Growing Up

Trish Martineck

Challenged with growing pains, the Children's Medical Center of Dallas, TX added six floors on top of an existing reinforced concrete building.

The existing concrete shear wall was extended for six new floors.

When the Children's Medical Center of Dallas was challenged to provide a streamlined, structurally sound method of continued growth for its facility, the solution was to build up—and create a six-floor addition atop a fully operational building.

"For every bed, it seems that we have four children to fill it," said Marc E. Leediker, AIA, vice president of facilities management for the hospital. "We want all of those children and their families to have access to the quality and specialized care that we provide at our children's hospital. To meet the constraints of the tight, urban site, we knew the best place to grow was up. Our goal was to maximize the number of patient beds within the existing footprint, obtaining the largest amount of physical floor space."

The high-rise tower design adds more beds while offering a dramatic view of the Dallas skyline. The expansion project includes the construction of six additional floors to the current

A detail at the connection between new chevron bracing and existing concrete structure.

Extensive measures were taken during construction to protect existing hospital pathways from construction hazards.

hospital located on Motor Street, doubling the size of the East Tower. This expansion of 159,000 sq. ft adds approximately 132 beds, and increases the number of ICU beds from 36 to 65.

STEEL GOES VERTICAL

The original hospital's concrete pan-joist structure was designed for only one future floor of vertical expansion. "Original floors were designed for 100-psf live load rather than the usual 40, which gave us some flexibility in the expansion," said James Whitt, P.E., of HKS, Inc. "By using steel to frame the addition, we were able to include the extra floors."

Whitt says the only system that was seriously considered for the addition was structural steel. "Steel floors offered flexibility for changes in HVAC or plumbing when modifying the space," he said. "We were able to design the steel before we knew exact exterior details and specifications. Unlike embedded connection plates used in concrete construction, steel offered us the ability to coordinate skin attachments after the structural steel was erected."

To maximize vertical expansion, all existing and new floors have the code-minimum live load of 40 psf-reducible in the wards and patient rooms via the 1997 Uniform Building Code. This large reduction in design live load, coupled with the use of a lighter structure, enabled the existing columns and foundations to accept six new stories when considering gravity loads.

However, the existing lateral system would not accept the increased wind load from the new six stories. To meet this challenge, a new lateral system was installed. The system includes an extension of the existing concrete shear walls as well as the addition of HSS chevron bracing. The bracing extends from the building's existing foundation to its new 12th floor. New construction also includes welded steel moment frames and double-angle steel knee braces.

COMPUTER MODELS

HKS applied software from RAM International to develop the project. RAMSteel was used to design the gravity columns and floor framing while RAMFrame modeled the complete lateral system for the existing and new parts of the building, including the concrete shear wall, concrete columns and girders on the first six floors. UBC 1997 wind loads were applied through the RAMFrame program.

"The PCA-Column program was used to verify the existing columns as well as the existing shear walls," Whitt said. "Because HKS designed the original building in 1990, the firm had easy access to field tests of existing concrete compression strength. These strengths—generally 20 percent higher than specified design strength—were used when reviewing individual existing columns."

BUILT UP

The building is built in two floor columns which include floors 8-12 and the roof. The gravity framing consists of structural steel wide-flange beams, girders and columns. The floor system consists of 2", 18-gauge composite metal deck with 3¼" of lightweight concrete, and a total slab thickness of 5¼". The lateral force resisting system consists of a combination of concrete shear walls that continue from below and field-welded moment frames.

To add floors that were not originally designed, HSS chevron bracing was added—both to the six new floors and to the existing concrete floors. These braces consist of HSS $8 \times 8 \times 1/2$" in an inverted-V brace configuration. The braces are field-welded to steel gusset plates in the new construction. In the existing concrete floors, the tube braces are connected to steel plate assemblies that were expansion-anchored into existing concrete beams and columns using Hilti HSL Heavy Duty Sleeve Anchors.

More than 876 tons of new steel columns and beams were fireproofed with spray-on, cementitious fireproofing. The composite floor deck, with a 3¼" lightweight concrete cover slab, is rated for two-hour protection.

The project's structural steel construction allowed for flexibility and mobility in sequencing, said Centex Construction Co. Superintendent Rob George. "As site conditions changed due to weather or hospital activities, we were able to coordinate continued construction operations. Moreover, all of the steel was pre-purchased and prefabricated in the project's design development phase. The steel—with pre-fabricated assemblies and perimeter beams—was assembled for quick delivery to the site."

STEEL IN BUSINESS

Structural steel framing, with lightweight composite slabs, minimized gravity loads on existing columns and foundations. The system also met the serviceability requirements of a hospital. The ability to stay within the capacity of the existing columns and foundations helped avoid any invasive remedial work within the existing hospital. Children's Hospital of Dallas required that the existing six floors remain as close to fully functional as possible during the entire construction process.

"We planned for this project one year in advance," said Leediker. "If a patient was bothered by construction noises, the superintendent moved the crew to another location. A few beds on the sixth-floor unit were closed for brief time periods during construction to avoid disrupting our patients."

Centex and HKS representatives met early in design to outline a process that would mitigate noise and increase job site safety. The building's original detail called for the drilling and setting of anchor bolts into the slab, which could create excessive noise and vibrations to the building floors below. To avoid this, the decision was made to form pilasters for the placement of the steel—avoiding the use of noisy jackhammers.

Residential-grade hammers were used to easily remove portions of the concrete around Lenton connections. "The existing columns were topped with couplers," Centex Project Manager Kirk Benken said. "The rebar was threaded into the existing couplers to form a 2'-tall pilaster. The steel columns were set atop the pilasters by a 160'-tall hammerhead crane with a 242'-long boom."

Centex worked with the hospital to schedule construction around daily activities. The construction work was set up in two main intervals: a 5:30 a.m. to 8:30 a.m. shift and a 3 p.m. to 6 p.m. shift. This allowed the hospital to operate under normal conditions from 9 a.m until 3 p.m.

FOR SAFE MEASURE

A number of safety measures were put in place at the hospital. A detailed erection plan outlined special sequence designs, such as hoisting columns low to the roof, as well as a per-trade job analysis. Each steel worker went through a safety training program conducted by Centex. Additional training was provided for riggers.

"More than 400 linear ft of tunnels were installed around the building to create a secure environment for people arriving and departing the facility," George said. "An expansive safety net was installed on the south side of the building. Courtyards and play areas were closed. The result: zero incidents and zero lost time during steel erection."

TOPPING OUT

Centex hosted a topping out ceremony on June 14, 2002 at the hospital. The festivities featured the hoisting into place of the structure's last steel beam.

"The steel workers, as well as everyone else on the project, felt proud of this structure," Benken said. "These patients inspired us every day by placing artwork near the workers' elevator."

The design and construction team collected more than $16,000 for Children's Medical Center of Dallas. The topping-out beam, covered with stickers of support, is now located in the elevator penthouse.

The expansion began in fall 2001, with completion targeted for January 2004. The 50-percent complete project is currently on-time and within budget. The project will be phased to allow for building occupancy as construction continues. The eighth floor will be activated for patient use by July 2003. Following the first move-in, one floor will be activated per month. ★

Trish Martineck is director of communications for HKS, Inc.

Steel tube chevron bracing was installed on both the new and existing floors to increase the building's lateral capacity.

OWNER
Children's Medical Center of Dallas

ARCHITECT
HKS, Inc., Dallas, TX

STRUCTURAL ENGINEER
HKS, Inc., Dallas, TX

STEEL FABRICATOR, ERECTOR AND DETAILER
Irwin Steel, Justin, TX (AISC member)

CONTRACTOR
Centex Construction Company

ENGINEERING SOFTWARE
RAM Structural System