Undeniably New Orleans

The urban presence of the façade changes at night, when passersby can catch glimpses of the biotech researchers working late. The non-profit lab/office incubator helps locally conceived ideas grow into jobs and industries.

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BY Z SMITH, PH.D., AIA

RECOGNIZING THAT THE MOST IMPORTANT PRODUCT OF A RESEARCH LAB is not chemicals, but insights and innovation, designers of the New Orleans BioInnovation Center sought to maximize human performance with daylight, views to nature, and places for reflection and collaboration. This urban biotech incubator weaves classic New Orleans architecture with sustainable systems and technologies, proving just how far lab energy use can be reduced even in a hot–humid climate.

This non-profit lab/office exists to help ideas conceived locally to become local jobs and industries. NOBIC is a four-story, 64,500 ft^2 structure adjacent to New Orleans's historic French Quarter, downtown university campuses, and the Treme neighborhood.

Built on a brownfield site, this LEED Gold research facility includes labs, offices, a 100-person conference center, breakout spaces and a café. The design reinterprets vernacular regional climate-responsive strategies—the slatted shutter, the landscaped courtyard water feature, and the sheltered porch—to provide a facility that is modern but undeniably New Orleans.

This project also helps local innovators develop new businesses in a very New Orleans way—with a spatial organization that promotes chance meeting, social interaction, and improvisational collaboration, inviting busy people to linger centered on the porch or the garden.

Climate, Site, Envelope

The New Orleans climate alternately delights and exasperates: mild winters, hot–humid summers with little wind, abundant sunshine punctuated by periods of intense rainfall and the occasional hurricane.

Less than 1% of the hours in a typical year fall in the range of temperature and humidity required by the National Institutes of Health (NIH) for biotechnology labs, and 68% of the hours are too hot or too humid

(*Figure 1, p. 9*). High air-change rates and once-through ventilation air with tight temperature and humidity control dominate lab building energy use, dwarfing skin loads.

The building form provides a protected courtyard following French Quarter precedents. The glazing choices allow a strong connection to the city and the landscaped courtyard while limiting solar gain. While the building has a window/wall ratio of 33%, glass is deployed to maximum effect on the primary street façade and lobby atrium that opens to social areas on each floor.

The site, selected for its proximity to university research and its urban prominence on the city's main thoroughfare (Canal Street), came with a built-in orientation challenge: the primary façade, where one might like the greatest degree of transparency, faces southwest, exposed to the afternoon sun during the hottest part of the day.

The ground floor is recessed from the property line, allowing sun and rain protection to be provided by the overhanging floors above. Horizontal louvers of varying depth and spacing protect the glazing on the upper floors (*opposite page photo, Figure 3, p 11*). In fact, these shading strategies allow a southwest façade that is 63% glass to have the summer solar gain of a façade with only 20% glass.

The opaque portions of the building envelope provide good thermal isolation and inhibit infiltration. The minimum R-25 high reflectance and high emissivity cool roof keeps conduction and solar gain down. The wall systems, a hybrid thin concrete pre-cast panel supported by light gauge steel framing, is insulated after installation with a continuous R-19 closed cell spray foam, minimizing thermal bridging.

HVAC

The HVAC strategy could be described as "all the ventilation you need, but only where and when you need it." Labs use a lot of energy for two main reasons: the power draw of the scientific equipment, and the use of high ventilation rates intended to protect the safety of staff working with dangerous chemicals—at fume hoods and via bulk exhaust of the lab room volume.

Conditioning all of the air that is subsequently being exhausted can take substantial amounts of energy. Design teams have little control over the equipment loads—although designs that make it easier to share equipment can lead to lower overall energy use. For example, configuring the plan to allow a shared freezer can result in less energy use than each researcher operating multiple separate freezers.

But ventilation strategies offer huge opportunities for energy savings. The energy cost of providing conditioned air in hot–humid climates is dominated by dehumidification and cooling air, characterized by the Ventilation Load Index (VLI) as proposed by Harriman, et al. in "Dehumidification and cooling loads from ventilation

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Above Staff enjoys a break on the stacked porches looking out on the emerging BioDistrict.

Left The urban location of the New Orleans BioInnovation Center means it is accessible by public transit and is near collaborating institutions. The ground floor conference center enjoys views of passing streetcars on one side and the landscaped courtyard to the other.

BUILDING AT A GLANCE

Name New Orleans BioInnovation Center

Location New Orleans (downtown near BioDistrict and French Quarter)

Owner New Orleans BioInnovation Center

Principal Use Laboratory
Includes Café

Employees/Occupants 200

Expected (Design) Occupancy 200
Percent Occupied 100%

Gross Square Footage 64,500
Conditioned Space 64,500

Distinctions/Awards
2015 AIA COTE Top Ten, 2014 Green Good Design Award, 2013 American Architecture Award

Total Cost $34 million
Cost per Square Foot $527

Substantial Completion/Occupancy 2011

ENERGY AT A GLANCE

Annual Energy Use Intensity (EUI) (Site)
119.9 kBtu/ft^2
Electricity (Grid Purchase) 87.7 kBtu/ft^2
Natural Gas 32.2 kBtu/ft^2

Annual Source (Primary) Energy 309.2 kBtu/ft^2

Annual Energy Cost Index (ECI) $2.15

Annual Load Factor 42%

Savings vs. Standard 90.1-2004 Design Building
26.6% (actual; model not calibrated)

Carbon Footprint 17.6 lb $CO_2e/ft^2 \cdot yr$

Percentage of Power Represented by Renewable Energy Certificates 64%
Number of Years Contracted to Purchase RECs 2

Heating Degree Days (Base 65˚F) 838

Cooling Degree Days (Base 65˚F) 2,645

Annual Hours Occupied 3,120

WATER AT A GLANCE

Annual Water Use 3,208,900

KEY SUSTAINABLE FEATURES

Water Conservation Domestic potable water use 40% below baseline through the use of low-flow plumbing fixtures. Landscaping and water features fed from captured rainwater.

Recycled Materials By value: 30% of building material content is recycled, 25% of materials were regionally sourced (within 500 miles), and 79% of construction waste was diverted from landfill.

Daylighting 75% of occupied spaces have access to daylight and views.

Individual Controls Each standard lab unit (~1,000 ft^2) has individual control of ventilation, temperature, and lighting, with the energy consumption associated with each lab unit individually sub-metered. Targeted ventilation strategy allows all of the airflow needed, but only when and where it is needed.

Carbon Reduction Strategies Envelope uses hybrid thin-wall (2 in.) precast concrete on light-gauge steel frame.

Transportation Mitigation Strategies Located on a major transit thoroughfare with five transit lines, WalkScore of 94/100. Bike commuter showers each floor. Electric vehicle station.

Other Major Sustainable Features "Working" water feature, bioswales, pervious paving over crushed stone water storage base allow 96% of rainfall over 20 year period to be handled on site.

BUILDING ENVELOPE

Roof
Type SBS (styrene butadiene styrene) with high-solar reflectance index (SRI) coating
Overall R-value R-25 minimum
Reflectivity 76%

Walls
Type Closed cell spray polyurethane foam inside precast concrete
Overall R-value R-19
Glazing Percentage 33%

Windows
Effective U-factor for Assembly 0.47
Solar Heat Gain Coefficient (SHGC) 0.26
Visual Transmittance 0.62

Location
Latitude 30 N
Orientation Front faces SW

BUILDING TEAM

Building Owner/Representative
New Orleans BioInnovation Center

Architect, LEED Consultant
Eskew+Dumez+Ripple

General Contractor Turner Universal

Local General Contractor Gibbs Construction

Mechanical, Electrical Engineer; Energy Modeler
Newcomb & Boyd

Structural, Civil Engineer Morphy Makofsky

Landscape Architect Daly Sublette

Commissioning Agent Newcomb & Boyd

air," published in the November 1997 issue of ASHRAE Journal. The load generated by one cubic foot per minute of fresh air brought from the weather to space-neutral conditions over the course of one year. Among major cities, the VLI for New Orleans is the second highest in the nation.

The NOBIC uses well-known strategies for reducing this impact (use of office return air as a dilutant for lab supply air, low-flow fume hoods, enthalpy recovery ventilation systems). But it gains most of its savings by allowing ventilation to be targeted strategically.

Not every type of research being performed needs a high ventilation rate. At NOBIC, each cellular lab is provided with independent control of airflow and temperature, allowing each lab to be set to the ventilation level appropriate to their kind of research (2/6/10 air changes per hour [ach]), and ventilation rates can be set back when labs are unoccupied.

A "panic" button is provided, which maximizes room flush-out and fume hood exhaust rates. Careful design and modeling of the air distribution system allows for lower air change rates without compromising safety.

The impact can be huge: in the New Orleans climate, the site EUI (energy use intensity) of an individual lab at 2 ach was modeled at 120 kBtu/ft$^2 \cdot$yr, while one operated at 12 ach was modeled to consume twice as much energy (*Figure 4, p. 11*). In a facility like NOBIC with diverse users, the building's EUI will depend on the mix of ventilation policies. Over the life of the building, as the tenant mix changes, so will the EUI.

Energy Performance

Laboratory buildings are among the highest users of energy per square foot of any common building type. Since the average source EUI values for labs (from the Labs21 dataset) is four times that of office buildings, making a lab building that is just 25% better than

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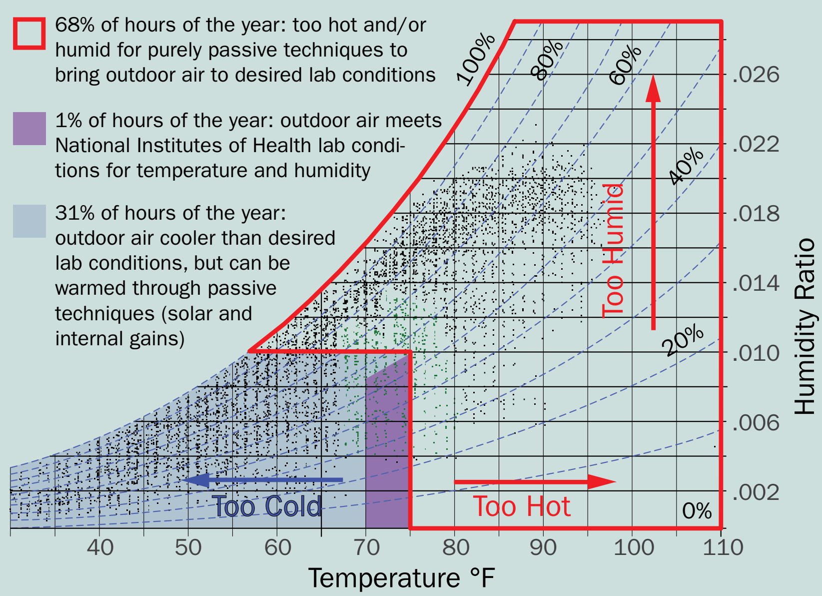
Above Break areas from each floor of labs look out through an east-facing atrium onto the landscaped courtyard.

Above Right The landscaped courtyard, inspired by those found in the nearby French Quarter, provides a place for staff and visitors to relax and recharge. Pervious pavers allow rainfall to be absorbed into the soil rather than burdening municipal storm drainage.

Figure 1 NEW ORLEANS CLIMATE CONDITIONS



Each dot on this psychrometric chart represents the temperature and humidity of outdoor air for one hour in a typical year. Sixty-eight percent of the hours in the year in New Orleans are hotter or more humid than the NIH guidelines for lab conditions.

Figure 2 ENERGY DATA

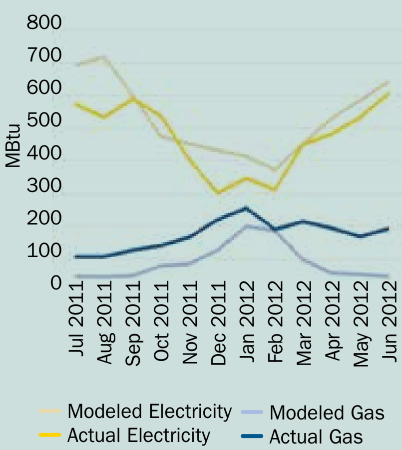


Table 1 EUI COMPARISON

	kBtu/ft²·yr
Median Lab Site EUI*	343
New Orleans BioInnovation Center Actual Site EUI	120
Savings Compared to Median Site EUI	223
Median Lab Source EUI*	601
New Orleans BioInnovation Center Actual Source EUI	309

*As defined by Labs21 Benchmarking Tool database.

average can save as much energy as a net-zero office building the same size.

This project uses less energy per square foot than 89% of the buildings in the Labs21 Benchmarking Tool database of almost 600 lab/office buildings nationally. The actual utility bills for the initial 12 month period (120 kBtu/ft²·yr) closely track that projected by computer simulation (*Figure 2*). This savings of 223 kBtu/ft²·yr (compared to the median site EUI for labs) is like making a net zero building of almost any other building type (*Table 1*).

Source EUI tells a similar story: The measured source EUI is better than 87% of labs, and is essentially half that of the median lab source EUI.

This level of verified performance is reinforced at the operations level by fine-grained energy and comfort monitoring. Each ~1,000 ft² lab plus support area unit is individually metered using a multi-channel submetering system

Surviving and Thriving after Katrina

By Mark Ripple, AIA

Above Mark Ripple's home in New Orleans' Lakeview neighborhood was still under 6 ft of water five days after Hurricane Katrina.

Right The offices of Eskew+Dumez+Ripple immediately after Hurricane Katrina.

When you say you're from New Orleans, everyone wants to ask you about Hurricane Katrina. My personal story was not too dissimilar from that of thousands of New Orleanians—our family evacuated to Baton Rouge, La., fully expecting to ride out the storm at a relative's house and return shortly to clean up the debris, perhaps replacing some broken windows. What transpired can only be described as surreal: watching the disaster unfold on national television while trying to fathom the magnitude of the destruction and the loss of human life.

With the city shut down for weeks and our firm's employees evacuated to multiple locations, we were left to improvise a means to communicate with each other and to retrieve critical files from our New Orleans studio. Since the city was under a government-ordered lockdown enforced by the National Guard, we created an official-looking document that allowed us emergency access into the city to retrieve our file server and other critical documents.

Climbing 31 flights of stairs to the top floor of our abandoned building, we found our open-plan studio decimated by the effects of several blown-out storefront windows. Wading through the wet debris, we retrieved the 40 lb file server and strapped it, Sherpa-like, to some 2 × 4's to facilitate the downward trek through the emergency stairs to the awaiting truck.

Twenty-four hours later, we completed the activation of a one-room office rental in downtown Baton Rouge. Together with a few staff members and some equipment loaned by the AIA, we were officially "open for business" again. We had absolutely no idea what lay ahead for New Orleans, but were confident that whatever transpired, we would be an integral part of it!

The damage to my own house and neighborhood was more severe. My neighborhood (Lakeview) had once been swampy land essentially at sea level; decades of drainage and pumping had caused the land to subside to 6 ft below sea level. If the topography of the city was thought of as a bathtub, my house was a few blocks from the drain!

Furthermore, being a quarter mile from one of the catastrophic levee failures, our house was flooded with over 6 ft of water, with 9 ft in the street, and stayed there for three weeks until the city was pumped dry. Borrowing a small boat from a relative, we managed to cross Lake Pontchartrain four days after the storm, and reach my flooded neighborhood by boat to retrieve the key items from our house.

Ten years later, we have rebuilt our house, thanks to the generosity of family and friends. More importantly, we have restored our firm and our community, thanks to the inspired passion and commitment of hundreds of individuals who cared deeply.

Post-Katrina rebuilding has also changed our firm, what we build, and how we build. We had always prided ourselves on our level of commitment to community, but participating in the rebuilding of our city, where neighbor helped neighbor while the government and insurance company officials wrote memos, made abundantly clear to us that it is communities that are resilient, not just buildings.

It forced us to double down on our commitment to engaging the community through pro-bono design services, from the Field of Dreams community sports field in the 9th Ward to the Martin Luther King Day of Service projects. We now look for opportunities to enhance resilience in all our projects, and have shared what we've learned in a monograph, "A Framework for Resilient Design," that we make freely available on our website, http://tinyurl.com/p3v6myh.

Katrina drew new attention to issues around climate change and healthy building materials (with residents developing respiratory problems from formaldehyde-laden FEMA-provided trailers). There was precisely one LEED-certified building in the entire state of Louisiana on the day Katrina struck. Today, between the rebuilt homes, schools, and commercial buildings like NOBIC, there are over 1,000.

One unexpected change post Katrina is the influx of idealistic, highly educated transplants to the city. The composition of our own firm has grown from almost entirely Louisiana natives to one with staff from around the world representing 40 university programs. And New Orleans has been recognized by Forbes and other organizations as one of the top cities for startups nationwide.

We are a firm and a city transformed.

Mark Ripple AIA, LEED AP BD+C, is a principal at Eskew+Dumez+Ripple in New Orleans.

with up to 160 circuits, enabling the building owner to track and compare lighting and plug load consumption, identifying best-practice high performers. Green power purchase agreements are used to reduce the carbon impact of the electricity consumed.

Living With Water

Located in a city that owes its existence to a river and its near destruction due to flooding, it was essential that the design embrace the theme of living with water. All phases of the water cycle were treated as a design opportunity, from dealing with the moisture that hangs heavy in the air on a summer day, to the frequent, intense rains, to the flow of surface water and its percolation into the city's heavy soils.

The project feeds all rainfall from the roof into a prominent water feature, which fluctuates in depth with the rains, allowing for biofiltration through water plants such as papyrus. Then it flows into a vegetated swale, on to detention in the parking lot subbase, and percolates back into the soils (*Figure 5, p. 12*).

This is the regional water/plant/soil ecosystem in microcosm, connecting people back to place. Simulations project that storm water will leave the site only a few times every 20 years. The water feature is also fed by the AC condensate, which provides all landscape irrigation.

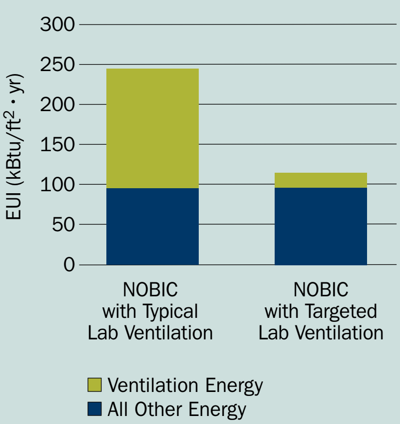
Low-flow plumbing fixtures are designed to reduce consumption of municipal water in the facility's washrooms by 40%. However, over 90% of the water used in the facility is the water evaporated by the cooling towers.

Reuse of rainwater for cooling tower makeup represents a huge opportunity for water savings. (The state plumbing code in force at the time of the facility's design required the use of municipal water for this application; in 2016, the state moves to the International Plumbing Code.)

Materials

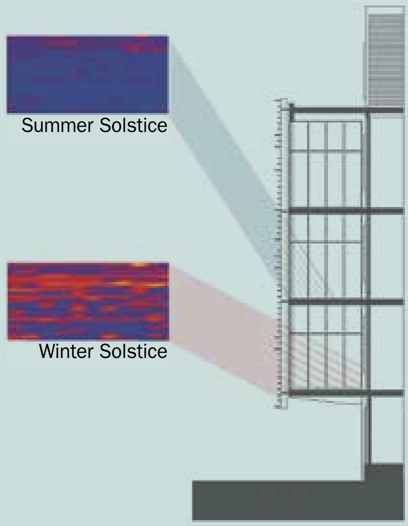
The first strategy in reducing materials impacts of any project is to construct only as much building as is needed. The design team developed strategies for shared use between tenants to increase collaboration while decreasing building area. This produced spaces that serve multiple program needs and multiple users, resulting in a smaller building and reduced material use.

Figure 4
VENTILATION STRATEGY COMPARISON



Energy model results for the site energy use intensity (EUI) of a laboratory in the New Orleans climate with bulk air change rates of 12 versus 2 air changes per hour (ach).

Figure 3
SOUTHWEST FAÇADE DESIGN



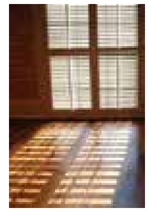
Solar exposure computer simulations show that although this southwest-facing façade is 68% glass, louvers and overhangs result in the same solar load as an unprotected façade with 18% glass.

The building is designed to promote and thrive on change. Plan layout includes a mix of dedicated lab and office spaces and an almost equal area of flex spaces with infrastructure to accommodate lab use, but which can be alternatively built out to offices according to the needs of the tenants.

Some 79% of on-site construction waste was diverted from landfill, in part thanks to innovative relationships with waste handling firms, including one that began new diversion programs as part of the project.

Indoor Environment

The standard NOBIC lab unit provides daylight and views, while also providing lower-light entry zone for locating light-sensitive equipment such as microscopes. Seventy-five percent of regularly occupied spaces achieve daylight levels that would allow lights to be off during daylight hours, and 77% of spaces have views to the outdoors.



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Top The horizontal louvers protecting the southwest oriented glazing facing Canal Street are a modern reinterpretation of the Louisiana shutters.

Above The ground floor massing is pulled in to provide rain protection for passersby and solar protection for the cafe and conference center.

Project Economics

A tenet of integrated design is that sustainable design choices have more impact and less cost when incorporated early. But this project's path to high performance was more circuitous.

Construction documents were initially completed during the height of the post-Hurricane Katrina construction cost bubble, and the design team was directed to use code-minimum levels of insulation and building systems. Then the project went on hold for over a year as financing was being arranged. When the project was restarted, bidding conditions were more favorable,

Lessons Learned

☐ **Ongoing Commissioning and Maintaining Performance.** After substantial completion and occupancy of three floors of the four-story structure, the design team and commissioning agent initiated an ongoing commissioning exercise, monitoring energy consumption, systems, and comfort performance, identifying a substantial number of items that had cropped up after initial commissioning. These included the usual mix of sensors that fail, reheat control valves that indicate they are closed when they are not, maintenance warnings that get silenced and then forgotten about as staff turns over. After unsatisfactory experiences with visiting maintenance service companies, the owner has invested in hiring and training a full-time on-site facilities maintenance staff person.

These efforts have allowed energy and comfort performance to be further tuned. The project is now part of a commitment of all design team members involved to long-term engagement and learning. The team continues to engage occupants and operators as the tenant mix changes, learning as they go.

☐ **People Use Ventilation Controls in Surprising Ways.** The interaction between occupant behavior and building performance is complex and has led to some surprises for the design team. For example, the design team assumed that occupants would set the ventilation rate according to their safety requirements and the temperature to suit their comfort. But some occupants treat the ventilation control like the fan speed control in their car: if they are feeling warm, they turn up the fan. Giving occupants more control means that we are not just designers of buildings and mechanical systems, but of user interfaces.

☐ **On-Site Storm Water System Proves Effectiveness.** When the site's storm water strategies—including the first installation of pervious concrete in the state over the parking area—were first proposed, it was decided to drain the loading dock area in the conventional manner, hard-piping that area directly to the municipal storm drainage systems. Weeks before the building opened, an especially heavy rainfall resulted in the municipal system backing up, shooting water into and flooding the loading dock. The rest of the site, with its unconventional storm water systems, remained dry. A backflow preventer was subsequently installed on the one portion connected to the conventional system. New Orleans has recently adopted a new Comprehensive Zoning Ordinance that requires all new commercial projects to handle a substantial portion of rain events on site, and NOBIC is provided as a reference for those who want proof that these systems can work even with our intense rains and heavy clay soils.

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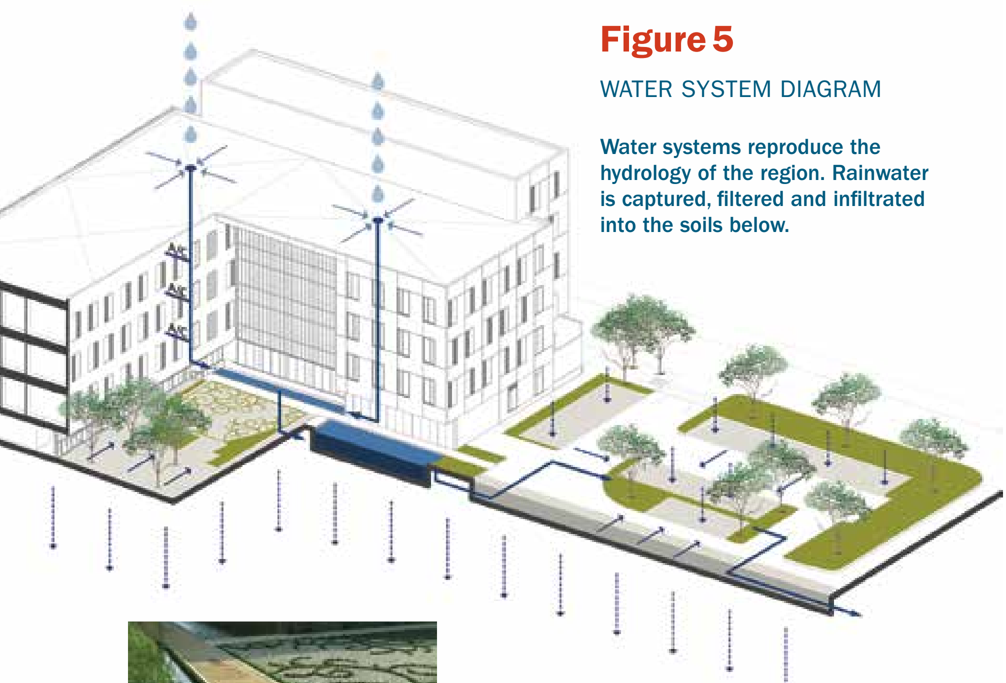
The most prominent element of the New Orleans BioInnovation Center's storm water system is the "working" water feature. Rainfall flows from the roof, through the water feature and then into a vegetated swale. The city of New Orleans points to this system as a successful example of on-site storm water management.

Figure 5

WATER SYSTEM DIAGRAM

Water systems reproduce the hydrology of the region. Rainwater is captured, filtered and infiltrated into the soils below.



Left The "working" water feature includes plants such as papyrus that like getting their feet wet. The microorganisms that grow on these plants help filter the collected rainwater and AC condensate before it is used for landscape irrigation.

and the owner asked the design team to recommend measures that might lower the long-term operating costs, "and could you do that LEEDs thing?"

The team explored opportunities for further enhancements in environmental impact and performance, identifying 21 possibilities for investigation.

Constraints were that the building's overall appearance could not change, and items that would have substantial schedule impact (e.g., major changes to the plan or structure) were not allowed. Computer modeling helped identify two kinds of items to pursue: items with good payback and low-cost items with big impact even if payback was negligible. Measures adopted included:

- Water-cooled chiller replacing air-cooled chiller;
- High-efficiency condensing boilers;
- Lab-by-lab VAV controls for airflow and temperature;
- High-efficiency power transformer;

Web Exclusive Q&A

Go in depth with author Z Smith.

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- Improved glazing system (low-emissivity, low solar heat gain coefficient, high visible transmittance glazing in a thermally broken framing system);
- High reflectance high emissivity roofing;
- Insulation R-values increased to 25% to 40% over code;
- Demand-controlled ventilation for conference room;
- Low-flow domestic plumbing fixtures;
- Enhanced energy metering at the level of individual labs;
- Bi-level light switching in labs; daylight dimming in other areas; and
- High-efficacy direct-indirect suspended linear fluorescent fixtures in labs.

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Every lab aisle enjoys a view to the outdoors.

The cost of these upgrades was equivalent to less than 2% of the project cost, but the simple payback was less than three years. It shows how much you can do with just a little more money.

Conclusion

The NOBIC demonstrates the energy savings that can be achieved despite the demands of a laboratory and the hot–humid climate. Sustainable strategies combine beauty and function, creating a more enjoyable, collaborative environment to encourage innovation. ●

ABOUT THE AUTHOR

Z Smith, Ph.D., AIA, LEED Fellow, is principal and director of sustainability and building performance at Eskew+Dumez+Ripple in New Orleans.