Str

PROJECT PROFILE

Project: Lewis and Clark Confluence Tower, Hartford, Ill.

Project Owner: Village of Hartford, Ill.

Project Architect: KAI Design & Build, St. Louis

Project Engineer: THP Limited Inc., Cincinnati, Ohio

Precast Manufacturer: High Concrete Group LLC, Denver, PA.

ength in Unity

The two towers of the Lewis and Clark Confluence Tower work together to achieve not only a unique design but a capacity for withstanding severe seismic stress and wind loads.

By Deborah R. Huso
Photos courtesy of KAI Design & Build (www.kai-db.com)
Cover photo courtesy of Lewis & Clark Confluence Tower (www.confluencetower.com)

In 2000, with the bicentennial celebration of the 1803-1806 expedition of Meriwether Lewis and William Clark approaching, the village of Hartford, Ill., just northeast of St. Louis, wanted to mark the event in a meaningful and enduring way. It was at Camp River Dubois that Lewis and Clark launched their "Corps of Discovery" exploration of the Louisiana Purchase within sight of the confluence of the Mississippi and Missouri rivers, the third-largest river confluence in the world.

Deanna Barnes, Hartford's project manager, says the village held a series of ad hoc community meetings to design a tower that would offer views of the rivers' confluence and also memorialize the historic partnership between the two explorers. She said the idea for a tower that would offer views of the two rivers stemmed from the hope of putting local residents and visitors back in touch with the waterways. "We wanted people to visit a viewing tower and then be inspired to go visit the rivers themselves," she says.

As the village looked for a site, the local fire department helped out by bringing a lift so that members of the village's Viewing Tower Committee could experience different heights for viewing the rivers. They learned the viewing platform for the tower would have to be 150 ft tall to allow for a full, panoramic view of the rivers' confluence.

Precast offers the design solution

The original design concept for the Lewis and Clark Confluence Tower called for a cast-in-place (CIP) structural core for the tower with precast architectural panels to serve as the tower's fins. But after discovering the cost savings and design control offered by an all-precast structure, the architectural firm worked with High Concrete Group, the precast manufacturer, to convert the design accordingly.

The project was funded entirely by grants and private donations, but because of the challenges of acquiring the funding, the confluence tower, associated park area and museum, took many years to build. Even though the village of Hartford broke ground on the project in 2002, it was not officially completed until 2010. The towers stood, fully erected, for several years without handrails on the stairs, while the village of Hartford worked to acquire more funding to complete the entire park project.

But this was to be no ordinary tower. It needed to

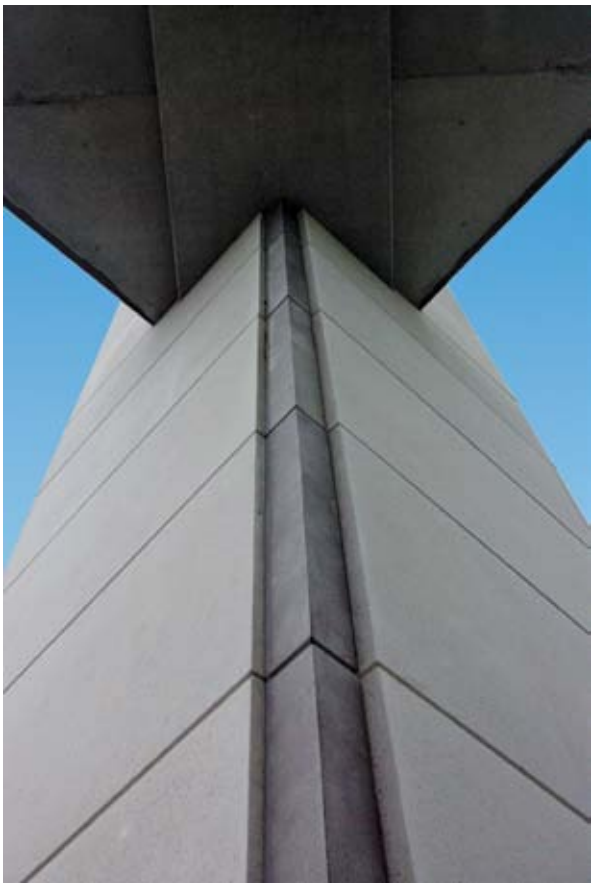
Construction actually began in 2002, but the monument did not open until 2010, as owners worked to secure funding to complete the grounds and museum.

reflect the symbiotic relationship of the two explorers it sought to memorialize. The Lewis and Clark journey was the only U.S. military expedition to go forth with two captains. President Thomas Jefferson designated Lewis as the head of the expedition, but the young explorer wanted his longtime friend to enjoy the title of captain as well, to have equal command over the expedition's corps of 50 men. As it turned out, the two men complemented one another perfectly with Lewis serving as the journey's naturalist and Clark as its cartographer.

The friendship and partnership between the two explorers was the basis for the tower's design, completed by KAI Design & Build of St. Louis. "[Lewis and Clark] are epitomized for their dedicated relationship, where the combined strength of the two exceeded the sum of the individuals," KAI's project manager Steve Smith explains. Smith notes that it was the idea of the two explorers as a single entity in our historic remembering of them that inspired the two-tower design of the expedition launch memorial. "KAI came up with the concept where each tower stood for one of the icons, and the bridge platforms represented their continuity through the entire expedition," Smith adds.

Consisting of two shafts of equal size and height, one representing Lewis, the other representing Clark, the towers rise 19 stories or 190 ft with one shaft containing the elevator, the other a stairwell. Three viewing platforms join the three towers at 50, 100 and 150 ft, symbolizing the working partnership of the two individual explorers.

Apart from serving as lookout, the viewing platforms also serve a structural purpose, allowing the tower shafts to work interdependently much like the explorers they symbolize.



Making a tricky design work in practice

THP Limited Inc., the engineering firm for the project, received the contract to work on the Lewis and Clark Tower while the client was still expecting to build a CIP structure. "They were concerned, however, about it being structurally sound because it was so skinny," says Shayne Manning, principal-in-charge with THP. The structure is 190 ft tall but only 13 ft 9 in. wide at the base. "We decided it would be structurally feasible to use precast, but because of the aspect ratio [height-to-least width ratio = 13.8], we could see the wind having a dynamic response."

In an unusual design, the precast panel fins that achieve the tower's fluted look increase in size as tower elevation increases, establishing a sense of openness at the top of the structure. "The fluting was actually easier with precast than CIP," Smith explains. To create the fluted look, the panels were cast using self-consolidating concrete (SCC). Smith says precast concrete offered a distinct time and cost savings advantage because of the repetition of the panel shapes. "As the tower goes up, you have the duplication of the two towers, which are both the same all the way to the top," he notes.

Manning says there were only a few different panel shapes and sizes in the project, with the structural panels that make up the towers' sides accounting for more than 170 of the pieces. These panels were over 1 ft thick and consisted of varying dimensions of the same shape that increased slightly in size to create the fluted expansion of the towers as they grew higher. "As the height increased, each panel got a little bit wider on the two sides that had the winged-look panels," Manning explains.

Connecting all of the panels offered a small challenge. The design-build team had to consider how to connect the rebar between the precast panels. The idea was to vertically align the connecting precast panels by aligning the splice sleeves at the base of each panel with the projecting vertical reinforcing bars at the top of the precast panel below. "As the panels went over one another, the rebar would grab the sleeves," explains

Precast concrete fins give the towers their fluted appearance, with viewing platforms at 50, 100 and 150 ft connecting the towers and symbolizing the partnership between the two explorers.

Above and Opposite Page: The site was dedicated on Sept. 23, 2010, and has hosted about 40,000 visitors since its opening.

Jason Martin, project structural engineer with THP.

The structural engineers considered the joining of the panels critical to the ability of the tower to withstand seismic stress given its location within the New Madrid seismic zone. The area around St. Louis was struck by a series of earthquakes 200 years ago, affecting a land area 10 times as large as the infamous 1906 San Francisco earthquake.

Like the towers, the viewing platforms, too, increase in size as the tower height increases. The lower one is 32 ft across and the highest, at 150 ft, is 36 ft across. The platforms were pivotal to the tower's structural design, particularly for maintaining the square shape of the elevator tower. Unlike the stair tower, it did not have internal diaphragms. Because it is so difficult to attain a moment connection at the inside corners with vertical precast panels, the connection of the three observation decks to the tower wall panels helped to maintain the square shape. The decks also keep the towers from rotating in high winds, removing the potential for structural twisting.

The decks themselves presented problems because of their size. As one precast unit, each deck would have been too large to transport by truck, so High Concrete cast each one as two pieces with support from a single center connector beam that spanned the space between the two towers. Both platforms are semi-cantilevered as well.

The tower's tall and narrow design, however, promised challenges with regard to wind-load carrying capacity as well as response to seismic activity. Before tower construction even began, designers subjected the structure's plans to wind testing to make sure the design could withstand severe weather and geologic events and to establish the human comfort level at the various viewing platforms in the event of high winds.

"Because of the structure's [high] aspect ratio, the design team decided that wind tunnel testing was needed to determine the response characteristics in crosswind loads and dynamic torsional loads caused by vortex shedding," explains Lyle Bowman of High Concrete Group. The test lab performed 50 different wind load combinations to test the strength of the tower's design in response to varying wind directions,

modal coupling and correlation of wind gusts.

The completed structure consists of 256 precast panels weighing in at about 4 million lb, and comprising 24,700 sq ft. The tower portion of the project cost $4.8 million with the cost of the precast accounting for about $1.35 million.

The Lewis and Clark Confluence Tower held its dedication ceremony Sept. 23, 2010, on the anniversary Lewis and Clark returned to the site of the Mississippi's and Missouri's confluence at the close of their journey to the Pacific Coast. Barnes estimates the facility has had about 40,000 visitors since then. On a clear day, visitors to the tower can see not only the confluence of the Missouri and Mississippi rivers but also the Gateway Arch in St. Louis 19 miles to the south.

"This project really helped me realize the flexibility of precast for building a very tall, thin building," says Manning. "You generally think of precast for parking garages, floors or building facades, but here we had architectural and structural precast working together as a single unit. Every single piece is structural and architectural in purpose." ps

Deborah R. Huso is a freelance writer who covers home design and restoration, sustainable building and design, and home construction.