A Hospital Reborn

BY MICHAEL G. BRENNAN, P.E.

With an upgraded and expanded facility, Children's Hospital of Pittsburgh of UPMC is bringing new life to a century-old medical campus.

AS PART OF A CONTINUED COMMITMENT to excellence, the University of Pittsburgh Medical Center (UPMC), in close cooperation with the Children's Hospital of Pittsburgh of UPMC, has recently completed a new hospital in the Lawrenceville section of Pittsburgh. This project is an ambitious undertaking in that it represents the integration of a new medical campus with the construction or renovation of eight major structures, all situated on close to 10 acres in a densely populated section of the city. The site, which formerly contained the St. Francis Medical Center, served as a medical community for over 100 years and this project will make it viable for another 100 years.

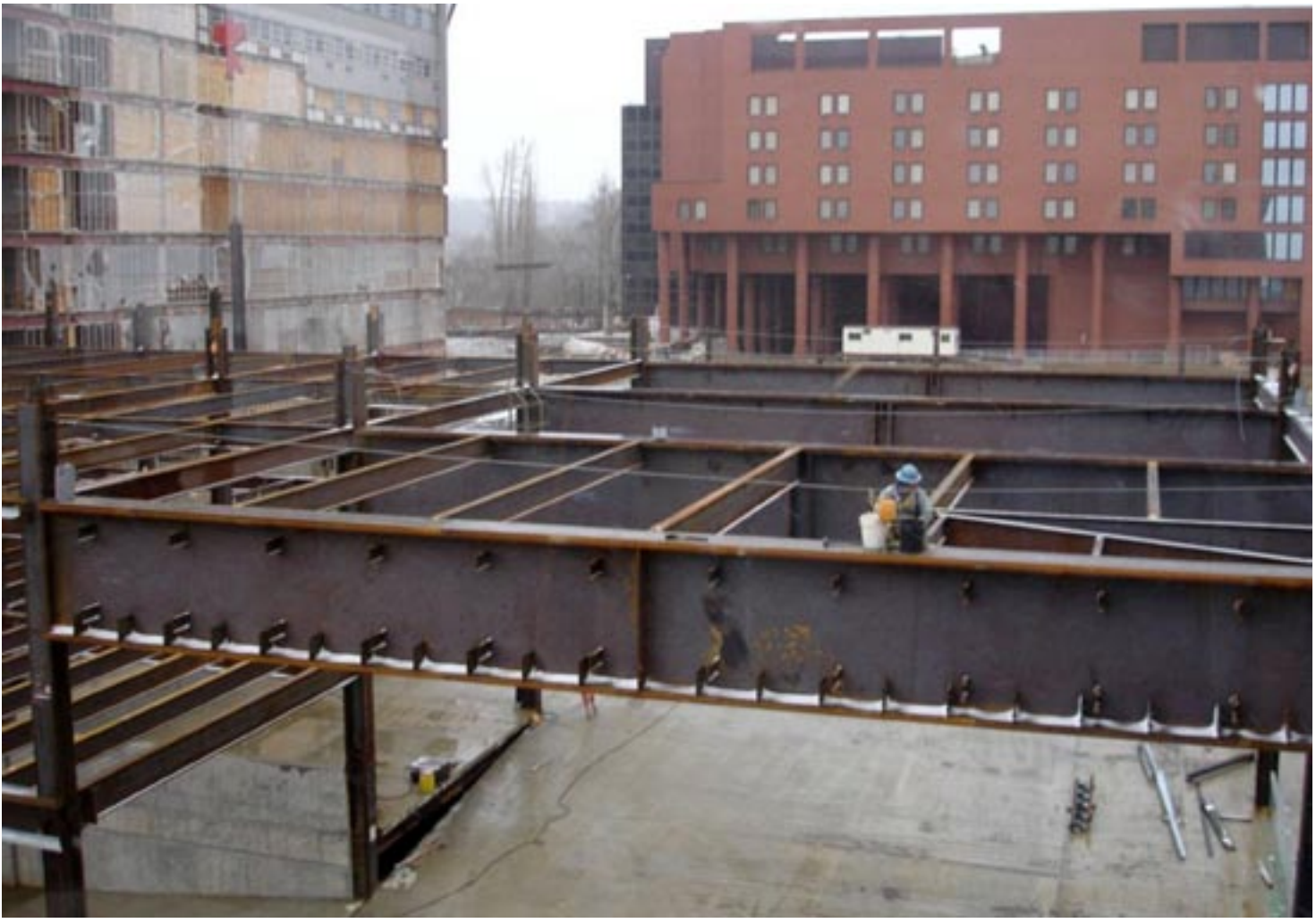
When completed, the campus will contain the main hospital, the John G. Rangos Sr. Medical Research Center, a Central Plant, the East pavilion, the Medical Office Building, the North Garage, the Midcampus Garage, and the Plaza Building as well as linkage bridges. Some of these buildings are existing and represent a conditional reuse. Some are additions to existing structures, notably an expansion to the Central Plant. Others are completely new buildings including the garages, the Rangos Research Center and the main hospital.

Main Hospital Building

The main structure is a new 13-story hospital planned around an existing South Tower. During the project's planning process it was decided that the South Tower should remain as intact as practical to preserve recently constructed operating room suites and ancillary cardiac care intensive care rooms, all extremely high-value, highly engineered spaces. Keeping the South Tower and mating the floors created one of the earliest identified design challenges for the project, in part because the use of ramps was prohibited.

Modern hospital planning suggests at least 16 ft floor to floor. This allows a 9-ft ceiling with ample annulus room to run medical gases, information technology, power, HVAC, pneumatic tube, plumbing, fire protection, specialty lighting, cable festoons, etc. The South Tower is 12½ ft floor to floor, which with a 9-ft ceiling height means the various systems have to coexist in a space of 3½ ft minus the beam depths.

The basic grid is 30 ft by 30 ft with a 2-in. composite metal deck and 3½ in. of lightweight concrete fill. Thirty 30-ft-long beams are spaced 10 ft on center. As early as practical, the structural designers coordinated with the mechanical designers to determine where



Opposite page: Building a new 13-story hospital on a century-old medical campus in Pittsburgh's Lawrenceville section presented both opportunities for renewed vitality and the challenge of working in tight quarters.

Above: Twelve 6-ft 6-in.-deep and 60-ft-long plate girders installed on the third floor of the main hospital building accommodate a 60-ft-wide, two-story-tall access drive cut through the building for an off-street pedestrian drop off area.

main distribution systems were to be routed. The conclusion was that above the third floor, the girder depths had to be limited to 18 in. Based on the results of the lateral analysis, the inertial demand warranted W18×97 girders; obviously a least weight design was not of paramount importance.

As a consequence of the floor-to-floor height limitations, a systematic network of penetrations was provided in the beams and girders to create the largest openings possible without having to provide stiffeners. The project was on a phased fast track so that the steel was designed long before the systems design could be completed. To encourage and enforce the use of the penetrations, practical and possible contractor coordination drawings were created and weekly meetings were held. The result is a highly coordinated, complex above-ceiling MEP distribution.

The main hospital building is situated on a busy city street. To allow controlled, safe pedestrian drop off, a 60-ft-wide two-story-tall access drive was cut through the building. Twelve deep plate girders, each 6-ft 6-in.-deep by 60-ft-long, were installed on the third floor to transfer the column loads of the nine upper floors.

John G. Rangos Research Center

The UPMC and Children's Hospital of Pittsburgh leadership team insisted that the new research building would be second to none, in both facility, and staff. Among other things, that meant the building had to be strong and it could not vibrate. Although

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Transfer girders on the fourth floor of the research building enabling a regular grid and shallower beams to be used for the upper floors of the building while still providing open space below for access to a loading dock.

simple in concept there were contributing factors that made the criteria interesting and challenging.

The planning called for a 12-story tower using 3½-in. lightweight concrete fill with 2-in. composite metal deck. Lateral load resistance is provided by discrete moment frames. The floors are designed for flex lab space, which can be arranged and adjusted as needed to support the requirements of the principal investigators. ASCE 7 Table C4-1 specifies a minimum live load of 100 psf, which was used as the design basis unreduced over the entire floor plate. The sophisticated laboratory requires copious airflow, so the facility has large inline discharge fans on the roof and three floors for mechanical equipment, as well as the distribution floor, penthouse and upper penthouse.

The research building is bordered on the east and west by one-way streets, and on the north and south by the Midcampus and North Garages. The garages directly abut the building and expansion joints are provided at the separation. A linkage crossover connects the two garages. The hospital's material management department is located in the basement of the Midcampus Garage and the loading docks are located in the basement of the Rangos Research Center where there is a controlled limited access dock. Trucks enter the east side, drive under the building, back into the docks, and drive out on the west side.

The initial architectural requirement was that no columns could land in the loading dock space. After evaluating various framing schemes, engineers settled on a plan allowing the perimeter columns and two interior columns in locations where turning radius modeling determined that it was possible to maneuver the design basis truck through the space. The column arrangement creates long span conditions, with 53-ft beams and 42-ft girders, requiring large, deep members. The deep members created impediments to the mechanical distribution, so 10 transfer conditions were established in the fourth floor so that a regular grid and shallower beams could be used for the balance of the building.

The loading dock provided a challenge, as did the parking crossover. It was a design requirement to connect the garages abutting this building. To accomplish that meant allowing vehicles to drive through the research structure. To alleviate the fear that moving cars could impart a vibration into the research areas, the two levels of parking crossovers were constructed as a separate structure, like a nested table isolated from the main building. Furthermore, due to architectural requirements, the elevator straddles the expansion joint between the parking crossover and the main building. This too had to be isolated. The result is that there are three discrete structures: the main building, the parking crossover and a self-supporting elevator tower.

The reconfiguration of the medical campus will allow UPMC and its Children's Hospital to enhance its leadership position in pediatrics and become the incubator for breakthroughs in medical research. MSC

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