The nonprofit began a search in 2006 for a new home that could accommodate the headquarters under a single roof and serve as a symbol of the organization’s mission. The four-story Packer-Scott Building, a neglected historical landmark built in 1892 and located on the blighted edge of Portland’s downtown, provided an opportunity to unite Mercy Corps headquarters staff while also stimulating positive change in the economically challenged neighborhood and underscoring Mercy Corps’ commitment to global environmental stewardship.

At the same time, Mercy Corps’ leadership felt it was critical that its new headquarters project be fiscally conservative. It shouldn’t compete with fundraising for humanitarian programs. The design process involved cost-benefit analysis with an emphasis on proven, readily available building systems, to achieve an initial goal of LEED Gold. That goal was elevated to LEED Platinum through a partnership with the Lemelson Foundation, a philanthropic organization focused on advancing technological innovation for social benefit. The organization agreed to fund the additional costs for meeting LEED Platinum requirements, and owns and uses a portion of the headquarters building.

The resulting headquarters is comprised of the restored 42,000 ft² Packer-Scott Building and a new addition of similar size.

Helping people survive natural disasters, poverty and conflict is not enough for international aid organization Mercy Corps. It also gives communities the tools to thrive using social innovations such as financing community-run village pharmacies and providing farmers in the developing world with financial services, market information and agricultural services to boost their harvests. But fulfilling its mission was frustrating because the organization operated out of six separate leased office spaces. Mercy Corps needed a place to call its own.

The Action Center features interactive exhibits that educate visitors about the constantly changing nature of relief and development work, and provide suggestions for concrete ways people can act now to help with today’s global and environmental issues.

The ground-floor reception area and open stairs of Mercy Corps Portland, Ore., headquarters reflect the organization’s open and collaborative culture.

Top left: The Action Center features interactive exhibits that educate visitors about the constantly changing nature of relief and development work, and provide suggestions for concrete ways people can act now to help with today’s global and environmental issues.

Opposite: View toward west from Burnside Bridge. The new building (foreground) is designed to be a clear expression of its time while simultaneously complementing the character of the adjoining renovated Packer-Scott building and the historic Old Town/China Town neighborhood.

Below: A spacious atrium that doubles as an informal meeting area is defined by a light-filled stairwell that connects the building’s levels. Culminating in a balcony and staff lounge encircled by operable windows, this airy core also functions as a stack ventilator.

MERICY CORPS WORLD HEADQUARTERS

BY CHARLES DORN, AIA, AND ROB SCHNARE, P.E., ASSOCIATE MEMBER ASHRAE

BUILDING AT A GLANCE

<table>
<thead>
<tr>
<th>Name</th>
<th>Mercy Corps World Headquarters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Portland, Ore.</td>
</tr>
<tr>
<td>Principal Use</td>
<td>Office headquarters building for nonprofit relief organization, Action Center (learning center) for students, gallery, public meeting rooms</td>
</tr>
<tr>
<td>Owner</td>
<td>Mercy Corps</td>
</tr>
<tr>
<td>Employees/Occupants</td>
<td>296</td>
</tr>
<tr>
<td>Gross Square Footage</td>
<td>82,800</td>
</tr>
<tr>
<td>Final Cost</td>
<td>$21 million</td>
</tr>
<tr>
<td>Distinctions/Awards</td>
<td>LEED-NC v2.2 Platinum, 2009</td>
</tr>
<tr>
<td>2012 AIA COTE Top Ten Green Project</td>
<td></td>
</tr>
<tr>
<td>2011 National Housing &amp; Rehabilitation Association J. Timothy Anderson (“Timmy”) Award for Best Historic Rehabilitation Involving New Construction</td>
<td></td>
</tr>
<tr>
<td>2012 TomKat Prize for Energy Performance Improvements</td>
<td></td>
</tr>
<tr>
<td>Cost Per Square Foot</td>
<td>$253</td>
</tr>
<tr>
<td>Original Structure Built</td>
<td>1892</td>
</tr>
<tr>
<td>Substantial Completion/Occupancy</td>
<td>2009</td>
</tr>
</tbody>
</table>
areas at the perimeter of the existing building and along the eastern façade in the new building, which offers views of the park, Willamette River and distant mountains. On the north and south façades, a terracotta rainscreen system, used for the first time in Oregon, is composed in a textile-like pattern, designed to be compatible with the scale and proportion of the existing façades. Terracotta, a natural clay material, relates to the existing building’s historic brick exterior in a modern way. In addition, its panelized construction will easily accommodate future expansion or replacement of damaged panels.

The east façade is composed of a subtle woven pattern of clear, translucent and opaque glass. The existing building’s brick wall makes up the west façade.

Water Strategies

Water conservation strategies focus on reduction of use, combined with filtering and retaining storm water on site. Permeable paving allows direct ground infiltration during rainfall. A 3,800 ft² vegetated roof filters water and slows storm water discharge, contributes to better air quality, and diminishes the project’s heat island effect. Potable water use is reduced by 44% by installing water-saving plumbing fixtures such as low-flow faucets and dual-flush toilets.

The green roof added to the historic building consists of a waterproofing membrane, root barrier, drainage mat and 6 in. depth of lightweight topsoil, blended specifically for eco-roofs. Plantings of sedum rooted cuttings and grasses in 4 in. pots provided complete vegetative cover after one growing season. Other site landscaping consists of native plants xeriscaped to eliminate the need for irrigation.

Energy Performance

The strategy for achieving LEED Platinum focused primarily on

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Energy performance. The design incorporated many energy efficiency measures (EEMs), including a variable refrigerant flow (VRF) HVAC system, a dedicated outdoor air system (DOAS), carbon dioxide sensors, daylight controls, improved envelope insulation, and high-efficiency fenestration.

**ENERGY AT A GLANCE**

| Annual Energy Use Intensity (EUI) | 36 kBtu/ft²·yr |
| Natural Gas | 2 kBtu/ft²·yr |
| Electricity (from Grid) | 34 kBtu/ft²·yr |
| Annual Source Energy | 118 kBtu/ft²·yr |
| Annual Energy Cost Index (ECI) | $0.98/ft²·yr |
| Savings vs. Standard 90.1-2004 | 60% |
| Design Building | 63% |
| Heating Degree Days (base 65°F) | 4,676 |
| Cooling Degree Days (base 65°F) | 551 |
| Average Operating Hours Per Week | 60* |

*In addition to the regular office hours (8 a.m. to 6 p.m. Monday–Friday), the Action Center is open on the weekends and the Community Room is open to the public on the weekends. When responding to a crisis, staff member work overtime, extending building operation hours.

Energy cost-saving goals for the building were calculated to be $37,350 per year, or 35%, compared to ASHRAE/IESNA Standard 90.1-2004. The building is exceeding design energy use goals, operating at 36 kBtu/ft²·yr with an energy cost of $0.98/ft²·yr. The energy-saving measures divert 222 tons of CO₂ annually.

**HVAC**

The team considered many HVAC options, including radiant heating and cooling, low temperature central VAV systems and VRF heat pump systems. The design team selected the VRF heat pump system because of its packaged-zone design, quietness, adaptability and moderately low initial cost.

Distributing loads between internal zones and external façades was key to achieving energy performance goals. Internal heat gains at Mercy Corps are generally from data closets, isolated conference rooms, and a few separate office spaces. While these internal loads are not great enough to significantly decrease the building’s overall heating loads, they do provide sufficient interior/exterior heat exchange for electrical energy savings.

The orientation of building façades and the layout of heat exchange systems has a more significant impact on heat-exchange energy savings. Ideally, all four façades would be incorporated into a single system, but due to the circulation layout, which supported the workplace strategy, the building was divided into east and west zones. This allowed the system to take advantage of the best opportunity for exterior heat exchange, transferring the radiant gains from south-facing spaces and to the cooler north-facing zones. While the Portland climate is generally heating dominated, a good portion of the year has moderate exterior conditions that enable this perimeter zone exchange.

The split rooftop heat recovery units allow for up to 20 tons of cooling, but the systems were designed to allow for cooling diversity and 25 to 30 tons of connected load. The focus on zonal heat exchange and maximizing diversity resulted in reduced capital system costs and increased energy savings.

**Controlling Comfort**

Consolidating Mercy Corps headquarters staff in one location also offered the opportunity to improve the comfort of the interior environment. Off-the-shelf solutions for adjusting comfort by zone and controlling the VRF system are suited for the building. Variable rates of air delivery from concealed fan-coils provides better airflow control than a typical fan-coil system.

Operating in parallel with the VRF heat pumps is a dedicated outdoor air system (DOAS) that better responds to the building ventilation needs. The DOAS is sized to provide 30% greater airflow than the ASHRAE Standard 62.1-2004 requirements and minimizes ventilation as necessary with CO₂ sensors in all occupied areas.

Rooftop gas-fired units with heat-wheel heat recovery provide the variable rate of ventilation delivery through variable air volume (VAV) terminal units, which serve ventilation zones that are defined by schedule and occupancy type. High-density zones such as conference rooms are provided with dedicated VAV terminal units and CO₂ sensors. The parallel DOAS system also allows for economizer air delivery separate from the distributed fan-coils.

In Portland there are more than 1,300 occupied hours per year when outside air conditions are favorable for air-side economizer cooling, enough to warrant an amendment to the state’s energy code. The code exception allows for heat exchange systems to be exempt from the economizer requirements, but Mercy Corps’ system uses both in parallel.

In addition to providing free cooling, the parallel ventilation system allows for a simplified sequence of control for the morning warm-up. Prior to building occupancy and VRF system start-up, the DOAS is converted to a recirculation air system and uses cost-effective natural gas to warm up the building from the overnight setback temperatures. In the same manner, a nighttime flush sequence is simplified during the summer. The design team chose parallel DOAS systems over series DOAS systems for the ease of sequencing.

When the building is occupied, control systems must also respond to ventilation air introduced through operable openings. Occupants typically use a weather data dashboard on their computers to monitor outside conditions while they are working. If they feel it is a nice day and want to open the window, they are free to do so. The roof monitor is activated when it isn’t raining and the outdoor air temperature is above a specified temperature setpoint.
SUSTAINABLE FEATURES

Water Conservation
Low-flow fixtures for 44% water savings.

Materials
- Eighty-seven percent of the existing historic Packer-Scott Building was reused. Wood was used for finish elements in the new addition’s main stair treads, reception desk, and coffee bars. Ninety-five percent of construction waste was recycled or reused.
- Exterior materials were selected to be durable and low maintenance, and all interior material selections focused on indoor air quality, renewable content, and local availability. More than 10% of the new materials used were extracted, processed, and manufactured regionally, and more than 20% have recycled content.
- Furniture is highly flexible and adjustable to minimize future waste, and the systems were fabricated with high recycled content and with an eye on future recyclability. Structural systems were left exposed and minimal finishes applied to save materials.

Daylighting
- Central atrium with roof monitor for interior space daylight.

Individual Controls
- Occupancy sensor temperature control.

Carbon Reduction Strategies
- Reducing fossil fuel use via increased envelope performance and electric heat pumps.

Transportation Mitigation Strategies
- The urban location was specifically selected to promote alternative transportation. In fact, 30% additional outdoor air ventilation is provided to improve indoor air quality, occupant comfort and well-being.

GREEN BUILDING ELEMENTS

Highly efficient mechanical system providing total building energy costs savings of 53.7% and a total building energy savings of 51.8%.

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Airtightness testing of homes has been around for more than 20 years. Various energy programs and incentivizing energy bills have provided homeowners an incentive to improve the airtightness of their homes. Energy tax credits can also be received by the homeowner but only if the house airtightness has been verified that it is less leaky after remodeling than before.

Efforts to make commercial buildings more energy efficient in the US has only recently been incorporated into various “green” initiatives. Tests of commercial buildings show that they tend to be more leaky than the average house, based on air leakage per square foot of surface area. That means that commercial buildings are less energy efficient than the average house.

To measure the actual airtightness of a large building means more air is needed to maintain a reasonable test pressure. The Energy Conservatory, a leader in airtightness testing, has kits available to directly measure more than 18,000 cubic feet per minute of air leakage. Multiple kits and fans can be used simultaneously to generate more air for accurate and reliable measurements of air leakage for testing before and after retrofitting.

For more information on multi-fan systems, contact:
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The Energy Conservatory 612-827-1117 or visit our website at www.energyconservatory.com.
Building Envelope

Advanced enclosure design that is appropriate to the renovated historic structure and new addition contributes to the project’s performance. Artificial light contributes to controlled airflow rates, better ventilation, better hygiene, better comfort, and helps to avoid damage largely by controlling humidity transfer through walls.

Optimal enclosure design was hard to achieve for the historic structure—composed of uninsulated brick bearing walls with a low window-to-wall ratio, the team decided to first focus on upgrading the wall assembly. The upgrades included adding continuous interior insulation of R-10, brick repair, and repointing of the existing masonry enclosure to improve its performance as an air barrier. The wall assembly design in turn drove the window improvements, which included upgrading windows from a U-factor of 0.5 to around 0.3. Introducing low-conductance frames and triple glazing to achieve a U-factor of 0.2 was considered too costly.

For the addition, exterior assemblies were based on two concepts. First, the control of heat flow in buildings requires insulation layers with minimal thermal bridge penetrations, an effective air barrier system and good control of solar radiation. Second, the perfect wall, roof, or floor on grade has all the control layers on the outside of the building assembly to protect the structure from temperature extremes and water.

Enclosure measures include continuous, all-exterior R-10 wall insulation, continuous air and vapor barrier, rainscreen cladding, thermally isolated subframing cladding support systems, and a 35% window-to-wall ratio with south-facing window shading. The roofs for both the renovated and new buildings average R-30.

Site mock-ups during construction were crucial to achieving high-quality construction and effective thermal and moisture performance. Based on the mock-ups the building performance was predicted by simulating the energy performance of the building. Since eQUEST cannot explicitly model a variable refrigerant flow HVAC system, a system supported by eQUEST was modified to simulate the performance of the system.

RESPONDING TO THE 2010 HAITI EARTHQUAKE FROM THE NEW HEADQUARTERS

From an organizational point of view, the new headquarters afforded significant, immediate benefits. Just three months after the new headquarters opened, the earthquake in Haiti put the workplace concept to the test. With all departments mobilized together in one site instead of six, crucial problems such as the logistics of sourcing and delivering humanitarian aid, processing an unprecedented number of gifas, coordinating with other entities, and starting to evaluate long-term recovery strategies—could all be addressed under one roof. “War rooms” were set up in large conference rooms. Casual seating in the social core accommodated impromptu brainstorming meetings and provided places for respite.

The coffee bar became an important place for staff to relax during the intense initial response period. The headquarters’ role within the Port-au-Prince community was also underscored when the local Haitian community, now more aware of Mercy Corps’ presence, asked for Mercy Corps’ help in organizing a vigil in the Action Center and adjacent plaza.

Energy-Efficiency Measures

The systems design incorporates many energy-efficiency measures (EEMs) that were analyzed throughout the design process for capital cost, energy savings, energy cost savings, payback and carbon footprint (Figure 1); the EEMs included in the energy metric include:

- A variety of HVAC systems;
- DOAS control schemes and exhaust air heat recovery;
- Maximized daylight control zones and sensors;
- Reduced artificial light levels;
- Improved envelope insulation including green roof;
- Improved windows; and
- 40% reduction in hot water flow.

The DOE2-based software eQUEST was used to simulate the energy performance of the building. Since eQUEST cannot explicitly model a variable refrigerant flow HVAC system, a system supported by eQUEST was modified to simulate the performance of the system.

From the outset, Mercy Corps’ new headquarters was intended to have a larger community purpose. The renovated and expanded building includes the Action Center, an educational environment that drew more than 22,000 grade school students in 2011.

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Conclusion

The Mercy Corps headquarters embodies the organization’s core values of participation, accountability, and peaceful change. The incorporation of these principles, along with sustainable design and construction, resulted in a building that meets those values. Detailed energy modeling was an essential tool in defining the design path and selecting efficiency measures. Actual energy use that beats the modeled predictions and actual energy costs that nearly match the predicted costs further strengthen the economic case for sustainability.

Energy Use Verification

After a year of operation, post-occupancy energy analysis revealed that the measured data results were consistent with modeled data (Figure 2). Actual gas use is significantly lower than predicted, a result that can likely be attributed to the highly adaptable ventilation rates within the building. This finding further strengthens the energy saving value of a DOAS.

The building’s first year energy use intensity (EUI) was 36 kBtu/ft²·yr, just below the energy model EUI of 36 kBtu/ft²·yr. Annual actual energy costs are $0.98/ft², just above the modeled $0.95/ft².

The building primarily uses electricity, a decision driven by its low cost and the relatively low carbon content of hydropower, prevalent in the Northwest and the predominant power source for this building.

Lessons Learned

Building Reuse Provides Unexpected Benefits. The seismic upgrade to the historic structure was robust enough to lend support to the new addition, allowing for more open floor plans. This openness supported the client’s goals for a flexible, collaborative workplace. Reusing the existing building maintains historic fabric and culture while the more transparent addition projects a spirit of openness to the local community. Synergies between the existing and new structures reduced construction while enhancing the project.

Mixed Mode HVAC. The mixed mode approach to building space conditioning and natural ventilation systems typically requires additional, more complex control systems and reduced HVAC zone sizes. Hybrid ventilation systems are best served by decoupled mechanical ventilation in parallel with natural ventilation concepts. At Mercy Corps, the ventilation system allows outdoor air to flow from manual operable openings to a central temperature-actuated roof monitor; the space CO₂ sensor’s fresh air requirements are partially satisfied by the DOAS unit with return air provided near the central monitor stack, allowing the hybrid systems to work concurrently.

Operable Windows in Communal Areas. The use of operable windows in the communal areas of the building was less successful than in the few private offices in the building. Individuals do not feel ownership over the large open office areas, and do not open and close the windows to control their environment’s temperature as much as hoped.

Southern glazing is provided with electrochromic glass sunshades. The shades are controlled to reduce solar gain during the cooling season and to reduce glare in the south-facing multimedia room.

Lessons Learned

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