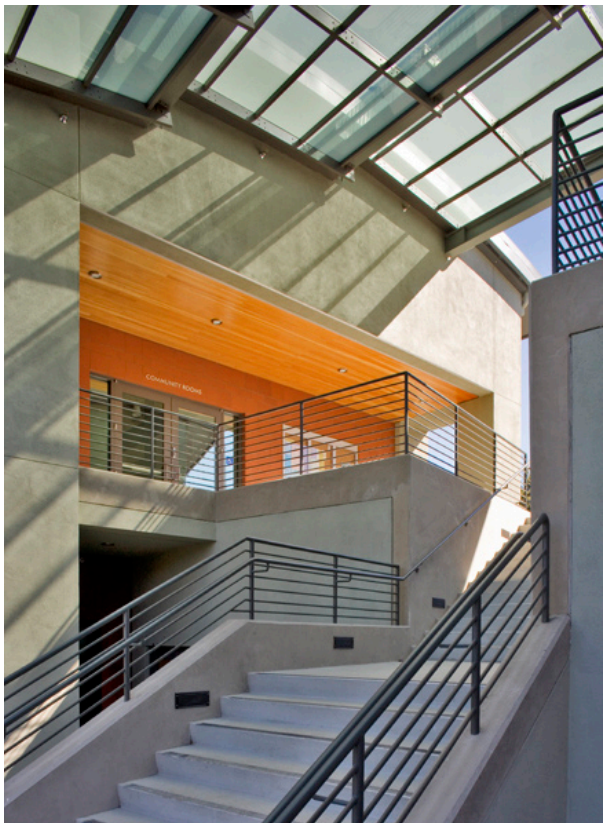

Fig. 3.The outdoor lobby

This exhibit, part of a larger case study describing the Orinda City Hall, was supported by a 2007 AIA Upjohn Research Initiative Grant. University of Oregon Professor Alison G. Kwok and Britni Jessup with Nicholas B. Rajkovich, Pacific Gas and Electric Company (PG&E), prepared the associated narrative.

Fig. 4. The outdoor lobby, community gathering space, and path to the village center below

Fig. 5. Street level

Fig. 6. Street level

Fig. 7. Detail of the outdoor lobby

Fig. 8. Material details of the facade

Fig. 9. Northeastern facade detail

Fig. 10. Outdoor lobby from the northern edge of the building

Fig. 11. Facade detail at street level

Fig. 12. Detail of the shading system

Fig. 13. Detail of the skylights to the lower level

Fig. 14. Detail of the shading system

Fig. 15. Interior cross-bracing

Fig. 16. Interior character and cross-bracing

Fig. 17. Interior view of a daylit meeting room

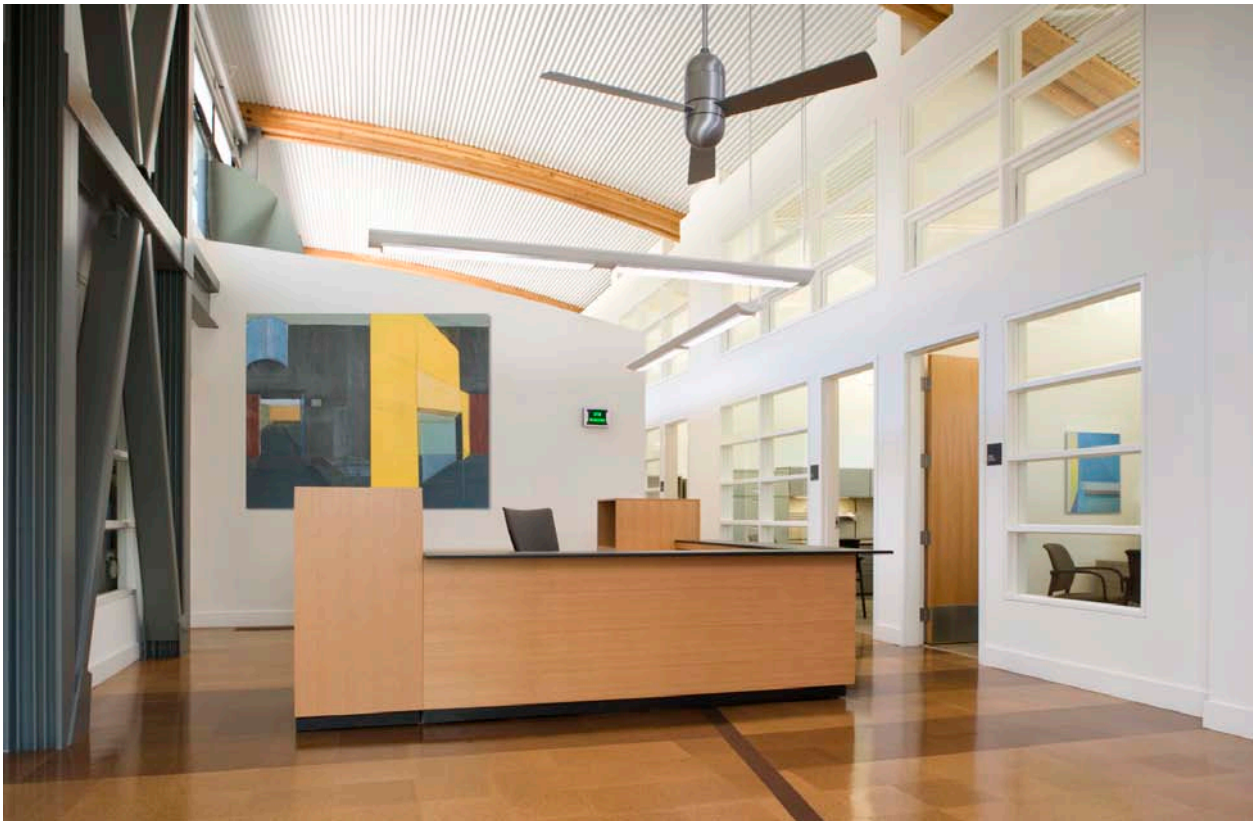

Fig. 18. Reception desk and enclosed office space

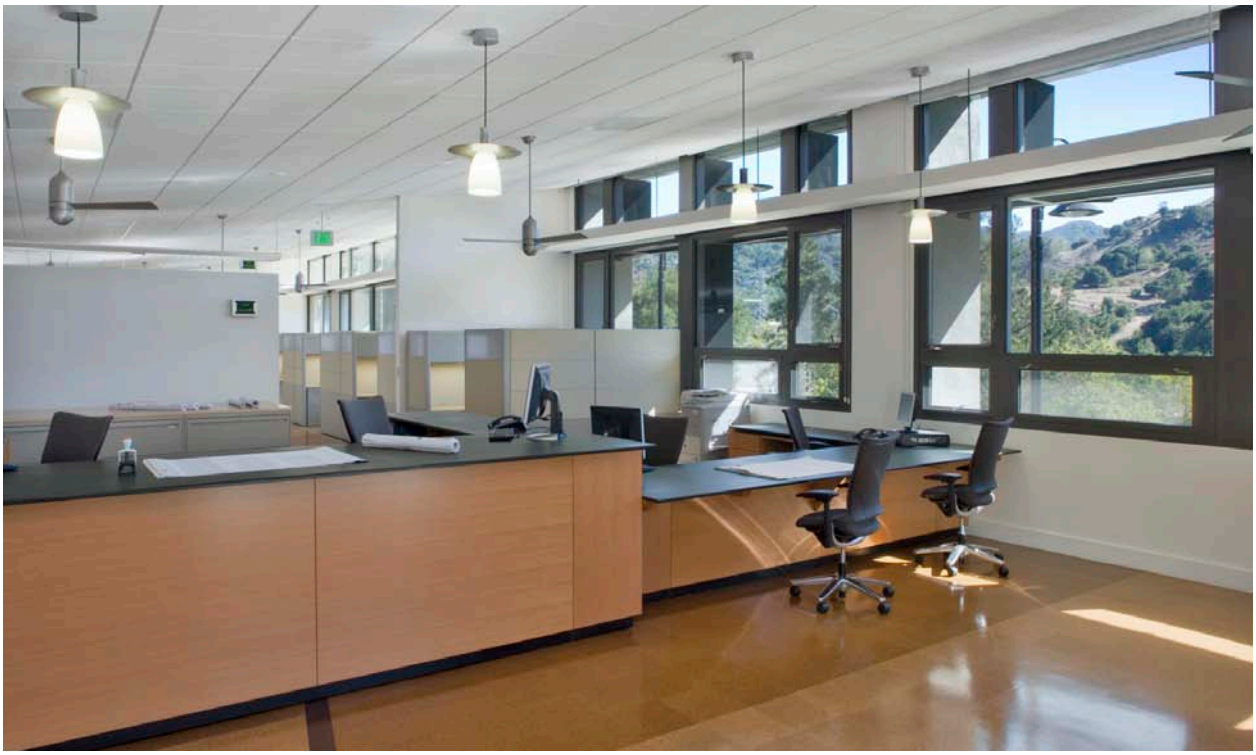

Fig. 19. Interior character and reception

Fig. 20. Sign alerting users to status of passive systems

Fig. 21. Open space above private offices and "Open Window" sign in the off position

2009-004-01
JUNE 01, 2009

ALISON G. KWOK
BRITNI L. JESSUP
NICHOLAS B. RAJKOVICH

Portland State University, Stephen Epler Hall Case Study

Project Description

"Stephen Epler Hall at Portland State University is a 6-story, 130-unit student residence situated over ground-level classrooms and faculty offices. Located on a campus in downtown Portland, Oregon, the mixed-use building is well positioned for urban strategies. It is close to multiple transit options, including bus, light rail and streetcars. The design carefully integrates energy conservation into the building's structure and the high-performance systems are exposed to increase awareness and learning opportunities. It represents a new direction in campus expansion—accommodating increasing numbers of students while reducing the carbon and economic footprints of new buildings."[1]

Architect:	Mithun Architects, Seattle, WA
Energy Engineer:	Interface Engineering, Portland, OR
Structural Engineer:	KPFF Consulting Engineers, Portland, OR
MEP Engineer:	Interface Engineering, Portland, OR
General Contractor:	Walsh Construction, Portland, OR
Landscape Architect:	Atlas Landscape, Portland, OR
Green Consulting:	Green Building Services, Portland, OR

Project Awards

- 2006 American Society of Landscape Architects Merit Award
- 2005 City of Portland BEST Award for Stormwater Management
- 2005 LEED NC v2.0 Silver, U.S. Green Building Council
- 2004 Excellence in Construction Award from the Associated Builders & Contractors Pacific Northwest Chapter

Project Data

Completion: August 2003

Cost: 10,000,000 U.S. Dollars (2003)

Area: 64,400 ft²

Location

City: Portland, OR

Latitude: 45.32 North

Longitude: 122.42 West

Climate[2]

HDD65: 4522

CDD50: 2517

Annual Precipitation: 36.3"

Solar Radiation: 376 kBtu/sf/year

Energy Metrics

Energy Code: Oregon Non-Residential Energy Code

Predicted % Below Code: ~49%

Measured EUI: 41 kBtu/sf/year[3]

[1] From the Mithun website at www.mithun.com
[2] From the National Oceanic and Atmospheric Administration website at www.noaa.gov
[3] EUI: Energy Utilization Intensity estimate for onsite usage. EUI calculated from gas and electric bills.

University of Oregon Professor Alison G. Kwok, graduate student Britni L. Jessup, and Nicholas B. Rajkovich of Pacific Gas and Electric Company (PG&E) prepared this narrative.

2009-003-02
JUNE 01, 2009

ALISON G. KWOK
BRITNI L. JESSUP
NICHOLAS B. RAJKOVICH

Stephen Epler Hall Narrative: Architects Roger Gula, Ron Van der Veen, and Steve McDonald

Getting the Project

Roger Gula (RG): The design of Epler was before the big green boom right before the wave, at least our internal wave.

We interviewed for the project. We were doing a lot of student housing at the time. We had just gotten done with projects for UW[1] and PLU[2] and were really gearing up for a lot of student housing. We responded to an RFQ[3] and got short-listed. We were so excited about student housing. We are a strong housing firm to begin with, but student housing is a very interesting type that's just a lot of fun. You get to do some innovative stuff with it. The client, College Housing Northwest, was a former contact. We got a hold of it and were really passionate and won the project. That was probably in 2001. College Housing Northwest is a public-private partnership. PSU[4] and College Housing Northwest controlled most of PSU's student housing and dormitories. They were very progressive when it came to environmental issues so that synergy right off the bat was pretty big between College Housing Northwest and us. Being a progressive Oregon school, PSU had it in the back of their mind, too, but it was that big spark between College Housing Northwest and us that really helped things out.

Selecting the Project Team

RG: KPFF[5] is a big firm and we work with them a lot. We got lucky and got Steve Murray as the principal engineer.

Steve McDonald (SM): Steve was a big advocate of innovative ways to deal with storm water.

Ron Van der Veen, AIA, LEED AP
principal

Roger Gula, AIA, LEED AP
associate principal

Steve McDonald, AIA, LEED AP
senior associate

[1] University of Washington in Seattle, WA
[2] Pacific Lutheran University in Tacoma, WA
[3] Request for Qualifications
[4] Portland State University
[5] KPFF Consulting Engineers in Seattle, WA

RG: That was a big click because we were pushing for celebrating some kind of storm water system and he just grabbed it. He was a big team member for us because he could get a civil (engineer) to think differently than just putting it underground.

We had a good repertoire off-the-bat; he's a Texas A & M Aggie — has a good personality, was a good team member, and embraced the fact that we wanted to do something that was progressive and educational about stormwater by making it visible.

SM: We encouraged him to participate in finding a solution that became visible for storm water. It wasn't something where you just stuck all the pipes underground; he was excited about it.

RG: He was a good guy, he still is a good guy, but he's still an Aggie. We often get dismissed by civil engineers, especially when they are looking at nuts and bolts and numbers. It was a breath of fresh air to have him embrace it and help us out. He was dealing with all the water issues.

SM: Structural[6] was done with KPFF also.

RG: And then our landscape consultant was from Atlas.[7] Nick Wilson was definitely was supportive when it came to those natural drainage bioswales in the courtyard. We pretty much drove –the-bus on that, but he supported us pretty well.

SM: The mechanical, electrical and plumbing was all done by Interface, but Mark Heizer was the person that really took the challenge of LEED[8] and embraced it.

RG: I remember selecting Interface because we wanted a local presence and a lot of experience in multi-family housing.

Ron Van der Veen (RV): The same was true for KPFF. We have worked with them here in Seattle and they had a lot of local experience.

ST: And the Atlas guy, he was your buddy.

RV: He was a buddy of mine from college at the U of O.

RG: I don't think we had done much sustainable work with any of those consultants. Maybe KPFF; we had probably already worked with them at that time.

SM: We chose them as much based on LEED or sustainable design as it was for their experience with the product type.

RG: Housing and urban adaptability.

RV: We wanted someone familiar with the downtown Portland market. All three of them were downtown Portland firms and they were all within less than a mile of the site.

RG: That probably subconsciously stems a little bit from us not being a local architect. When they want to stack-the-deck locally we can say, "hey, everybody we are working with is local and eight blocks away. I know KPFF is right down there. "

RV: That was part of trying to get the job. To select the internal team, you rolled a pair of dice or something, right? It was darts, really. It ended up being the three of us and a few others.

RG: We were mostly the student housing team at that time.

SM: I had done student housing for a while.

RG: I think it was a convergence of a lot of student housing people, perfect timing, and schedule. We were all available. It was probably the greatest asset that we all knew each other and get along really well. We have the same kind of design groove.

[6] Structural engineering services.
[7] Atlas Landscape Architecture from Portland, Oregon.
[8] Leadership in Energy and Environmental Design.

RV: We had already, before the project ever came out, worked with College Housing Northwest. That is the company that runs their student housing at Portland State University. We already knew Gary Meddaugh[9] quite well and he had already been up here to talk about sustainability in general. He's a real leader of sustainability in Oregon. By the time we had interviewed for the project, he knew us quite well.

RG: We were really excited about this project because there was almost an inherent future with College Housing Northwest. Gary was really progressive and environmentally savvy. We hoped there might be a lot of projects down the road, so we were really revved up for this.

RV: The other thing is that up until that point most of our sustainable projects were more suburban or rural. This was an opportunity to do a very urban project that had all of the problems of a real typical urban site. It had poor orientation, it was next to a freeway, right in the middle of a city and it had a low budget.

SM: A very low budget.

Setting Goals for the Project

RV: Up until that point we had exceptional projects that were sustainable. The exceptional projects were the sustainable projects, not the sort of mundane, regular projects. We thought this was an opportunity to solve a real, more typical, urban issue. It was a chance to tackle a more typical urban project, something that we knew, down the road, was going to be a foreshadowing of a lot of projects that we are doing now.

RG: It was a challenge. There was a lot of in-house discussions. I remember talking to the team working on Islandwood.[10] They basically controlled their own destiny with that greenfield[11] development where you can do what you want, especially with solar orientation. Like Ron was just saying, we were stuck with a thin site, poor orientation and all these other challenges. People were watching us, saying, "ok, can you pull this off?" There was a high challenge mark.

RV: The fact that it was next to the freeway made the challenge even greater.

RG: You can't have natural ventilation when you are looking out onto a highway. A lot of things were happening at the site. The density, or unit count, was really high and, like Steve said, the budget was really low. A lot was stacked against us.

RV: We did an eco-charette and it was big.

SM: The entire consultant team was there. College Housing Northwest was there; the University was there, and so was KPFF.

RG: The whole team.

RV: We probably had 40 people there. That's where we laid out the strategies and how we were going to go about getting the LEED points. After that we also had an in-house crit[12] with Rich Franko and Dave Goldberg.[13] They really challenged us to design this as though it were a natural building as opposed to designing a building and then adding the sustainable parts. We took a little bit of a different approach after that. We were more aggressive about natural ventilation. It was a mixture of both those that set our goals and our direction. The design direction came out of the sustainable goals. The concept that we started with was "dumb box, smart box." We looked at the typology of Portland apartment buildings in downtown and it was a very clear, simple, rectangular box. We said, "well then, let's start with a dumb rectangular box and every move, every design move, we make after that has

[9] Gary Meddaugh is the CEO of College Housing Northwest.
[10] IslandWood School is located on Bainbridge Island, WA.
[11] Greenfield development is building site that has no prior construction and is in a natural state.
[12] critique
[13] Richard Franko and David Goldberg are principals at Mithun.

to have a sustainable rationale to it. We're not going to just add modulation or material just to add it, but we wanted it to be looked at in a series of layers; that main layer being sustainability. That's how we came up with this idea of "dumb box, smart box." The dumb box, with no orientation, actually became four smart boxes that each had an orientation and a way to address its microclimate. That's why all four sides are different.

RG: We also looked at the entire alphabet; we looked at the "O"-scheme, the "A"-scheme, the "E"-scheme, etc. The "Z," and then we had the "S."

RV: The "Z"-scheme. Also the "D."

SM: We started with the "I."

RG: When we looked at all the alphabet, the strongest and cleanest was the "I," meaning a rectangular, north-south building.

SM: That also broke it free from the King Albert.[14] A lot of those other ideas tapped into tying the two buildings together.

RG: Exactly. At first, when it came to the master plan, those buildings were supposed to tie together. When we looked at the floor heights and the ceiling heights, it was just not going to work. It was pretty intense, so we just detached.

RV: We definitely led the process and were just flying ideas out. They were just coming from everywhere. Then we'd have an in-house crit and we'd get more ideas. We were looking at all kinds of complex things and finally we just remembered what Dave Goldberg said, "The best situation here is probably a simple I-scheme. That's probably the best for ventilation and the other goals you are trying to accomplish." We explored that and it turned out to be the case. Because of the nature of the site and the geometries of the site, it didn't hinder the density that we needed to hit. It actually helped it a little bit because we got rid of the inside corners that you can't do much with.
RG: We also looked at an even more sustainable model. It was a three-bar scheme that was all single-loaded and south facing. That was the hyper sustainable, hyper-green answer. We grabbed onto what we could use from that because, obviously, the unit count was really low. We grabbed onto some of the concepts that brought out.

SM: If you look at the I-scheme, the north and south wings are single-loaded corridors. We call those the "gills." Those are the indentations with the operable windows that bring in light and air. Another goal was to bring natural light into the double-loaded corridors. You don't see a lot of that. The organization allowed a really nice and rational way to accomplish that goal.

RG: You have to have a client that is willing to give up a little of the square foot benchmarks. A lot of those developers are looking at every inch saying, "nope, we could probably squeeze another unit or two in there if you get rid of those gills," Because the client was so excited about that, we had the breathing space, pardon the pun, to use those gills. We had the leeway we needed.

RV: It was a challenge. I realized the importance of daylight in the corridor experience. Consequently, all the projects I've been working on since then push for more and more daylighting. That started to generate some ideas for a lot of what we did. A lot of the ideas were intuitive because there wasn't a lot of science or precedent around. We probably started designing this way only about eight years ago; LEED was pretty much in it's infancy at the time. We worked with the engineers and they gave us things they thought were going to work like, for example, the solar chimneys.

SM: The mechanically-assisted natural ventilation system idea bounced back and forth as did the structural system, but that was more of an

[14] King Albert Residence Hall on the Portland State University Campus, adjacent to Stephen Epler Hall.

economic necessity. We were looking at whether a 24-foot space is better than a 20-foot or an 18-foot. There was some iterative design that went back and forth.

RV: With the structural system, for instance, we were trying to push for certified wood, but it just couldn't, didn't, and wouldn't work. Instead, our structural engineer came up with this super-framing system where the goal was to reduce 25% of the framing in the building. We looked at every corner of the building, every inside and outside corner where we could reduce the amount of wood used.

Project Tax Credits and Incentives

SM: From the State's perspective there was a mandate for SEED,[15] the State of Oregon SEED program. That tripped us into monitoring and predicting the energy performance of the building. It dovetailed into what LEED was at the time. There were a couple of grants that the owner, College Housing Northwest and Portland State University, received. They received a grant from an organization in Portland; there was sponsorship that helped us with our LEED charette. I believe it was Northwest Natural Gas, the local gas utility. They helped us administer the eco-charette.

RV: We had some water subsidies, too.

SM: There was a grant from PDC, the Portland Development Commission to help us offset the cost of our rainwater harvesting system. The Portland Office of Sustainable Development, with the assistance of Greg Acker,[16] provided funding for the eco-charette. Those were the two incentives that we got.

[15] SEED is the State Energy Efficiency Design program that designates through policy of the State of Oregon that state facilities be designed, constructed, renovated and operated so as to minimize the use of nonrenewable energy resources and to serve as models of energy efficiency.

[16] Greg Acker formerly the director of sustainability for the Portland Office of Sustainable Develop and is now in his own firm as principal of Gregory Acker Architect.

There was additional compensation that wasn't an incentive but it was something the city offered for the reduction in water use we were proposing. If we could demonstrate that the project used a lesser amount of water in it's in practice then they would offset some of the system development charges. That ended up amounting to a sizeable amount of money, approximately $70,000. After everything was said and done, there were approximately $140,000 in system development charges that College Housing Northwest would have paid otherwise. They recognized a year later that it was not going to provide as much waste, as much stormwater, or utilize as much water as the city had planned initially.

Selecting Technologies for the Project

RV: None of those were really the motivators behind the project. The biggest motivator was the challenge to get all these things integrated into the building and within the budget that was required.

RG: If anything, there were couple of speed bumps I can remember since sustainability was still pretty young, like flushing toilets with rainwater and other little, teeny, tiny things.

RV: That became a huge thing.

SM: The state plumbing board that was governing the use of certain elements, such as rainwater use, had not approved it. They ended up approving it tentatively on the project for use in the public spaces but not in the private spaces.

RV: And we had to put some signs up in the bathroom.

SM: It says, "Do not drink the toilet water."

RG: It is the stuff like that that, if anything, slowed us down a little bit and maybe disheartened us, but we kept moving on.

SM: I think all of those challenges were playing alongside the water and energy strategies. I don't think it's as visible an element in the building, but

it certainly was an important element to the design. Without that energy savings we would not have been able to meet the SEED requirements or get the LEED certification.

RV: We were trying to make an elegant building, an infill building, in an urban context that expressed sustainable ideas in a beautiful way. Portland is a city of fountains; I think of the rainwater harvesting system as sort of a 21st century contribution to that city of fountains. One of the first times when it was raining and we went down into the alley and heard the crashing of the water on the rock it was astounding; I didn't realize the power of those design decisions until then. We never anticipated that was going to happen and that it would make this great sound and reverberate off the walls and create that visceral kind of experience. We never, never, thought it would turn out like that. We just wanted a cool way to get the water across the alley without piping the water across. We thought it would be cool to see the water and that's how that whole idea emerged. We were determined to make that water work and we were determined to make it visible, come hell or high water, we were going to make that water visible.

SM: And it became high water.

RG: I think the biggest driver of that was trying to activate the space.

RV: The "bio-alley."

RG: We had disengaged ourselves from the other building and the proportions aren't great for the alley so we said, "we are going to do everything in our power to activate that space so it kind of detracts from the alley-ness." That's why Ron just said "bio-alley." We really tied it together as the "bio-alley." Everything had to go through it: plants, water, and as much sun as possible. That's part of the activation.

SM: And getting people there; getting people to utilize that spot.

RG: Exactly. The water was one of the big layers of activation on that alley space and it works. When it is raining, it's active.

RV: That was new stuff, but it's old stuff, because it's old technologies. You see it in the Alhambra.[17] We wanted the runnel[18] and we had to work it for ADA,[19] which was the big problem. We couldn't make the gaps more than ¼" inch. Between the Oregon State Plumbing Board and the stringent ADA requirements, that almost killed the project. We just couldn't figure out a way to make this runnel work so that it is wide enough. Portland State University was worried that there was going to be a maintenance problem if leaves got into the system. Then Gary Meddaugh said, "Listen, I manage these buildings, I'll get out there with a rake or a pressure washer if I have to myself, to make that work."

RG: That helped. We wanted to avoid putting in the grates, the kind of underground grate that you can roll the wheelchairs over. We didn't want to do that; we went for the strict stone runnel.

RV: Then they brought up a "what-if scenario." What if a dog goes to the bathroom in the water. Then the water goes through the bioswale and doesn't get completely cleaned. Then it goes into the detention system and is used as grey water. What if there's an earthquake and somebody has to drink out of the toilet in an emergency?

RG: That was the emergency.

RV: It would still be unclean feces from the dog; that was the worst-case scenario. I said, "Well, if that happens, you have a lot bigger problems to worry about."

SM: The way we solved that, at least from their standpoint, was to introduce those UV lights so all that water went across the courtyard, went down

[17] Alhambra Gardens in Spain.
[18] A runnel is a small channel for a waterway.
[19] American Disabilities Act requiring accessibility.

through the bio-filtration patterns, was collected underneath the ground and then piped back into the building but it went through a UV filter, which is supposed to kill the *Giardia* or *E. coli*.

RV: We also had to put signs on the toilet to warn against drinking the water.

RG: Another great part of this project is that we had a good team that either laughed it off or took it as a challenge. Some teams hear "we can't do it," and think, "OK, let's try something else." But I think we had a strong enough team that we chuckled and just kept moving.

RV: Roger and I had worked on several projects together, so we were kind of in a groove. This was the most urban student housing project that we had worked on. And when Steve came on board, we all knew that we wanted to make a real urban building. We wanted it to be more planar and have the same kind of relationships to the street that a real urban building has. We put it in the materials, the richer materials, and less of the suburban modulation that you would see. That was a big point. I was really interested in that myself. We all kind of grooved on that and we knew that it wasn't going to be a real exuberant building in terms of form, but it was going to be a well-crafted building.

RG: The joke was that it would be like a "German box." We knew that it would be elegant and fit together really well.

RV: We had just done Nordheim Court,[20] another student housing project, which was LEED certified. I always said that if that was sort of our "Moulin Rouge" of student housing, this project was sort of our "student housing, unplugged." We were trying to push the typology in terms of everything: the floor plans, how students congregate, and how a sense of a community develops. We were trying a lot of different things and asking a lot of different questions about how to create community, how to create a neighborhood, and how students live together. It was a really fun time; we had some good clients that didn't want to do the same cookie-cutter buildings. When we got to Nordheim Court we really began to experiment with different unit types including two-story units and townhouses. That was something that we were particularly interested in.

RG: You can't really neglect the fact that the contractor was the same on a lot of these projects: Walsh Construction. That's when our mind-meld started to gel because we had done so many other buildings with Walsh. They anticipated our next move and were very good about it. We were able to go further with Nordheim. We wanted more and their energy was there.

RV: They had a sustainability director at that point, which was really unusual at that time.

RG: It was huge.

SM: Carrington Barrs. He was a University of Florida grad, that's why I remember. It was great to have the contractor come to the table with an eye for sustainability, not only the talk. Also, to have a focused staff member looking at all of their jobs and how to integrate sustainability into the construction site—that was a huge breath of fresh air.

SM: It wasn't just the design team, it was the execution team as well, and that was part of the process. They were part of the eco-charette as well.

RV: That was pretty important. They were part of the eco-charette; we specifically hired them before the eco-charette.

RG: It was a negotiated-bid coming in.

RV: That makes a big difference because it's hard enough to make any kind of project work properly. When you have a project with

[20] Nordheim Court is a pedestrian-oriented student housing development of walkup townhomes at the University of Washington completed in 2003.

aspirations like this, it is a new thing for a lot of people, and you have to push up hill. Your contractor wants to expedite the construction process. They have to buy-in to the process of documenting LEED and making sure that their subs[21] are honest.

Tracking Progress on the Project

RG: We tracked ourselves by meetings and phone calls.

SM: Walsh Construction was involved in a lot of our team meetings. The contractor was a part of those team meetings early on, during design, and late into design. They had to be conscious of the costs of what we were trying to implement. They moved along with the design like everyone else.

RV: We had some times where there were money issues and I remember it was thrown out on the table not to go for LEED certification. That would have saved pennies on the dollar for this project but they wouldn't have gotten the benefit that they are getting, performance-wise, on the project. At the end of the day, nobody says now, "Gosh, I wish we would have spent $100,000 less on this project." You don't hear that. Mostly you hear that they wish they had spent $100,000 more to implement a few of the things that we weren't able to. Now they are seeing that they're saving. The Epler Hall project has more than paid for anything we did for LEED.

RG: And they are only at only 6 or 7 years later.

SM: They've seen energy conservation, resource conservation, and a demand for this housing from the students to the point where they've doubled up three different floors. There are tangible benefits to this method. The top floor was a cultural-pairing for students that were attending Portland State University from the Pacific Rim. The top floor they had always planned on doubling up, but I think since then there has been such a demand for this building and housing in general on campus that they've doubled up other floors. I'm not sure what their overall occupancy is now; I think it's in the 180s. It was designed for 120 or 130.

Lessons Learned

RV: There was a post-occupancy evaluation that was done on the building that looked at energy and water savings.

SM: Cathy Turner[22] was a graduate student at PSU and did her thesis on it.

RV: She did her Masters thesis in Environmental Management on Epler Hall. She did a post-occupancy evaluation and ran the numbers on the payback for water and for using the conservation techniques that we are using. We have used it ever since because it's so provocative; it's one of the few pieces of information that we have about performance—she did a great job. It was funny because I was speaking at a conference about sustainability at Portland State University. I found out she was speaking right after me and I read her bio and what she was speaking on and I said to her, "Tell me, how's the building doing?" She said, "Oh, it's doing great. You're going to be happy to hear this presentation." She found it was using about half the amount of energy that code required for a building of this type.

RG: It's a comprehensive report, too.

RV: The building is doing really well with respect to water, too. She looked at paybacks based on 2002. I'd love to see that adjusted to the kind of energy costs to present day.

SM: I still think there is more water conservation there than we were anticipating and I think the occupancy has gone up and grown so much that we're not recognizing the additional savings there, too. We need to find a different matrix for the

[21] Subcontractors

[22] Cathy Turner is a senior analyst at the New Buildings Institute, www.newbuildings.org/

measurement that's not by suite, but by occupant. We measured it by fixture count.

RV: At the time it was using 27% less water, but there was also a extra floor of students. So it's 27% less water counting an extra floor of students.

SM: We assumed 130 occupants and there were 156 right off the bat, 26 per floor. And now they've added 52 students in that building which is going to drive that water use up.

RV: This project was a real prototype for a lot of our strategies for water and energy in future projects, both urban and non-urban. REI[23] was such a one-off project, Islandwood was another one-off project, but Epler Hall was different because it is basic—this is how you solve urban problems.

RG: It wasn't talked up a lot; we were just doing it. We didn't market the green features. We were just doing it because we wanted to; there wasn't a lot of hype.

RV: It did take on a life of its own. It received national press, but we never really expected that, it just kind of happened.

SM: I think it has affected our design process in terms of integrated design. This project emphasized getting and seeking input from the balance of your design team. It was not about taking that traditional path of creating a building and then applying all these systems within the building, but learning how those systems can influence the building's design. It can be expressed and reflected and tell a story while making architecture. We now bring those consultants into the picture a lot sooner even than they were when we worked on Epler Hall.
RG: They were all great consultants, every one of them. Team-wise, the planets were aligned. The issues are still there and the techniques are still there, but it was still the best team I've ever been a part of. We were on the fifth dimension.

RV: We were the fifth dimension of architects. We didn't even know what the fourth one was.

RG: The fourth dimension is love, right?

RV: I thought it was sustainability.

Hiring New Staff

RV: We are still looking for conceptually strong people. As we get into more and more sophisticated projects we need people that understand complicated programming issues, and how to put complicated buildings together.

SM: We are looking for people that are listening to the entire team; that have a strong concept and are willing to push for that, but are also willing to step back and listen to what the influences of those other positions can offer. That's a really important part.

RV: I f you come here under the old paradigm of the architect as the lone genius, you're going to get your booty whipped at this firm because you will have too many strong landscape architects and interior designers. You can't do that anymore. They will come down hard. The projects that we are involved with now are so complex that you need multiple voices. At the end of the day there are still certain things that are fundamental about architecture: we want to be conceptually driven. We're not just a function of double loaded corridors and checking all the programmatic functions off. We still want to create very beautiful work that enhances community, brings people together, and is timeless. It's really hard with the old paradigm to accomplish that. That's why the firm is Mithun; it's named after a dead guy because there isn't technically a personality driving this design. We have purposely not created a hierarchical system here where there are three or four lead designers and then it is handed off. We try and keep it as horizontal as possible.

[23] REI's flagship store located in downtown Seattle, WA.

SM: We have systems within the office; we have a process called "glimpse." We take projects at various stages of development, they could be something as developed as construction drawings or something that's in a very conceptual level, and we post them up on the wall for the week along our "main street" to get feedback. Sometimes it's welcome, sometimes it's unwelcome, but that's what it's all about. It really is. We get different perspectives at different levels of the development of the drawings. It can be very influential.

RV: We also have an in-house review process. We modeled it pretty closely after the UW[24] design studios where we have different crit processes. We have all-office crits or select crits but, technically, every project is supposed to have other eyes on it as a fresh look. We usually have someone that acts like a professor would and follows that project through. They give input periodically. A couple of other people come in at a few points and then we have what we call the "four musketeers." t's changing a little bit, but it's basically four focuses: technical, management, sustainability, and design. Those four people are making sure that our projects are honest, aligned with our values, and not making stupid mistakes. There's an overriding check. We're not a very organized firm; we're kind of a more organic, entrepreneurial firm. I've been involved with the quality support person as the design lead in the office and it's like riding a bucking bronco, it's all over the place, all the time. That's part of the beauty of the energy. It can be unnerving sometimes because there are so many different projects going on and so many wild things going around.

RG: It's like a zoo

SM: I think it's that tension that creates a good product

[24] University of Washington

Closing Thoughts

RV: I think the University of Oregon is producing some great students; much more well-rounded students. We hire students from all around the country. When we hire U of O graduates we do not have to teach them a lot about sustainability when they come in. They know what LEED is, they know what LEED buildings are, and they know sustainable strategies. If they aren't accredited when they get here, they will be within six months or they're not here anymore. All our technical staff is LEED accredited.

SM: For most of our staff that comes here it's not a big stretch, they know that coming in, and they know our commitment to that effort.

RV: They come here because of our commitment to sustainability. We're trying to find a design vocabulary that expresses LEED, expresses sustainability, and creates a new vocabulary in architecture. That might be a little bit nebulous. Norman Foster's work exemplifies that that kind of vocabulary that we are searching for; a northwest or American expression of that. Students that we perceive can help move us in that direction and have strong conceptual bases, understand natural systems and how a building needs to respond to natural systems are what we are looking for. They can then begin to use those as ways to design and express building form. That's particularly interesting to us.

RG: The joke is that we're looking to this expression of sustainability and hopefully it doesn't look like a straw bale, geodesic dome. We're trying to look for something that is very contemporary, very modern, and also is very sustainable. That's a weird balance that you have to grab. Epler Hall does that; it expresses the rainwater system but it's not overtly green, flower children dancing everywhere. It's still pretty contemporary.

RV: There's this idea that the sustainable firms all do shed roofs, like Miller Hull and Mithun, and that we're all trying to out-do each other with

heavy timber and metal roofs. It's a serial type that we've had to overcome. Some of these urban buildings, particularly the buildings we've done for Universities, we have purposely gotten away from the wood and some of those traditions and materials that you might stereotypically think of and gone to the more modern choices. We've used the Europeans to help guide us. I have flat out told my teams that whatever we do, we will solve this without a shed roof. I've done that on the last several projects. We just have to figure out a different way to solve it.

RG: You do a lot of mansard roofs now.

RV: I am doing mansard roofs because mansards are coming in; they're very in.

RG: You must do a mansard. That's it.

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This narrative is based on an interview with architects Ron van der Veen, Roger Gula, and Steve McDonald at the Mithun office in Seattle, Washington on April 15, 2008. University of Oregon graduate student, Britni Jessup, transcribed a digital audio recording of the interview. The interview was conducted by University of Oregon Professor Alison G. Kwok.

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Stephen Epler Hall Narrative: Engineer Mark Heizer

Getting the Project

Mark Heizer: Mithun had the project. We had heard of it and had approached them about being on the team while they were searching.

Selecting the Project Team

We hadn't done many projects together prior to Epler, but have done a few since and continue to do some work together.

I was the lead for the mechanical side and did a bit of the project management, although they may have had different principals on that project.

Setting Goals for the Project

The overall goals were directed by College Housing Northwest (CHNW).[1] This was back when the State didn't allow the University to own their housing stock. PSU was looking to get an example building and had noticed some interest from students who wanted to live in a more environmentally friendly building. They also were conscious of the budget restrictions of new housing, but still wanted to get something that would attract students by showing them that they could actually live a more environmentally-friendly lifestyle in this building. It was going to be their first project like this. It was a pretty early LEED project and probably the first one for Portland State University. It was my first one, and I learned a lot as well on this project.

CHNW wanted to know what they could do to minimize the impact from the standpoint of water and energy. They were also looking at constructing this as a pseudo developer- run project and to make it

Mark Heizer, PE, LEED AP, Associate, Interface Engineering was the lead mechanical engineer for Epler Hall.

[1] College Housing Northwest (CHNW) is a non-profit organization providing housing for students at Portland State University and Central Oregon. They are the owners of the project.

They wanted smaller rooms that fit the style of student that goes to school at Portland State, which is more of a year-round type of occupant, as opposed to the living style in a dormitory (9-month occupancy).

We wanted to reduce energy use as much as possible within the limitations of the project budget. We also tried to take advantage of how the building was going to be used. The small apartments and studios were actually pretty good from a heating standpoint. They didn't have a lot of exposed perimeter per living space. We thought from the beginning that the people themselves could keep the place warm most of the year.

Tracking the Progress on the Project

First we met with the owner, College Housing Northwest, and the University who provided the maintenance staff. We discussed how they planned on operating the building, what they're used to dealing with, and how they would keep the building operating. We also worked with the architects, and went through early versions of a LEED charette to figure out some of the goals. We recruited some student-input [as users] as a part of the charrette. We decided not to air-condition the upstairs and we experimented with the office space downstairs. We thought, "What can we do for them if they aren't going to get cooling? What can we do to ventilate and keep them from being miserable in the middle of summer?" We looked at trying things that hadn't been done before at that time, such as a mixed mode system. We were trying to do that and also move toward a natural ventilation system for the downstairs. We were always looking at how we could keep the upper levels from getting too warm in the summer time, and also use the vegetation for shading from the nice set of trees on the west. The trees kept the lower levels pretty cool, but we had to do something for the upper levels.

We gave feedback about the glazing, the wall insulation, and the roof insulation to help us reduce the heating and cooling loads. That is my motto, "We're here to provide comfort, but let's see what we can do to not use energy to keep people comfortable, and try to find ways to let it happen on its own."

The architects and contractor looked at new framing techniques for the building that helped provide better insulation in the walls. Again, we looked at the glazing and how we could make it perform better. We figured out how we could get the frames to reduce the heat loss in the winter. Throughout the whole process there was a lot of discussion back and forth. There was a tough time finding a locally-produced glazing material within the 500-mile range. It came down to deciding whether it was more important to have the overall energy savings from this type of glazing or finding local suppliers that could give as good of a window from an energy standpoint.

Everybody learned a lot on this process. The water closets were one of my favorite parts of the whole project. We showed the owner that a couple of manufacturers had low-flush toilet fixtures. We were trying to convince them that they really needed to consider a toilet that not only uses less water, but also performs better than the existing fixtures. There was a perception that the low-flow toilets were going to clog and give them all kinds of problems. There was a lot of back and forth with the maintenance staff. We said, "These work better even at a low-flow or a lower quantity than the one you're used to getting." Back then, if there was a clogged toilet, they would actually call in an outside contractor like Roto-Rooter to fix it. It cost $200 each time. We explained they were getting a very good cost for the fixture ($120 for the low-flush versus $75 for the traditional). They balked at more than a $50 increase per fixture.

We finally got the manufacturer to install a low-flush toilet in their maintenance office to try out and after a few weeks they said,"Yes, we want this one." We did do a lot of work with the owner using real-world situations. We let them try it out themselves. Back then, people remembered the first 1.6 gallons-per-flush toilets, which didn't work because all the manufacturers did was change the flapper. We were able to show them

that they could get a good quality fixture that in the end has saved them $200 a fixture just on clog calls.

Water was a really big focus. We looked at as many things as we could. There were some things that didn't make it in. We looked doing heat recovery because it was five stories of residential over office space. We wanted to get all of the showers and drains to pipe into one tank and do heat recovery from that. It just didn't make it into the budget. We wish it could have been included in the building and saved a little bit on heating domestic hot water, but you win some and you lose some. And deciding what is important was part of the process.

We also looked at the energy recovery potential using the exhaust air that leaves the building, to pre-heat the air coming in because it was such a densely populated building. Heating the air coming in was where most of our heating load was going to be, so it became a critical issue for us to find a way to make that more efficient. It turned out quite well and the energy use was less than the model predicted.

The one surprise is that this building has nearly double the population that we expected. The 128-square foot rooms were supposed to be just for one person and evidently close to half of those rooms have two people in them. They are getting a lot for their money especially since the model predicted occupancy at a much lower level. With the increased occupancy there is more water use, from an increased number of showers, plus more water heating. The water use is definitely higher than initially expected.

A lot of students are actually cooking in the space. We didn't expect that they'd use those kitchenettes as much as they do. Even with those unexpected increases, the building is still coming out at a lower energy-use than we had expected. That's why we're happy with it. CBECS, [2] unfortunately, doesn't take into account the per-person data of this building.

Mithun's architects and designers were the ones running the meetings and doing the general meeting notes. Then, through the construction process, Walsh was doing most of that. Walsh had a very aware construction manager on that project to help get people through the whole process. They wanted to do well on a good LEED project, so they were bought into the process early. That's something that is now becoming more commonplace now. In the past seven or eight years it hasn't been something that has happened on every project. Getting that support, not just from the contractor, but from the people who were on the site, was really helpful.

In other regions you may get one out of six major players into a building's design process that has the true buy-in. It may be that owner, the subcontractors, or the person who's actually running the job site for the general contractor to say, "I want it; I want a plaque," but still don't really support (the LEED process). Many engineers are not buying into the process yet. I don't think it is as across-the-board throughout the country as it is here in Oregon and Washington. Here [in the Northwest] there may be only 5-10% of the project team that is not fully aware and bought-in to the process, but it's lining up to be close to 100% on a lot of projects these days. The awareness factor and the desire to be a part of the whole process are much more prevalent nowadays.

On our Interface team the principal was Jon Gray, and electrical and lighting was done by Robert Dupuy. Over time a lot of people worked on the project. Internally our company is divided within teams. Other than our specialty lighting group, the mechanical, electrical, and plumbing, all met

[2] CBECS is the Commercial Buildings Energy Consumption Survey of end-use consumption data of commercial buildings conducted by the Energy Information Administration (EIA).

weekly and discussed their projects and goals. John Gray managed how the plumbing would integrate with the HVAC and the lighting. It's just how we normally do business.

Selecting Technologies for the Project

We used eQuest[3] for our energy modeling. We used it to see our baseline, what our building would be for the LEED submission, and for looking at how the building was performing.

Some of the heat recovery system hadn't been modeled before so we created some metrics. We did small iterations to see what happens if we increased the wall thickness or tried a different insulation. It was at the last minute that SEED[4] was looking at this project as well. Dealing with the State energy people was fun. They had their ideas and made us model this building against heat pumps while we were saying, "But we don't have cooling in the building. How can we model it against heat pumps?" Then the students would use the cooling in the middle of summer and that's not going to do much for energy conservation efforts.
The small block of space that the students would be in, would have their computer and their light on. It took some discussion to convince them that you can heat the building effectively (down to the about 40 degrees outdoors) with that energy. The energy savings of putting in the heat pump cost just wasn't going to be that much over a small electric baseboard heater, the owner could easily replace. That allowed us to put money into other things like heat recovery of the outdoor air. We went through a process of saving money here, putting it over there, to get more bang-for-our-buck. One other item about the small baseboard heaters; we said, "You should buy the oil-filled models. They're $50 more per unit, but are a little safer, and they came with a long warranty, since we never know what students using in their rooms. Sure enough, there was a fire the first month of occupancy and all the heaters were swapped out and there hasn't been a problem since. That was just the learning process. This was an early building to really test a lot of strategies.

We got very lucky on the construction of this building to have some of the footprint about 6 feet underground due to the slope of the site along the west side. The nice, heavy concrete walls work well for us. We didn't have to air condition the elevator machine room because of that and it's done quite well for 7 years. They have a fan-assist on the ventilation for the offices and classrooms, on the upper levels it's just operable windows for cooling. If you look at the naturally-ventilated buildings in England and Germany, the temperature difference between us is just a few degrees. It's that extra couple of warmer degrees that we have here that makes the whole difference.

The rainwater harvesting and storage was a little different. I wish we could have done it for all the rooms, but it's the back and forth, especially with residential. There was fear of someone using the toilet as a back-up water supply. Other than my dog, I don't think anybody would use it for a back-up water supply. But over time, these different issues would come up. We hashed things out with the contractor and they were very helpful. I think the process went rather well from that "holistic design" standpoint. It wasn't, "we need to save $5,000.00, let's cut this out."

There is a tendency to have a line-item driven process but that doesn't look at the connections between all the different pieces. This affects this, which affects this, which affects this and it actually costs money in the long term. It was a very well-run team. Everyone realized that there was an overall goal of making this a good working example and a learning laboratory. There were goals for the future. They wanted people to go

[3] eQuest is an building energy use analysis tool used to compare building design and technologies and uses a DOE-2 engine to run the building energy use simulation program.
[4] SEED is the State Energy Efficiency Design program that designates through policy of the State of Oregon that state facilities be designed, constructed, renovated and operated so as to minimize the use of nonrenewable energy resources and to serve as models of energy efficiency.

further with these ideas in terms of energy, water conservation, and construction methods.

Lessons Learned

In terms of residential projects, we've taken some of the lessons we learned on Epler Hall and applied them to other projects, such as pre-heating the outdoor air and with the exhaust air. I think we've learned that residential projects, especially student residences, use a lot more water than the LEED calculations tell you. The students are going to use a whole lot more because of their dishwashing habits, like turning the faucet on and letting it run forever. It also taught us that we should not give them high-flow fixtures or really anywhere near the normal flow levels, for kitchen fixtures. From the water efficiency side, we are now seeing better fixtures on the market that we can bring into dorms or similar projects. Now there are other new technologies that do an even better job of taking advantage of energy use in buildings that we didn't have for Epler Hall.

There were some hard lessons learned. The things that worked okay and the things that worked very well are now used in our current projects.

Hiring New Staff

We are seeing more people who have the fire to do projects like this. People are seeking us out to work here because they see our past work. It's still tough, even now, to find people in the engineering business. This project has helped us recruit people because they want to work in our environment, even here in the rain. They are coming here from around the country. We're looking for people that are trained as LEED Accredited Professionals.

Closing Thoughts

There needs to be a bit more research in getting information to owners to backup the strategies. With rising energy costs, they need to know the certain things should be considered as far as insulation and glazing. There's a need to get owners familiar with some of the small items that help get the project to that next level. At that time on Epler, there was no way to show the pay back benefits. Providing education to owners and showing them what happens if energy costs get to a certain level and how different technologies might remediate that cost, is essential. They need to know why they should consider using these technologies and higher efficiencies that weren't considered once upon a time. Ground source heat pumps are an example out there right now that nobody wants to touch because of the drilling costs. People have said it just doesn't pay back. Well, that was a few years ago.

The radiant heating and the low-temperature systems that don't take as much energy, natural ventilation, and mixed mode systems like the ground-floor offices of Epler, are all technologies that people are starting to talk about. Now the topic is, what is acceptable as far as temperatures go. If there is a 105 degree [F] day you're going to have to treat it like a snow day. Tell people not to come in to work that day or to close business at noon. We allow people to dress for the weather. The biggest need is for people used to a larger range of temperatures. People did quite well without air conditioning for a long time. Having 72 degrees year round is something that just isn't going to happen anymore. Can we get everybody to buy-in to it?

This narrative, part of a larger case study describing the Stephen Epler Hall, was supported by a 2007 AIA Upjohn Research Initiative Grant.

This narrative is based on an interview with engineer Mark Heizer by telephone to the Interface in Portland, Oregon on July 9, 2008. University of Oregon graduate student, Britni Jessup, transcribed a digital audio recording of the interview. The interview was conducted by University of Oregon Professor Alison G. Kwok.

Exhibit 1: Stephen Epler Hall

Fig. 1. Stephen Epler Hall

Fig. 2. Epler Hall exterior

Fig. 3. Epler Hall exterior

This exhibit, part of a larger case study describing Stephen Epler Hall, was supported by a 2007 AIA Upjohn Research Initiative Grant. University of Oregon Professor Alison G. Kwok and Britni Jessup with Nicholas B. Rajkovich, Pacific Gas and Electric Company (PG&E), prepared the associated narrative.

Fig. 4. A detail of the runnel and connection to the bioswale

Fig. 5. The connection between Epler Hall and adjacent King Albert Hall across the "bio-alley"

Fig. 6. Detail of the downspout system and its connection to the runnel across the alley

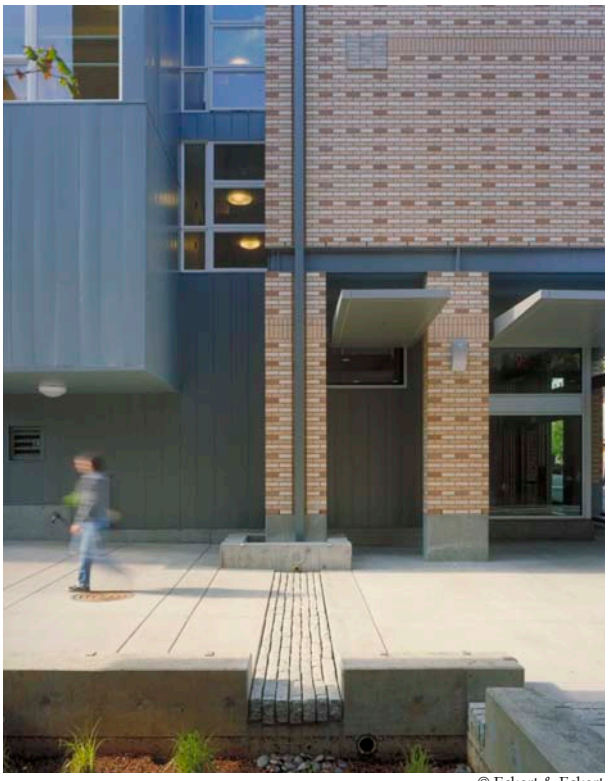

Fig. 14. The courtyard and bioswale

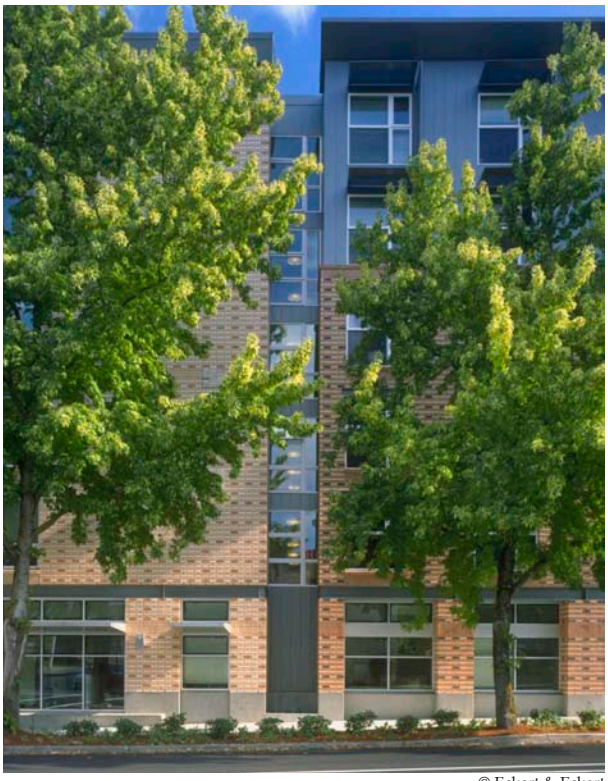

Fig. 15. Epler hall elevation

Fig. 16. Detail of shading devices

Fig. 7. The “bio-alley”

Fig. 8 A runnel taking water from Epler across the “bio-alley”

Fig. 9 Entrance hall for the ground floor classrooms

Fig. 10. Upper floor residence interior

Fig. 11. Upper floor residence kitchenette

Fig. 12. Upper floor residence restroom

Fig. 13. Upper floor residence restroom

2009-002-01
JUNE 01, 2009

ALISON G. KWOK
BRITNI L. JESSUP
NICHOLAS B. RAJKOVICH

Tillamook Forest Center Case Study

Project Description

"The Tillamook Forest Interpretive Center focuses on the story of the Tillamook Burn, a series of fires approximately 60 years ago which consumed 355,000 acres of forested land. A massive restoration effort followed, spanning several decades. The forest is now healthy and successful, harvesting of timber has begun following a set of newly developed guidelines called "Structure Based Management." The center provides a base for a wide range of education programs, taking advantage of the many site features including the Wilson River, an original homestead site, and a variety of forest types."[1]

Architect: Miller|Hull Partnership, Seattle, WA
Interior Designer: Allbee Romein, Seattle, WA
Interpretive Design: Aldrich Pears Associates, Vancouver, BC
Energy Engineer: PAE Consulting Engineers, Portland, OR
Structural/Civil Engineer: Tetra Tech/KCM, Portland, OR
Bridge Engineer: Breshears/Thornton Consultants, Vancouver WA
MEP Engineer: PAE Consulting Engineers, Portland, OR
General Contractor: Precision Construction, Portland, OR
Landscape Architect: Walker Macy, Portland, OR
Green Consulting: O'Brien & Company, Seattle, WA
Acoustics: Listen Acoustics, Seattle, WA
Lighting Design: Luma Lighting Design, Portland, OR

Project Awards

- 2008 State of Oregon's State Energy Efficient Design (SEED)
- 2007 Honor Award from the American Institute of Architects, Seattle Chapter
- 2000 Award of Excellence for Landscape Planning and Analysis from the American Society of Landscape Architects (ASLA)

Project Data

Completion: March 2006

Cost: 7,300,000 U.S. Dollars (2006)

Area: 18,800 ft²

Location

City: Tillamook, OR

Latitude: 45.36 North

Longitude: 123.26 West

Climate[2]

HDD65: 4923

CDD50: 2051

Annual Precipitation: 90"

Solar Radiation: 434 kBtu/sf/year

Energy Metrics

Energy Code: Oregon Non-Residential Energy Code

Predicted % Below Code: ~30%

Measured EUI: 99 kBtu/sf/year[3]

Renewable Energy: heated with biofuel (locally sourced wood pellets)

[1] From the Miller Hull Partnership website at www.millerhull.com
[2] From the National Oceanic and Atmospheric Administration website at www.noaa.gov
[3] EUI: Energy Utilization Intensity is calculated from onsite usage from data gathered by the Oregon Office of Energy in their 18 month check-up on the project's energy use.

2009-002-02
JUNE 01, 2009

ALISON G. KWOK
BRITNI L. JESSUP
NICHOLAS B. RAJKOVICH

Tillamook Forest Center Narrative: Architects Robert Hull and Teresa Russell

Getting the Project

Bob Hull (BH): Before the request for proposals or qualifications, the Tillamook group had done a really interesting thing. Oregon Department of Forestry wanted to put together a project that was educational and also had value beyond what is usually done. They had already done quite a bit of research. We spent a lot of time at the very beginning with Doug Decker[1] who was going around and finding sources of money. They did a lot of that to begin with although, in the middle of this process, there was a lot of fundraising that still had to be done. It was basically handled privately. There was a little bit of state money in there, but that process of getting the money was a story in itself.

When they put out the request for architects, we went right away and investigated the job. We knew there were several sites they were looking at. We have done interpretive buildings, and some in Oregon and we knew that this was a really nice piece of work to be involved with because there was so much essence to it. First of all is the Tillamook Burn.[2] The whole story—talk about carbon footprint! Did you realize that the Tillamook Burn actually was a burn that occurred in the 1930s that just obliterated the entire mountain range so badly that not even seeds germinated afterwards?

So they had a history of these tremendous fires in the area. This center developed around the idea of the Tillamook Burn. It's really an idea about reforestation. You can come back to that, the human history of all these people that planted all these trees, the history that it was one species of tree and so they lacked the diversity. The forest has kind of reached its prime.

How are they going to make it diversify? These are the story lines that we were starting to see as we started to look at this project.

Robert Hull, FAIA and his partnership pursue socially responsible, human architecture in the public realm. They have won over 170 awards including 2003 AIA Firm of the year.

Teresa Russell, AIA was the project architect for the Tillamook Forest Center.

[1] Doug Decker was project leader for the Oregon Department of Forestry.
[2] In 1933, a vast fire occurred in the northwest corner of Oregon, now known as the Tillamook Burn, burned 355,000 acres of forest.

When we went for our interview we talked about what the interpretive center might be: regeneration, lack of diversity, the human side, and all these things that swayed the jury and we got the job.

Teresa Russell (TR): I think it was the largest reforestation project in the U.S. at the time when they re-planted. A lot of school children were involved in planting, hand-planting, the forest so it was a real community effort that Oregon is proud of.

BH: For the opening of the Center those very same children were there. And now, of course, they've got canes and walkers and all sorts of stuff. That was great! It was so invigorating to have that happen at an opening. The young kids that planted the trees now came back to see the results.

Selecting the Project Team

BH: We had a great team. We had been working with both Walker Macy and AldrichPears[3] so we had already had a working relationship with them. We worked with Walker Macy[4] on the planning and the landscape design. This project won a national planning award, too. We worked with AldrichPears on the interpretive design and they are great, they are out of B.C. We worked with Paul at PAE[5] on the engineering and mechanical side. I wonder if this was the first project with Paul?

TR: This was one of the early projects with PAE. We worked with them for mechanical, electrical, plumbing. They were a big component of this large group of consultants and diverse group of consultants.

BH: I don't think I remember Paul being at the interview, because usually Paul stands out, he's so different than most mechanical engineers. He's got an active kind of showmanship. He backs up what he says.

TR: And Tetra Tech/KCM[6] was the civil and structural. We used two companies, structural in Seattle and civil in Portland.

BH: We hadn't done much work with Tetra Tech. I had done some work with KCM and they had done a lot of Oregon work so they seemed natural to put on this team, too. All of these consultants are really important in a big project.

TR: They (KCM) had done pond work. The pond does a lot of work for the building. It collects the rainwater and uses a scupper that we created. We found old railroad ties out in the forest and designed a scupper that cantilevers out over the pond. I think that was Bob's idea.

BH: We really had the rainfall to do this.

TR: Right, and this area is essentially a rainforest—the Tillamook Forest. The pond collects the rainwater, it's treated and used for fire sprinklers in the building. For the local firemen, if there were a fire, we've created an access point to this pond where they could drain the pond in an emergency to help fight a fire because they can't get to the river to use the water there. It's also used to flush the main toilets, in the building, and also for cooling. They don't have a cooling tower. Instead it allows cooling from the chiller. It helps in that respect.

BH: The firefighters actually requested that the pond become larger, so it's quite a sizeable pond and can be used for multiple purposes: for mechanical cooling, flushing toilets, the firefighters could use it, and rainwater catchment for detention. It seems like there is even one more purpose.

TR: The irrigation system.

BH: It's kind of a microcosm of systems.

[3] AldrichPears Associates, based in Vancouver, B.C., work includes museums, science centers and zoos for master planning, vision, feasibility, and conceptual planning.
[4] Walker Macy is a landscape architecture, urban design, and planning services firm in Portland, OR.
[5] Paul Schwer is President of PAE Consulting Engineers in Portland, OR.
[6] Tetra Tech/KCM Inc. provides environmental and consulting services. Their corporate offices are in California, with offices globally.

TR: And it's right at the entry. You walk across a footbridge and then there's the wildlife habitat.

BH: The salamanders found it and they were mating in the bottom of the pond. But they were also being dredged into the system. We had to put screening across to make sure that they didn't get pulled into the mechanical system. It's a classic example of a whole team working closely together on an idea.

We selected our internal team partially because of the team we worked together with on Yaquina Head[7] in Newport. We did an interpretive center quite a few years earlier and Craig Curtis[8] and I, at that time, became the natural ones to go on to this project. We don't' always do that, we don't say, "Because you did interpretive centers you will do more." We really mix it up in our office, but that's where we started for Tillamook. Craig and I were kind of the vanguard of that. Craig did the background work on this project, and figures out the way things work. He designed the homestead site. It's a nice little park structure that's used a lot for educational programs and as a wayside for people who are travelling through the mountains. It's only about a half a mile down the road.

TR: For the team at Miller Hull, there was Amy[9] and then when I joined Miller Hull in 1998. We were starting the drawing phase of this project. It was pretty early on. Maybe it was a little later when I hopped on the team as a project architect. At the time I joined, I had worked with a lot of wood and detailing and I was at the University of Oregon. So I had this Oregon connection and that was part of it. It was a good team.

BH: It was a great team.

TR: It was a really great team.

[7] Yaquina Head Interpretive Center in Newport, OR was completed by Miller Hull Partnership in 1997.
[8] Craig Curtis is a partner at Miller Hull Partnership.
[9] Amy DeDominicis was an associate at the Miller Hull Partnership, now founder of the Tacoma Design Collaborative.

Setting Goals for the Project

BH: We did a visioning document at the start. It did lead to a design, but it started with all the goals of the Oregon Department of Forestry. It was quite a document. It contained the storyline and the original ideas about how the interpretive experience would be. They were doing a visioning document for the interpretive part of the project. All of that was our first phase of this project. We didn't know for sure what they were looking for until we got into the project and did this document. It talked a lot about the significance of the forest fires and the natural environment of the site. The reforestation part of it was a really important element and the Department of Forestry wanted to make sure that a couple things came through on that.

One is what we already talked about; the project was on a completely devastated site that had since been reforested. It wasn't quite successful. Oregon has a new mandate to make sure that it's not just chopping trees down, but that it's also creating recreation and education. The whole idea was about how you can create diversity within in the forest again. They have a management plan and it was always kind of a dry term. It was a program where they were getting diversity back into the forest, that all had to be in the visioning document. That was an important plan from the State's point of view including the human history, diversity and then the fact that they actually did have a site, they didn't know where on the site they were going to go, but they had a site.

The first conception that we had about the site was not so thrilling because you walked into the middle of the very same problems they are talking about: lack of diversity. What started as, "Gosh, I wish this was a little bit more beautiful," became, of course, that the whole idea is not just interpreting within in the building, it's interpreting the whole site, so you look out at some of the devastation. There are some charred stumps out there that talk specifically about this issue. That turned out to be a silk purse, but at the time it seemed not so great.

TR: In fact, they broke it up into landscape areas, different areas for education, and so on. There is an area with a lot of stumps, which is used to teach the children about the history. They tried to diversify the forest in another section, planting different trees. The children and adults, can go through and learn about that type of forestry practice planting. There's a zone along the river that was important to them–the riparian zone. It had to be treated carefully, lightly, and delicately as we worked around the river. So the site was diverse, even though, at first, we saw it as not as diversified.

BH: It is full of salmon at times.

BH: There are some very beautiful sites in Oregon, this wasn't quite one yet.

TR: They had broken it up and then there was the BPA[10] power line. There was a swath right through the whole site where the power lines ran and they were able to move the power lines across Highway 6 to another location. We took advantage of that. At first you look at the swath as an, "oh no," but we created an entry, that was where our road would be, so we wouldn't have to cut down any more trees. So they used that area for the road, the septic system, and the drain fields are out in that area, too.

BH: Parking also went in that area. We took that swath and, you know, they really swath it when they swath it! Then they re-forested it and put a swale through it and did a lot of things to mend it. Even today, you can still see it.

We were so drawn to the river and later on that became a really important aspect of the concept of the building. We went out on the edge a little in saying we thought it would really be important to bridge the river and tie the two sides of the site together. There are campgrounds and other things on the other side of the river which ultimately will always remain true to this project. They really were strengths to begin with. There was this "line"–a kind of direction–that went through the site that took you from the beginning to the end. That became a strong concept, and it started really early. Sometimes these projects do that. The skids that they have in the forest, this is a devastated forest, started the idea. Somewhere near the site the loggers will set up steam donkeys and mills. They would bring the logs in and run them along the skid, take the sawn material off the other end, and transport them back. That's called a skid. It was a platform that never changed in elevation; they just ran it over the ground. The ground undulated, the platform didn't. Items were on a stable platform. The skid became a really strong idea for this project, in fact, that's what you see running through this whole building. The skid becomes the bridge as it moves across the river. We had this amazing section idea of this project. You get on it and you're on for the ride. Eventually you end up on the other side of the river. The skid was a really a strong element along with the idea about the line, the idea about being drawn to the river, the idea of being able to connect to the other side, and the skid all came together.

The choice of materials wasn't such an energy issue as it was about the context related to the forest products and the forest industry. It was natural that this building would show off the wares of the forest industry. There are a lot of new products out there now that are really good about saving energy and being able to reuse waste, such as, oriented strand board,[11] TJIs,[12] and glulams,[13] which are not big timbers, but small dimensional lumber. Being able to show the products within the building was really an important thing and as a consequence we really wanted to make a celebration of it as a structural material. This idea showed up real early in the design process.

[10] Bonneville Power Administration (BPA) serves the Pacific Northwest through an extensive electricity transmission system and marketing wholesale electrical power at cost from federal dams, one non-federal nuclear plant and other nonfederal hydroelectric and wind energy generation facilities.

[11] Oriented strand board (OSB) is an engineered wood made of layered wood pieces and strands, similar in form to plywood, but less expensive.

[12] Trus Joist I-Joist is an engineered floor and roof joist made by Trus Joist that provides resistance to warping, twisting, and shrinking.

[13] Glue-laminated beams are a type of structural timber made from dimensional piece of wood that are laminated together to create a stronger beam.

TR: The client was concerned about energy and sustainability. From early on we had O'Brien[14] as the sustainability consultant on the team. Elizabeth Powers[15] came on and we had team meetings with the client. The client had a whole group there representing ODF and we all met and talked through all of their goals and important concepts on sustainability and energy savings.

Project Tax Credits and Incentives

BH: I don't think incentives were in there yet. Paul Schwer may have different knowledge on that one. I don't think we were finding any incentives at that stage. Mechanical engineers, if they are good ones, talk about it all the time now, but I don't think they were any then.

We had a sustainability charrette,[16] but this was before the LEED[17] rating system began. It was something we did and it was a heartfelt focus with everybody, including the client.

TR: They really wanted sustainability goals. We worked, we thought about, and we created all these goals which guided this matrix. Some of it includes the materials and goals for the materials, but there were other goals as well. We worked to try and achieve the energy savings and sustainability. It was just something they wanted and were concerned with.

Selecting Technologies for the Project

BH: Right off, we're up in the mountains and intermittent power cut offs can happen quite often because they get some big, frightening floods through there. That river can really do powerful things. So, there was a need, in terms of sustainability, to have a steady source of power. We had to figure out what the power was going to come from. They did have electricity on site, but obviously it gets expensive up in the mountains because it has to be transmitted so far. Even with those big power lines going through we couldn't tap off of them. I think that's when things clicked about using wood pellets. I think Paul started it. At first I thought it was a crazy idea, you know, wood pellets were what hippies were using out in the forest back then. The more we looked into it, the more we realized there were so many things about using wood pellets that made sense for the basis of the building. It's a waste product of this very industry, it's local, and it has a good carbon footprint because it's highly efficient if it's burned in a high-efficiency boiler. From a lot of different sides it became the material of choice. It can also be delivered. We invented a delivery system for this building that uses a conveyor belt and a big bin on the back of this building.

TR: It's like a grain silo.

BH: There is an auger in back and it sends the material down into the building. When we started to think about this material, carbon neutrality did come up. You know you can say, "Well, it's not really carbon neutral," but if you look at it in the way we just described it, it can be. It's not coal or petroleum product. It wasn't put into the ground millions of years ago. The forests here were planted. They pulled in that carbon as they were growing and then, if you turn around and make it a highly efficient fuel, you release the carbon very efficiently, so is that carbon neutral? Some people would say yes, some people might say no. It does satisfy a lot of the term "carbon neutral."

Considering that this place had probably created one of the largest carbon footprints of all with this fire, to be able to turn around and use that same material this way, it's pretty neat.

TR: The forest fire came out of poor practices with the loggers, I believe.

BH: There are differing philosophies about how you fight fires. Some say, let it go, that's what nature would have done. I was interested to learn that the Native Americans would set fires like crazy because it was a way of attracting game. They would create meadows and then in the

[14] O'Brien & Company is a sustainability consultancy based in Seattle, WA.
[15] Elizabeth A.D. Powers is a principal at O'Brien & Company.
[16] A charrette is known as a collaborative design session where designers work out solutions to design problems.
[17] LEED stands for Leadership in Energy and Environmental Design, developed by the United States Green Building Council, and provides the voluntary standards for green buildings.

meadows you could get a smaller height of plant growth, where there weren't bushes and that attracted game. It was a technique for keeping game around.

TR: We had a whole report written, with documentation, first for the client, then the charrettes. We wrote down everything the client wanted and that we, as a team, came up with. We brainstormed and created a document and that was given back to the client. They reviewed it and we fine-tuned it. We had a few meetings with them, with O'Brien, not just one charrette, but then, as a team, we'd go back over the refined document and look through it together.

BH: We had some big budget issues, too. In a way, sustainability is a microcosm of everything. They had a very strong irrational approach to methodology, for our presentations, and for our SD[18] and DD [19] They really kept our feet-to-the-fire on making sure that we checked everything off. They were quite good about that.

TR: The grand opening of the Center was May of 2006.

BH: The visioning document was done in May 1998.

TR: They chose to not to follow through on all of the goals, but they didn't actually do the LEED certification, but they did follow SEED.[20]

BH: It was prior to LEED. What does that mean? We probably weren't as rigorous as some of the processes. Certainly we were talking the talk, walking it, too and we would come back to it because there were kind of implications about cost and things that constantly came up.

Methods and Tools Used on the Project

TR: One of their main goals was to find resources within a 150-mile radius if possible. We were doing that, with the windows and a lot of the materials were used locally. Recycling, using salvaged products, on-site re-use, that was a big one. They dug up a lot of the stones from the site and actually created part of the site. They crushed the rocks and then used those for the base of the road, the entry roads, and the trails. That was a huge part of not having to haul crushed rock in from somewhere else, they just crushed it right on site and used it. That saved them money and it saved energy costs, gas and fuel.

BH: We have a matrix that shows salvaged materials, on-site re-use, pre-engineered or engineered products, 50-year life minimum, refurbished, recycled, salvageable, local within 150-miles, and local within 500-miles. The discussion about rapidly renewable materials began about the time we started talking about wood chips. It's a rapidly-renewable resource because it grows in about three years or so and can be recycled. There are a lot of things that I think pre-dated LEED. It must have been at about the time that we started, that "green" was kind of coming into the picture. We can kind of piggy-back on that, but that's kind of about the right time.

Obviously we have a friendly relationship with our consultants and a good relationship with the State and the committee, but a lot of it did happen in the marathon meetings. We had meetings that would go maybe two days and things were discussed and a lot of info got taken care of there. A lot of it had to do with structured meetings. Ideas would come out of the consultant team. They would meet separately as a group, without the client, so a lot of these ideas, like the pond idea and the building orientation idea, came from not just one source, but from three.

The north-south orientation, which is not ideal in terms of solar orientation, came from the location of the skid. What's interesting about it is we didn't have to worry about heat gain, but we had to worry about daylighting. The orientation of the

[18] "SD" is an acronym for Schematic Development, a phase of the architectural design process.
[19] "DD" is an acronym for Design Development, a phase of the architectural design process.
[20] SEED is the State Energy Efficiency Design program that designates through policy of the State of Oregon that state facilities be designed, constructed, renovated and operated so as to minimize the use of nonrenewable energy resources and to serve as models of energy efficiency.

building did not have much to do with the performance of the building because we weren't really relying on it for heating or cooling. We didn't even really have to worry about shading because of the surrounding trees. Our more important task was the lighting. The original idea was to do these long buildings that would sit on the skid. Lots of daylight comes in from the sides.

There's a reliance on electric light and that's because interpretive design was coming out of the era when everything was in a black box. We wanted a different experience. We designed a long building that, when you walk into it, you're immersed in the exhibit, the interpretive experience. You don't walk through the front door and go through another door and then find the interpretive experience. In this project, you're thrown into it immediately. That was kind of a revolutionary idea, frankly.

TR: Even before walking in the door, when you arrive at the lookout tower, then approaching the building along the bridge over the pond—you know that the site is the interpretive exhibit.

BH: The interpretive experience drove what happened internally and I thought we relied a little too much on electric light. I wish we put a skylight down the middle of that top peak; we would have gotten a lot out of that

TR: We talked about doing that and then and we did a cost analysis and it got VE-ed.[21]

BH: There it went.

TR: It went because the costs have to be controlled.

BH: Down the road at the Smith Homestead site you'll see that skylight. It makes such a huge, night and day difference. Reflecting on that, I think our daylighting scheme on Tillamook suffered a bit, but it's doing quite well.

TR: However, the indirect lighting helps the interpretive nature of the experience.

BH: We considered the entire experience. It was how you came to the site, how you even found the site, and because of the big forest service look-out tower there, we wanted to make the kids say, "Let's turn off." When you are inside the building you are constantly looking out at the forest at the experiences that are happening outside. It was kind of an inside-outside interpretive building. It was definitely not a black box. But I still wish we had a little more daylight inside.

Managing the Project

BH: Budget was always a challenge and, in fact, Craig [Curtis] and Mike Jobes[22] are going down to Tillamook soon because they want to add some food service spaces. They want to make the administration area a little bigger. They want a food service area and larger classroom areas. We were constantly chopping down the spaces of the building. I think the project got a little bit small, even thought it doesn't feel that way. Also, buildability was an issue because the building season is short. The skid turned out to be an advantage because you could build on it.

TR: To manage the project, I was down there every other week during construction.

BH: We have this amazing bridge that's incredible that got into the project. Willamette Industries[23] devoted a couple of engineers and some wood products to make it happen. Then Willamette got bought out by Weyerhaeuser [24] and they took over the project and donated that portion.

TR: It's amazing. That was actually another difficult part, to place the building with respect to the height of the river. We analyzed the maximum height of the 100-year flood plain and made sure the overall height of the building and the bridge was above that.

[21] "VE" is an acronym for "value engineering."

[22] Mike Jobes is a principal at Miller Hull Partnership.

[23] Willamette Industries was a forest products (lumber and paper) company based in Portland, Oregon. In 2002, it was purchased by Weyerhaeuser.

[24] Weyerhaeuser is one of the largest pulp and paper companies in the world; the world's largest private owner of softwood timberland; and the second largest owner in the United States. It is based in Federal Way, Washington.

BH: It was well-tested. The other hard part was keeping the bridge in because it was kind of outside our budget. If Willamette or Weyerhaeuser pulled out, it would have come to a screeching halt. It was great to see them stay involved.

TR: That bridge design was a lot of fun. We worked as a team with the engineers to integrate the design of the bridge with the design of the building. I think Craig initially came up with a bridge concept and worked with Weyerhaeuser. From there we wanted it to work together and it was successful because, when you look at it, it all fits!

BH: There were a lot of constructability issues. The bridge had to be built first, then the building. We were hanging by our toenails, let's say by our fingernails, on the bridge.

TR: They found soft rock where we were going to place it, so we ended up digging a deeper hole to pour concrete into. We also shifted the building. We were joking, we spun it, just like spinning-the-bottle, because the engineers discovered that it would be better for it to be just shifted slightly.

BH: I am so glad they did it.

TR: So we rotated it slightly.

BH: It did take a long time to raise money and that was another thing that we were involved in: presentations to the donors or potential donors. It was a really important part of this. It took a long time for the money to come through. That came from individual donors, just people, from counties and school districts to the Department of Forestry.

TR: The Building Department donated some money also.

Lessons Learned

BH: I'm not sure if this project wouldn't have happened, that would we be going down the same course that we do now. We probably would be, but it definitely started it. It was the first time that we really thought about sustainability and the whole arena. This was the first workshop that we did. In that respect, it really did start us looking at all the different aspects that go into the making of a sustainable project, from the outside to the inside.

Hiring New Staff

The level of training is so high for people coming in now. We work better as teams, now, and we not only expect people to draw, but to be actively involved in the design process. We are doing this more now, and this is something I have had to learn. I was sort of old school. I would draw the original idea and move off of that as time went on, the idea was done by one person. Nowadays I probably do something like, "I'm thinking that we have got this idea of a skid, it runs across the river and it goes from here to here," and so then look for more team discussion and buy-in. That's where we can use the talent that comes up from architecture schools.

If the system is good, it can come from people from different universities. Since so many from our firm teach and Dave[25] is the chair,[26] we can get the cream from them. The University of Oregon has been great and we have all sorts of really good talent from there. We draw in good people and now we make sure that these people get involved in the design process early, so they come up with ideas. These ideas then get sifted and picked apart and some chosen and some not, and there's probably still a lead designer, but it has become more of a team-design approach. You still need the vision and you still need your team's buy-in to the vision, but now you need the team to move ideas along farther.

TR: With this project, too, it was a really a good team internally and with all of our consultants. The team was very successful in communicating with each other. All the key players worked together on this goal. Bob's vision of a skid, was a good experience. The contractor that was selected was really great to work with, particularly with

[25] David Miller, FAIA is co-founder with Robert Hull of the Miller Hull Partnership.
[26] David Miller is chair and professor of the Department of Architecture at the University of Washington.

Precision Construction. They're affiliated with Hoffman Construction[27] and their superintendent and the owner were really great individuals to work with. The client rep, Frank Evans and the Superintendent, Phil Broome, those two gentlemen were just great. I went down there to work with them, to work out all the problems. The entire team talked through all of the problems and was very open.

BH: They were craftsmen with pride in their product.

TR: Phil was very well versed and was very open to the goals of sustainability and energy savings. We had a whole recycling plan of how to dispose of different materials and they followed all the processes that were written into our documentation from our goals

BH: Nowadays, we do work better as teams and we let young people get more involved in the team. We let them do exploring and some research, which I think they are very good at, and that comes out in our design panel, too. That's something we have every Thursday. It's actually an important part of keeping continuity in the office. At 4 o'clock we break and discuss projects. This project was probably up three or four times, posted on the wall, for an hour-long discussion. These discussions are geared towards certain answers. You might say when this project is in contract documents, "we're not going to talk concept any more, we're done with that," and maybe talk about some of the critical details, which Teresa and Amy DeDominicis were heavily involved with.

TR: Bob was saying he's old school, but he will come up with the concept and from that point there's still so much design to still work out. We usually circle back to his original concept.

BH: Or greatly alter it!
TR: Well, you know, you look at these drawings and they are all pretty consistent.

[27] Hoffman Construction Company is headquartered in Portland, Oregon.

BH: It's pretty amazing

TR: There's so much design still to do and, speaking as part of the team, it's exciting. There's so much detailing. I felt like I had ownership of the design. You know the railing detailing, how it flows through the whole building, the wood work, trusses, there's so much. It's just endless, really, hours.

BH: We're still not done.

TR: Right away I think of when I was at U of O. Integrating the building systems and building envelope and learning about how a building actually works and functions, was terrific. It's learning the real parts of the building and the process and all sides of it. Learning about mechanical, electrical, plumbing, that, I think is a strong component that you can nurture even further. Once you get into the field and start working as a team, when we have those team meetings in Portland with just the consultants and an architect, you have to understand what they are talking about. You have to understand the mechanical and the civil and the electrical, so in school, that's an important thing to learn. It just improves the building even further. If you understand what they are saying then you can help integrate that into the drawings and then talk to the other consultants. You're communicating with all of them.

BH: I say, trust your consultants, pick their brains and use them more. I don't think you ever stop growing in that respect. For example, with mechanical, you can come out of school having an understanding about how air moves but even I, right now, when I take on a project, I will learn something new about the project in terms of energy consumption or how the building may operate or human comfort. I think now we are starting to bring our consultants in at a much earlier stage. Ideas come much sooner and there are real breakthroughs to be made there. I think if there's a criticism of students coming out now, they know the field so well that they are almost kind of dangerous and they want to use every idea. You've got to kind of cut–to-the-chase and look for the strong ideas and the other ideas may

come or they may get divided off. It isn't a matter of making sure that every slot is filled with a number or checked off. For this particular project, what are some of the big ones that we really want to make sure happen? That's something that students can learn in an office, they don't have to learn it in the University. They just have to be comfortable with some of these trends. Later on one of the most satisfying things is to find ways of working with consultants. I don't think of sustainable design as something that is non-architectural. I always think that the building takes on a certain kind of character partially because of sustainability. It's not the answer to everything; it is doing a lot of things. Because it involves people and comfort, it's a really important thing, but it's only one of a big bunch of things an architect still has to look at. I just find this idea about how energy conservation is starting to really impact our buildings interesting. How are we going to deal with carbon footprint? I mean, in a way, we kind of limped into an interesting side aspect of it here, but that won't work for every project. How do you really conserve energy? I think that's just fascinating stuff.

TR: I think what you said, too about listening to your consultants and working with them is important. As a student, too, is learning to work as a team and not thinking that you yourself know it all. Working on your team-building skills and people skills would also help. Often on this project, I am sitting at my desk with my phone ringing off the hook and email coming in, working with all these different consultants. Everyone has questions or suggestions, so you have to juggle everything, work with them and listen to them. Listen to what they are saying and try to communicate that with another consultant or contractor. It's a lot about communication.

BH: You can't talk your way through it, you really still have to draw. It's still incredibly important and still can't be forgotten. To me, it's paper architecture now, it's computer, paper architecture where you think you are done and you're not. You've drawn it and it seems almost complete, but it's a hollow shell of a building until you really get in there and draw. Computers sometimes leap you ahead so much that you don't get the richness out of working the old-fashioned way.

When I look back on it, we had been doing some sustainability, inherently. Back in the Peace Corps days, Dave and I were designing buildings. I was designing schools in Afghanistan before any of the wars, that did perform well, that did help us and, when we started, they taught us about passive solar in our school rooms and wind in terms of earth shelter and in terms of getting your orientation of the building right to pick up winds. When we started our firm, one of the first energy crises came along. You couldn't get gas and everything shot up price-wise. People started to become interested in this new field because of their bills and so we were, all of a sudden, thrown into this. It was great. It's been there for quite awhile with us, but also because it has architectural implications. I have to admit it wasn't just because of saving energy; all those things have architectural implications.

TR: It's a fun building to go visit, I have to say, for adults and children; it's a great site. There's the fire look-out tower, you can see all around, just moving through the building and then out on to the Wilson River is really awesome. It's just awesome.

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Tillamook Forest Center Narrative: Engineers Paul Schwer and Conrad Brown

Getting the Project

Paul Schwer (PS): We had done some work with Miller Hull on the Wilsonville City Hall. Our relationship with them is probably only about five or six years old, which is relatively new, since both our firms have been around for 30 years. For whatever reason, our firms have kind of synchronized on a cultural level. Sometimes you have projects where project managers get along and the project goes really well, but we're now up to about our eighth or ninth project with them, with six different project managers, and everything seems to be hitting. Our firms have a very similar culture in terms of being very open, very collaborative, very straightforward and willing to listen. We got this project because Miller Hull asked us to submit as part of their team. The only other project we worked with them on before we got this one was Wilsonville City Hall. That project just went well. This one was in Oregon and they wanted an Oregon connection. They knew we did sustainable design work. We connected and we landed it together. They actually had an inside track because they had done some master planning before the actual project came to be. They had done a small picnic area just up the road from the site.

Paul Schwer, LEED AP, is president of PAE Consulting Engineers and a leader in energy-efficient design. He has consulted on close to 30 LEED projects.

Selecting the Project Team

PS: Internal teams are typically selected based on experience with that project type or with that architect. Some of it depends on if the systems are going to be innovative in a certain direction. Even at the interview stage, sometimes we start saying, "Well, is this going to be a carbon neutral building, or do we go geothermal?" We have a bunch of guys who have done geothermal projects. If it's an interpretive center, which has a lot of coordination and lighting design elements, there are different key team members.

Conrad Brown, LEED AP, is s senior associate with PAE Consulting Engineers and was project manager for the Tillamook Forest Center.

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In general, it's who has the client relationship and who has done work on that type of building; an interpretive center is very different from a laboratory, for instance.

Our firm is set up a little differently than some engineering firms and architectural firms that are set up in design studios where you may be in a K-12 studio and spend 10 years working on K-12 project. We intentionally don't set up as a studio so that someone who does different projects gets to take that experience and use it in a different sector. That helped because Conrad has done everything from healthcare to labs to interpretive centers to office buildings. You find out that there are some things that you learn from one project type that are applicable to another and if you're in a studio you never get to see that.

Setting Goals for the Project

PS: There was a firm called O'Brien Company.[1] They do eco-charrettes. We had an eco-charrette very early in the process that was very well-attended from the entire design side, meaning we had civil engineers and landscape architects and architects and lighting all at the same meeting. That does not happen very often. Five years ago, I don't think I could have named a landscape architect. Most of the time we dealt with civil engineers because where their "pipe ends and our pipe starts." The whole eco-charrette process has changed that dynamic. It tends to get very high-level people in those meetings. It's almost impossible to get Bob[2] and I and a couple other people in the same room at the same time. That becomes the one or maybe two times during the entire project where the entire team and all the people who are making decisions are in the same room. In this case, we probably had ten or fifteen people from the owner's side. They didn't have the guy that was going to maintain the building, but they had facilities people from other buildings and they had programs people and guys who were literally foresters.

Conrad Brown (CB): The owner had one of the women that was the originally involved with the area. She kind of spearheaded that project 30 some years ago.

PS: There was someone who was involved in the fundraising and the tree planting that ended in the 1950s or 1960s that wanted to see this building built. She was at that meeting, too. It was very early. There might have been some sketches, some massing studies done, but nothing was set in stone. The building wasn't really located on the site, but they knew roughly where they wanted to put it because they knew they wanted to cross the river, but it was all open in that meeting.

CB: There were certainly no internal building systems or anything like that at that point.

PS: I am not sure they even knew how big the building was going to be other than a rough budget established and a rough schedule. It was early enough in the process where, if we wanted to spin the building around or make it two stories or move it onto a different part of the site, it was all open game. Elizabeth Powers,[3] who ran that charrette, did a good job of opening it up to big picture thinking. That's when we started talking about things like "carbon neutral" and "net-zero." It was four or five years ago so carbon wasn't on everyone's mind; I would bet you 2030[4] wasn't even around. We talked about those kinds of things in setting the goals, and we realized pretty quickly that the traditional way to get to net-zero in small buildings is PVs.[5] We knew in an area that had 110 inches of rain each year, in the forest, that wasn't going to be an option. Conrad and I had had the opportunity to listen to the owner's vision of this building. It was going to be more

[1] O'Brien & Company is a sustainability consultant based in Seattle, WA.
[2] Robert Hull, FAIA is co-founder with David Miller of the Miller Hull Partnership.
[3] Elizabeth A.D. Powers is a principal at O'Brien & Company.
[4] Architecture2030 Challenge asks the architecture and building community to adopt specific targets to reduce the use of fossil fuels. www.architecture2030.org
[5] Photovoltaics (or PVs) are a technology that converts solar energy into electricity.

than just an interpretive center about the fires. It was kind of beyond that; it was about how the fires came to be and how the forest is managed, and how the watershed is managed. It's also about the recreation spot, the wood that comes out of it and what happens to that wood. It became the whole life cycle of the forest and how it's managed. That's when Conrad said, "Well, if you're going to do that, then we should talk about how the wood is used in the building." Bob is a big fan of using wood so he was an easy sell. I had never designed a wood pellet blower system before.

CB: There was a bit of a story behind that. I grew up on a farm, so most of those components, the silo outside, the flex-logger system and the ladder, are all actually things to move pellets into a chicken-growing operation. They're made by a company down in San Francisco that makes farm equipment. That whole system is where I got the idea for the delivery system. Because there are no other systems like this out here right now, there's no delivery system; we didn't even know how we were going to get the pellets out there. We knew roughly where we were going to get them from, because there are only three places here in Washington and Oregon to get pellets, but we didn't know how we were going to get them to the site. Once we got it there, we didn't know how we were going to get it into the silo. We were kicking around some ideas and we were talking to Frank[6] and some of his folks about that. We thought, "What about bark-blower trucks?" because they blow bark up onto green areas on the 20th story of buildings sometimes. There's a bark-blowing company close to where I live so I phoned the guy and I said "hey, this may sound crazy, but I am going to come over with seven bags of pellets from Home Depot in my truck and I want to try blowing them through one of your bark blowers into a plastic garbage can and we'll see what happens." I wanted to know whether the machine would pulverize the pellets or not because the wood pellet boilers can't take the dust, they need the pellets.

PS: If it turns into sawdust it's not nearly as efficient.

CB: I went over there and we threw them in the back of his truck. We started the big old truck up and we were blowing pellets out of it. I took a bunch of pictures of them. It was pretty fun. I think that, overall, the amount of pellets that were damaged was reasonable so, that was how we delivered the first load of pellets to the site.

PS: It was a field study, essentially. The way they deliver them now is interesting. After that first truckload, which was a little awkward because no one had done it before, when the truck stalled out because the pellets got stuck, one of the guys at the site who had grown up on a farm said that, at the farm, they just deliver it with an auger. I've seen those trucks around. Every feed truck in Tillamook has an auger for delivering corn. The next delivery the guy just came up in his auger truck and he said, "Well, I didn't clean out my bed, I have a bunch of corn in it and I threw the wood pellets on top of that, is that OK?" It turns out that if these boilers will burn wood, they'll burn corn, so they just delivered it with their regular delivery truck. Twelve miles away there are deliveries of corn to the silos to feed the cows. It was just a local community kind of thing, the trees come down, they go to a saw mill and the pellets come back all within 60 miles of the site. All within the rural community.

CB: It's a really interesting place where they get the pellets: Columbia City Wood Forest Products. The guy's name is Peters. It's an interesting project where you see the vendor for the fuel source. He's actually on site, standing down in the boiler room, chatting with the owners and the delivery guys. He stops by to see how things are going. It's a little different dynamic than you see in a normal building.

PS: We talked about that with Frank because they had to go out on a pretty big limb. We could not take them to any examples in the Northwest. The

[6] Frank Evans was project director for the Oregon Department of Forestry.

manufacturer's rep for the piece of equipment was in New Hampshire. One of the other engineers we had on the project, Kate Turpin, happened to be from New Hampshire was flying back for a wedding and we asked her to head to this distributor after the wedding and take a look at some of the existing systems in New Hampshire and find out the "lessons learned." She did that when she was back in New Hampshire and it became this kind of family thing.

CB: That was a strange coincidence, too, because the vendor is near her hometown and she knew the store.

PS: It was a little serendipitous there. The other piece is that the day the bids came in the contractor, who was completely uncomfortable with this system because he had never installed one and we had never designed one, made a big push to say, "you know, this is all pretty risky, I'll give you another price just to put in a propane boiler and do it conventionally." It happened in our conference room, I still remember it. It was an hour away from losing everything after a year's worth of work because he was the one that brought up that if they turn into sawdust it won't work, or it'll get wet in the silo and it won't work. He had reason after reason why it wouldn't work. I really thought we were going to lose it because the owner started getting nervous. He knew he was out on a limb already. The owner said, "Now we've got a contractor that doesn't think it's going to work, but, what do we do?"

Conrad was very good about doing his experiment and convincing them that it was going to work, especially with his experience on the farm. Back at the silo, on the farm, they lose their livelihood if the grain gets wet. After they decided to consider it, we stepped back and we wrote a bunch of memos. It could have just been a propane tank out in the field, but they decided to go with the new system.

CB: The funny reversal of all that is that the contractors loved that job. The general,[7] the mechanical,[8] they all loved it. They had their families out there in fifth wheel trailers, they lived on site, and they had barbeques.

PS: By the time they were done everybody was saying it was sad to see the job end. It was quite the turn around. It was a really neat project from beginning to end.

Selecting Technologies for the Project

PS: Before we even got into the energy modeling of those kinds of tools, we had to get to a comfortable level with Miller Hull and know that they would be okay with this system. This is another one of those meetings I remember four or five years later. We were in Miller Hull's office and we were meeting with Bob. We started talking about wood pellet boilers and he's said, "OK, you've got to store the pellets, right?" And l said, "yeah, you've got to store them, and it's going to be big, Bob." He said, "well, how big?" and my response was, "well, it depends on how often they want to refill it." I'm thinking I've got to come up with something small enough that he'll buy-in to it, but Bob just sat there and wasn't judging the discussion. This is classic Miller Hull. For guys that design beautiful work they really don't have the egos that go along with that. He will patiently sit there for 20 minutes and listen to an engineer explain the system. He asked me a bunch of questions and it got to the point where we were talking about the storage tank again, we said it might be 10′ x 10′ and he said, "10′ x10′ is kind of hard to deal with," and I responded, "well, if you make it 5′ x 5′, they will have to refill it every week," and he said, "no, no, no, why don't you make it bigger, you know, it's part of a big building." I said, "wow!" That is when I said that if you make it a silo with a diameter of 15 feet and 20 feet tall they'll only have to fill it twice a year. He said, "Yeah, yeah, that's what I want." How many owners or architects will let you put a silo

[7] General Contractor
[8] Mechanical Contractor

next to their work of art? He just thought the other way. He wanted to make it big enough that he could integrate it into the building. Even his gutter that comes out of the front of the building is this massive thing that dumps the water from the roof onto the pond. It's not a gutter, it's a big 12-inch "V"! When you're at the site you see that it's a massive thing. He was completely comfortable with it, and more importantly, he listened to the whole thing without pre-judging and saying "oh, storage is going to be too big, what else can I do?" Now we had something that the owner's not going to have to refill every two weeks and it kind of made more sense. Then we got into the energy modeling.

We didn't want to model the whole system and then not be able to store the pellets. For the modeling portion of it we used DOE-2[9] and the various products associated with that. Since part of this money was to be funded by the State we had to use the SEED[10] process which can be a bit challenging. We do a lot of energy models but their requirements are very, very specific. But they were fine. They were very open to the idea. A lot of owners see the SEED process as an unfunded mandate. It has to do with the energy model, which is fine. What the owners are then required to do is if something has a certain payback period, they're required to do it. As engineers we want to use it, but if it's not in the budget sometimes it doesn't happen. If, all of a sudden, out of our $11 million budget we have to spend $100,000 on something that's sure to take up two to three years, they might not want to go down that path. The modeling of the biomass was very difficult.

PS: Energy models usually aren't that accurate so the reality is that we over-predicted the heating and under-predicted the electricity use. It's using a lot fewer wood pellets than we thought it would and a little bit more electricity, but they happen to balance out to make it very close. That model looked at the biofuel, but also looked at one of the tricky things in interpretive centers: interpretive lighting. It's different. Usually there are two lighting designers on an interpretive center and the interpretive lighting designers really crank up the lighting; we're talking 4 or 5 watts per square foot. We've been trying to get interpretive exhibit designers away from that. We have another one we're designing now in Montana and we have two different lighting designers. They're both on board with really knocking that down because in that particular project the electrical lighting is a big chunk of the load. Once we design a real efficient building with a good skin, good glazing and an efficient heating system, what are left are the lights. We really couldn't knock those down as much as we would have liked to.

Tracking Progress on the Project

We didn't get net zero, but we hit some goals and, in hindsight, maybe we did a little too much. One of them was the pond that's outside the front. We're using that for an incredible number of things. It is fire storage for the building and for the area, and it is rainwater reclamation coming back into the building and being used to flush the toilets. It's there for landscape and aesthetic reasons and a nice way to enter the building. We also use the water to cool our chillers which is a relatively small cooling load. We put in a water-cool system. It is probably more sophisticated than it needs to be for the amount of energy it saves, but we just couldn't resist, having a water source right there, not tapping into it. Ponds aren't all that clean so you have to filter it. That's some added maintenance. One of the things that we talked with the owner a lot about early on was how the building was going to be maintained. Is it going to be some guys from Salem coming out once a month to check on it? Or is there going to be on-site staff because it's such a large park area? They said they were going to have an on-site staff guy and we said, "Okay, as long as there's

[9] DOE-2 is a widely used freeware building energy analysis program sponsored by the U.S. Department of Energy (USCOE) that can predict the energy use and cost for many types of buildings.

[10] SEED is the State Energy Efficiency Design program that designates through policy of the State of Oregon that state facilities be designed, constructed, renovated and operated so as to minimize the use of nonrenewable energy resources and to serve as models of energy efficiency.

someone on-site and if something goes wrong we don't have get a work order in Salem to get it fixed." If they hadn't done that, we probably wouldn't have gone as sophisticated as we did. No one's ever done the biomass piece and the water cool chillers at that scale. It's an intimidating mechanical room to walk into. It's become a part of the tour of the building these days, going down into that room.

CB: We've periodically dealt with trying to resolve the commissioning issues that are left over. One piece would get fixed and then we'd get a call 4 or 5 months later. We started working with Darryl Anderson[11] up there, the guy that takes care of the building. Every once in awhile he'll call me up and say, "Guess what happened…" Then I'd walk him through the subtleties of what that meant with respect to the control system. They're getting used to running the building now and they're able to fix most things on their own.

Lessons Learned

PS: If I were to do one thing differently, I would have had Darryl involved in the design process. They just couldn't get the funding to hire him early enough and came on afterwards. Conrad and I went a long way to make it work by just being out there and walking him through and showing him how it works until he got comfortable with it. It was a little bit of a labor of love but, in general, you need to commission buildings that are this unique. We ended up commissioning this one, which I think worked out fine.

CB: The other thing that made this project successful was Frank Evans. He's an architect and his job is not to stand down in mechanical rooms and figure out how to run pumps, but he was down there just like the maintenance guys learning every aspect of the system. He really wanted it to be successful. He took a personal interest in it and he spent the time to learn how things work. He would be out there on the weekends fixing things or cleaning things and, from the owner's standpoint, he was pretty instrumental in making the continued operation of the building successful.

PS: Even during design he was doing all of his own research to find out where they're using similar systems, why they are using what they are using, and how well they do. He knew the manufacturer's names by the time we brought them all to the table. He did a lot of back work. He was kind of the nuts-and-bolts guy to it all. Doug Decker[12] was a visionary in terms of getting the fundraising and getting all the agencies together. They made a really good team: a visionary guy and a guy who wasn't afraid of getting his hands dirty. There were some things that were really out of whack on the commissioning.

CB: There are two things that were crazy when we started commissioning the building. We couldn't figure out why the chiller would come on and run and run and run and never seem to reach a set point. The chillers are supposed to come on, cool all the water down, and, once there's no more need for that cool water, cycle off and not turn on again until there's a need. This chiller would come on and it would keep running and running and running until it would go off by means of a safety limit. We'd look at the temperatures on the building automation system computer and on the digital display or on the chiller and everything looked fine. We couldn't figure out what was going on. Eventually, what we found was that the sensors were switched so it was always reading the return water temperature instead of the supply water temperature. It makes the return water temperature really cold.

PS: It would just never get there.

CB: The other thing that was happening was that there was a similar scenario with the supply air. It was trying to maintain a temperature of the air

[11] Darryl Anderson, facilities manager at Tillamook Forest Center.

[12] Doug Decker was project leader for the Oregon Department of Forestry.

leaving the air-housing unit, but it was reading the wrong sensor. It was reading the sensor that was in the mixed air stream or the outside air stream. It was in front of the heating coils so, no matter how much energy it dumped into the air stream, it would never read the warm air. It was just get hotter and hotter and hotter until the building overheated.

PS: And the computer thinks it's satisfied. Those are two pretty big mistakes and, if you didn't commission, that building would have been using tons of energy. It would have been cooling all the time and heating at the wrong time.

CB: It caused all kinds of grief because the building automation system started to try to correct for this problem, not knowing what it was doing, and it switched the building to 100% outside air thinking it needed cooling, but the heating coil was still trying to heat.

PS: From my perspective, I know now that the Miller Hull guys are open to just about anything so it makes us very comfortable talking about systems. We're pretty forward engineers to begin with, but you don't want to get shot down ten times in a row when you bring up geothermal or biomass or try to do something funky. We know that they're the kind of client that's completely open to it, and they were into it, too. That makes it much easier to suggest things to them; in fact, we have a project now with them with a wastewater treatment facility in Olympia where we are using methane combined heat and power to heat the building. There's really no limit to the kind of things we can suggest and work together on as a team, but it's kind of a special relationship. We work with dozens and dozens of architects, but there's only maybe five or six where you get to the point where you're really part of the design team.

CB: It's hard to explain, but Miller Hull has a little different approach to the way they do things. Like Paul was explaining about that silo, they are not necessarily scared by some feature in the building, as long as they can figure out a way to make it work with what they are trying to achieve, they are open to doing it. Not all architects are like that that we work with.

PS: The other thing that they have is a good mix of true artists and designers and technical guys. Bob Hull is the true artist guy and there are guys there like Rich Weiland that when he's working on lab buildings with us he wants to know how things are ducted. He's fine talking about the details and where the shafts and ducts go and relating it to structure. I spent a half an hour last week describing how the methane-combined heat and power system works to Scott Wolf,[13] which is just completely a mechanical system. To most architects it's a pipe coming into the building, but he really wanted to understand how it worked and what was happening to the methane. We can talk for an hour about mechanical systems. Most architects want to get to the next thing.

Project Tax Credits and Incentives

PS: The project was such a small scale that the incentives, if they're only 25 cents or 50 cents a square foot on a 12,000 square foot building, are not worth our time to fill out.

CB: We had a lot of comments back from the State about what we were doing and why we were trying to use something other than conventional fossil fuel. We had to deal with the actual ability to use biomass out there quite a bit. Eventually they got through their reservations about the system and we got the SEED process completed, but it was a bit of a bumpy road.

PS: One good thing about the SEED process is the 18-month checkup that's required on all the buildings to see where they're at. Looking at our energy model versus what's actually being used, that's really helpful information for the industry in general, but also for the State agencies to know. That particular model predicted that the building would be 30 % more efficient and it was within 4 or 5% of the actual energy use.

[13] Scott Wolf is a principal at the Miller Hull Partnership.

Hiring New Staff

PS: I know what I am looking for. I am looking for people who are lifelong learners. Engineering school or any school, really, is just one step in the whole process, especially when you get into this industry. I look for people that look beyond whatever training they've done; people that have a broader base of knowledge than just the discipline. It's not just the technical skills I am looking at because the technical skills will only get you so far in consulting. At some point you have to be able to engage the client and that's something that's missing from the engineering program. Architectural programs do a much better job of it. Architects in school, from time to time, listen to an engineer or take an environmental controls course and get deep into it. I literally got through four years of engineering without taking one class in architecture. It is typical, but it's not a service to the architects.

CB: What I look for when I interview people is other engineering experience. You can, like Paul said, go through mechanical engineering school and never take one class in HVAC. You can go through an entire four years, walk out of there and have no idea what a duct is or a building heating system. What I like to hear from the people that we interview is that they're interested in our side of the business and took the time to at least figure out what it is, what we do and have some particular areas that interest them. One guy, that we interviewed only a couple of weeks ago talked about trying to do some work to his house so he had taken a class on eQuest. He put his house into eQuest and he was analyzing the window upgrade. I can tell he has a particular interest in something that we do and he could probably find the rest of the things we do interesting and stimulating and make it part of his career. That's what I look for. I look for something, some link to what we do in their lives. Whether it's that they have practical experience, other than what they do in the summer. Some of them would have taken the first job they could get. Others focus in on something they think is helpful to them and their careers. If that happens to be something that is related to what we do, then I can get a feel for their direction and what their potential might be.

Closing Thoughts

PS: We need better feedback tools. We need to know how the energy in buildings is actually being used. It's amazing that we design dozens and dozens of buildings, but we rarely go back and get the kind of data that we have on Tillamook because, when the job's done, our fees are done. ASHRAE,[14] for all of its benefits, doesn't do a lot of research or monitoring of buildings after they have gone up. It's something I think the utilities should really do or share what they do. Here's an EUI,[15] here's how much carbon there is, etc. The feedback database is going to get used a lot more now that it's a tracking device for Architecture 2030. We need really good data bases like that and then we need the information on how the top ten buildings in that data base get to where they are. If all of the energy studies in the world say you're 50% better it doesn't mean squat if the building doesn't perform. The best example of that is probably the Four Times Square building, the Conde Naste building. All kinds of press for years and years and years and they finally measured it after it's been occupied for a few years and it's below average. It just missed and there was something wrong.

CB: I would like to see utilities, in all the incentives they offer, get building owners to break out their power systems. Even if they don't want to pay for the metering now, they should be installing a system where they can be metered separately. Break out the lighting, break out the HVAC and break out miscellaneous modes in electrical circuiting so that later on people can come back in, clamp meters on there, leave them there for a year, and get some real usage data.

[14] American Society for Heating, Refrigerating and Air-Conditioning Engineers.
[15] EUI stands for Energy Use Intensity. It is used to provide a benchmark of comparison of energy use.

PS: And that doesn't take that much going into it. There aren't enough people to interpret it all. I'm always asking my energy modelers to give me the last ten laboratory buildings and their EUI and they can't find it. There's nothing out there. Even our own last ten lab buildings don't have data. We have to call the owners. Sometimes they have the data, most of the time they don't, and they can't bring it down. That feedback loop is not there yet. For other industries it would be ridiculous not to have that feedback loop, but when you think about the A and E[16] fields, the average architectural firm in this country is only ten people. The big ones are 1500. Intel has 150,000. There's a different scale in terms of the GMs and the companies that can afford R&D budgets. Our industry needs to find a different way to do it, whether it's through academia or ASHRAE and professional organizations.

CB: I also think it is standard to pay your utility bills and not ask questions, whether it is your house or your company. How many people say, "This is totally wrong, I'm not paying this much in water," or try to figure out why it seems like it's too much. People don't have anything to compare it to.

PS: It's interesting. Miller Hull is starting to call our people to create an internal database. We're starting an internal database, which is great for our companies, but not so much great for the industry. At GBD, they're starting to have people share the little things they are doing at home and how they changed. I think that would be a great thing for those internal green teams. That's something you can control and you learn, when you swap out those windows, what it did to your EUI. And then you can share that with the other people in your office. I am sure there is someone else in your office that has single pane windows and is thinking about changing them out. What better than to talk to your fellow cube-mate and discuss how it really came out.

[16] Architecture and Engineering

This narrative, part of a larger case study describing the Tillamook Forest Center, was supported by a 2007 AIA Upjohn Research Initiative Grant.

This narrative is based on an interview with engineers Paul Schwer and Conrad Brown by telephone to PAE Consulting Engineers in Portland, Oregon on May 12, 2008. University of Oregon graduate student, Britni Jessup, transcribed a digital audio recording of the interview. The interview was conducted by University of Oregon Professor Alison G. Kwok.

Exhibit 1: Tillamook Forest Center

Fig. 1. The approach to the Tillamook Forest Center

Fig. 2. Aerial perspective with a view of the bridge across the Wilson River

This exhibit, part of a larger case study describing the Tillamook Forest Center, was supported by a 2007 AIA Upjohn Research Initiative Grant. University of Oregon Professor Alison G. Kwok and Britni Jessup with Nicholas B. Rajkovich, Pacific Gas and Electric Company (PG&E), prepared the associated narrative.

Fig. 3. The scupper that collects rainwater between the two roof planes and delivers it to the pond

Fig. 4. Aerial view of the scupper

Fig. 7. Aerial view of the multi-functional pond near the entrance

Fig. 5. The bridge that crosses the Wilson River

Fig. 6. The silo that sits to the West of the building, just out of sight of the bridge

Fig. 8. The approach from the river, the silo off to the western edge

Fig. 9. The bridge over the Wilson River

Fig. 10. The pellet boiler in the mechanical room

Fig. 11. Detail of the exposed interior roof structure

Fig. 12. Detail of entry sequence and exposed interior roof structure