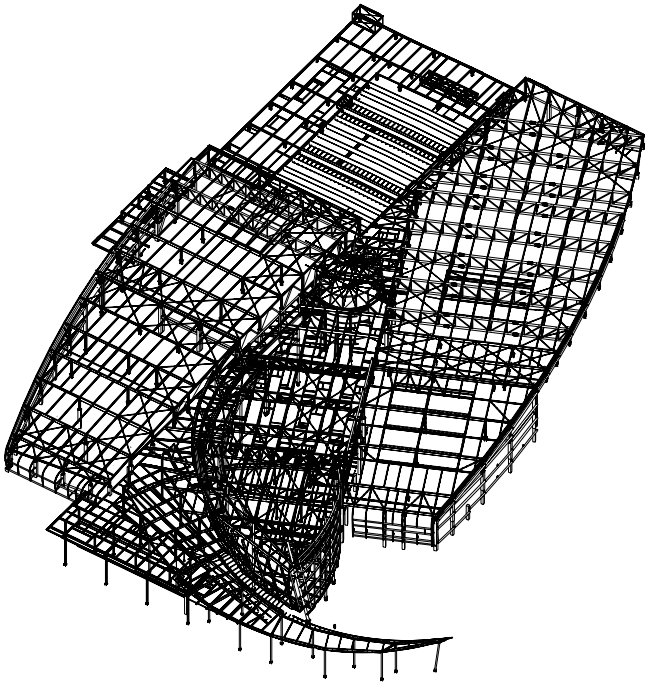
Making Waves

BY LARRY MCDOWELL

Atlanta's ship-shaped Georgia Aquarium navigates the stormy waters of long spans and complex structural geometry, opening on schedule and blowing attendance expectations out of the water.

Robb Helfrick



SteelFab's 3D model of the steel for Atlanta's Georgia Aquarium.

MORE THAN TWO HUNDRED MILES FROM A MAJOR BODY OF WATER, ATLANTA ISN'T A CITY KNOWN FOR SHIPBUILDING. But that's essentially what the structural designers of Uzun & Case Engineers were tasked with: creating an exterior façade, in the shape of a ship's bow, for the new Georgia Aquarium.

The 500,000-sq.-ft facility, which contains the largest volume of water ever housed inside an aquarium structure, was conceived with a central atrium space from which five major exhibit spaces radiate, displaying a wide range of salt- and freshwater species from around the world. These exhibit spaces contain more than 75 individual exhibit tanks ranging from hundreds of gallons to millions and housing more than 120,000 animals of over 500 species. With a total water volume of over eight million gallons, the Georgia Aquarium ranks as the largest in the world.

Riding the Wave

The architect, Thompson, Ventulett, Stainback & Associates, Inc., envisioned an exterior façade resembling the bow of a huge ship breaking through a large rolling wave. As a result, a complex geometry was required for the sides of the "ship" and the "waves," with many curved, sloping walls and roofs. Horizontal and vertical radii varied from as little as 7 ft, 6 in. to as much as 2,500 ft. In several instances, the tops of walls were curved both horizontally

SteelFab

Erection of the bow of the "ship" supported by a 24-in.-round HSS leaning at approximately 15°.

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Roof trusses and gantry over the Ocean Voyager exhibit, a saltwater tank measuring over 260 ft long, 120 ft wide, and 30 ft deep at its deepest point.

and vertically, as well as leaned outward, to create the necessary effect. Large interior volumes were dictated by the interior and exhibit designers.

Massive and direct exposure to corrosive saltwater called for using reinforced concrete to build the large exhibit tanks, exhibit floors, filtration areas, and other "wet" areas. But because of long interior spans, required to minimize exhibit congestion, and the need to meet economic and scheduling parameters, structural steel was identified early in the design as the material of choice for the exterior walls and roof structure. The construction process for forming, casting, and curing the immense walls for the exhibit area would allow sufficient time for detailing and fabricating the steel, and the erection could quickly follow the completion of the concrete below. Lateral loads are transmitted through braced frames from the roof down to concrete shear walls. In all, the project's fabricator, SteelFab, provided 1,926 tons of structural steel, 200 tons of bar joists, and approximately 2,400 squares of steel roof and floor deck.

Because of the complex roof geometry, Uzun & Case worked closely with the SteelFab and detailer, Hutchins & Associates, to meet the fast-track schedule set by the general contractor. Complicating the process was the fact that the aquarium exhibits were still being designed at the same time column layouts were being conceived. To provide maximum flexibility for future exhibit changes,

Curbing Corrosion Concerns

Potential for steel corrosion was of particular concern to the design team. No structural steel was located within 20 ft of water surfaces in exhibit areas, eliminating the need for fireproofing and largely removing the potential for direct water contact.

Steel in exhibit areas is protected by three layers of high-performance coating, including a layer of zinc primer and a shop-applied layer of fast-dry epoxy from Sherwin-Williams. The chords and diagonals of trusses were composed of HSS to minimize surface area exposed to the corrosive atmosphere, and completely seal-welded. The ends of all HSS were capped and welded to prevent intrusion of moisture inside. Likewise, rolled shapes were used as filler beams in lieu of steel joists in exhibit areas to simplify the application of the high-performance coatings and any required reapplications. Field bolts were galvanized and field-coated as well. Decking for the structural steel roof was galvanized with a G140 coating and fastened with powder-actuated mechanical fasteners to minimize the amount of galvanizing touch-up normally required by welding.

the exhibit designer requested that columns within the exhibit areas be minimized. The introduction of long spans with 40-ft. clear heights in these areas created challenges for the structural engineers' lateral load-resisting systems and required horizontal roof trussing in several locations. Steel detailing and fabrication was sequenced to accommodate the early turnover of exhibit areas, allowing aquarium management the maximum time for tank preparation, waterproofing, and acclimation for the animals. Fortunately, the "bow of the ship" and the most complicated geometry were in the public spaces and were scheduled in the later stages of construction.

This bow was perhaps the most intriguing feature to the designers. A 24-in.-diameter HSS column supports the framing at the tip of the bow, leaning outward at an approximate 15° angle. On one side of the bow, the upper wall curves horizontally while maintaining this 15° lean. The other side of the bow is vertical, but curved horizontally to receive an immense back-lit curtainwall system to form a "lantern" effect.

Going the Distance

Long spans were required in several areas of the aquarium. A variety of alternatives were considered, but only structural steel afforded an economical, easily constructible option. The most challenging long span work was over the Ocean Voyager exhibit, the largest single enclosed aquarium tank in the world. Irregular in shape and measuring over 260 ft long, 120 ft wide, and 30 ft deep at its deepest point, it contains more than six million gallons of saltwater. With maximum clear spans in excess of 170 ft, the main roof trusses support a movable gantry and a hoisting system to provide the animal husbandry staff access to 100% of the tank's top surface. The bottoms of the trusses were located a minimum of 20 ft above the top of the tank. However, the gantry structure was suspended down to travel within about 2 ft of the water's surface.

Here Comes the Sun

The size, number, and angles of skylights played a significant role in the roof framing. Many of the animals and exhibits rely heavily on natural light, and skylights as large as 5,000 sq. ft, made of special low-filter glass, bring sunlight into the exhibit spaces. Sun studies specified that the skylights had to be canted at certain angles to absorb maximum seasonal light. From the structural standpoint, these skylights created several large openings in critical roof diaphragms, requiring close attention to deck fastener spacing and secondary horizontal trusses.

Full Steam Ahead

Through the superior framing and scheduling advantages of structural steel, the "good ship" Georgia Aquarium was completed on time—within a 27-month span—and has been a smashing success since its launch. In the first nine months following its grand opening, it entertained more than three million guests, far surpassing the projected first year attendance of two million. MSC

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Skylight framing over the Tropical Diver exhibit.

Owner
Georgia Aquarium, Inc., Atlanta, Ga.

Project Manager
Heery International, Inc., Atlanta

Architect
Thompson, Ventulett, Stainback & Associates, Inc., Atlanta

Structural Engineers
Uzun & Case Engineers, LLC, Atlanta

General Contractor
Brasfield & Gorrie, LLC, Kennesaw, Ga.

Fabricator
SteelFab, Inc, Norcross, Ga. (AISC member)

Detailer
Hutchins & Associates, Winston-Salem, N.C. (NISD and AISC member)

Erector
Williams Erection Company, Inc., Atlanta (TAUC member)

Engineering Software
ETABS, GTSTRUDL, RAM