All-Precast Concrete Design Delivers On-Time Opening for Florida's LECOM Medical Students

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Located near the Tampa Bay area in southwestern Florida, the Lake Erie College of Osteopathic Medicine (LECOM) at Bradenton is a new 109,000 ft² (10,130 m²), innovative, problem-based learning facility for 600 medical students. Built at a price of $25 million, the all-precast concrete, three-story structure was delivered in a very compressed schedule, with medical students arriving for classes in September 2004, only 14 months from the onset of design. Planning and building LECOM from the outside in toward the center, a rapid delivery team made maximum use of economies of precast concrete prefabrication, production, and erection schemes. This precast concrete solution proved superior to cast-in-place concrete and structural steel alternatives in aesthetic appeal, total project cost, structural durability, and particularly in its remarkably rapid completion. With white-aggregate concrete encompassing a blue central skylight, this impressive medical education center offers state-of-the-art wireless classrooms and forensic laboratories in a striking facility that is both architecturally beautiful and thoroughly modern.

Just 12 months after local, state, and federal leaders met to break ground for the first branch campus of the Lake Erie College of Osteopathic Medicine (LECOM) at Bradenton in Lakewood Ranch, Fla., this contemporary medical school opened its doors to the Class of 2008 in September 2004. The Bradenton LECOM campus offers the only Problem-Based Learning (PBL) pathway: a student-directed, small-group, active approach wherein students have the opportunity to learn basic and clinical science by following the medical cases of actual patients.

Located in a diverse 18 acre (7 ha) setting that includes a small lake, woodlands, and wetlands, this three-story, 109,000 ft² (10,130 m²), state-of-the-art medical school has a design that reveals aesthetic harmony with its subtropical Floridian climate (Fig. 1, 2). Within its bright and spacious interior, LECOM will accommodate a total student body of 600.

Modern wireless laboratories and classrooms provide outstanding facilities for studies in anatomy, microbiology, histology, and osteopathic manipulative medicine classes (see “Treating the Whole Person,” page 85). With natural light pouring from a large, central, inverted skylight roof, students using the focal space of the library, lounge, and dining area are provided beautiful views of the lake and wooded property to the west.

In this article, the authors explain how the LECOM project’s rapid response team was able to meet the owner’s stipulation that it open the doors of the new medical school to its first students in September 2004, only 14 months after design began (Table 1). Such a compressed construction schedule called for a flexible construction system that could be planned, fabricated, and erected with remarkable speed.

After consideration of several construction materials and systems, an all-precast concrete structural solution was proposed to meet the early occupancy date. Prefabrication of
Tampa, Fla. After intense initial collaboration, the rapid response team was able to produce the most efficient design and erection program for meeting the owner’s mandate for an on-time delivery for start of the following year’s fall classes within the cost parameters.

A DESIGN FOR SPEED AND BEAUTY

Planning and design processes for LECOM were an inclusive effort that defined the academic requirements of the institution and the architects’ ability to achieve a design solution to provide the image for the facility in a timely delivery method. Initially, HOK Architects and Fawley Bryant Architects Inc. held programming charrettes with the college dean and key members of LECOM to determine the specific requirements of each space. The overall scope of the building was outlined and described thoroughly during this process.

Subsequent charrettes addressed the overall building location and land use of the facility, the building organization, and the specific layout. With the overall scale of the building established, a structural solution began to develop. The consideration of using architectural precast concrete for the exterior of the building was explored during the evaluation of structural options, including those of steel framing and cast-in-place concrete alternatives. By establishing a building vocabulary that was clear and straightforward, an all-precast system was adopted for the building.

The owner was looking for a beautiful, modern, and dynamic image for LECOM. White aggregates set within a white, precast concrete matrix would create a clean, crisp palate and sleek, high-tech appearance that the owner hoped to establish for its newest branch facility. Banding the white precast concrete shell with extensive use of green fenestrations and tinted inverted skylights would reflect the college’s use of the latest technology within a structure that also presented a cool, welcoming freshness in counterbalancing Florida’s subtropical climate.

Following the setting of the structural parameters, final design of the interior spaces was completed as a “fit-up” of the building envelope. Detailed design sessions continued to address the functional requirements of each individual space and the overall character of the building. One competitive benefit over other structural materials was the cost-effectiveness of selecting a system that would provide an architectural precast concrete exterior finish that was integral with a load-bearing structural system.

Selecting precast concrete, with its built-in production and

<table>
<thead>
<tr>
<th>Table 1. Project timetable and price.</th>
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<tr>
<td><strong>Start of design</strong></td>
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<tr>
<td>Precast concrete fabrication</td>
</tr>
<tr>
<td>Site preparation and grading</td>
</tr>
<tr>
<td>Foundation work</td>
</tr>
<tr>
<td>Erection</td>
</tr>
<tr>
<td>Completion of precast structure</td>
</tr>
<tr>
<td>Occupancy date for start of school year</td>
</tr>
<tr>
<td>Precast concrete price</td>
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<tr>
<td>Total LECOM project price</td>
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TREATING THE WHOLE PERSON—AN INTEGRATED APPROACH TO MEDICINE

The Lake Erie College of Osteopathic Medicine (LECOM) wanted a teaching facility that created a student-centered learning atmosphere for medical students. The Bradenton campus provides medical education through a Problem-Based Learning curriculum. Students work in small groups using real patient cases that gradually take the students through the basic sciences and eventually to a clinical diagnosis. This type of curriculum requires more small classrooms and fewer large lecture halls and laboratories than traditional lecture-based curriculums. The building provides a large Learning Resource Center and student lounge with expansive study space. Students have access to hundreds of online journals and wireless access to all course material. The LECOM Bradenton’s Osteopathic Manipulative Medicine (OMM) Laboratory is equipped with a track and video-camera system to allow OMM instructors to remotely control a ceiling-mounted camera to zoom in on the subject of their demonstration and broadcast the image on screens throughout the classroom.

All LECOM Bradenton students must complete a 12-week gross anatomy course and other required lecture courses. To accommodate these classes, the campus has two 200-seat, smart-classroom lecture halls offering the latest audiovisual technology at the professors’ fingertips. The Gross Anatomy Lab comes equipped with computer terminals and tracking cameras that provide video projection on large screens and monitors. This equipment requires fewer cadavers and students view close-up images of anatomical features that are exposed by prior dissection. The Bradenton anatomists also use plastinated specimens that have undergone a high-tech preservation process. At LECOM Bradenton, the faculty trains future doctors of osteopathic medicine to practice an integrated approach to medicine, treating the whole person rather than just specific symptoms. Students learn to look at the totality of the patient and use the musculoskeletal system as an avenue of diagnosis and treatment. One of the core subjects taught during the first two years of training at LECOM Bradenton, OMM involves the use of hands-on techniques to diagnose, treat, and prevent illness or injury. The whole-health philosophy and OMM make osteopathic health care unique within the medical profession.

—by Dr. Silvia Ferretti

Table 2. Precast/prestressed concrete components for the LECOM project.

<table>
<thead>
<tr>
<th>Number of Components</th>
<th>Precast Concrete Components</th>
<th>Linear Feet or Square Footage</th>
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<tbody>
<tr>
<td>212</td>
<td>Field-topped double tees</td>
<td>88,480 ft²</td>
</tr>
<tr>
<td>26</td>
<td>Architectural column covers</td>
<td>352 linear ft</td>
</tr>
<tr>
<td>24</td>
<td>Architectural wing columns</td>
<td>1080 linear ft</td>
</tr>
<tr>
<td>24</td>
<td>Interior columns</td>
<td>1272 linear ft</td>
</tr>
<tr>
<td>110</td>
<td>Architectural spandrel beams</td>
<td>3269 linear ft</td>
</tr>
<tr>
<td>24</td>
<td>Inverted tee beams</td>
<td>672 linear ft</td>
</tr>
<tr>
<td>24</td>
<td>Flat slabs</td>
<td>2200 ft²</td>
</tr>
<tr>
<td>34</td>
<td>L-beams</td>
<td>1049 linear ft</td>
</tr>
<tr>
<td>94</td>
<td>Architectural wall panels</td>
<td>15,024 ft²</td>
</tr>
<tr>
<td>70</td>
<td>Shear walls</td>
<td>13,607 ft²</td>
</tr>
<tr>
<td>58</td>
<td>Architectural sills</td>
<td>547 linear ft</td>
</tr>
<tr>
<td>12</td>
<td>Raker beams</td>
<td>284 linear ft</td>
</tr>
<tr>
<td>36</td>
<td>Voided slabs</td>
<td>1667 linear ft</td>
</tr>
<tr>
<td>2</td>
<td>Rectangular beams</td>
<td>44 linear ft</td>
</tr>
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Note: 1 ft = 0.3048 m; 1 ft² = 0.0929 m².
Fig. 3. Layout of second floor shows locations of columns and open spans designed for flexibility in room use.
erection efficiencies, shortened the design and construction schedule by four months. Because of the low-lying site limitations, the LECOM project team needed to facilitate early plan approval from the U.S. Army Corps of Engineers District for the 3 acres (1.2 ha) of on-site wetlands, meet state site (Southwest Florida Water Management District) restrictions, comply with the local Economic Development Council for the state of Florida, and obtain Manatee County zoning and construction permits.

Permitting for this type of project typically requires nine months to one year, which was unacceptable for a fast-track project such as LECOMs; the rapid response team was able to obtain approvals and zoning and construction permits in only six months.

Obtaining an early county-issued foundation permit was critical in enabling the project team to pull the building’s shell permit first, thus beginning site and erection work before obtaining approval for the interior plans. On the LECOM project, initial site work started at the same time as the building’s erection, requiring careful, day-by-day construction supervision to prevent conflicts between trades operating in close proximity. The speed of construction with premanufactured components was the single deciding advantage of the precast concrete system over alternative solutions.

All of the precast components in the total building footprint of 39,336 ft² (3654 m²) are listed in Table 2. Out of the total project budget of $25 million, about $3.1 million accounted...
for the precast concrete portion of the contract.

The precast concrete floors were framed with 24-in.-deep (610 mm), 10-ft-wide (3 m) double tees and a 3-in.-thick (75 mm) concrete topping slab. This design allowed for an efficient, shallow floor structure with two clear spans of 50 ft (15 m) and columns spaced at 30 ft (9 m). Clear spans provided a high degree of flexibility for layout of rooms and future use of the floors. Figures 3, 4, and 5 show second level plan and sectional drawings.

On an east-west axis, the facility floor plans shown in Fig. 6, 7, and 8 indicate the location of the central lobby, classrooms, laboratories, auditorium/amphitheater, library, and administrative offices on the three levels of the school. Designers oriented the structure eastward to create a formal palazzo entrance. An airy and spacious lobby unites the public areas of the first floor with educational spaces on the second floor and also serves as an elegant space for student functions, college fundraisers, and events (Fig. 9).

SKYLIGHT AND WHITE ARCHITECTURAL PRECAST CONCRETE INTERIORS

Incorporation of a continuous, inverted roof skylight (Fig. 10, 11, 12) gives the central gallery, from the east lobby to the west library, a bright and inviting ambience. Natural sunlight and a feeling of spaciousness and serenity pervade the student and public areas, as light reflects from the clean, white, architectural precast concrete interior walls and supports. Special fritted, low-e, clear, opaque, and tinted glass was used throughout the structure. Glass panels incorporated a 1 in. (25 mm) air space for indoor temperature maintenance.

Fritted glass minimized glare on interior surfaces, especially important for computer screens, and the opaque glass over spandrel beams served to conceal support structures beneath. Glass was also arranged in a banding pattern that worked in geometric harmony with the horizontal and vertical reveals cut into the white, precast concrete panels.

The skylight element works to connect the formal main entrance way to the rear of the building, which is the west-side student entry. By creating a strong sense of space, the multistory skylight gallery is an effective design continuation of
the building’s exterior appearance. Essentially upside down in section view (Fig. 10, 11), the skylight is designed and sloped to collect and distribute rainwater.

The owner wanted to create an entranceway to the college that would be distinctive, dramatic, and inviting to students, faculty, and visitors (Fig. 13). Exposed white aggregates, obtained locally, were used with a white cement color to produce stunning finish and clean lines with reveals for the exterior surfaces. With its wing-shaped structure, the flying canopy sculpture above the entrance established the bold and uplifting atmosphere that is reminiscent of a bird in flight.

The strong, expressive, precast concrete facade, using simple materials and building processes, met the fast-track schedule and produced the attractive finish on the loadbearing precast concrete walls. A rich, clean finish was particularly important to the owner both for the exterior and exposed interior surfaces of the college. In serving as both a prefabricated, loadbearing element and as the architectural finish, precast concrete proved to be a cost-effective, dual solution.

Projecting out the back of the building, the two-story...
Fig. 12. View through the library and lounge, looking west. This focal space boasts splendid natural lighting from the tinted skylight and the crisp, clean environs created by the white, architectural, precast concrete interiors.
amphitheaters/lecture halls overhang the first floor colonnade, effectively shading occupants in the library below and adding visual interest to the exterior. Precast, prestressed, voided concrete slabs, 15 in. (380 mm) thick, were used to create the floor of the auditorium, achieving the required fire rating and taking advantage of the custom cross section. The slabs also provided a 45 ft (14 m) open span between the precast concrete raker beams; this precast concrete slab design effectively reduced the total weight on the structure. Sloped-stadium concrete raker beams span 65 ft (20 m) to establish the open space for the two 200-seat amphitheaters that the students will use as lecture halls.

This first branch campus of LECOM in Florida has incorporated the latest in smart classroom technology. Professors will have access to all audio, video, and computer images at the lectern. The entire building has wireless computer network capabilities. Group study rooms vary in size to accommodate the PBL methodology of learning, and spaces are designed to support a collaborative learning experience.

The 2001 Florida Building Code defined the structure as being located in a “Windborne Debris Region” where wind speeds reach 125 mph (201 km/h). For structural stability, a system of precast concrete shear walls, located at the stairwells and elevator shafts, provides resistance to wind forces. Foundations for the structure are spread footings with a bearing pressure of 4000 psf (20,000 kg/m²). Very loose, soft sands onsite required specialized deep densification using stone columns to a depth of 25 ft (8 m).

**PRECASTER PREPS FOR ARCHITECTURAL PRODUCTION**

Initially, it was thought that the structure would be enclosed with gray, precast concrete panels with a standard production finish that would later be painted. After the contract was awarded, however, the owner requested an upgrade for completing the job with architectural precast concrete and integral color. As a result, the job was quoted as a structural product with integral color, subject to the quality control provisions of PCI’s Quality Control Manual (PCI MNL 116). Because of the high-profile nature of the LECOM facility, the precaster employed strict in-house acceptance standards for finishes and dimensional tolerances.

Small 12 in. × 12 in. (305 mm × 305 mm) samples were generated with varying types of white cement and differing depths of sandblast until the owner selected the one with the desired look. Three full-sized mockups were then produced and sandblasted to varying depths. Both the owner and the project team selected the finish treatment.

This adaptation did not delay the speed of product delivery (Fig. 14, 15). The precaster’s facility used steel casting tables, and epoxy-coated wooden decks were made for the tops of the steel casting tables.

Cast entirely with a white cement—based concrete, the loadbearing panels produced at Coreslab (Tampa)’s facility used a self-consolidating concrete (SCC) to aid in the casting and smooth appearance of the finished surfaces. Local white aggregate, Florida limestone, and sand were used with the white cement product to create the architectural finish.

*Fig. 13. Uplifting and almost weightless, the welcoming entrance to LECOM impresses the visitor with its semblance of a bird in flight. Vertical photo shows 5000 address on precast concrete.*

*Fig. 14. Obtained locally, the white aggregate in the white concrete matrix creates the clean look desired by the owner.*
Fig. 15. Closeup of architectural precast concrete demonstrates the crisp reveals and uniformly white surfaces mandated by the owner.

specified by the owner.

Consistency in the appearance of the finished white concrete surface was critical to the owner; special attention was paid to quality control in screening incoming materials for color consistency and precise production methods. These precautions were particularly critical in producing the three-story-high, precast concrete panels. All panels were inspected against the approved mockup before being green tagged and put into storage.

White columns were cast monolithically with the structural gray columns to effectively reduce the number of required precast concrete pieces and the connections required for the loadbearing panels. With the profile of the column cover protruding out from the structural column within, it was undesirable to rotate the columns from their “as-cast” position. The exposed, architectural, precast concrete column covers were, therefore, sandblasted overhead and stored and shipped in as-cast positions. Casting the precast pieces monolithically translated into more efficient production and erection processes.

White concrete column covers concealed the gray structural columns beneath and served as bearing support for the horizontal loadbearing spandrels (Fig. 16). To increase production efficiencies, the spandrel cross sections were also monolithically cast in C-shaped sections; this allowed for the inset look of the windows as designed by the architect.

To maintain the sleek, clean look desired by the design team and owner, it was particularly important to locate the lifting eyes for precast concrete pieces so they would not be visible to occupants of the building.

Formwork was built to allow for one continuous casting of the flat spandrel shape and the vertical as-cast extensions of the spandrel. Because of the use of SCC, special production considerations were needed to prevent concrete from flowing out of the vertical portions and to avoid casting lines. Attention to detail in the engineering and scheduling portion of the LECOM project minimized the amount of form changeovers, thereby increasing efficiencies and speed of production.

Due to the symmetrical nature of the building footprint, design was first completed on the two north and south wings of the building that flank the auditorium. These two wings were mirror images of one another and, from a design, detailing, and production standpoint, were the most efficient places to begin. While seemingly in conflict with a typical erection sequence, engineering efforts were concentrated in these north and south wings at the start of production to best meet the schedule constraints.

The team effort between the erector, precast engineers, and production personnel ensured that careful attention was paid to construction tolerances with no delay to the accelerated schedule. Reveal patterns in the exposed, architectural, precast concrete finish were laid out and sequenced for casting to maximize form use.

This formwork efficiency was the result of moving the headers around to achieve different lengths; sometimes this required shifting a header and reversing a piece in the form to
make repetitive use of the form. Good planning at every step of precast concrete production was critical for meeting the LECOM early-occupancy date.

BUILDING FROM THE OUTSIDE IN

A particular challenge for the erector, PreCon Construction Co. of Tampa, was constructing the two outer wings first, at the north and south ends of the building, and only later moving in to complete the center’s glass skylight panels. Transitioning of production and erection from the outer building footprint in toward the center of the structure demanded careful fabrication quality control and erector oversight of as-built construction tolerances for all the elements to meet accurately in the middle.

In retrospect, the erection crew did an excellent job in maintaining layout and erection tolerances; all the precast concrete pieces and fragile glass skylight panels fit together well, causing no delays.

Transporting the precast concrete components 60 miles (100 km) from the precasting plant to the construction site did not entail unusual methods or load permits. The contractor used two 250-ton (230 Mg) cranes with 80-ft long (55 m) booms to erect the column covers and loadbearing panels (Fig. 17, 18, 19). Lateral stability was achieved using 8-in.-thick (205 mm), precast concrete shear walls that also doubled as mechanical chases, stair towers, and elevator enclosures. Particular attention was given to jointing between the precast concrete components, and extensive caulking was applied around each of the pieces. A 3-in.-thick (75 mm), field-applied topping slab ensured a level, joint-free floor.

The total price for site and construction work for the LECOM project was about $192 per ft² ($2070/m²) according to the construction manager.

Foundation construction began in September 2003, and the construction schedule called for topping off the exterior work by January 2004, to allow for the required occupancy date in September 2004. Hurricanes Charley, Frances, Ivan, and Jeanne repeatedly blew over the newly planted palm trees onsite, but these storms did not adversely affect the construction schedule.

One incident in particular illustrates the remarkable flexibility of working with precast concrete systems. Because production and erection began before the design work for the interior of the LECOM building was complete, exact locations for the utility ducts (mechanical, electrical, and air-conditioning) were not available until after a substantial portion of the precast concrete enclosure for the north and south wings was complete, about three months into the project. This meant that the openings for utility runs had to be cored into the already-erected precast concrete enclosure on site. The project team had to ensure that reinforcing steel was not in the path of the utility coring and that the structural integrity of the precast concrete panels was not adversely affected by creating the openings. Over a two-month period, the erection crew and a special subcontractor successfully cored the designed utility openings in the already-erected precast concrete envelope.

Fig. 17. Construction shot of structure.

Fig. 18. Construction shot of structure.

Fig. 19. Construction shot of structure.
Fig. 20. Interior stairwell with glass wall panel is an excellent illustration of the enlightened combination of building materials to create a clean, bright ambience in a totally contemporary structure that takes maximum advantage of its natural setting.
CONCLUSION

In September 2004, students were welcomed into their first medical classes in the new branch campus of one of the nation’s fastest growing medical schools. The completed LECOM school provides students with open, bright, and clean architectural forms that create an energized space for learning (Fig. 20, 21). Students attend classes in amphitheater-style lecture halls and classrooms that display the latest technologies, including wireless computer network capabilities. The precast concrete components did not interfere with wireless transmission from antennas mounted within the college.

Rapid production and erection of the precast concrete shell was key in meeting the project schedule. Speed and the dual functioning loadbearing capacity with an architectural finish gave the precast, prestressed concrete system the decisive advantage over alternative building materials. With a team effort, the project’s fast-track schedule was completed on time and within budget, taking maximum advantage of the efficiency of precast/prestressed concrete systems.

This project won a design award for Best All-Precast Concrete Solution in the 2005 PCI Design Awards Program. The jury comments were as follows:

“This project features an extremely wide and interesting range of precast/prestressed concrete elements integrated into a complete package. The speed and flexibility of precast concrete is totally evident in this structure. No other material or solution could have provided such a high-quality structure in this limited time frame. The solution uses all of precast concrete’s abilities to shorten a schedule.”

ACKNOWLEDGMENTS

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The authors are particularly grateful to Susan Bryant, marketing coordinator at Fawley Bryant Architects, for entering LECOM and its Project Design-Build Team in the 2005 PCI Design Awards competition.

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