

# Raising the Bar

**Strand Jacks Star in the High-Flying Hanger Expansion for UPS by Ruby+Associates, a Degenkolb Company**

BY STEVE HENDERSHOT





**W**ith a 225-foot wingspan, the Boeing 747-8F is the largest plane in UPS's fleet. Parking a pair of them side by side requires a truly immense hangar.

That's something the global delivery giant lacked—until recently. This spring, the carrier completed work on a \$220 million expansion of its Worldport hub in Louisville, Kentucky, that includes a 520-foot-span door capable of accommodating two 747-8Fs in the same maintenance hangar.

## THE SKY'S THE LIMIT

The conventional approach to building the 45-foot-deep-by-20-foot-wide box truss required to span the door opening is to use multiple cranes and assemble the truss in the air on top of numerous 80-foot-tall shores. This method requires not only the procurement and foundation of those shores but also the rental of large crawler cranes, with iron workers assembling the truss at heights in boom lifts. Rather than relying on cranes to build the new hangar's box truss, engineers from Ruby+Associates, a Degenkolb Company—working on behalf of its client Midwest Steel and alongside general contractor Hensel Phelps—proposed using an alternate technology: strand jacks.

A strand jack is a hydraulic jack that works by gripping and pulling bundles of stranded steel wire ropes through a hydraulic jacking cylinder. The strand is then clamped down while the cylinder releases its grip and moves to grab and pull the next portion of the strand—"kind of like the hand-over-hand method of pulling on a chain," explains Jeff Gasparott, a principal and regional practice area leader of construction engineering services at Ruby.

Strand jacks are most often associated with offshore projects, but that's hardly their only application. Indeed, 20 years ago, Ruby worked extensively with strand jacks during the construction of Ford Field in Detroit, home of the NFL's Detroit Lions, as the stadium's roof was largely assembled on the ground and then hoisted into place using strand jacks. Two decades later, as the firm's engineers grappled with the challenges of constructing the UPS maintenance hangar in Louisville, the technology again seemed the right fit.

The use of strand jacks enabled construction team members to build most of the box truss at grade, including half of the bolted connections, with boots on the ground. The Midwest Steel team constructed a central 380-foot section on the ground, directly beneath the installation location, then used the four strand jacks to hoist the 1.7-million-pound load into place.

To achieve this, Ruby led the analysis to develop lifted load magnitudes, truss construction forces, and member checks, and determined shoring tower loads. With full cooperation and coordination of the design and steel build teams, truss design members were upsized and final connection designs were accommodated. With the final design accounted for, Ruby then designed the necessary temporary falsework and fixtures, including the jacking platform, lift beams, and shoring heads, to be incorporated in the detailer's fabrication model.

## **WEATHER OR NOT**

Once construction was complete on the ground portion of the box truss, specialty lifting company Engineered Rigging took the lead on the actual lifting, using four 300-metric-ton strand jacks from manufacturer Enerpac. The heavy lifting began early on the afternoon of September 19, 2022, and went until after dark, with the strand jacks pulling the truss continuously until it was in position 80 feet above the ground. The next day, Midwest Steel bolted the truss into place.



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**PRINCIPAL**

**REGIONAL PRACTICE AREA LEADER**

**RUBY+ASSOCIATES, A DEGENKOLB COMPANY**

Why wait until the next day to make the final connections? That’s tied to one of Gasparott’s key takeaways from the project: Don’t forget about Mother Nature.

“We were in the middle of an airfield, working in blue skies with no shade and a blazing hot sun. So over the course of the workday, the 380-foot box experienced a fair amount of thermal expansion,” says Gasparott. “We realized it would be much easier to make the bolted splice connections on these long spans first thing in the cool morning versus at the end of the hot day, giving the steel time to cool and shrink into alignment.”

Establishing strong benchmarks and control points for surveying while the components were on the ground was essential to the project’s success—there were four primary bolted connection points to make, and all three primary axes were critical for hole alignment. Additionally, the team was careful to leave enough room at the top of the shoring tower to lift and remove the temporary support points.

“You’ve got to take care and consider overall deflection when de-shoring. On this project, we anticipated roughly 2 inches of deflection at the shoring points of the now 520-foot span. If your jack bottoms out or your structure is too tall, you’re left with a bearing point that has roughly 450,000 pounds on it and only a cutting torch to fix the problem,” Gasparott explains.

Now, UPS can park two of its flagship aircraft next to each other in its newly completed Northwest Aircraft Maintenance Complex in Louisville. And Ruby+Associates, a Degenkolb Company has expanded its repertoire for complex projects that require exceptionally heavy lifts.

“Strand jacking is a great alternative to conventional cranes for structural steel erection,” Gasparott says. “Their use takes a considerable amount of engineering and planning, but it’s a nice option to have in the toolbox.”

***Steve Hendershot*** has contributed to Crain’s Chicago Business, Chicago magazine, and Chicago’s NPR affiliate, WBEZ, and is host of the Project Management Institute’s Projectified podcast. He lives in Chicago.