



## Cleveland Aquarium

Cleveland, Ohio, USA



Design Firm  
**MARINESCAPE**

Construction  
**THE ALBERT M. HIGLEY CO.**

Engineering  
**LIENWEBER ENGINEERING**

Ready Mix Supplier  
**ROCKPORT READY MIX**

Products  
**ADMIX C-500, CONCENTRATE,  
PATCH'N PLUG**

Project Type  
**AQUARIUM**

When local developer Jacobs Investments proposed to create the 70,000 ft<sup>2</sup> (6,053 m<sup>2</sup>) Greater Cleveland Aquarium in the lower level of the vintage FirstEnergy Powerhouse (fig 1) on the west bank of the Cuyahoga River, it posed multiple engineering and logistical challenges.

One of the key concerns was how to protect the critical concrete bases and walls of the more than 40 separate aquarium tanks (fig 2) to be built in the basement of the nearly 130-year-old building. About 1,100 yd<sup>3</sup> (841 m<sup>3</sup>) of ready-mix concrete were needed to create the assortment of fresh and saltwater tanks.

The tank designers, New Zealand-based Marinescape and structural engineer, Cleveland-based Lienweber Engineering, needed a way to protect the concrete aquarium structures from leakage as well as the effects of the simulated seawater to be used in the saltwater tanks. Given the tight confines of the aquarium and 7-day-per-week public access, any waterproofing treatment that might require future follow-up or maintenance was ruled out.



Don Leinweber, founder and principle engineer of Lienweber Engineering, worked with Marinescape designers and the local Xypex representative to develop a concrete specification that would solve this puzzle. Ultimately, the team chose to use Xypex **Admix C-500** for all water holding structures, providing integrated and life-time waterproofing and chemical protection. The use of Xypex Admix C-500 saved on installation time and cost less than the cost of coatings or membranes, which would need periodic maintenance and restoration.

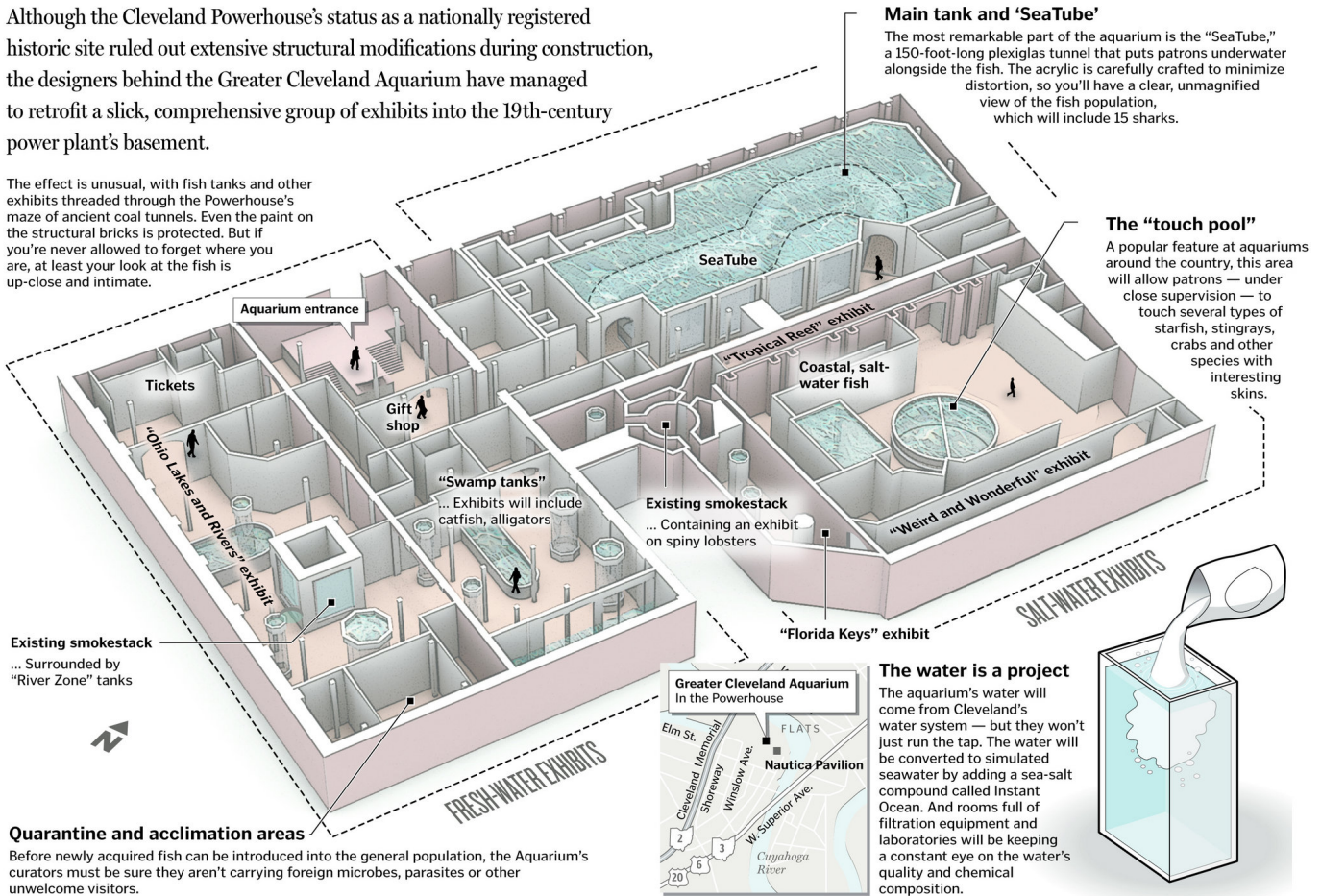


Fig 1 -- The historic Powerhouse, built in 1892, was extensively renovated in 2011 to accommodate the 70,000 ft<sup>2</sup> Greater Cleveland Aquarium.

Fig 2 -- The 230,000-gallon Shark Gallery & SeaTube are a key highlight of the Greater Cleveland Aquarium.

Although the Cleveland Powerhouse's status as a nationally registered historic site ruled out extensive structural modifications during construction, the designers behind the Greater Cleveland Aquarium have managed to retrofit a slick, comprehensive group of exhibits into the 19th-century power plant's basement.

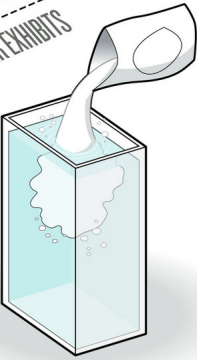
The effect is unusual, with fish tanks and other exhibits threaded through the Powerhouse's maze of ancient coal tunnels. Even the paint on the structural bricks is protected. But if you're never allowed to forget where you are, at least your look at the fish is up-close and intimate.



**Main tank and 'SeaTube'**  
The most remarkable part of the aquarium is the "SeaTube," a 150-foot-long plexiglas tunnel that puts patrons underwater alongside the fish. The acrylic is carefully crafted to minimize distortion, so you'll have a clear, unmagified view of the fish population, which will include 15 sharks.

**The "touch pool"**  
A popular feature at aquariums around the country, this area will allow patrons — under close supervision — to touch several types of starfish, stingrays, crabs and other species with interesting skins.

**The water is a project**  
The aquarium's water will come from Cleveland's water system — but they won't just run the tap. The water will be converted to simulated seawater by adding a sea-salt compound called Instant Ocean. And rooms full of filtration equipment and laboratories will be keeping a constant eye on the water's quality and chemical composition.



**Quarantine and acclimation areas**  
Before newly acquired fish can be introduced into the general population, the Aquarium's curators must be sure they aren't carrying foreign microbes, parasites or other unwelcome visitors.

SOURCE: The Greater Cleveland aquarium

WILLIAM NEFF | THE PLAIN DEALER

**Admix Solves Multiple Challenges**

Xypex **Admix C-500**, which was added to the concrete at the time of batching, consists of Portland cement, silica sand, and various active, proprietary chemicals that react with the moisture and the by-products of cement hydration to cause a catalytic reaction that results in the formation of non-soluble crystals that fill the natural pores and capillary tracts in concrete. This crystalline formation prevents the penetration of water and other liquids from any direction.

Admix C-500 becomes a permanent and integral part of the concrete structure and continues to work to prevent the ingress of water and other liquids for the life of the structure. Admix

C-500 not only permanently seals the concrete and can heal hairline cracks up to 0.4 mm, it also provides chemical resistance properties that mitigate the attack of chlorides, sulfates and the effects of carbonation and alkali-aggregate reaction.

The aquarium designers chose to preserve as much of the character and structure of the original Powerhouse as possible. Built in 1892 as a power plant for Cleveland's electric streetcars, the Romanesque revival style structure was closed in 1920 due to the rise in popularity of automobiles.

The Powerhouse was extensively renovated in 1987 (fig 3) and evolved into the Nautica Entertainment Complex (fig 4), which includes the

Greater Cleveland Aquarium, several restaurants and banquet facilities, the Jacobs Pavilion, the Nautica Queen river cruise ship, and the IMPROV Comedy Club.



Fig 3 -- This 1975 photo captures the state of the Powerhouse at that time. A lack of funding caused the renovation project to fold four years later, leaving the building abandoned and a literal casing of its former self until it was restored in 1987. [Image courtesy of Cleveland State University.]



Fig 4 -- Located in the Flats area along the west bank of the Cuyahoga River, the Nautica Entertainment Complex is home to multiple restaurants, the Jacobs Pavilion (tent structure) and the Greater Cleveland Aquarium.

### First-Time Xypex User

The aquarium construction project took place throughout 2011 (fig 5), enabling the new aquarium to open in January 2012, the first standalone aquarium in Cleveland since the Gordon Park aquarium closed in 1985. The general contractor for the aquarium concrete work was Cleveland-based The Albert M. Higley Co.

Rockport Ready Mix, located just 3.5 miles from the aquarium site, was selected to supply the 1,100 cubic yards of 4,500 psi concrete needed for the project (fig 6). More than 11,000 pounds of Xypex Admix C-500 was used to enhance the concrete mix. The Admix C-500 was added to the concrete trucks during initial loading using 15-pound water soluble bags. Xypex Concentrate and Xypex Patch'n Plug were used by the concrete contractor during the project to seal joints and make repairs where necessary.

"It was our first experience using Xypex Admix," recalls Rockport chief operating officer John Sarrouh. "We worked with the local Xypex representative to understand exactly how to incorporate the Xypex product in the mix with the proper dosage and deliver it to the job. Once the Xypex Admix was added to the concrete mix in the truck, we mixed it for five to seven minutes. Since the aquarium project,

we have used Xypex many times as a waterproofing admix on other structures. In fact, we used it very recently on a NASA project."

Delivery and placement of the Xypex-treated ready mix to the aquarium construction project was especially challenging due the enclosed (fig 7) and relatively inaccessible Powerhouse structure. "We made deliveries to the aquarium project over a six-month period in 2011," Sarrouh says. "Due to the tight spaces inside the building, getting the mix into the job was very demanding and time consuming. Two methods of placements were utilized, concrete pump and powered buggies (fig 8)."

Sarrouh noted that adding Xypex Admix C-500 to concrete mixes has very little impact on the mixing process or the consistency of the mix. "It typically does not change the characteristics of the concrete mix or its workability," he says. "Now that we understand the product, its application, and the benefits it provides, it is a value-added product we can offer to our customers for the proper projects."

### Aquatic Dreams Realized

Since opening in early 2012, the Greater Cleveland Aquarium has drawn an estimate 1.5 million visitors, including more than 250,000



Fig 5 -- The Shark Gallery & SeaTube exhibit begin to take shape. Every tank and feature in the aquarium used concrete treated with Xypex Admix C-500 to provide waterproofing and chemical protection.



Fig 6 -- Concrete bases and walls were treated with Xypex Admix C-500 to provide integrated and maintenance-free waterproofing for the life of the aquarium. The circular concrete aquarium bases in the Asia & Indonesia exhibit received custom-made acrylic tanks (see inset photo).



Fig 7 -- The basement of the Powerhouse required extensive renovation and reconstruction to accommodate the unique needs of the Greater Cleveland Aquarium. Engineers determined that the timber piling foundation could support the weight of the concrete and acrylic tanks, as well as the nearly 500,000 gallons of water the tanks collectively hold.

*Fig 8 -- Engineers determined that the aquarium tanks could be built in the Powerhouse lower level as long as they were self-supporting and did not require the building walls for support. Much of the original character of the 1892 building was preserved.*



*Fig 9 -- The 175-foot long SeaTube puts you inside the tank without getting wet.*



*Fig 10 -- Weedy Sea Dragons are new this year.*



*Fig 11 -- The Touch Tank is a popular stop for kids of all ages.*

in 2017 alone. A recently completed \$250,000 renovation and enhancement project has helped enhance the visitor's experience. The historic brick building, located in the Flats along the Cuyahoga River, features nine re-imagined galleries that afford up-close, eye-level and 360-degree views of more than 300 species (figs 9-12).

The themed galleries—Ohio Lakes & Rivers, Asia & Indonesia, Tropical Forest, Industry & Habitat, Giant Pacific Octopus, Coastal Boardwalk, Tropical Reef, Shark Gallery & SeaTube

and Imagiquarium—feature 2500 freshwater and saltwater animals from nearby Lake Erie and from across the globe.

“We were excited that Rockport Ready Mix played a part in the Greater Cleveland Aquarium project,” says Sarrouh. “It not only provides a high-quality experience for thousands of visitors every year, but it offered us a chance to learn how Xypex can be used to protect and enhance the properties of concrete. It’s now part of our tool kit and we’re comfortable providing it and recommending it when appropriate.”



*Fig 12 -- Huge acrylic tank walls provide close-up views.*