Design-Build Takes Flight

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Innovation and coordination were key components in the quick design and construction of the Boeing South Carolina 787 final assembly building.

THE SUCCESS OF ANY CONSTRUCTION PROJECT is a direct result of a cohesive and cooperative team of designers and contractors with positive attitudes assembled to deliver the owner's expectations on time and within budget, and this project was no exception. The extreme challenge was to provide a 1,000-ft-long roofed area with a 460-ft clear span between two 75-ft-wide, 86-ft-high towers—on an extraordinarily short timeline. The new facility serves as the final assembly operation for assembling the Boeing 787. Boeing selected the design-build construction project delivery method to minimize the cost and construction duration.

Boeing's expert in-house group of architects, engineers, and construction administration staff kept this project moving smoothly by understanding the design-build process and providing the resources to make quick decisions. Boeing's staff was amenable to value-added design suggestions and made the design submittal approvals both fast and efficient.

This is only the third site in the world where large commercial airplanes will be fully assembled and delivered. The other two are Boeing's Everett, Wash., site and the Airbus facility in Toulouse, France. The new South Carolina facility is adjacent to Boeing's existing aft and midbody fuselage fabrication, assembly and paint facilities, which were also designed and constructed by primarily the same design-build team, of which CMC was a part.

All photos courtesy of CMC South Carolina Steel

▲ Sway trusses 100 ft long and 25 ft apart provide the bracing for the main trusses and were also assembled on the ground before being hoisted into place.

▲ The 610-ft-long trusses were assembled on the ground in two sections.

▲ The initial sway brace assembly being hoisted into place.

The Selection and Design

After Boeing selected the BE&K/Turner Joint Venture, with design partner BRPH, to design and build the facility, the design-fabrication-erection of the steel portion of the project was awarded to CMC South Carolina Steel and CMC Cary Engineering. The selection was based primarily on CMC's innovative design approach, which allowed the depth of the trusses to be approximately 10 ft shallower than other designs, and CMC's ability to consistently expedite project schedules. The 10-ft height savings was significant because it kept the structure just below the airport's radar cone.

The design phase began in mid-November 2009 with a visit to Boeing's current operations in Everett, Wash., by the CMC Cary Engineering Design Coordination Team. That visit allowed the design team to explore a number of value-engineering options prior to beginning final structural design, as well as confirming what Boeing's needs were for this facility.

Preliminary structural design models were completed during December 2009 and the team worked closely with domestic mills to facilitate time-sensitive mill rollings of the large W14×311 and W14×211 columns as well as truss sections as large as W14×605. Additionally, the extremely large bolt quantity requirements made it necessary to coordinate the manufacturing of the more than 250,000 tension control (TC) bolts, of which 100,000 1⅛-in.-diameter TC bolts would be used to assemble the trusses.

The owner's specifications required a Building Information Modeling (BIM) product be used to generate construction documents and to provide a final "as-built" model. The design team used Revit to generate the 3D model. This model was instrumental in formulating material take-offs, clash detection, and for meeting the aggressive design/construction schedule. The Revit model also enhanced the team's ability to generate and review structural shop drawings.

In addition to being designed for 130 mph hurricane force wind loads, the structure is designed to resist extremely high earthquake loads associated with Seismic Design Category D requirements. The roof trusses are

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