

Architectural Significance in Metal Buildings: An Educational Series

# MILNE CENTER FOR OCEAN SCIENCE AND CONSERVATION

Mystic, CT

Created in coordination with Capital Studio Architects,  
Carlin Construction and Mystic Aquarium

Photo Courtesy of Mystic Aquarium





Photos Courtesy of Mystic Aquarium

“If you look at the Milne Center, you would never have expected that we did this with a metal building. You’d say all day long that it’s a conventional steel building. But there is so much flexibility in designing with a metal building system.”

— Daniel Carlin, Director of Operations, Carlin Construction

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# PROJECT DETAILS



Photo Courtesy of Mystic Aquarium

**Building:** Milne Center for Ocean Science and Conservation

**Location:** Mystic, Connecticut

**Client/Owner:** Mystic Aquarium

**Building Function:** Education center and aquaculture, rehabilitation and fish and invertebrate research facility

**Size:** 18,000 square feet

**Site:** 0.75 acres

**Budget:** \$10 million

**Completion:** March 2019

**Architect:** Capital Studio Architects, LLC

**Construction Manager:** Carlin Construction, LLC

**Metal Building Systems Manufacturer:** Butler Manufacturing

**Civil Engineer:** Loureiro Engineering Associates, Inc.

**Structural Engineer:** William M. Lapoint PE, LLC

**Mechanical / Electrical & Plumbing Engineer:** Progressive Engineering, Inc.



Photo Courtesy of Mystic Aquarium



## PROJECT DESCRIPTION

Located in Mystic, Connecticut, on the campus of Mystic Aquarium, the Milne Center for Ocean Science and Conservation helps to further the nonprofit's mission of inspiring people to care for and protect the ocean through its efforts in conservation, education and research. (1) The 18,000-square-foot building features a multi-level education wing with interactive

“We sought to not just get away from the stereotype of the basic box, but to ask ourselves how we could, in essence, destroy the box.”

— David Holmes, Principal, Capital Studio Architect



Image Courtesy of Capital Studio Architects

classrooms, a multipurpose room for up to 300 people, offices and an art gallery. (1, 2) The facility also offers space for the education department to host a wide variety of classes and events for students and families. The second wing of the center features a 6,000-square-foot, temperature-controlled animal care center with 12 aquatic systems and 37 tanks of various sizes containing 45,000

gallons of water. Within this non-public space, veterinary staff care for fish and invertebrate species that are out of public display, as well as local sea turtles in need of rehabilitation. Additionally, staff use the center as an aquaculture laboratory for research and conservation efforts to support declining populations of horseshoe crabs. (3)

## Destroying the Box

Ten years before the opening of the Milne Center, Keith Sorensen, senior vice president of Facilities and Capital Projects at Mystic Aquarium, created what he called a “very crude basic sketch” of his concept for a new center. “I was involved with the project from the beginning, but it took many years to develop,” Sorensen said. “At the time, our educational programming and animal holding areas were scattered throughout the campus. To have a central location for education and animal care would be a real game changer for the aquarium.”



Image courtesy of Capital Studio Architects

But to marry two seemingly disparate functions in one space on just three quarters of an acre of Mystic Aquarium’s campus proved to be a challenge. “The building had to skirt existing parking and avoid underground utilities, making it a tight and unusually sized space to build on,” he said.

Enter the concept of a metal building. “Some people have this preconceived notion that a metal building is just a basic box, like a warehouse,” said David Holmes, principal of Capital Studio Architects. “But there is so much more you can do with the design. We sought to not just get away from the stereotype of the basic box, but to ask ourselves how we could, in essence, destroy the box.”

The resulting design marries education and animal care/research by joining two separate metal buildings in a unique, perpendicular design that’s not only eye-catching but scores high on functionality.

## Design Priorities

### 1. Create a Welcoming Education Center

Through its educational programming, the aquarium fosters an interest in and understanding of aquatic science and conservation. (1) With busloads of children arriving each school day and thousands of community members visiting each year, the education wing of the Milne Center needed to be welcoming and easy to navigate. To help differentiate the two building functions, Holmes varied textures and hues on the center’s exterior, combining exterior insulation and finish systems (EIFS) with metal cladding. For the education wing, two opposing planes of blue EIFS and silver metal panels evoke movement, like a ship hull rolling through the ocean. (4) A wall of windows and windowed lobby on the left side of the building provide an open and welcoming entry point for visitors. The nautical theme continues into the two-story lobby with hues of light greens, blues and silver reflected in the flooring. Soft indirect light lends brightness and softness to the space, which leads into the multipurpose room, classrooms, preschool and offices.

### 2. Provide an Open, Flexible Space for Animal Care/Research

Juxtaposed to the blue, windowed visitors’ side of the center, the climate-controlled animal care area is grounded by masonry and light green EIFS panels that extend the length of the right side of the building. Inside, clearspans between columns and high ceilings provide a wide-open space for 37 tanks—some fiberglass tanks as large as 30-foot wide. (5) “The animal care center features an uninterrupted, 60-foot clearspan to accommodate these larger tanks,” Holmes said. “The wide-open area provides a flexible space that can change as animal care needs change.” A crane, attached to the metal roof framing system, lifts 4,000-pound palletized bags of sea salt to a second-story, 1,200-square-foot mezzanine where a monorail system, also anchored to the roof structural system, guides the sea salt to three large tanks of water, where seawater is created. The seawater is then gravity-fed down to the first-floor tanks.





“What was really important with this project was having a team that could realize our vision. We had to be creative in the design—it was certainly a challenge—but because of the quality of the team, we were able to make it happen. The Milne Center exceeds our expectations.”

— Keith Sorensen, Senior Vice President,  
Facilities and Capital Projects, Mystic Aquarium

# PROJECT CHALLENGES, GOALS & OBJECTIVES

## Preventing Leaks, Increasing Roof Life

Though the two rooflines are perpendicularly situated, both metal buildings feature a standing seam metal roof system. “With this system, movable clips, which anchor the roof panels to the purlins, accommodate roof movement under changing temperatures, providing superior performance and leak protection,” said Jingyi Zhu, Lead Estimator – East Region for Butler Manufacturing. .

“There are no bolts or fasteners penetrating through the surface of the metal roof panels,” said Daniel Carlin, Director of Operations for Carlin Construction Company. “All the panel connections to the structure are done through the moveable clips, which are located integral to the roof seams. When the roof panels are seamed, it’s like a soda can—absolutely watertight.”



Photo Courtesy of Mystic Aquarium

## Enhancing Energy Efficiency, Improving Aesthetics

Mystic Aquarium previously used an overhead canopy on an outdoor tank for larger animals in recovery or off-exhibit. The animal care center in the Milne Center includes tanks large enough for sea animals like sea turtles and smaller marine mammals. It is not only enclosed but temperature- and humidity-controlled. The proprietary roof insulation system encases 12 inches of fiberglass insulation between the roof framing and a steel liner panel, taking the R-value from R-19 to R-40, and providing a smooth finished white ceiling in the climate-controlled space. “With this system, you can include twice as much insulation without compressing the fiberglass between panels, increasing the energy efficiency of the space,” Carlin said.

## Engineering for Heavier Loads

To accommodate heavy loads of sea salt, which are lifted from ground level to the mezzanine level and transported via the monorail system, the roof system was engineered with several additional carrying beams. “The transport system added to the load that the roof needed to carry,” Carlin said. The entire roof system was modified further to accommodate the structural loads of solar panels, which help to reduce energy costs.

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— Daniel Carlin, Director of Operations,  
Carlin Construction

## Planning for Building Movement

Metal buildings expand and contract, and two separate metal buildings mean that each is going to move differently. “The design provided a certain degree of separation between the two buildings to allow for thermal expansion and wind movement,” Carlin said. In addition to the mezzanine in the animal care area, the Milne Center features two other mezzanines in the visitors’ wing—one of which connects from one building to the other. “We designed in an expansion joint that allows for movement,” Zhu added.

With tanks that extend up to 30 feet in length, the building’s columns and bracing elements needed to be designed in such a way to maintain space around the tanks during normal building movement. “We engineered clearance controls so there’s suitable space for movement between the columns and the tanks,” Zhu said.

## Additional Reflections

“If you look at the Milne Center, you would never have expected that we did this with a metal building system,” Carlin says. “You’d say all day long that it’s a conventional steel building. But there is so much flexibility in designing with a metal building system. One of the major advantages is the ability to create clearspan spaces economically—without having to install huge trusses and a much heavier conventional steel support system.”

That attention to the economics of a project is important for any client, but especially for a nonprofit organization where every dollar matters. “With conventional steel, you’re sometimes buying structural shapes that are oversized for what you need because those are the only sizes that are manufactured,” Carlin said. “But in a metal building, structural frames and beams are manufactured exactly to specifications. If the column web is engineered to a requirement that can be 3/16-inch-thick, it’s fabricated that way. If you’re using conventional steel, you might have to use a steel shape with a 3/8-inch web. More materials are heavier and mean more money, and that can really add to the cost of a project.”

More materials also translate into a heavier design. “Because a metal building is lighter, you need less foundation, which reduces project costs,” Zhu said. Also, because what arrives on-site is fabricated to exact specifications, the erection process is much easier with

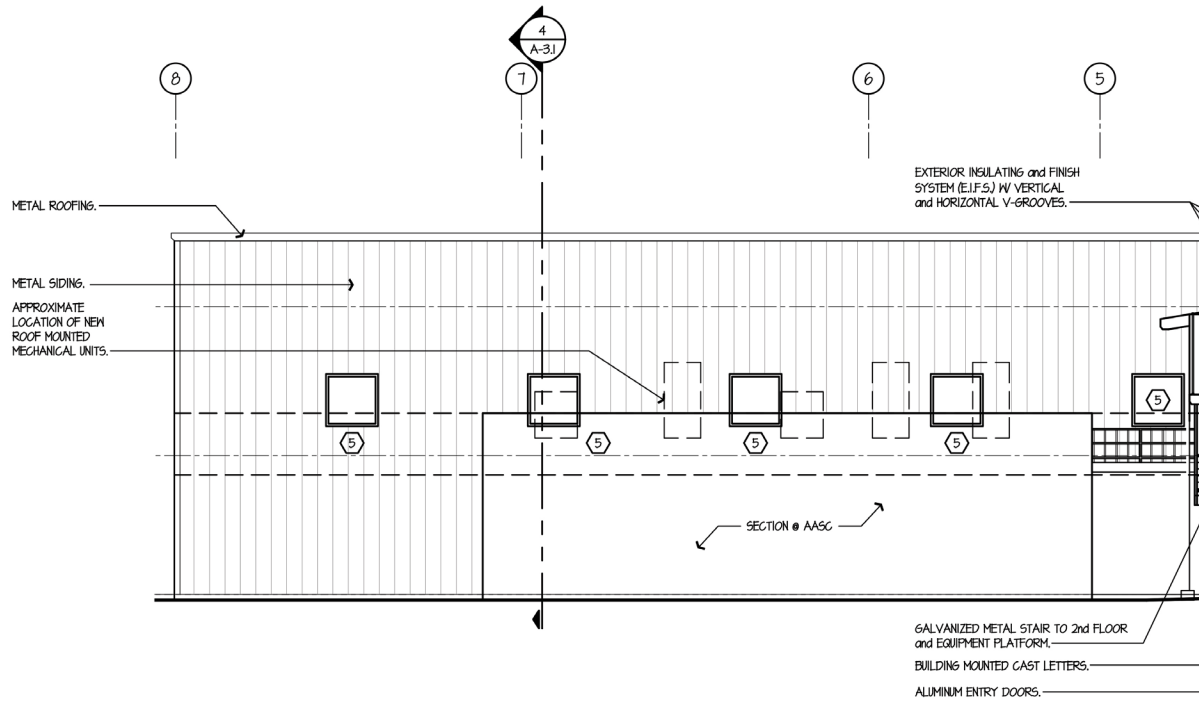


Photos Courtesy of Carlin Construction

prepunched holes and few, if any, field welds. “A metal building requires less labor during the erection process,” she said.

“You can get the shell of a building up and enclosed so much more quickly with factory-fabricated steel components than with a conventional steel system,” Carlin added. With such a unique design, Holmes and Carlin traveled to Butler Manufacturing’s plant in Annville, Pennsylvania, to meet with Zhu and her engineering team before the fabrication process began. “In-house, we designed the foundation and laid out the grid of columns that we thought would work,” Holmes said. “We then took our schematic drawings to Butler. With roof slopes that are so unique, we wanted to sit down together and make sure we were all on the same page.”

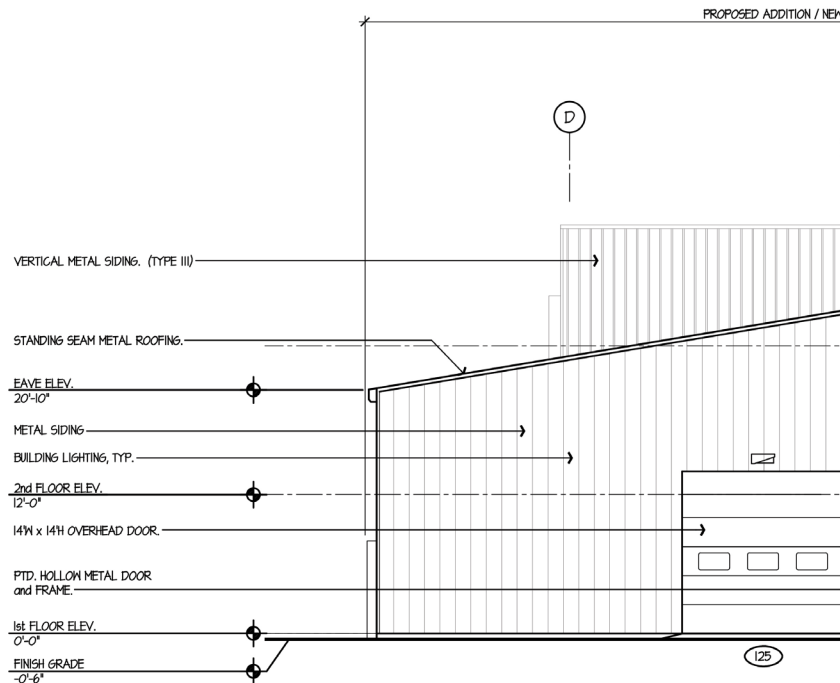
“Together, we could confirm the scope and optimize the structural design to make sure the building would be as economical as possible,” Zhu said. “The preplanning meeting was a final check to make sure we were all aligned before fabrication.”



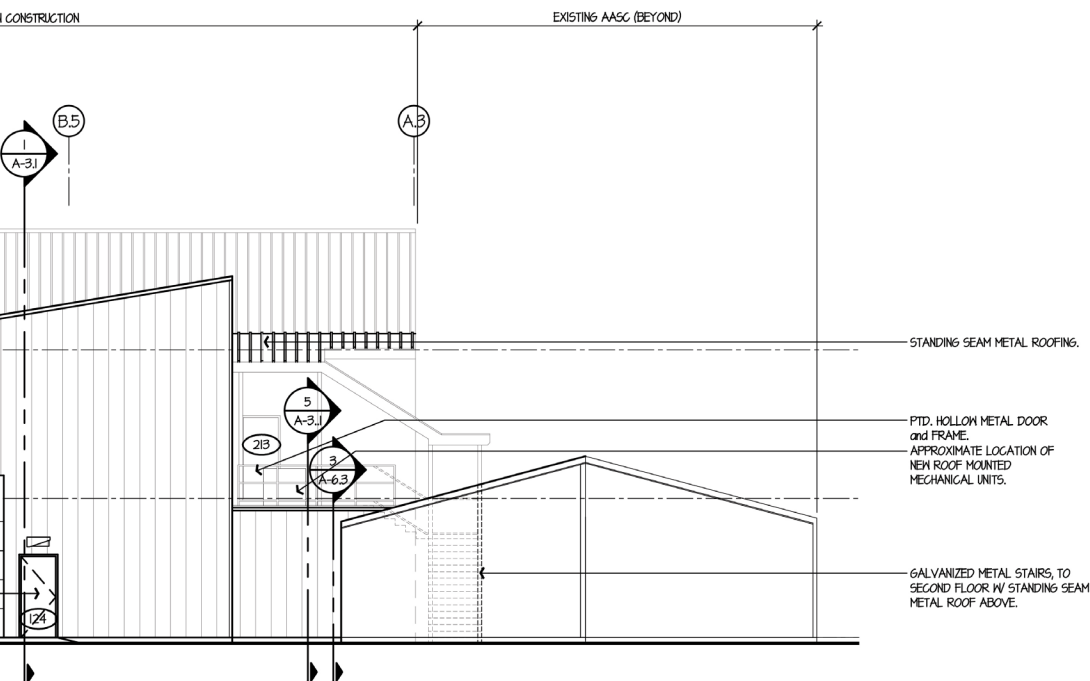
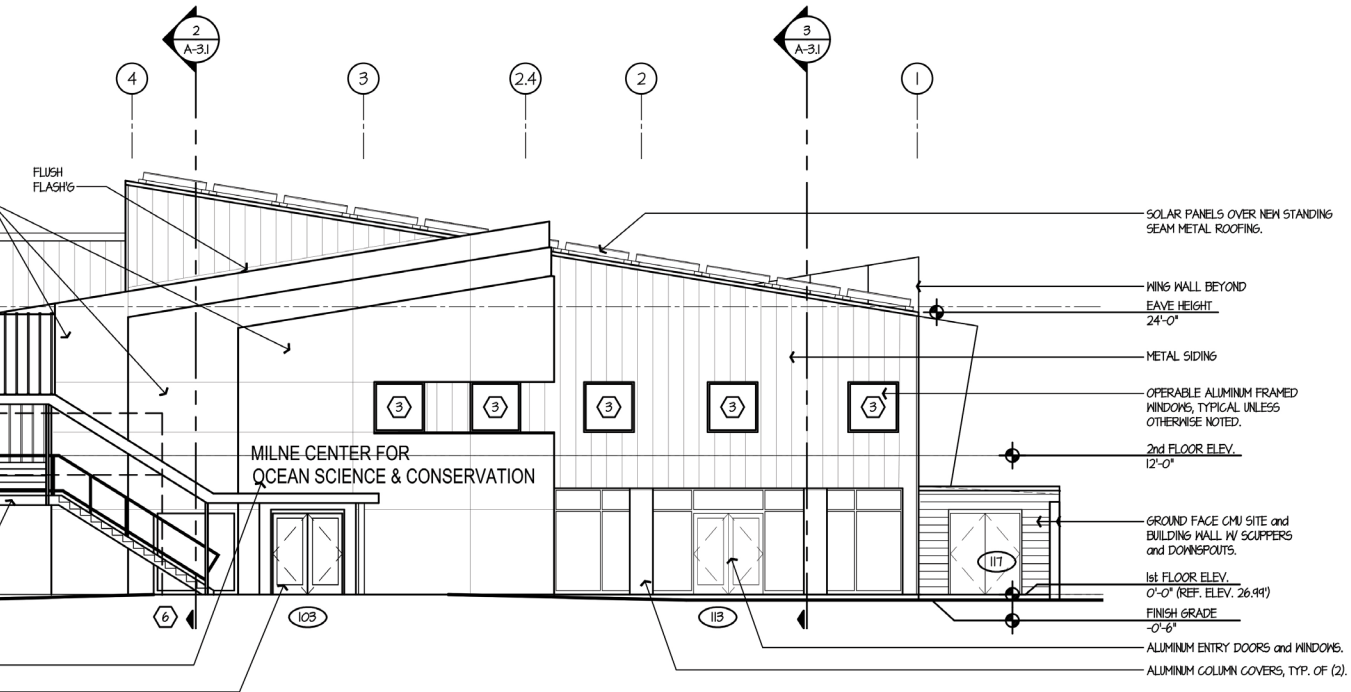
2 WEST ELEVATION  
A-2.0 SCALE: 1/8" = 1'-0"

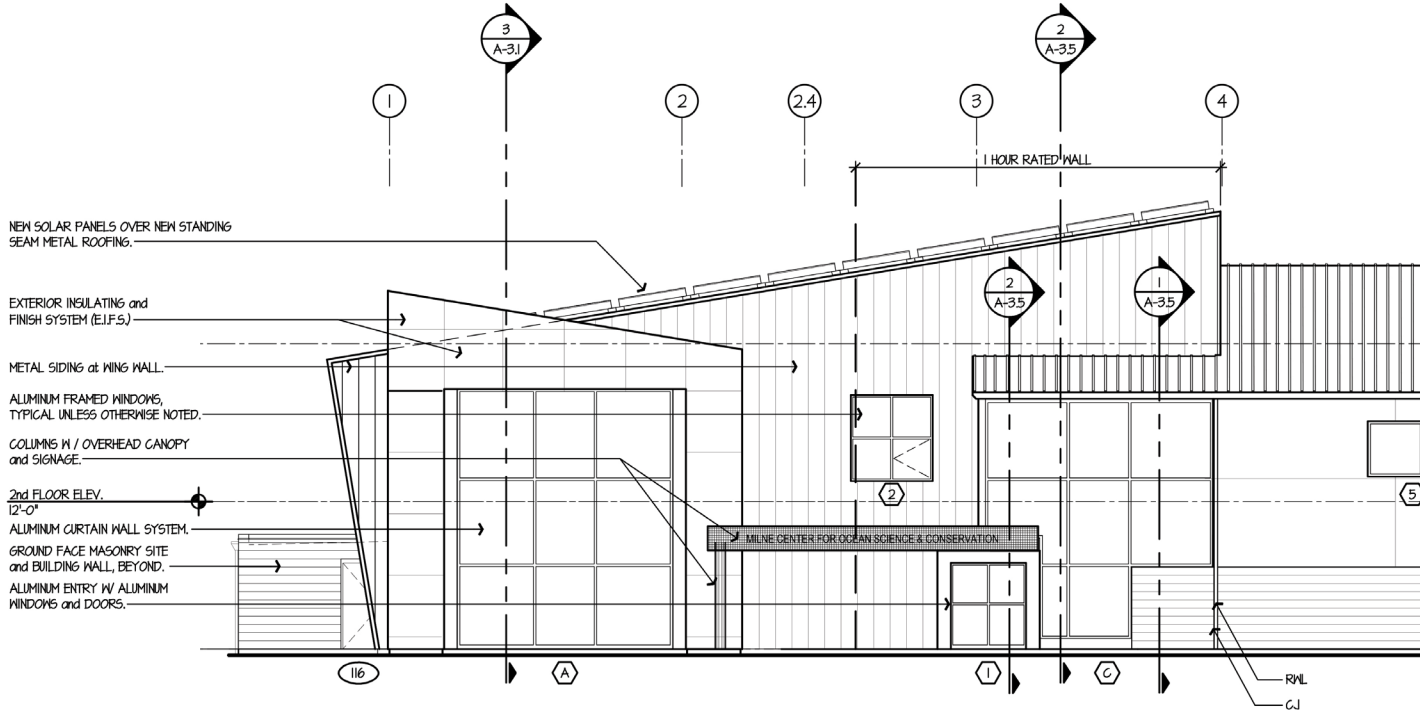
“With a metal building system, your money goes further because these systems are more economical—that’s what they sell themselves on—and you can do amazing things like join two buildings or achieve 60-foot clearspans, like we did with the Milne Center.”

— David Holmes, Principal, Capital Studio Architects

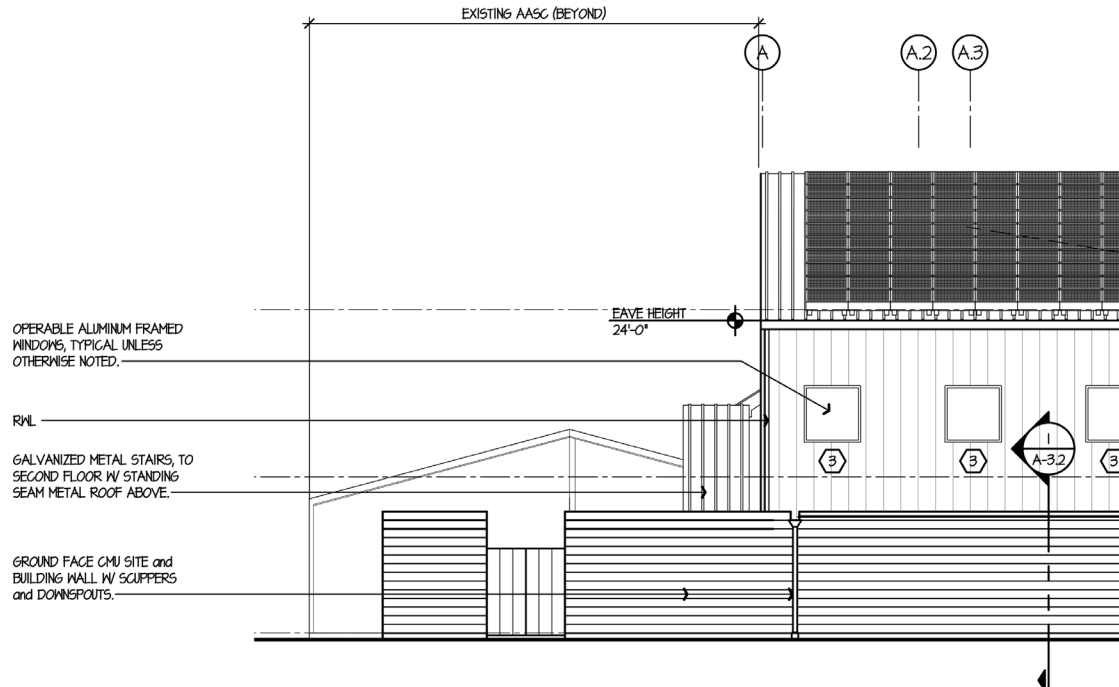


1 NORTH ELEVATION  
A-2.0 SCALE: 1/8" = 1'-0"

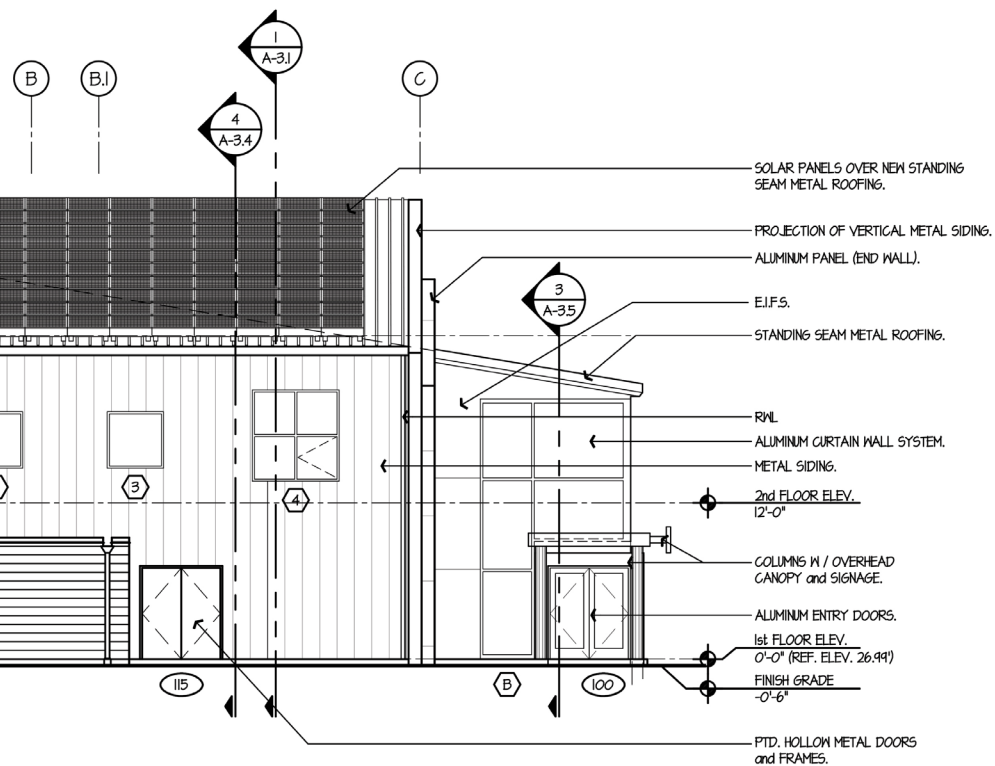
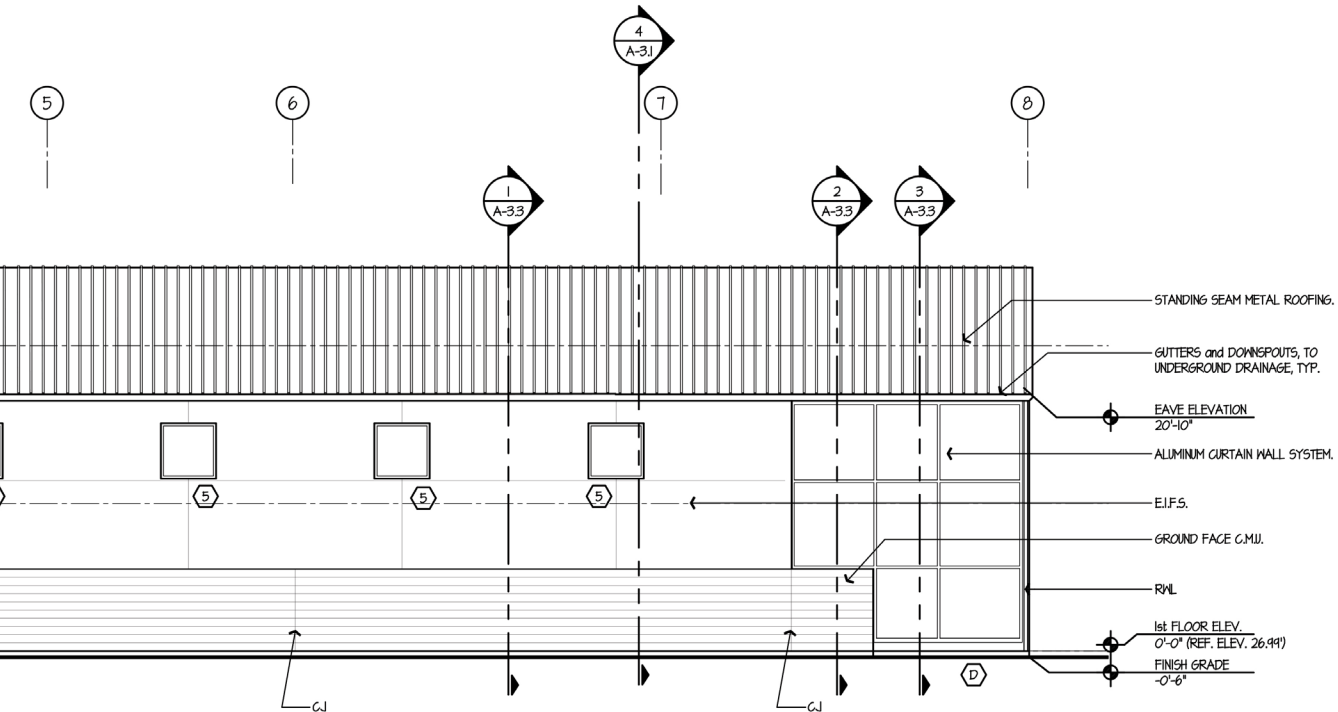




**2 EAST ELEVATION**  
 SCALE: 1/8" = 1'-0"



**1 SOUTH ELEVATION**  
 SCALE: 1/8" = 1'-0"



# RELEVANCE FOR STUDENTS

Holmes acknowledged that a generation ago the metal building market was really pigeon-holed with fairly simple designs, but with today's large palette of materials, textures and colors, the design possibilities are endless. "You can do anything with a metal building that you can with a conventional steel-frame structure. You don't have to limit yourself," he said.

"Every project has rules. You'll have construction, budget and structural limitations with any material. Working within the rules, you take what could be negatives and you turn them into positives," Holmes said. "With a metal building, your money goes further because these systems are more economical—that's what they sell themselves on—and you can do amazing things like join two buildings or achieve 60-foot clearspans, like we did with the Milne Center."

To think about what it takes to design a building from scratch can feel overwhelming, Holmes said. "There are a million decisions that need to be made when you're

designing a building. Break those problems into smaller problems, solve them one by one, put it all back together, and you'll have your final design solution."

When Holmes went to architecture school, he thought he was going to be the next Frank Lloyd Wright. "We all think that," he mused. "But that only happens to a handful of architects; however, it doesn't mean you don't make an impact. For example, I do a lot of public housing renovation projects. They aren't sexy, but for example, I'm helping to modernize a 50-year-old building for the elderly community. It might not win a design award, but what I do helps to improve the quality of life for senior citizens. There's huge satisfaction in that."

## PRACTICAL APPLICATION

1. Why was a metal building the right fit for this project? What were some challenges that necessitated this unique design? How would you have designed the Milne Center differently?



Photos Courtesy of Carlin Construction



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David Holmes, Principal,  
Capital Studio Architects

2. David Holmes said that the design possibilities with a metal building are endless. Research other innovative building designs that were created with metal building systems.
3. The roof of the animal care center in the Milne Center had to be engineered to carry the load of solar panels, a crane that lifts 4,000 pounds of sea salt and a monorail system. Explore what elements of the roof system have to be engineered to accommodate additional weight.
4. How did the project team address movement in the two metal building systems? What were some important considerations in the animal care center regarding movement? How does an expansion joint work, and how would it allow movement in the joined mezzanine?
5. Research the effect of temperature on a metal building. How much does a metal building expand and contract? How does this change in different climates or with different weather patterns?
6. How does a standing seam metal roof prevent water leaks? Research the construction of a metal roof system. Are there advantages or disadvantages to this type of roof system?
7. Metal buildings are designed optimally which results in a lighter structure. What does this mean for project cost, the erection process, site waste and the use of labor? Why is it important for the contractor to meet with the metal building manufacturer early in the planning process? How can that interaction add value/efficiency to the design and construction processes?



# RESOURCES/RELATED READING

## Related Reading

- MBMA. n.d. "Case Study: Educational Campus Facilities"
- MBMA. n.d. "MBMA-NAIMA Acoustical Performance Guide"
- MBMA. n.d. "Roof Framing Design Guide for Metal Building Systems, 2nd Edition"
- MBMA. n.d. "Energy Guide For Metal Building Systems: Code Compliance, 2nd Edition"

## Video Resources

Over 50 videos highlighting metal building architecture, engineering, design and application can be accessed at [www.youtube.com/mbmamedia](http://www.youtube.com/mbmamedia). We recommend you begin your educational process with the following programs:

- Metal Building Systems 101
- An Introduction to Metal Building Systems
- How It's Made: Metal Building Innovations Are Revolutionizing Low-Rise Commercial Construction
- How It's Built: Metal Building Construction Raises the Bar for Low-Rise Commercial Structures
- How Do I Know a Metal Building is Right for My Project?
- Metal Building Nomenclature
- MBMA Travels with Tony: Bay Insulation
- MBMA Travels with Tony: Starshine Texas

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Photo Courtesy of Carlin Construction



Photo Courtesy of Carlin Construction

# CREDITS

## Managing Editor

W. Lee Shoemaker, PhD, PE  
MBMA Director of Research & Engineering

## Production Design & Management

TWI Publishing

## Photography & Drawings

Capital Studio Architects, LLC  
Carlin Construction, LLC  
Mystic Aquarium

## Information Sources

David Holmes, Principal, Capital Studio Architects, LLC  
Daniel Carlin, Director of Operations, Carlin Construction, LLC  
Jingyi Zhu, Lead Estimator – East Region, Butler Manufacturing  
Keith Sorensen, Senior Vice President, Facilities and Capital Projects, Mystic Aquarium

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Bouquot at [mbma@mbma.com](mailto:mbma@mbma.com).

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