In the period prior to Katrina, New Orleans often ignored its rich history of climate-responsive and cost-effective architecture, creating environments that were entirely artificially cooled, even in temperate weather. In its reconstruction, the architectural culture developing is also at risk because of limited interest or investment in more sophisticated models of sustainable building developing in other parts of the world.

The project to transform Tulane University’s 112,000 ft² university center into a dynamic new center for university life was 50% complete at the time of the flooding. The new 148,000 ft² building reprograms the existing concrete structure by pairing microclimates with social activities such as studying, dining, and meeting. It also acts as a demonstration project by bringing together climate-responsive architecture that uses both passive and active systems.
The passive system includes traditional New Orleans architectural responses to climate. These include balconies, canopies, shading, and courtyards that create layered spaces similar to this region’s vernacular buildings, which permit variable exchanges of air, light, and social activities.

Using support from a German climate engineering firm collaborating with local engineers, the passive systems are enhanced by active building systems that adapt to a range of climatic conditions and control extremes of humidity and temperature. Active systems include extensive radiant-cooled surfaces, customized ventilation systems and systems for creating variable shade. These innovative systems use two principles, thermal zoning and expanding the comfort zone, to actively engage New Orleans’ climate.

**Thermal Zoning**
Programmatically, the Center for University Life was organized to facilitate easy movement through the building and provide direct connections with exterior gathering spaces. As a result, the interior is zoned with varying levels of conditioned spaces that respond to differing levels of activity found in dining areas, commercial spaces, administrative offices and meeting areas.

**Expanding the Comfort Zone**
Although New Orleans is known for its hot and humid climate, there are prolonged periods during the spring and fall months in which daily conditions fall within the human comfort zone. Introducing shade, radiantly cooled surfaces, and air movement, increases thermal comfort and extends the period the building can remain open to the exterior (open-mode) up to six months, decreasing cooling requirements by an estimated 42% overall. In periods of extreme humidity and temperature, the building is shifted into its “closed mode” and treated more conventionally.

The building management system (BMS) is used in both an “open-mode” and a “closed mode” of operation. When humidity levels or
Opening The Building—Air, Light and People

The previous building had minimized use of daylighting due to heat gain and natural ventilation due to humidity. The newly constructed building creates healthy spaces that emphasize natural light year-round and natural ventilation, especially during the spring and fall. By increasing the comfort zone, the period that a building can remain open in New Orleans is expanded by an additional one to two months (for a total of six months). This is achieved by using combined criteria to predict thermal comfort as per international standards (ISO 7730) over the traditional ASHRAE Standard 55 (1992) method that prioritizes air temperature and assumes no air movement and physical activity. The new thermal comfort criteria emphasize radiant surfaces.

Vertical trellises, fixed louver systems and fritted glass shade the building as needed, reducing heat gain while allowing indirect daylight to minimize the need for artificial lighting.

Exterior shading design responds to the specific orientation of the building. Exterior vertical trellises, fixed louver systems, fritted glass, and canopies shade the building as needed, reducing heat gain while still allowing an appropriate amount of indirect daylight, thereby reducing dependence on artificial lighting.

Shading design responds to the orientation of the building.
levels of direct solar radiation, and humidity levels. This allows for a higher cooling setpoint in specific zones with a design goal of reducing energy consumption an additional 30%.

The envelope allows the building to remain open to daylight and to natural cooling and fresh air when possible, while tempering the effects of solar gain with shading and low-e glazing. The building is divided into thermal zones related to the distinctive requirements of offices, assembly, and retail. Radiant cooled surfaces, solar chimneys, and large fans and chilled water walls provide air turbulence and radiant conditioning for spaces and increase thermal comfort where needed. The custom water walls and fans were developed in collaboration with an artist and use pre-chilled water from the central campus plant.

Site & Connectivity
The Tulane University Campus is located on a 110-acre site in the uptown region of New Orleans. The newly constructed building is centrally located on McAlister Drive, the major pedestrian axis through the Tulane University Campus.

and increased air turbulence combined with air movement to estimate the thermal comfort zone, but also include activity levels (program), levels of direct solar radiation, and humidity levels. This allows for a higher cooling setpoint in specific zones with a design goal of reducing energy consumption an additional 30%.

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Although the New Orleans climate is hot and humid, there are prolonged periods during the spring and fall months in which daily conditions fall within the human body’s comfort zone. The introduction of shade, radiant cooled surfaces, and air movement significantly extends the number of days the building can remain open to the exterior.

Programmatically, the building was organized to facilitate movement through the building to exterior gathering spaces. As a result, the interior is zoned with varying levels of conditioned spaces. Thermal refuge zones are maintained as core spaces with a consistent design temperature of 75°F and 50% relative humidity.

60-ft clerestory custom solar vent admits daylight to center of the building, and provides solar-drive ventilation.

Commons area with pendulum fans, water walls, microporous ceiling, radiant surfaces and solar vents.
At the heart of the campus, it connects and overlaps two important green spaces: Central Quad and a small but popular courtyard (Pocket Park). Existing pedestrian circulation patterns through the center of campus are reinforced in the design with multiple new entry points into the University Center from Pocket Park and the Central Quad enabling students to take shortcuts through the building.

Parking on the west side of McAlister was relocated to mitigate conflicts between pedestrian circulation and vehicular traffic and to improve the appearance of the McAlister Drive streetscape. A pedestrian connection between the service area and Pocket Park is also provided. Bicycle parking is located near each entry to the building. An entry canopy protects students waiting for the bus from inclement weather.

**Site Ecology**

The project redevelops an urban site on a university campus. Impervious paving for the project was significantly reduced and replaced with a combination of porous paving and plantings. Green walls provide exterior shading in the Pocket Park while the basement level lightwell/sunken garden was designed with a porous gabion earth retaining structure planted with a low-maintenance “monkey” grass. Large trees with extensive root systems on site were
Large canopies minimize solar heat gain and glare. This canopy shades students sitting outside the dining room.

Preserved for shading. New plantings are also used to increase shade and usability of courtyard spaces.

**Responding to Climate**

Calculations to determine allowable air temperature considered hourly weather data for a typical year in New Orleans using parameters in addition to activity level that include incident solar radiation, diffuse radiation, ambient temperature, relative humidity, wind speed and direction, and cloud cover. Solar analysis was used to determine shading—suggesting systems that varied in density and orientation as you move around the building. The very southern location creates very high sun angles in the summer, producing high roof cooling loads and suggested shading by overhangs and roof insulation as well as a light-reflecting ballast.

The building proposes a different approach to adaptation to the New Orleans microclimate than has been normally adopted in the last 25 years. Departing from the hermetically sealed envelope that relies completely on mechanical air conditioning, the building will operate as a hybrid or mixed-mode system that tempers spaces with natural ventilation supplemented with fans. Mechanical conditioning is used as required to adjust to more extreme weather conditions. The project uses a mixture of passive and active systems to temper the microclimate and maintain a comfortable environment for varying activity levels throughout the year. Interior areas with the highest activity levels specifically have increased radiant cooling and air turbulence to mediate comfort levels.
and flexibility to serve changing needs.

The building was also programmed to locate the most heavily occupied spaces in the daytime closest to sources of natural light and ventilation. Spaces that were located in naturally darker areas of the building were mainly storage, service, and spaces for student activities used mainly after hours. This results in 56% of the building being naturally daylit. In addition, 50% of the building is naturally ventilated.

Water Cycle
New Orleans is situated below sea-level and receives an average annual rainfall of 64 in. The site is also below the water table and requires any stormwater to be quickly evaporated into the central system rather than retaining on-site and risking flooding. Due to the high water table in the city, water flow on the site was reduced and managed 100% on-site and then directly evacuated into the city’s centrally hydraulically pumped underground canal system, minimizing water buildup on-site. Porous surfaces also replaced impervious paving in the pocket park. A retaining wall at the existing garden level lightwell/Sunken garden was designed with a porous gabion retaining structure planted with a low-maintenance grass to also deal with extremes of drought and flooding.

The building is also designed for flood control. In addition to water-retaining site walls above the 100-year floodline at the lightwells, the surface of the building was designed to resist waterflow both vertically and horizontally as is typical during a hurricane. The pump system used has backflow preventers and is a redundant system.

Materials & Building Systems
The newly constructed building reuses the existing 112,000 square foot, two-story site-cast concrete frame structure and foundations. The reuse of this structure saves significant expense, resources, and landfill. The majority of exterior cladding materials were selected for their durability and low-level of maintenance in a humid climate. Interior materials were also selected for their thermal performance — terrazzo floors function as thermal mass to assist in tempering the spaces. The metal microporous ceiling acts as a diffuser for dehumidified preconditioned air and as a radiant and acoustical surface and light distributor.

Longevity and Adaptability
More than almost any other building type, student centers are in a state of constant change, and this building is capable of significant future modification. Areas like the central food service servery are specifically planned to accommodate reconfigurations as dining trends and preferences change. Other areas, like student organization and program spaces can also be reconfigured as needs change.

Another important objective is to accommodate the diversity of activities that take place on the University campus. While many of the services offered at the University Center are very specific, activities such as studying and socializing are often spontaneous and unpredictable. An important objective in the development of the new University Center was to provide enough variety and flexibility to make the building serve many unexpected needs. Students work and interact in many different ways and the new design offers a range of fan systems were developed for use in the perimeter spaces of the building that include a series of pendulum fans, large circular fans, and flap fans (cool wave) integrated into radiant surfaces to increase thermal comfort through turbulence and moving air.

Thermal Zoning
A hybrid solution mixes mechanical cooling with natural ventilation and zones the building into either the tempered zone or the thermal refuge zone. The tempered zone has a higher design temperature of 80 degrees F with 75% RH and blends with adjacent inhabited exterior spaces. These spaces emphasize natural ventilation and radiant cooling and include perimeter spaces such as the Dining Hall, the Commons, and the Main Entrance spaces. They form a transitional zone between the exterior and the fully-conditioned thermal refuge zones of offices and conference rooms.

Radiant Surfaces
To increase thermal comfort, the perforated metal ceilings act as a diffuser for dehumidified air while creating radiant cooled surfaces. Waterwalls use water from the central plant, prechilled to below the dew point of the indoor air.

Conservation of Energy

Using the model of an open-mode building, two main criteria reduced energy consumption:
1. Increasing natural light (artificial light = 70% of the building’s total energy consumption).
2. Using thermal zoning and an increased period of natural cooling when combined with strategies to increase thermal comfort.

When the building is used properly, these shading, lighting and ventilation strategies are estimated to reduce annual energy consumption for the building by at least 30%. Though the building is not separately metered, the new building envelope is estimated to reduce energy consumption by an additional 16% (verified using the Comcheck program) for a total savings of 46% annually.
Despite its high ambitions, the project had a modest budget and was successfully completed for $189 per square foot, 14 months after Hurricane Katrina. Since its completion, Tulane sees the project as a new model for sustainable design in New Orleans.

**Performance Criteria: Past and Future**

In characteristic New Orleans buildings, many techniques have evolved to respond to local climatic and cultural conditions. Exterior doors and shutters add a range of subtle adjustments to walls. Galleries, balconies and abat-vents (louvered overhangs) form the perimeter of many buildings and city blocks and are layered against the inner volumes, thereby expanding the building enclosure into habitable space.

These galleries facilitate ventilation, and provide shade and shelter from tropical rains. Socially, this in-between condition allows for increased connections between private and public spaces and uniquely expands into the surrounding landscape. While acting as a local model for climate responsive design, these techniques increase the openness of a building—both to the landscape and within interior spaces. As a prototype, the local vernacular forms function on many levels—impacting quality of life and increasing social interaction while reducing energy consumption. The Lavin-Bernick Center acts as a model of how these architectural strategies can be understood and applied in a modern context.

Despite its high ambitions, the project had a modest budget and was successfully completed for $189 per square foot, 14 months after Hurricane Katrina. Since its completion, Tulane sees the project as a new model for sustainable design in New Orleans.

**Lessons Learned**

Even with a highly automated system, the biggest issue with respect to the environmental program remains in the education of the owner after the building is completed. No matter what you do during design and construction, the end user needs to commit to the environmental function of the system—even the most basic operation such as opening doors or windows.

**About the Authors**

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