Hangar Life

BY KEVIN LEWIS, AIA, AND GREG FOSSETT

Massive steel box trusses support the U.S. Navy's largest aircraft hangar in hurricane-prone Jacksonville.

THINK ABOUT HOW BIG a football field is. Now imagine having to construct a building three football fields long and almost one football field wide. As if such a large undertaking weren't challenging enough, suppose it had to have two, 450-ft-long unobstructed openings—and the building interior had to accommodate several different types of aircraft.

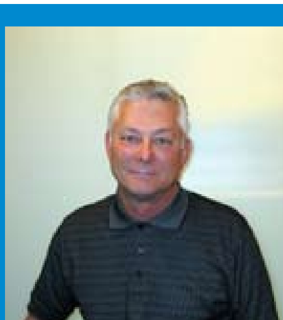
Such a project can be summed up in two words: Hangar 511. The massive building, and its attached apron, was recently constructed under the U.S. Navy's Naval Facilities Command (NAVFAC) procurement at the Jacksonville, Fla. Naval Air Station. The project is now the Navy's largest active aircraft hangar and administrative facility; it opened this past spring.

The $123 million project, prompted by the military's Base Realignment and Closure (BRAC) program, will support the relocation of six aircraft squadrons to the Naval Air Station in Jacksonville. Initially, the hangar will house the Navy's P-3C Orion (99-ft wingspan) squadrons and a C-130 Hercules (132-ft wingspan) logistics squadron. Ultimately, the Navy will replace those aircraft with the advanced P-8 Multi-Mission Maritime Aircraft (117-ft wingspan).

Expansive and Flexible

With a variation in wingspans between the P-3 and the P-8 of 33 feet, the hangar certainly needed to be flexible, but it also needed to provide easy access for maintenance crews and house the necessary support spaces, shop areas and tool rooms and adhere to strict budget and schedule requirements.

To determine the most efficient framing scheme, the team created and tested several 3D models, and a long-span steel box truss system ultimately proved to be more than 25 percent more efficient than the second most efficient design. Overall, the 137,000-sq.-ft hangar bay space and the 140,000-sq.-ft, two-story office portion use approximately 3,000 tons of structural steel.



Kevin Lewis is the architecture practice leader for HNTB Federal.

Greg Fossett is a senior project manager for M.A. Mortenson Company.

The massive hangar bays, at a combined 950 ft long by 213 ft deep by 86 ft tall, required a customized structural design using robust, three-story-deep box trusses each measuring 15 ft wide by 25 ft tall. These box beams, more common in bridge design, support 15-ft-deep roof trusses that span 141 ft across the depth of the hangar. Structural frames, built within each of the six "lanterns," brace the entire long-span structure, allowing the hangar to withstand wind speeds of up to 120 mph.

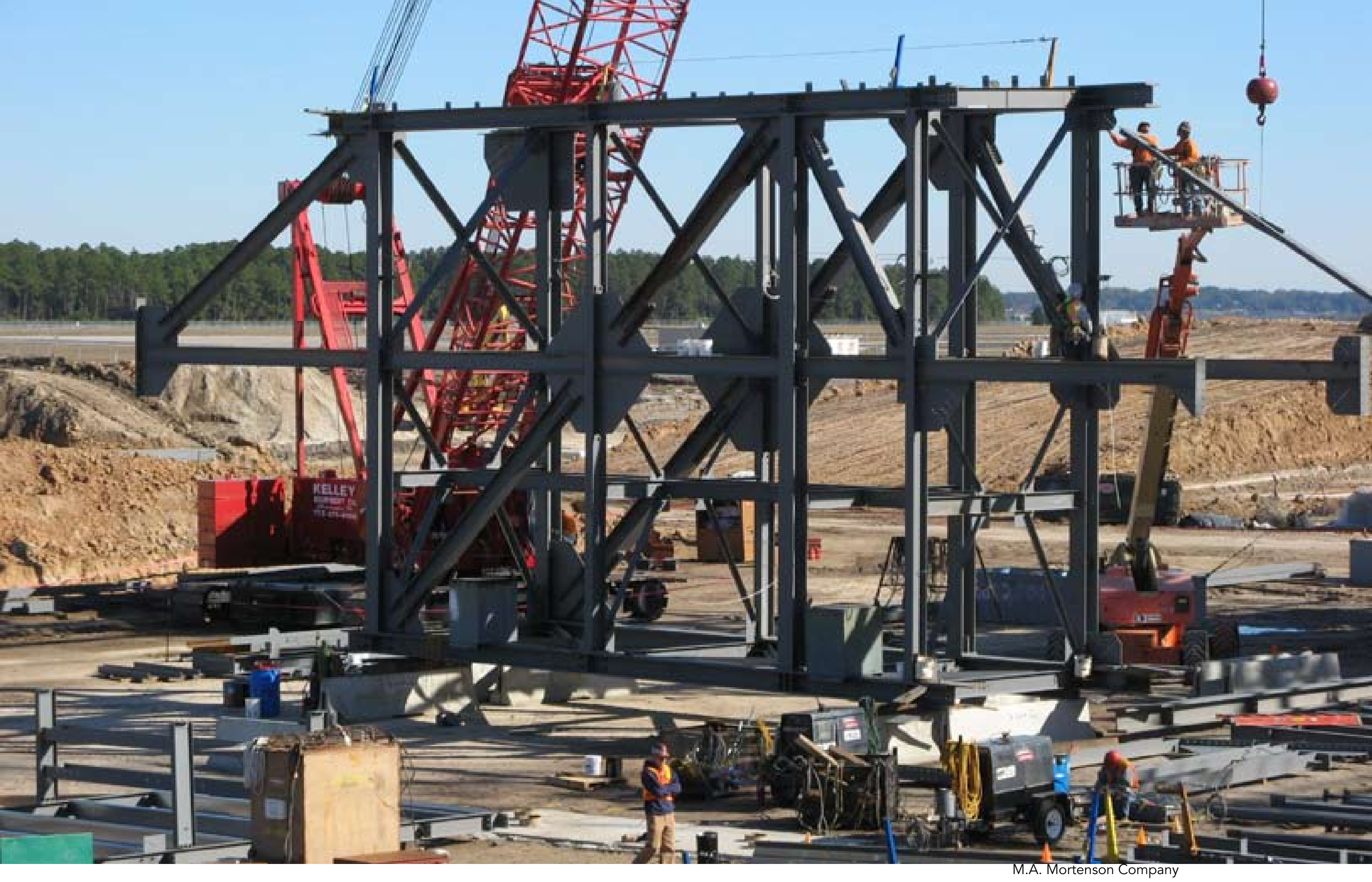
Because of the large scale of the box trusses, each section was assembled on the ground, then hoisted into place by a Manitowoc 2250 crane. The first, placed on the core, cantilevered out almost 72 ft. The other trusses were supported by temporary 51-ft shoring towers as the spans were extended in either direction from the hangar core. Besides supporting the overall structure, the trusses also support multiple overhead cranes, as well as the vertical lift fabric hangar door system, which provides the flexibility to open smaller sections of the door as opposed to the entire door section.

The hangar's structural frame consists of steel beams with girts and a factory-insulated metal panel skin. Lightweight concrete floor slabs poured on a composite steel deck were supported by open-web steel joists spanning to wide-flange steel girders from the elevated floors. The hangar doors openings were comprised of typical box truss sections, which created the large clear span, and were wrapped with 2-in. pre-insulated panels installed vertically. A 1,400-linear-ft steel catwalk allows access for overhead and door maintenance.

Conventional steel framing was used for the administration building, which provides office space for more than 1,525 personnel. NAVFAC also expressed early concerns about balancing the contrasting scale of the massive aircraft hangar against the long two-story administrative wing. To overcome this, a hierarchy of building heights was developed. Six translucent-paneled "lanterns" were positioned to visually break down the scale of the hangar while providing natural light to each squadron plane location. The office component of the structure had three different types of wall panels that were installed horizontally: single span, one-layer panels; 2-in.-thick insulated metal panels; and translucent panel systems.

High Winds

Butler Heavy Structures provided the STAAD model, a structural engineering and design software program, to HNTB to incorporate into BIM. HNTB then used Autodesk Revit to ren-



M.A. Mortenson Company

The massive hangar bays (below) are a combined 950 ft long. Three-story-deep box trusses (photo above), each measuring 15 ft wide by 25 ft tall, support 15-ft-deep roof trusses that span 141 ft across the depth of the hangar.

©HNTB 2009

©HNTB 2009

Hangar 511 is the Navy's largest active aircraft hangar and administrative facility.

der the virtual pre-built hangar and office complex. But the model didn't just help with the design process; it also helped with the scheduling and sequencing, particularly important when building massive structures through a hurricane season. As the area is hit by a hurricane approximately once every three years, it was important that the building was designed to resist 110-mph winds after it was complete. However, it was also critical for the structural elements of the building to be completed to a point where it could withstand a hurricane prior to the first hurricane season the building would have to endure mid-construction in June 2008. Using BIM allowed the team to create a building design and test the building against wind scenarios at various points in the construction process—a very fortunate situation, as hurricane season arrived with a storm stalling over the greater Jacksonville area. As a result of aggressive schedule management and pre-planning—and BIM—the project suffered no structural damage and was impacted only by the excessive rainfall (more than 28 in.). In addition to hurricane protection, fire-proofing and antiterrorism standards were implemented to ensure the safety and security of the operators and installation assets.

BIM also assisted builders to track sustainable features as outlined by the U.S. Green Building Council's Leadership in Energy and Environmental Design. Builders were able to assign points to the project's sustainable features—such as translucent panel systems that provide natural light, solar shading, light shelves, and heat-resistant designs—which helped the project pursue a Silver LEED rating (certification is pending). The Navy is considering purchasing the BIM model to aid in facilities management once the project is complete. MSC

Architect and Structural Engineer
HNTB Architecture, Washington, D.C.

Design-Build Contractor
M.A. Mortenson Company, Minneapolis

Steel Fabricator
PKM Steel Service Inc., Salina, Kan. (AISC Member)

Steel Erector
LPR Construction Co., Loveland, Colo. (AISC Member)