A new sail-shaped structure welcomes visitors seeking cruise ships and spaceships on Cape Canaveral.

Sea & Space

BY ZACHARY D. KATES, P.E., AND ROHAN TALWALKAR

Thornton Tomasetti

PORT CANAVERAL has long been the gateway to Florida's Space Coast.

More recently, it has also been the gateway to the area's growing cruise industry. And now a major redevelopment, geared toward transforming the area into a tourist destination, is underway with the new Port Canaveral Welcome Center serving as the centerpiece. The facility, which is expected to be inaugurated by the end of this year, marks a significant leap toward providing more efficient and fast-track solutions for steel buildings through integrated design and construction support services.

Hurricane-Ready

The facility is designed in accordance with ASCE7-10, which classifies the Cape Canaveral area as a hurricane-prone region and requires the structure to withstand up to 150-mph design-level wind speeds. Due to its unusual shape and the presence of canopy framing and louvers, a wind consultant, CPP, joined the design team to perform a wind tunnel study in order to predict more accurate loads on the structure and cladding. By taking into account the drag coefficient for the louvers, the wind tunnel study helped to reduce the design wind pressure on the canopy members, enabling structural engineer Thornton Tomasetti to provide an aesthetically pleasing, slender structural frame.

Designed by Baltimore-based architects GWWO, Inc., the welcome center is a 22,000-sq.-ft, seven-story structure that houses four stories of exhibit space, a cafeteria, a gift shop, office space and an indoor and outdoor observation deck. Paying homage to its geographic location, the building is designed to celebrate engineering achievements in transportation. Steel was ideal to accommodate the sail-shaped structural frame, which consists of a curved metal panel shell, sloping exposed columns, cantilevered floor plates, a column-free interior and architecturally exposed structural elements such as the louvered canopy atop the building. Typical floor framing consists of steel beams and peripheral columns with composite slab. Two stair towers on the east and west sides of the building, consisting of 10-in.-thick reinforced concrete walls, form the lateral system.

The back side of the structure has a curved metal panel shell whose shape is governed by the geometry of a partial ellipse. Segmented wide-flange columns (ranging from W14×132 at the bottom to W14×90 at the top) follow the elliptical shape and support horizontally curved HSS12×6×$\frac{5}{8}$ girts that back up the curved, cold-formed studs directly supporting the metal panel wall. Straight-line structural framing members such as columns and spandrel beams were used on the curved façade whenever possible to minimize fabrication costs. The

▲ The "crown" canopy of the facility, installed...

◄ ...being hoisted...

► ...and on the ground.

▼ Paying homage to its geographic location, the building is designed to celebrate engineering achievements in transportation, evoking both a rocket and sail.

straight members were W16×31 and W21×44, and the other half of the horizontal beams in this curved wall were rolled W18×71 and W21×68 members, with a rolled MC12×50 welded to the top flange. The elliptical geometry was established using curved plate at the edge of slab locations and horizontally curved HSS girts.

Two exposed HSS columns support the entire front side of the structure and extend above the roof to support the canopy struts. To maintain the slender profile desired by the architects and support the structural loads, 16-in.-diameter HSS was specified. Each floor plate cantilevers up to 16 ft beyond these exposed columns.

An exposed steel canopy towering approximately 70 ft above the roof level is the structure's most prominent feature. Arced HSS20×12×⅝, profiled to a three-point curve, extend from the top of the curved metal panel wall and gracefully join together at the apex, and the steel canopy is in-filled with airfoil-shaped aluminum louvers. Structural steel for the project totals 265 tons, of which 36 tons is architecturally exposed structural steel (AESS).

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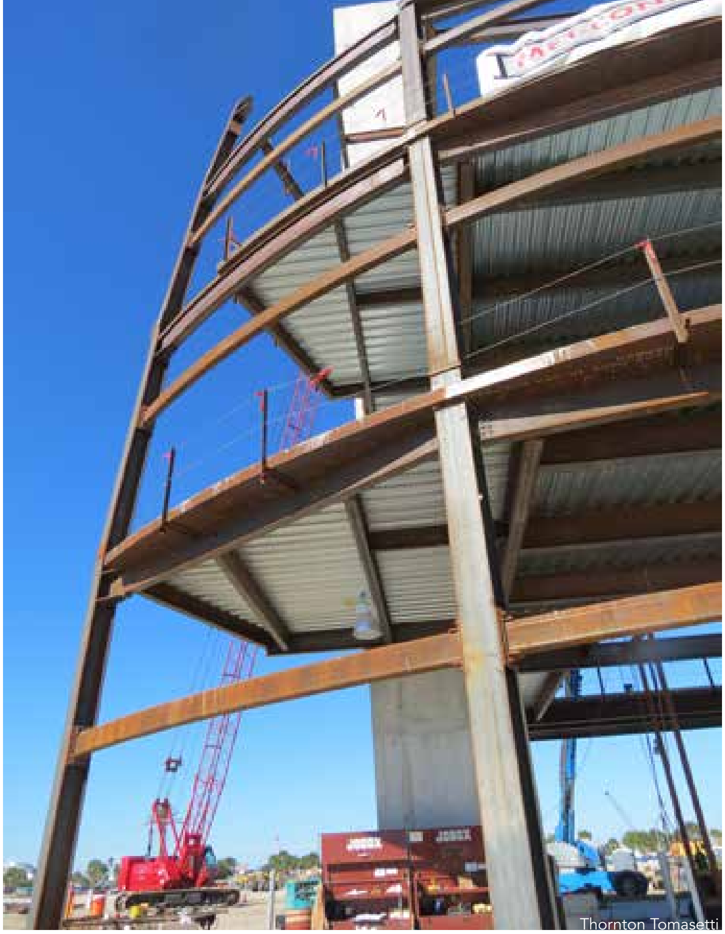


▲ Wide-flange columns supporting wind girts.

➤ The canopy weighs 38 tons.

▼ The facility, nearly completed here, is scheduled to be inaugurated by year's end.

Compressing Time

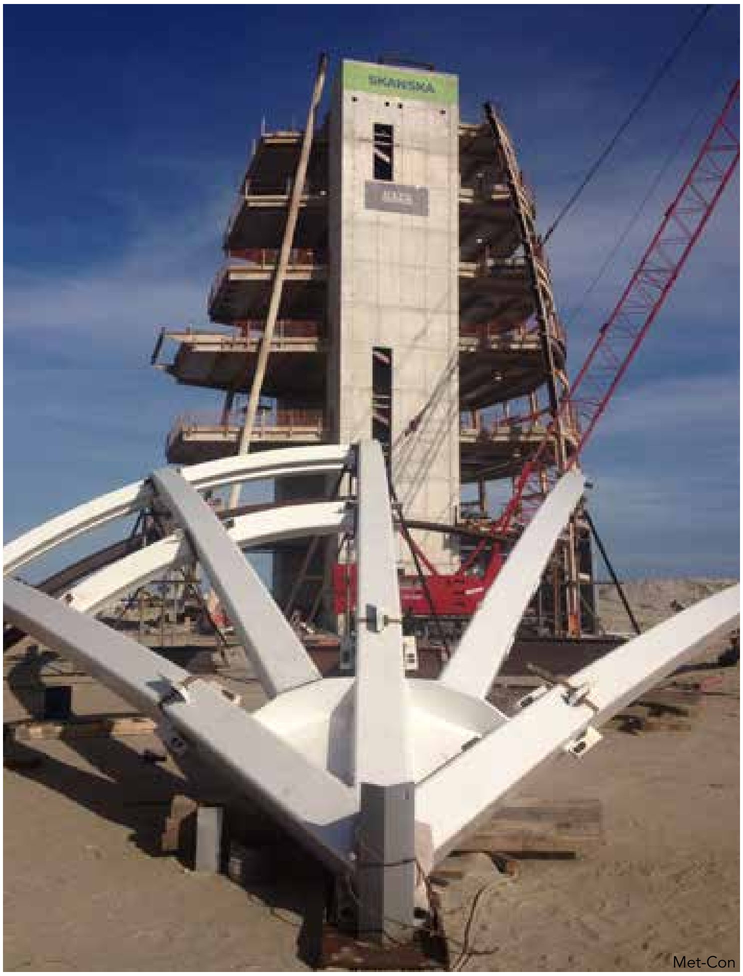
Skanska USA was brought on board as construction manager during the design phase and quickly identified steel as a critical path item in terms of schedule. With a goal of compressing the steel timeline, Thornton Tomasetti proposed to provide steel detailing and connection design services for the project. As part of the proposal, Thornton Tomasetti would issue a fully connected Tekla model concurrent with the structural construction documents to be used in the competitive bid process. The Canaveral Port Authority (CPA) recognized the potential benefits and accepted the proposal, and the detailing work began roughly one month prior to the completion of the construction documents.

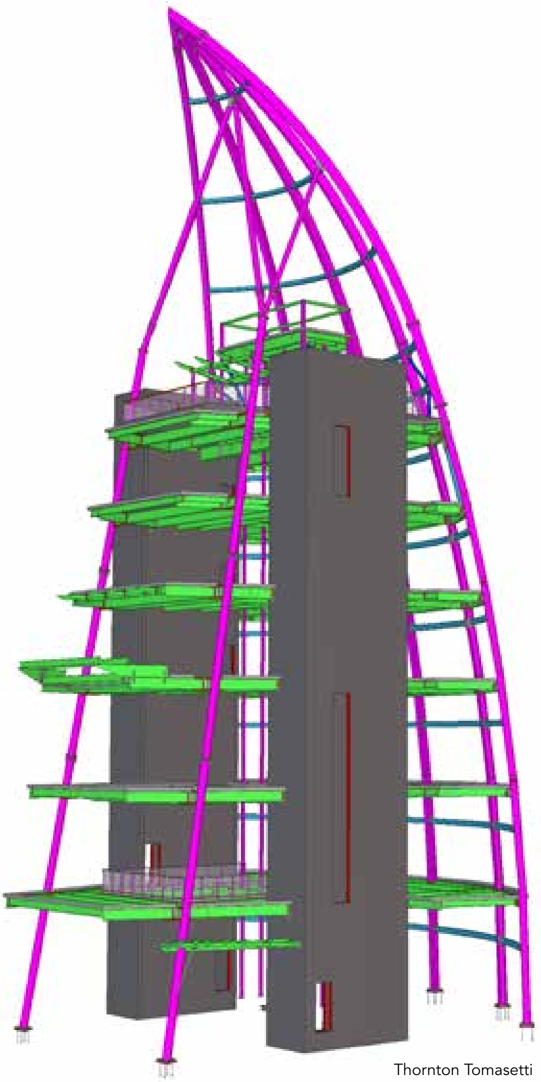
With Thornton Tomasetti performing detailing in addition to engineering, they were able to provide a concept design for numerous key connections to GWWO for their input, which would then be incorporated in the design. The connection at the apex of the canopy and connections at the canopy struts were refined by such collaborations between the designers and architects using the Tekla renderings. This was especially helpful for the AESS members as aesthetic value was the chief aspect that needed to be considered in their design and detailing. Architectural components such as stainless steel handrails were coordinated into the steel detailing model early, preventing changes during construction.

The access to design information streamlined the detailing process, and the complex shell and canopy geometry, already defined in the structural REVIT model, was used as the basis for the steel detailing model. The connection designers communicated directly with the structural designers to resolve issues that would have slowed a conventional shop drawing process, and the actual number of steel-related RFIs barely surpassed single digits.

▲ Steel, in transit.

▼ The facility uses 265 tons of structural steel in all.





The framing system for the seven-strory building.

By issuing the steel detailing model for bid, all bids were based on actual connection designs without contingency factors associated with the typical bid-build process. And because connection design and the model were complete at the time of bid, Thornton Tomasetti was able to produce shop drawings very soon after the selection of the steel fabricator, Met-Con, Inc. At the kickoff meeting, Met-Con suggested changes to some of the field and shop splice locations based on material availability and erection methods (while Thornton Tomasetti was responsible for the shop drawings, Met-Con checked, reviewed and commented on all drawings). Modifications were quickly made, sequences were implemented, Tekla detailing templates and standards were obtained from Met-Con and the first sequence of shop drawings was generated within a few days. Since Met-Con also runs Tekla Structures, they were able to help Skanska retrieve information from their Tekla model that would have been more difficult to figure out by simply looking at the contract drawings. The Tekla model was also used by Met-Con to develop the lift plan, design the lifting rigging and detail, fabricate and install the airfoil-shaped aluminum louvers. This compressed production approach provided approximately two months of schedule savings over the conventional process and brought the total review period for structural steel to less than two months.

Precision Erection

Steel erection culminated with the installation of the canopy. Met-Con, who also did the erection work, constructed the entire canopy in the horizontal position at grade. To accommodate the architectural vision, the majority of canopy connections were welded and field-welded splices were detailed into the canopy system to join shop-welded assemblies, such as the apex, to the remaining canopy members. Measuring 85 ft in length (with a true vertical of 71 ft) and 68 ft wide and weighing 38 tons, the completed canopy was lifted and set on the receiving stub columns as one unit.

The team itself acted as one unit as well, forming a partnership that was marked by ongoing communication, a sharing of ideas and a passion for steel construction MSC

Owner
The Canaveral Port Authority, Cape Canaveral, Fla.

Architect
GWWO Inc./Architects, Baltimore

Structural Engineer
Thornton Tomasetti, Inc., Washington, D.C.

Construction Manager
Skanska USA

Steel Fabricator and Erector
Met-Con, Inc., Cocoa, Fla. (AISC Member/AISC Certified Fabricator/ AISC Advanced Certified Steel Erector)