Oregon Health & Science University Center for Health & Healing is one of only 50 buildings in the country to have been awarded U.S. Green Building Council (USGBC) LEED® Platinum certification and the largest and most complex building in the country to have achieved it.

The secret to the success of the project was the integrated design process that was undertaken from the beginning of the project. Collaboration between the developer, engineers, architects, commissioning agents, and owners allowed the team to make key design decisions early in the process and conceive the project holistically.

The integrated design process not only changed the way building design approached the project, but showed that sustainable design need not cost more. The more closely the team looked at building systems, the more they discovered opportunities to reduce costs by reducing equipment or rethinking it to perform multiple functions, rather than opting for the status quo. The Center for Health & Healing is located in the South Waterfront District, a former industrial area along the Willamette River just south of Portland, Oregon’s downtown. In a pioneering public/private partnership, the city teamed with its largest employer, Oregon Health & Science University (OHSU), and Portland’s more environmentally progressive development companies to build a dense urban enclave with housing, green spaces, commercial and retail buildings, and an expanded campus for the school.

Goals and Challenges
The development and design goals for the project were to provide cutting-edge health and wellness technology in an environmentally responsible building. The developer challenged the design team to reduce the capital costs for the building’s mechanical systems by 25% and also outperform the Oregon energy code by 60%. For a single-use building, the goal would have been bold enough. Given the building’s size and exceptional mix of uses, it was nothing short of audacious.

The building contains a three-story underground parking garage that provides approximately 660 parking spaces for patients and staff. In addition, eight floors are devoted to medical research, clinics, surgery, classrooms, and ground floor retail and underground parking.

Cost: $145.4 million
Distinctions: LEED Platinum

Owner: RIMCO, LLC
Developer: Gerding Edlen Development
General Contractor: Hoffman
Architect: GBD Architects
MEP Design + Energy Modeling + Commissioning: Interface Engineering
Structural Engineer: KPFF
Civil Engineer: Otak
Landscape Architect: Walker Macy
Commissioning: Glumac
LEED Consultant: Brightworks
Building Management: CB Richard Ellis

By Dennis Wilde

Photo © Bruce Forster

Photo © Jamie Forsythe
to physician practices, surgery and imaging centers serving a wide range of specialties and programs. Four levels are dedicated to education and research activities, including laboratory space for the biomedical engineering program. Three floors house a comprehensive health and wellness center which includes a full gym, four-lane lap pool, therapy pool, cardio and weight training areas, multipurpose studios and a day spa. The biggest challenge was the complex uses inside the building. Owned by OHSU and the university doctors’ group, the project had no major foundation or government grants, so the pro forma was similar to spec office, where every use inside had to pay its own way.

The project began with a two-day eco-charrette to kick off the integrated design process, which allowed the team to share ideas about how the building could be designed for optimal building performance. As a result of the charrette, the team added further goals for the project including 100% capture and reuse of rainwater falling on the building, 50% or more reduction in total use of potable water in the building, providing significant amount of power and chilled water on-site from a combined heating/cooling plant, and treating all sewage on site and reusing that water for non-potable uses. Then at mid-design, the project team targeted a sustainability goal of LEED Platinum, a first for a medical and research facility of this type, size and complexity. All of this was accomplished with a 1.3% cost premium on the project, again a testament to the

**ENERGY-EFFICIENT DESIGN MEASURES**

- Passive heating/cooling and natural ventilation of stair enclosures
- Radiant cooling for the atrium and lobby ground floor, using reclaimed water and ground water in the thermo-active concrete slab
- Heat recovery systems, including from laboratory and general exhausts and returning gym air through the locker rooms
- Demand controlled ventilation (DCV) using carbon dioxide sensors and occupancy sensors, so spaces are not overventilated or overlit when not in use
- Night flush precooling with outside air up until one hour before daily occupancy
- Building commissioning, including field verification of all energy using equipment

The use of sustainable and low-toxility materials in interior finishes and furnishings provides optimal air quality. These include agrifiber door and cabinet cores and urea-formaldehyde free composite woods.

The Center for Health & Healing is open to the public and provides a neighborhood café, a day spa, and membership access to the extensive wellness center. The atrium functions as a public gathering place—a living room—as the primary civic building in the district. Radiant cooling in the atrium and lobby uses reclaimed water and ground water in the thermo-active concrete slab.
value of integrated design and collaboration from day one of the project.

**Sustainable Strategies**

The project set out to meet the highest standards of environmental stewardship and energy efficiency. The building garnered 55 points out of a possible 69 on the LEED scorecard, three more points than required for platinum. Thirty-seven energy conservation measures were incorporated into the final building. According to the Energy Trust of Oregon, the building set the record for the greatest number of strategies integrated into a facility. The result is energy cost savings of 61% more efficient than a building built to Oregon code, 50% more efficient than required by ANSI/ASHRAE/IESNA Standard 90.1-1999, and approximately 50% more efficient than required by Standard 90.1-2004. This is a remarkable achievement given the complex array of uses and systems that were needed in the building.

**Architecture of Integration**

The project team set out to capture every opportunity to integrate function, architecture and engineering through a great collaborative team effort. Right-sizing and expandability were key strategies for making the HVAC system efficient and affordable. Instead of designing for maximum loads, the system was sized for current uses with the ability to expand later if needed. To help the building meet its financial requirements, leasable square footage was

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**ECONOMICS**

<table>
<thead>
<tr>
<th>Total Project Costs</th>
<th>$150 million or $375 per square foot</th>
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<tbody>
<tr>
<td>Construction Costs</td>
<td>$120 million (construction only)</td>
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<tr>
<td></td>
<td>$160 million (including FF&amp;E)</td>
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<tr>
<td>Operating Costs</td>
<td>$7.15 per square foot (base building expenses)</td>
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<tr>
<td>MEP Initial cost savings</td>
<td>$4.5 million (15% of original MEP budget)</td>
</tr>
<tr>
<td>Financial Incentives</td>
<td>$1.5 million (DOE; Energy Trust of Oregon)</td>
</tr>
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</table>

**TOTAL ENERGY USAGE AT CHH**

![Graph showing total energy usage at CHH]
Designing a high performance building began with assessing the natural resources available on the site. Temperature, rainfall, groundwater and wind flow data were analyzed and a computational fluid dynamics (CFD) model of site wind flow were used to identify climatic loads and sources of “free” energy. Next, an estimate of the baseline energy use helped identify where the greatest savings could be found. Heating, hot water, and lighting uses offered the most significant savings. Daylighting models and the energy model informed the placement of sunshades and stair tower ventilation that helped reduce cooling loads and downsize the mechanical system by 30 tons. These cost savings helped pay for the expense of adding PV panels to the sun shades. Discussions with the client regarding thermal comfort allowed relaxed temperature ranges in circulation areas.

This doubling up of functions informed a number of integrated design strategies. The most significant is the sanitary waste reclaim/rainwater/groundwater reclamation system, which performs six different functions: toilet flushing, cooling tower makeup, irrigation, radiant cooling, microturbine inlet cooling, and storm water detention.

Additional equipment savings were found by strategies such as combining garage ventilation fans with atrium smoke evacuation fans, timed egress analysis of atrium to reduce smoke control exhaust, and chilled beams for radiant cooling that reduced duct runs. Besides energy storage in the water cistern, the concrete slab provides thermal mass and the swimming pool in the health club is used for load shifting of excess heat.

**People: Health and Comfort**

Personnel costs can be from $200–$600/square foot, costing far more than rent and operating costs. Even minimal increases to worker productivity can increase the income of an organization far beyond the most ambitious O&M cost savings. Therefore, optimal air quality and thermal comfort were top line priorities for the project. Significant energy savings were realized by relying on natural ventilation in the stairwells and air pressure and the inherent properties of warm air rising.

Optimum health and reduced energy use were the primary goals that guided the mechanical design system. For examination and office spaces, displacement ventilation was selected as the best method to achieve both of these aims. Displacement ventilation drops cool air from the high point of an interior wall at relatively low

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**PERFORMANCE DATA**

(7/2007 to 7/2008)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
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<tbody>
<tr>
<td>Total Energy Use</td>
<td>170,954 Btu/ft²</td>
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<tr>
<td>Electricity</td>
<td>57,656 Btu/ft²</td>
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<tr>
<td>Natural Gas</td>
<td>113,259 Btu/ft²</td>
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<tr>
<td>Energy Cost Savings</td>
<td>61% more efficient than Oregon code; 58% more than Standard 90.1-1999; and approximately 50% more than Standard 90.1-2004</td>
</tr>
<tr>
<td>EPA’s ENERGY STAR® Performance Rating</td>
<td>77</td>
</tr>
<tr>
<td>Percent On-Site Renewable Energy Generation</td>
<td>2% (0.7% BIPV, 1.3% solar thermal)</td>
</tr>
<tr>
<td>Percent Grid-Supplied Renewable Energy</td>
<td>50%</td>
</tr>
</tbody>
</table>

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The Center for Health & Healing demonstrates in bricks and mortar that a healthy built environment is integral to healthy living.
Rather than using the energy models to confirm expectations, the team used the models as a tool to develop new strategies, systems choices and material selections. Several innovative features were incorporated in the project, some of them highly visible and others not as readily apparent. The exterior sunshades combined with solar PV panels make energy while they make shade. The PV system provides 66,000 kWh annually while contrib-

speeds in a waterfall effect. As the air is warmed by bodies in the room, it rises, but remains cool enough to cool the occupant. Displacement ventilation reduces fan energy by two thirds, as well as eliminating the reheat of incoming air.

The selection of sustainable and lower toxicity materials was also emphasized for interior finishes and furnishings. The team used low volatile organic compound (VOC) paints and sealants, urea-formaldehyde free wool products, and sustainably manufactured carpeting systems throughout the interior to further maintain indoor air quality.

Energy: Solar, CHP, HVAC

Energy savings at the Center for Health & Healing are 61% better than code, an accomplishment for a building of this size and complexity. Using energy models, the integrated design team was able to identify the most advantageous approaches for

Water is increasingly regarded as one of the most important environmental and infrastructure issues, and rightly so. In a climate like Portland, rainwater harvesting seems an obvious choice, but the available rainfall only met about 10% of the building’s requirements. In addition to capturing every drop of water that fell on the roof, the team looked at several other strategies to make the Center for Health & Healing one of the most water-conserving buildings in the region.

Portland’s relatively high fees for water usage and connections as well as the estimated annual sewage contribution of 5 million gallons made a strong case economically and environmentally to contribute as little wastewater and stormwater as possible to the city’s combined sewer system.

To keep all rainwater onsite, a 20,000 square foot eco-roof was installed, covering more than 50% of the total roof area. An underground storage tank, required for fire suppression, was made larger to accommodate more water.

To provide for all of the building’s non-potable water needs, the team decided to use a membrane bio-reactor to treat all of the building’s wastewater on site. The building reuses 14,000 gallons per day for non-potable uses such as irrigation and flushing toilets. By identifying end uses and using low-flow fixtures, the project was able to reduce potable water use by 62%. No potable water is used for waste conveyance or irrigation in the building.

The green roof is used for rainwater harvesting and temperature moderation, as well as to provide for some wildlife habitat.

A sitting area along one of the green roof decks offers laboratory employees access to fresh air and dramatic views of the Willamette River and Mount Hood.
The prominent solar collector/trombe wall that occupies the 15th and 16th floors provides a prime example of the advantages of an integrated design team. Engineers identified the potential of the space early in the process and were able to work with the architects to incorporate into the design a 190 feet long by 32 feet high solar heater. The warm air produced inside the trombe wall by the greenhouse effect is recirculated through the building in winter, reducing the building’s energy use.

A combined heating/power plant using microturbines provides combined heat and power to the building; the turbines achieve 78% efficiency of fuel conversion compared to a typical electric power generation and transmission plant that realizes only 32% efficiency. Additionally, waste heat from the turbine exhaust is converted to hot water which is used to pre-heat water for the center and for hot water demand, as well as stored in the thermo-active first floor slab or the health-club swimming pool.

The overhead chilled beams that provide radiant cooling are less obvious to the naked eye but also provide substantial savings to the building. The building uses passive and active chilled beam systems, and combined with the displacement ventilation and baseboard convective heat, providing thermal comfort with a mostly passive system. An additional advantage of chilled beam systems is the corresponding HVAC system can be more than three times smaller than a forced air approach for cooling.

Dennis Wilde is a principal at Gerding Edlen. He has a bachelor’s degree in architectural engineering from Washington State University, and master’s degree from the University of Pennsylvania. He is a board member of the Oregon Natural Step Network.

**LESSONS LEARNED**

Setup is key for all parties. Obtaining collective buy-in/ownership by all parties to project objectives is critical.

Whole systems thinking is essential, meaning you cannot look at the building in a system by system manner, you have to look at interrelationship between the systems.

If you squander the opportunities in terms of building orientation, etc., at the beginning of the design process it’s impossible to make up.

Value to user is critical. The user is seldom effectively considered in design process. It’s not just optimizing the programming, consider the user experience.

Architectural outcome must reflect all inputs.

Look for opportunities for joy and delight. Happy accidents are often the best parts of the built environment.

Everyone is under the spotlight, not just the architects.

MEP consultant and general contractor must feel invested in the outcome from the beginning, neither the MEP or contractor can take a “sit back and wait” attitude.

Commissioning agents and building and facilities managers must be involved early. The building’s complex operations took considerable time and expense in the commissioning process. Most of the building’s systems were monitored through the direct digital control (DDC) system, and in the early months of commissioning, the system was painfully slow. The complexity of systems also creates more potential for problems and domino effects when one part of the system breaks down. For example, the newly planted green roofs and landscapes demanded more water than anticipated, leaving the building’s cistern too low at times to flush the toilets. That triggered the backup system along with the 17-cents-per-gallon penalty the city demanded for the accelerated permitting of a previously untried system. The team acknowledged that many of the building’s technical features were quite complicated and pointed to features like the solar heater, with no moving parts, as a goal that every new building should strive towards. Future design of more sustainable buildings should aim to be smarter and simpler. We habitually build buildings full of mechanical equipment that’s seldom used and systems that do not complement each other. Why not get creative?

High performance glazing, along with the sunshades, minimizes glare, heat gains, and electric lighting usage.

**ABOUT THE AUTHOR**

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