The Bassett Army Community Hospital in Fairbanks, Alaska, is designed with an airtight seal to keep out frigid temperatures and to remain operational in the event of a major seismic event.

Designing hospitals for intense climatic conditions

BY RONALD L. SKAGGS, JOSEPH G. SPRAGUE & GEORGE J. MANN

EXTREME DESIGNS

rchitects and contractors, as well as their clients, must collaborate closely as they work in a variety of geographic settings to design and construct medical facilities — not just in the United States but all over the world. The ability to grasp and quickly comprehend a variety of climatic and geographic settings, and develop appropriate designs, has a profound impact on their practices — both individually and collaboratively.

A broad spectrum of issues must be considered when designing exteriors for health facilities and hospitals.

The Homestead Hospital, in Homestead, Fla., is designed to withstand a Category 5 hurricane.

In order to understand the specific local climatic conditions, designers/builders should visit and observe the site conditions and review research facts, including the history of climatic data for the area and its context. The designers and builders also should visit and inspect buildings that have been built locally, analyzing how they have fared over time.

For example, in areas near the seashore, the sun and salty air cause special building maintenance challenges. Local architects and builders began using different materials and methods of construction when they grasped how destructive salt and sunlight are to a building's exterior over time.

A time for research

Prior to design and construction, in-depth research must be undertaken including officially recording temperature ranges, humidity, average annual precipitation, days of sunshine during the year, 50- and 100-year flood plains, fire occurrences (such as chronic forest and brush fires in Southern California), hurricanes, earthquakes, tsunamis, tornadoes, sandstorms and natural and man-made disasters.

Exteriors of hospitals and health facilities in flood-prone areas need to be designed to prevent encroaching flood waters. Too many buildings have been designed as sealed glass boxes. This can be problematic in a disaster, as occurred in some hospitals during Hurricane Katrina in New Orleans. When HVAC systems failed, windows could not be opened for natural ventilation.

Hospitals located in earthquake-prone areas, such as California, should be designed so that both exteriors and exterior components can absorb the tremors.

Hurricanes in Florida have uprooted telephone poles and palm trees have become flying missiles, horizontally hitting the windows of hospitals as well as other buildings with extreme force. These windows have to be specially designed to withstand such direct hits. Some humid tropical areas also have insect problems that can create issues in exterior vents of hospitals and health facilities.

Airtight in Alaska

At Bassett Army Community Hospital in Fairbanks, Alaska, exterior designers created an airtight seal to keep out frigid temperatures by designing the building using 4-inch deep insulated glazing units with thermal breaks to bring light into the building while maintaining energy efficiency. An 18-inch thick exterior wall system controls temperature migration — ranging from 90 degrees to minus 60 degrees — into the building as well as humidity migration out of the building.

To support the masonry veneer walls, the engineering team collaborated to design an innovative system of cantilevered fiberglass reinforced plastic, or FRP, I-beams and channels that bolt to the structural steel building frame. The FRP members provide a thermal break by spanning between warm and cold sides of the wall because plastic has low thermal conductivity properties. An additional insulated interior wall provides an extra barrier of temperature protection.

Bassett Army Community Hospital also is designed to remain operational

in the event of a major seismic event — noted to occur once every 1,000 years. Structural steel framing with braced frames provides the durability necessary to absorb seismic energy by allowing the building to flex without structural damage.

To meet seismic code, the design required all critical building components — including exterior walls, interior partitions, mechanical, electrical and plumbing equipment — be anchored and braced to the structure to minimize damage and provide for continued operation after a major earthquake. This is not a typical request, even for the most experienced design and construction team.

The hospital is designed and built to operate through an extreme earthquake, with redundant fire protection and heating systems, and an emergency central energy plant. In the event of any natural disaster, this hospital will stand ready to immediately and continually serve the community.

When the heat is on

In Florida, the Homestead Hospital is designed to withstand a Category 5 hurricane.The structural stability of the hospital had to be tested to ensure it would withstand the 155 mph winds that come with a Category 5 hurricane. The precast concrete panels that make up the exterior are 8 inches thick, and the glass in the windows is a half-inch thick. The hospital site is in a hurricane flood zone, so the site grade was elevated to 9½ feet above sea level.

The hospital's atrium is located in the middle of the building where it has the most structural support. Clerestory windows are positioned along the ceiling, allowing natural light to penetrate the space.

With less than 5 inches of rain falling annually, St. Rose Dominican Hospital Siena Campus is an oasis in the desert designed to counter the long and hot desert days in Henderson, Nev.

Given the consistent dry climate, an External Insulation Finish System was chosen as an economical and efficient wall cladding system. The building, located in the valley portion of the desert, is positioned to provide passive shading at the front entry. Patients, family and staff also are not exposed to the elements when inside the building. The hospital is designed similar to a mall, providing connectivity to the nearby medical office building. The design also serves as a chassis for the future addition of medical facilities.

A three-quarter acre healing garden is located in the center of the facility. The building is sited to shade the garden during the hottest part of day. The area creates a peaceful environment where patients and their families can visit. A special part of the project, Monet's Garden, features an ornamental lily pond, providing a sanctuary in the desert heat.

ARCHITECTURE FOR HEALTH AT TEXAS A&M UNIVERSITY

The unique Architecture for Health program at Texas A&M University was founded in 1966 by Professor George J. Mann, AIA. HKS, Inc. — a top architectural firm with 25 worldwide offices — has been the advisory teaching firm to the program since 1973.

Since its inception, the program has emphasized the integration of collaborative and interdisciplinary teaching, research and practice aimed at leading Architecture for Health.

Through the Architecture for Health program, Texas A&M University students have collaborated on actual projects including the National Taiwan University Cancer Hospital in Taipei; M.D. Anderson Cancer Center in Houston; Children's Medical Center in Dallas; Women and Children's Hospital in Colorado Springs, Colo.; and the Hebrew Rehabilitation Center for the Aged in Dedham, Mass.

In 1999, Texas A&M University together with Dr. Yasushi Nagasawa of the University of Tokyo, now at Kogaquin University in Tokyo, founded the Global University Programs in Healthcare Architecture, which has promoted the development of new programs in Architecture for Health around the globe.

In 2006, Texas A&M University students organized Students Health Environments Association. SHEA is the active student voice in the development of the Architecture for Health program.

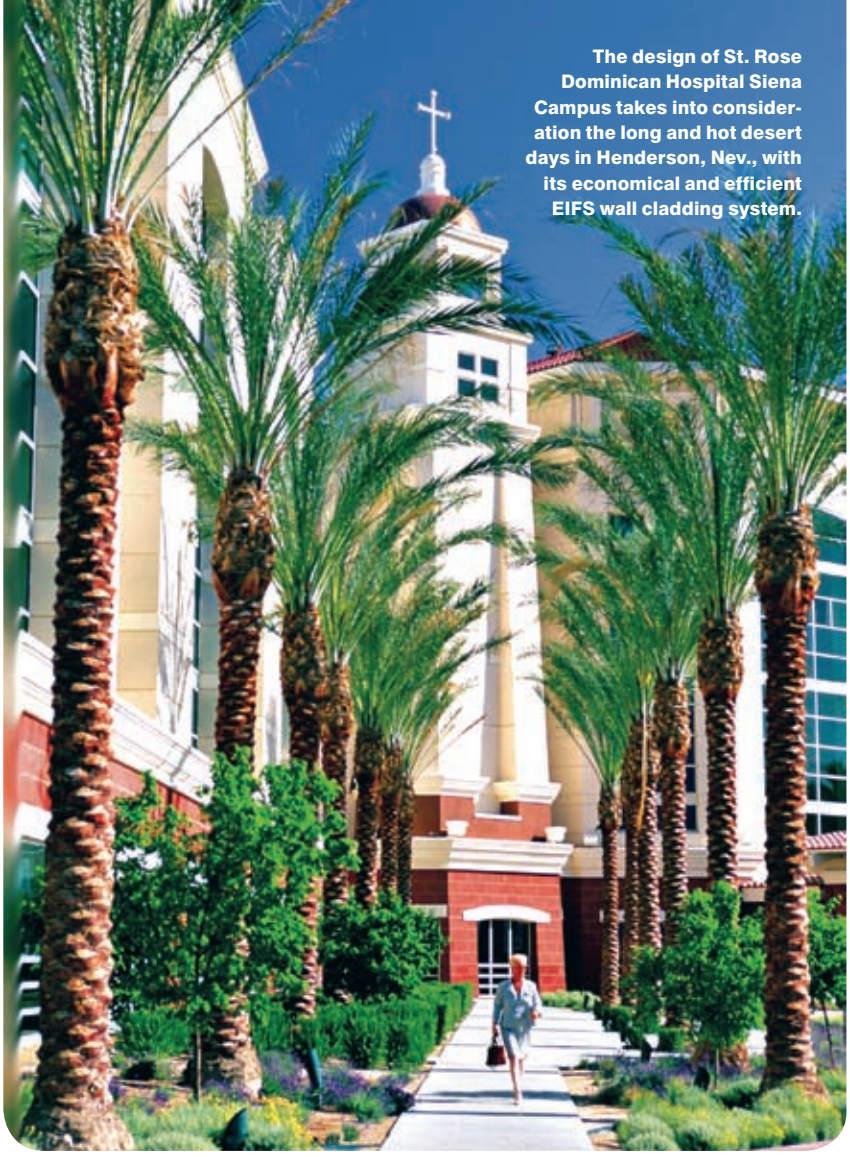
Basic principles of exterior design

> **Materials and methods** — Exteriors of hospitals and health facilities can be made alternatively of precast concrete panels, curtain wall construction, masonry and glass. These selections should be based on climate and availability of labor and materials. The materials selected for health and hospital exteriors should properly withstand the extremes of the local climate. If the temperatures swing to extremes — fluctuations season to season as well as between day and night — the building exterior panels must safely expand and contract.

> **Exterior color** — The colors of exterior materials are a highly important element in the overall facility design and vary depending on the location and local climate. If the climate is in a desert area such as Arizona, New Mexico or Southern California, the exterior colors tremendously can affect energy utilization and operating costs. Light exterior colors can reflect the sun's rays, whereas dark exterior materials and colors can absorb heat and increase energy and air conditioning costs dramatically.

> **Site orientation** — The manner in which a hospital and health facility building is oriented on a site has a significant impact on the design of the exterior of the building. In northern climates, the building may be oriented to bring in maximum daylight. In hotter climates, the building should be oriented to keep excessive sunlight out. Creative designers actually have designed one hospital in southeastern Florida so that the building became its own shade umbrella, as the design stepped back each floor from the roof.

> **Fenestration** — Whether the exterior design is made up of expanses of glass — so natural light can bathe the interior of the building — or minimal glazed exteriors to keep out the sunlight in a hot desert environment, fenestration design decisions are critically important. Also of vital importance is what is best for the patient in the design and size of the patient bedroom windows, in the context of the exterior of the hospital. Having views and natural light can be most beneficial for



The design of St. Rose Dominican Hospital Siena Campus takes into consideration the long and hot desert days in Henderson, Nev., with its economical and efficient EIFS wall cladding system.

the patient as well as for the staff of these health and hospital facilities.

Research and development

Architects, contractors and government officials should partner to undertake research and development on more sustainable energy-efficient, economical, functional and aesthetically pleasing exteriors of hospitals and health facilities.

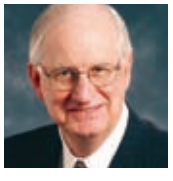
Partnering with scientists, such as biologists, would also allow the design and building community to understand how flowers and trees can sense their environment changing and adapt accordingly. Learning from this, designers should ask themselves, "Why should a building exterior be the same during the day as at night, or in July as in February in a temperate climate?"

Working on interdisciplinary teams, research and development groups can generate new knowledge by working collaboratively toward thinking about building design, construction and operation in new and dynamic ways.

For example, a research study was undertaken at the Desert Architecture Unit of The Jacob Blaustein Institute for Desert Research at the Ben-Gurion University of the Negev in southern Israel by professors Yair Etzion and Evyatar Erell. It featured an innovative glazing system that converts short-wave solar radiation to convective heat and long-wave radiation that, in turn, reduces energy consumption. While maintaining all of the benefits of a direct gain solar glazing, it reduces glare, minimizes fading and reduces the problem of hot spots in solar place.

The group experimented with a rotating Trombe wall system that absorbed radiant heat during the day and rotated at night to face inward, allowing the interior to use the heat collected during the day for heating the space during the cold nights. The result was energy cost savings during the summer and winter months. This concept opens tremendous possibilities for the design of hospital exteriors that would actually reduce energy costs and make hospitals more sustainable.

Thoughtfully designed hospital exteriors can help reduce energy consumption, allowing healthcare facilities to be more sustainable and energy efficient in an era of limited resources. In a time of worldwide energy conservation, it is imperative that all building team members lend their expertise to create aesthetically pleasing, energy-conscience and sustainable buildings. ■



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