By Mike Larson

Windy City Win

Meticulous planning and spot-on execution deliver perfect lifts in challenging conditions.

In the lifting business, proper planning is vital to excellent performance.

One recent case in point was a project that required two mid-January lifts to be made from a tight street and narrow alley hemmed in between high-rise buildings in downtown Chicago.

The red 44-story building at 333 South Wabash Ave. in Chicago's central business district provides premium office space for several tenants. As new tenants move in or the needs of existing tenants change, the building and its systems are sometimes modified to suit their specific requirements.

One of those modifications, or build-outs, led to two fast-track lifts on a recent weekend.

The build-out included installing two natural-gas-fueled 1,250-kW electrical generators to meet a tenant's need for standby power. The plan called for the generators to be mounted atop a four-story section of the building.

The project's construction team included Executive Construction Inc., Hillside (general contractor); Prime Electric Co. Inc., Chicago (electrical contractor); Standard Cartage Co. Inc., Broadview (rigging contractor); Prime Scaffold Inc., Bensenville (shoring contractor); Anker Trucking Inc., Lynwood (heavy haul); Central Contractors Service Inc., Alsip (crane services), and Dearborn Companies, Bridgeview (heavy-lift and engineering consultant).

Working together, the team planned and performed the two flawless lifts.

Considerations that made the project unique were the size of the generators, the size of crane and length of boom needed to make the lifts, the very tight space available to work in, the site's underground vaults, the short time available to complete the lifts, and, of course, Chicago's cold and windy winter weather.

The team member tasked with analyzing all of those considerations, developing a precision plan, and overseeing the lifts was Dearborn Companies.

Dearborn is a 66-year-old engineering and nondestructive examination firm that delivers solutions for complex projects. Its data collection expertise includes laser scanning, ground-penetrating radar, and drone mapping.

The company works nationally in demanding environments from power plants and refineries, to infrastructure sites and dense urban areas.

Dearborn can provide ground-condition surveys and ground-stabilization design for heavy lifting and heavy transportation; route surveys for road, rail, and marine transport; rigging and shoring engineering; 3D mapping both below and above ground; and nondestructive examination services for concrete and steel structures.

All photos and illustrations courtesy of Dearborn Companies.

The crane on the job was a Liebherr LTM 1450-8.1 all-terrain model from Central Contractors Service. Basements and underground utility vaults required precision placement of the crane, and engineered matting and underground shoring to assure solid support. Dearborn Companies designed the lifting and crane support plans.

Plenty of Challenges

The project presented at least five challenges for the team.

First, the generator mounting pads sat atop a four-story building tucked between occupied high-rise structures that flanked a narrow street and an even narrower alley.

Second, the tight site dictated use of a crane that was large enough to set 57,000 lbs. up about 40' at a 133.9' radius, yet compact enough to operate in the narrow street.

Third, the site would need to be scanned and analyzed for underground voids, and support would have to be designed for any areas that needed it.

Fourth, the crane was not allowed on site before 8:00 p.m. Saturday, then had to be rigged, make both lifts, and be gone by 6:00 p.m. Sunday.

Fifth, the Chicago winter tossed in ice, snow, and 40-mph wind gusts while the crane was being assembled, followed by clear skies, but -15° F wind chills during the generator lifts.

Detailed Data Gathering Above and Below Ground

Although crane setup, the two lifts, and crane teardown and removal all took place in less than 24 hours, Dearborn invested three full months of site inspection, data gathering, engineering analysis, planning, and site preparation to help make sure the operation went smoothly and the project was a total success.

Dearborn's work included:

- Imaging of the road and vaulted sidewalk using ground-penetrating radar to map underground utilities and structures and to evaluate the crane deployment area for potential voids and unconsolidated soil.
- 3D laser scanning of above-ground obstructions in order to check for tailswing and boom-swing clearances. The data was also used to analyze movement of the lowboy trailers that carried the generators into prelift positions.
- 3D laser scanning for analysis of piping, structural elements, and equipment in the building's basement and subbasement to help in designing shoring.

The tight site was bounded on three sides by tall buildings. At middle right, a generator starts to rise as the crane lifts it off its lowboy delivery truck.

- Engineering analysis and design of crane matting.
- Engineering analysis and detailed design of shoring towers located in the building's basement and subbasement to accommodate the more than 331,000 lbs. that two of the crane's outriggers would each put onto a sidewalk that sat over part of the basement.
- Prelift inspection of the shoring in the building's basement to support the sidewalk and crane setup.

"When you're planning crane support, you always have to check for underground vaults and voids, particularly in the central parts of large cities like Chicago," said Mike Walsh, president of Dearborn. "Basements often extend under sidewalks and utility vaults or tunnels run under streets. If you don't find, analyze, and plan for them, you may get nasty surprises when the crane goes to work."

Analysis and Plan Answer All Challenges

Looking at the space available for crane operation, the load weight, the radius of the lifts, and the setup and teardown schedule, Central Contractors Service, a member of the ALL Family of Companies, chose to use a Liebherr LTM 1450-8.1 550-U.S.-ton all-terrain crane.

The LTM 1450-8.1 measures 65'7" long by 9'10" wide for travel. To lift the generators, its outriggers would need to be set at their full 31'6"-wide, 34'2"-long footprint, and the crane equipped with 295,400 lbs. of counterweight. Also, the crane would need to be rigged with 52.7' of main telescopic boom plus 138' of lattice luffing jib.

The two outriggers at right sit on the vaulted sidewalk. The engineered mats plus shoring in the building's basement provided solid support. The mat in the left foreground includes a steel plate to protect underground utilities.

Dearborn's mapping and analysis helped Central pick the best place to spot the crane in the tight work area. "At one place, the luffing jib had just 6' of clearance to a building as it swung from setup to working location," said Walsh.

Once the luffing jib was aligned over the four-story section of the building, it had to swing only a few degrees to lift each generator off a truck and set it onto the roof.

Designing support for the crane was more complex. Two of its outriggers would sit on the sidewalk over a two-story-deep section of the building's extended basement, and a third outrigger sat over a utility vault under the street.

Dearborn calculated that the two outriggers on the sidewalk would each put down 331,000 lbs. of force, far more than the sidewalk could handle. So Dearborn designed temporary shoring both in the basement and the subbasement to support the sidewalk from below during crane operation.

To reduce the outriggers' ground-bearing pressure on the sidewalk, Dearborn precisely engineered supporting mats for the two outriggers that sat on the vaulted sidewalk.

At the bottom was ¾" plywood for full surface contact. Above that came 4" timbers that sat flush with a concrete light-pole foundation. That made sure loadings were spread evenly over the mat. Then came a 6' x 16' x 12"-thick crane mat, a 1"-thick steel plate, and a top layer of 4"-thick wooden studs. That reduced maximum bearing pressure on the sidewalk to 3,498 psf.

On the street side, one outrigger sat over a utility vault. That support started with an 8' x 20' steel plate to protect the utilities and was topped with a crane mat.

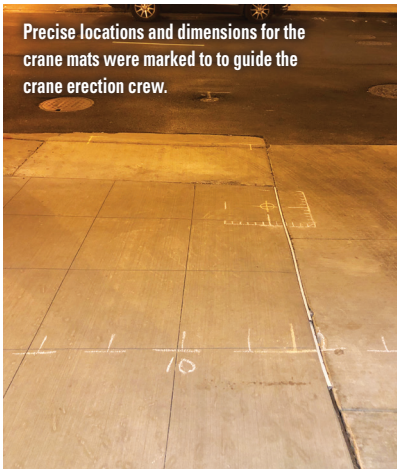
When the crane was solidly supported and ready to lift, the generators were delivered by lowboy trailer to the alley alongside the building. Each one stood 40'4" long, 10'8" wide, and 13'2" high, and weighed 52,000 lbs. (57,000 lbs. with rigging). The alley was just 17'9" wide, so the crane operator had only 3'6" of clearance on each side while hoisting the generators from the trucks to roof height.

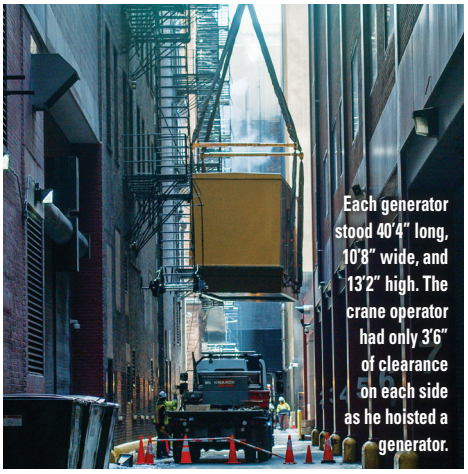
Successful Operation

Dearborn's well-thought-out plan and excellent performance by everyone on the project team delivered a flawless result. Both generators were picked and set precisely on target. The whole operation was completed in a few hours less than the allotted time. And the safety record was perfect.

"Combining powerful data-gathering technology, strong analytical experience, and engineering know-how yields a solid, accurate plan," said Walsh.

"When you execute that plan with a cooperative team of lifting professionals like those on this job, you can't help but deliver excellent results," he said. ■


Precise locations and dimensions for the crane mats were marked to to guide the crane erection crew.


Each generator stood 40'4" long, 10'8" wide, and 13'2" high. The crane operator had only 3'6" of clearance on each side as he hoisted a generator.


Each generator weighed 57,000 lbs. with rigging. Both were set side by side atop a four-story building at a 133.9' radius. They were staged and lifted from the narrow alley visible at right.


At left: the tens of thousands of points Dearborn laser scanned and used in verifying the position and dimensions of in-basement shoring installed to support the sidewalk under two of the crane's outrigger pads. At right: the shoring.


Dearborn President Mike Walsh (right) and Project Manager Brian Walsh check the basement for equipment and ducting that might complicate shoring placement.