STUDIO 804 Futuristically Green

University of Kansas professor Dan Rockhill and his students design KU's Center for Design Research building.

When a group of energetic graduate students is led by an architectural mastermind and backed by the efforts of 100 manufacturers, a recipe for building "green" is perfected. Recently, education, art, architecture, engineering, energy efficiency and an eclectic collection of building materials came together under one roof at the University of Kansas (KU).

Distinguished professor Dan Rockhill and the 23 students in the 2010 – 2011 graduate design/build program, Studio 804, began designing the University of Kansas's new Center for Design Research (CDR) only nine months before it was finished in July of 2011. The 1,820-square-foot building is pending not only LEED Platinum certification but also recognition as the nation's second passive-certified commercial building.

The project strays from what Studio 804 usually accomplishes. Single family homes have, for the most part, been the focus of the program. "I do whatever comes through the door," Rockhill said. "But it needs to be a holistic experience, from idea to completion." The low impact theme for the CDR fits in nicely with Studio 804's commitment to sustainability.

Hard working Studio 804 students gather around the 1,200-gallon rainwater catchment tank to take a break in the shade.

"The design brief was pretty simple," says Gregory Thomas, CDR director and a design professor at KU. "It had to serve a dual purpose, as a meeting and presentation venue and as a working laboratory. It also had to be a place that's shared with the public as a source of information about sustainability."

Stone, glass and mass

Inside and out, two materials appear continuously. Various uses of stone and glass are everywhere, accented by steel and concrete. Outside, dry-stacked limestone from quarries across Kansas makes up the first layer of the tight building envelope. Inside, sophisticated monitoring equipment displays the building's real-time energy performance.

In the conference area, a living "green wall" accents one side of the room. Covered in fern and irrigated by the building's BRAE® rainwater harvesting system, the wall improves indoor air quality and organically offsets the stark, elemental architecture. "We often get comments about how fresh the air in the room is," said Rockhill.

Although indoor foliage cover is unusual, the opposite wall also takes more than a second glance to appreciate. A 10-inch-thick trombe wall sits 2 1/2 feet behind an electrochromic glass curtain-wall, which makes up nearly the entire southern facade. Six inches of sand-filled block, sandwiched between two inches of limestone on either side, make up the wall. Thick sheets of laminated glass are laid horizontally between every other course of concrete block. Light from the glass wall penetrates the trombe wall, naturally illuminating the conference area. The solar-thermal mass stored in the wall provides much of the building's heat during the winter months.

"We couldn't do this based on the university's shoestring budget," said Rockhill. More than 100 companies sponsored or donated to the project. Much of what wasn't donated was made from scratch, including the plate steel floor and the limestone exterior."

Rainwater collection

One facet of the project that scored many LEED points

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GREEN SYSTEMS

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A 1,200-gallon tanks that serves as the storage for a Brae rainwater harvesting system is installed in the back yard of the Center of Design Research.

was a BRAE rainwater harvesting system. The donated Brae system supplies water to flush toilets and keeps the green wall lush. The system collects rainwater from the building's flat roof. From there, it's filtered and stored in an underground, 1,200-gallon storage tank.

"The storage tank is equipped with a pressure transducer," said Eddie Van Giesen, policy coordinator at BRAE. "The device senses the level of water in the tank and gives a digital readout inside the building. If they're experiencing a dry spell and the rainwater system can't produce enough water for the green wall and toilets, the transducer will communicate this to a solenoid valve, allowing it to open and draw makeup water from the local water utility.

Four times a day, a high efficiency, one-horsepower pump moves water from the rainwater cistern to the green wall. Ten different species of fern cover the 12 x 34-foot wall, which has more than 10,000 plants. The amount of water that the wall consumes depends on lighting and temperature in the room; in an average month it uses 250 gallons.

In addition to the tank and transducer, BRAE supplied four separate leaf/debris filters, and a rainwater pump with pump controller. The students installed the entire system, calling Van Giesen whenever a question came up.

High performance HVAC

"This isn't the first time we've worked with Rockhill and Studio 804," said Roger Scott, owner of Scott Temperature in Lawrence, Kansas. The 10-technician heating and cooling firm has assisted student efforts many times over the past decade. This time, their focus was ventilation and ductwork.

To provide energy efficient ventilation, an ERV was installed. For the best indoor air quality, frequent air changes are needed, and it's guilt-free at the CDR. Stale air moves, but Btus remain where they are. The ERV also controls humidity. To help temper exchange air, the ERV includes a small heat exchanger connected to a ground loop. A 120-foot loop of 1/2-inch PEX serves as the exchange medium. Scott Temperature completed the sheet metal work for the ERV and installed the ductless split system.

"It's always an adventure working with Studio 804," said Scott. "You never know what kind of equipment they'll have on hand."

A three-zone, mini-split system handles supplementary heating and primary cooling for the super-insulated structure. The trombe wall serves as the main source of Btus during much of the winter.

Extra credit

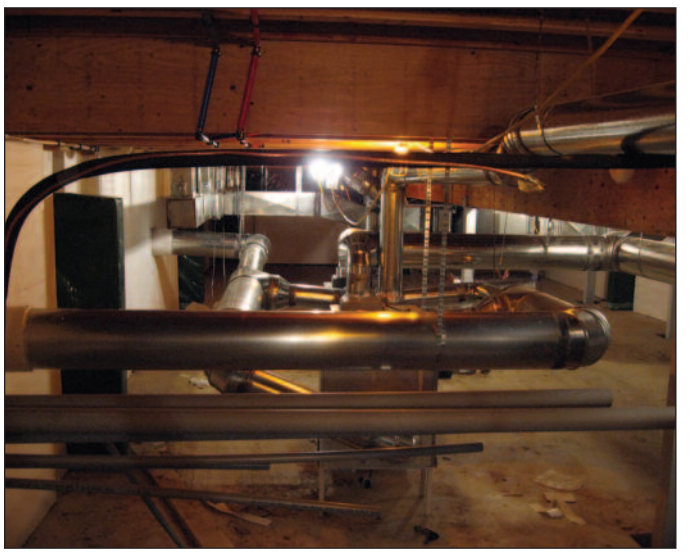
To achieve Passive status, it took more than lots of insulation and a living wall. The rainwater harvesting system was a gigantic leap in the right direction, but even more was needed. Southwest Wind Power provided a 35-foot high, Skystream wind turbine to provide up to 400 kW per month. Electronic controls provide performance data inside the building.

"The white, EPDM synthetic rubber roof is shared by the rainwater collection system, 33 Yingli photovoltaic panels and sedum plants," said Melissa Schoch, architecture graduate student and the official hostess of the CDR. Behind the building is a charging station for two electric cars, capitalizing on the 7.4 kWh output of the impressive solar array. A tankless water heater located near the bathrooms meets the small domestic demand.

Joist and stud cavities are filled with blown cellulose insulation. "We kept the envelope clean and taut," Rockhill says. "In order to maximize insulation and prevent thermal leaks, there's not any wiring in the walls."

The project has garnered national and international recognition. Rockhill and Studio 804 received the 2011 Acknowledgement Prize by the Holcim Foundation for Sustainable Construction.

Projects like the CDR challenge the way building materials are applied to modern structures. Pushing the (building) envelope fosters the development of new products and methods, while instilling a sense of responsibility and environmental awareness in the next generation of architects, engineers and contractors.



Round ductwork in the basement of the Center of Design Research provides both intake and exhaust for the ERVs, which are the backbone of the systems in the building.