

SPLISH SPLASH

AN ICONIC TRAIN STATION IS
REIMAGINED AS AN AQUARIUM

FAST FACT

One-thousand-five-hundred-fifty-two square feet of permanent acrylic panels, weighing 53,000 pounds and ranging in size from 3 by 3 feet to 16 by 18 feet, were installed.



ST. LOUIS AQUARIUM

AT UNION STATION

WRITTEN BY | BRYAN MEYER

Building an aquarium is complicated. But building a spectacular 21st century aquarium inside the footprint of a 19th century train shed designated as a National Historic Landmark adds multiple levels of complexity. Fortunately for McCarthy Building Cos. Inc., which built the 2-story, 120,000-square-foot St. Louis Aquarium at Union Station, construction challenges are its strength.

A signature element of the \$187 million redevelopment is that the aquarium provides visitors with immersive perspectives of underwater life in the world's rivers, streams and oceans, including up-close viewing of more than 13,000 animals, from 257 species, in 44 exhibits. This diverse range of aquatic animals—from freshwater and marine environments—are housed in 1.3 million gallons of water, including a 250,000-gallon shark habitat that serves as the centerpiece attraction.

HISTORY OF ST. LOUIS UNION STATION

Located adjacent to the heart of downtown St. Louis, St. Louis Union Station first opened to the public in 1894 and became one of the world's largest and busiest passenger rail terminals. Designed by Theodore Link, an architect for the 1904 World's Fair, the iconic structure encompasses an 11.5-acre train shed, headhouse and midway.

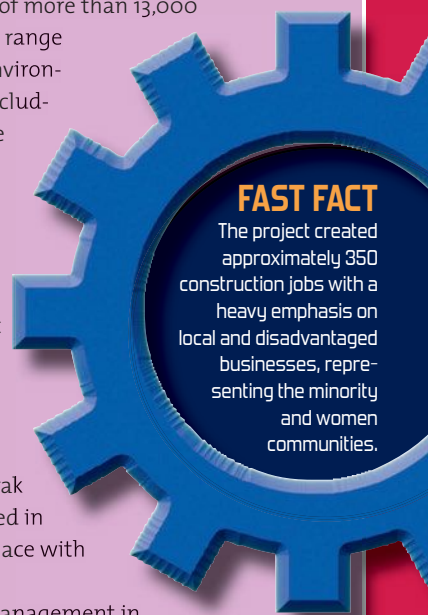
Union Station closed its doors in 1978 when Amtrak relocated its St. Louis station, but the facility reopened in 1985 following its conversion into a festival marketplace with retail, restaurant and hotel components.

When it was purchased by Lodging Hospitality Management in 2012, St. Louis Union Station was completely transformed again into a family entertainment and tourist destination. Today, in addition to the hotel and aquarium, the complex includes several new restaurants, a ropes course, mirror maze, 200-foot-high observation wheel, carousel and mini-golf course.

RENOVATION GOALS

Retrofitting space that has a national historic designation requires leaving the entire existing infrastructure in place, including protecting and preserving the original columns, footings, foundation, underground piping and other infrastructure.

Given these restrictions, builders had to figure out the best way to design and install 17 independent life-support systems to accommodate each of the unique animal species that lives in each exhibit, as well as separate holding tanks, quarantine tanks, piping, ozone and temperature control systems to provide individualized, treated water to each exhibit. In addition, five overhead viewing areas, a switchback tunnel,

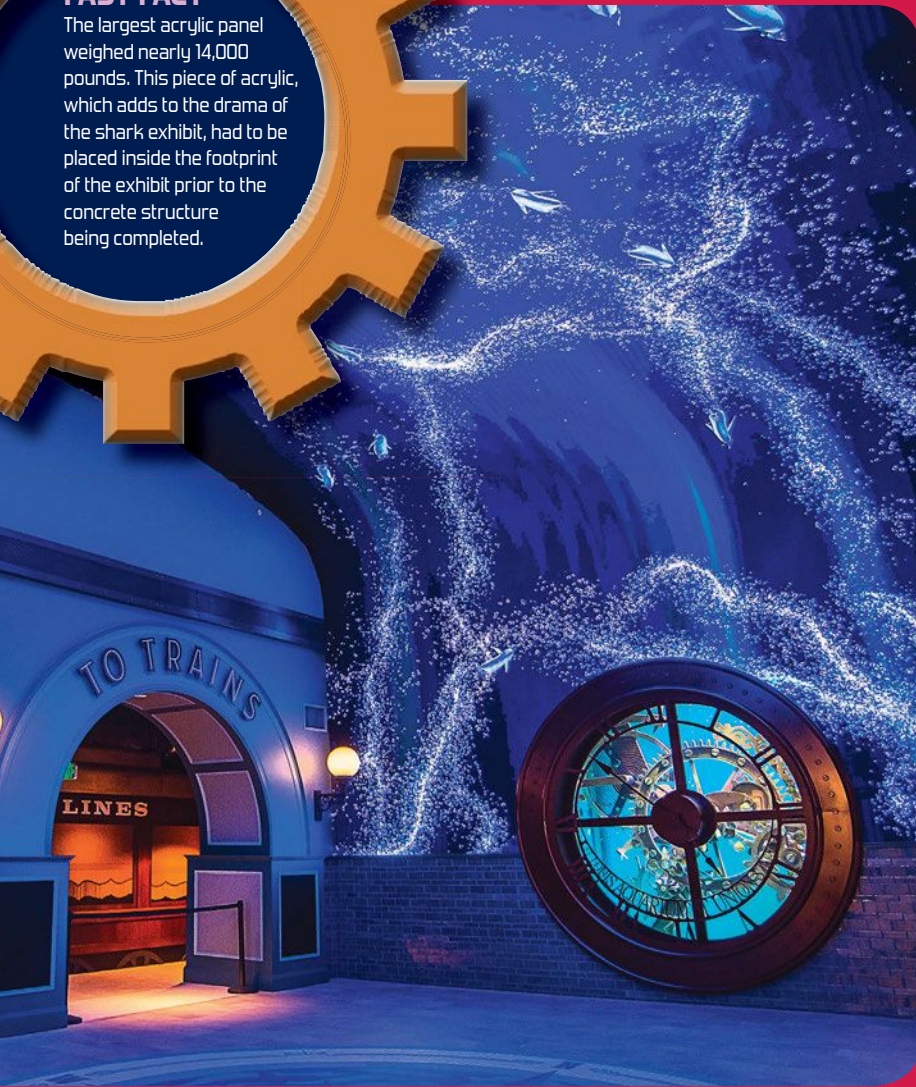


FAST FACT

The project created approximately 350 construction jobs with a heavy emphasis on local and disadvantaged businesses, representing the minority and women communities.

FAST FACT

The largest acrylic panel weighed nearly 14,000 pounds. This piece of acrylic, which adds to the drama of the shark exhibit, had to be placed inside the footprint of the exhibit prior to the concrete structure being completed.



RETROFIT TEAM

OWNERS // Lodging Hospitality Management, www.lhmc.com, and zoOceanarium Group, www.zooceanarium.com

GENERAL CONTRACTOR // McCarthy Building Cos. Inc., www.mccarthy.com

ARCHITECT // PGAV Architects, www.pgavarchitects.com

CIVIL CONSTRUCTION // Castle Contracting LLC, www.digcastle.com

MECHANICAL CONTRACTORS // Charles E. Jarrell Contracting Co. Inc., jarrellcontracting.com, and Rock Hill Mechanical Corp., www.rhmc.com

PLUMBING CONTRACTOR // Franklin Mechanical Inc., www.zakcompanies.com

GEOTECHNICAL CONSULTANT // Geotechnology Inc., www.geotechnology.com

BUILDING ENCLOSURE // IWR Building Systems LLC, www.iwrbuildingsystems.com

MASON // John J. Smith Masonry Co., (314) 894-9500

PAINTING // Jos. Ward Painting Co., www.joswardpaintingco.com

LANDSCAPING // Landesign LLC, www.lan-design.net

ELECTRICAL CONTRACTOR // Sachs Electric, www.sachsco.com

CONCRETE CONSTRUCTION // Vee-Jay Cement Contracting Co. Inc., www.veejaycement.com



and deep-water-area panels needed to be built to create an engaging and immersive visitor experience.

CHALLENGES ALONG THE WAY

The most recent set of as-built drawings for the structure dated to the late 1800s, so one of McCarthy's first steps was to laser scan the entire former train shed portion of the facility. Laser scanning enabled team members to accurately assess existing conditions and mitigate future design issues that would potentially delay or complicate the project.

The design and construction team worked together to design, coordinate and install an underground pipeline system encompassing more than 10,000 linear feet of pipe. Custom-built piping assemblies—ranging in size from 2 to 24 inches—service the 17 independent life-support systems, each of which is designed to accommodate the animal species that occupy a specific exhibit. Building Information Modeling (BIM) facilitated the entire process—from model to field layout.

Construction activities also included installation of 1,552 square feet of permanent acrylic panels, ranging in size from 3 by 3 feet to 16 by 18 feet and weighing a total of 53,000 pounds. BIM and laser scanning enabled the team to verify tolerances and embed locations before placing each acrylic



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Other construction challenges involved controlling noise and dust while working in close proximity to an operational 567-room hotel and adjacent restaurants.

SAFETY ONSITE

In addition to routine safety precautions, building an aquarium also required flotation devices, life vests and other life-safety equipment that was staged nearby to protect individuals suspended over water-filled exhibits. Other safety measures included controlling silica dust during the large-scale interior demolition and excavation, ensuring safe access to confined tank spaces and maintaining consistent indoor environmental quality.

Temporary bracing was erected to support the existing structure while individual sections were demolished and replaced with a new self-supporting structure. On the second level, the use of lightweight aerial lifts with outriggers ensured weight remained under loading limits.

A separate safety plan developed for the rockwork/theming contractor emphasized

the safe use of high-VOC products. Installation of above-and-beyond air exchangers helped ventilate workspaces during the application of specialty coatings on tanks and themed features.

Minimal use of gas/propane-powered equipment and the strategic placement of fans ensured exhaust rose above work areas, mitigating carbon-monoxide risk throughout the interior environment. The team also followed meticulous procedures for moving trucks in and out of the site to protect pedestrians in the high-traffic, urban area outside the fence.

TECHNOLOGY TRANSFORMED HISTORICAL ARCHITECTURE

Laser scanning of the entire aquarium footprint within the existing building enabled the team to identify various columns, walls and foundation conditions that did not match as-built drawings so they could be adjusted on the design documents before negatively impacting the project.

McCarthy's subsurface utility mapping group used an electromagnetic locator, Sonde camera and acoustic pipe locator to gain a better understanding of the existing underground infrastructure and proactively address subsurface concerns to mitigate

MATERIALS

CUSTOM FIBERGLASS TANKS // Waterdog Products Inc., www.waterdogproducts.com

CUSTOM CONCRETE TANKS // Concrete waterproofing admixture by Xypex, www.xypex.com, and constructed by McCarthy Building Cos. Inc., www.mccarthy.com

AQUARIUM ACRYLIC WINDOWS // Reynolds Polymer, www.reynoldspolymer.com

AQUARIUM FILTRATION SYSTEMS // Longhorn Organics, longhornorganics.com

ANIMAL CONTAINMENT PANELS // A thru Z Consulting and Distributing, athruzcad.com

ROCKWORK AND CUSTOM-THEMED ELEMENTS // Nassal, nassal.companiesofnassal.com

CUSTOM SIGNAGE // Warren Sign, www.warrensing.com

CUSTOM CURVED LED CEILING/WALL DISPLAY // DesignLED, designledpro.com

RETAIL FIXTURES // OPTO, optosystem.com

RECLAIMED WOOD WALL PANELING // Lost Coast Paneling by TerraMai, www.terramai.com

CUSTOM ARCHITECTURAL WOODWORK // Gravois Planing Mill, www.gravoisplaningmill.com

PLASTIC LAMINATE // Formica, www.formica.com, and Wilsonart, www.wilsonart.com

ACOUSTICAL CEILING CLOUDS // MDC, www.mdcwall.com; Arktura, arktura.com; and Kirei, kireiusa.com

RESILIENT FLOORING // Assurance II by Mannington, www.manningtoncommercial.com

FLUID-APPLIED FLOORING // Stonhard, www.stonhard.com

CUSTOM FLOOR TILE MURAL // Keystones by Daltile, www.daltile.com/product/keystones

FLOOR TILE // Ragno, www.ragnousa.com; Mirage, www.mirage.it; and Daltile, www.daltile.com

WALL TILE // Ken Mason Tile, www.kenmasontile.com; Mercury Mosaics,

mercurymosaics.com; and Daltile, www.daltile.com

STONE VENEER // Indiana Limestone Co., www.indianalimestonecompany.com

CARPET TILE // Milliken, milliken.com, and Shaw Floors, shawfloors.com

QUARTZ COUNTERTOP // Cambria, www.cambriausa.com

RECYCLED GLASS COUNTERTOP // Geos, www.eos-surfaces.com/geos

WALLCOVERINGS // D.L. Couch, www.memosamples.com

EXTERIOR DECORATIVE CONCRETE PAVING // Exposed Aggregate System by Bomanite, bomanite.com

LIGHT FIXTURES // Spectrum Lighting Inc., www.spedlight.com; Rosco, us.rosco.com; Eaton, www.eaton.com; Sternberg, www.sternberglighting.com; Lumenpulse, www.lumenpulse.com; and USAI Lighting, www.usaillighting.com

LIGHTING CONTROLS // ETC, etcconnect.com

project changes and risk. Utility location data collected by an onsite total station was subsequently developed into a BIM deliverable for use in BIM coordination with other trades.

McCarthy's virtual design and construction (VDC) team then worked closely with the company's subsurface utility mapping professionals to model existing underground utilities to accurately coordinate subsurface conditions with other new utilities prior to the installation of new foundations and piers.

Throughout the design and construction phases, early design team collaboration and 3D building systems coordination was key to keeping the project on schedule and helped facilitate owner buy-in of the aquarium's complex MEP/FP systems prior to fabrication and installation, ensuring long-term maintenance and accessibility.

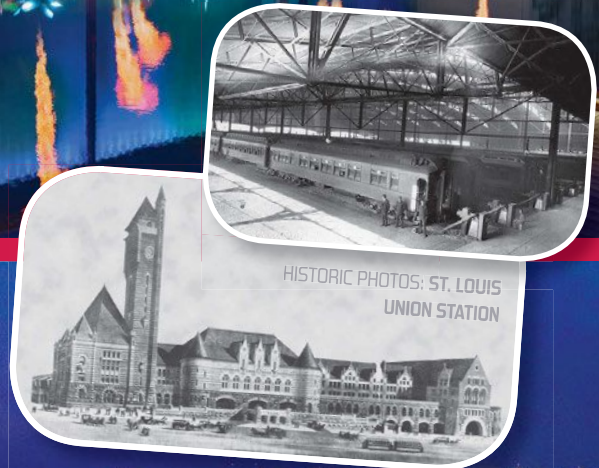
Laser scanning of all acrylic panel installations created 3D models of the frames with thousands of data points that could be compared to the manufacturers' 3D models to detect any physical abnormalities before installation. This process enabled McCarthy's field team to identify—and correct—a minor discrepancy on the aquarium's largest glass panel, which weighs nearly 14,000 pounds, before installation.

The 3D modeling of concrete lift drawings for field coordination with McCarthy's self-perform concrete team saved time and potential rework by combining all information into a streamlined, coordinated set of graphical, easy-to-understand drawings.

CONSTRUCTION QUALITY AND CRAFTSMANSHIP

McCarthy created mockups to authenticate the optimal concrete placement method for the 1,145 cubic yards of aquatic concrete that form the walls of each exhibit habitat. The 4,000 to 5,000 psi specialty concrete included antimicrobial and moisture-mitigating admixtures.

Several building elements, such as the large acrylic viewing windows with thousands of pounds of water pressure behind them, required very precise measurements with virtually no room for error during placement. Through the use of laser scanning and BIM, the construction team pre-coordinated these challenging field installation conditions to ensure that delicate measurements and installations were physically possible



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FAST FACT

Key construction phases ranged from structural work that included 250 micropiles, footings and underground systems; procurement and installation of acrylic glass for multiple fish exhibits; as well as tank testing, theming, and life-support system installation and testing.



FAST FACT

One-thousand-one-hundred-forty-five cubic yards of aquatic concrete were poured for exhibits, in addition to 2,006 cubic yards of standard concrete in other areas.

prior to the deployment of expensive cranes and labor onsite.

A sophisticated VDC coordination process drove self-perform concrete placement/lift drawings to ensure field install accuracy and coordination prior to pouring structural elements.

Highly skilled artisan labor constructed the rock work and theming, in addition to the other specialty scopes of work, according to the design by PGAV Architects, a planner and designer of unique destinations for six decades. The firm has designed exhibits at other aquariums nationwide, as well as environments for the grizzly bears, polar bears, and penguins and puffins at the St. Louis Zoo.

UNEXPECTED DISCOVERIES

Historic construction restraints limited access to spaces that would house

pipework—sometimes allowing less than 2 feet of access space. McCarthy successfully coordinated construction in these tight spaces by planning ahead, using compact equipment, and having piping assemblies custom-built for the space and delivered ready to install.

The geotechnical team relied on maps to indicate details associated with the stacked limestone footings and timber pile foundations beneath the original structure, as well as the 50-foot-deep driven concrete piles added in the 1980s to support the redeveloped festival marketplace. To increase loading capacities,

the team reused some of the existing foundations and installed an additional deep foundation micropile system capable of supporting the exhibits, mechanical pump rooms and other back-of-house systems.

A PERSONAL PROJECT

Construction for the St. Louis Aquarium at Union Station began in November 2017 and the project opened Christmas Day 2019. For the McCarthy team, the aquarium was a very personal project. “As a long-time St. Louis-based company, this project has special significance because not only did we build it, but we get to bring our own families to visit the aquarium now that it’s finished,” says John Buescher, Central Region president, McCarthy Building Cos. “There is a unique sense of pride that goes along with that.”



FAST FACT

Nearly 3 miles of pipe service multiple life-support systems, including public exhibits, each representing a different ecosystem from riverside to oceanside and freshwater to saltwater, as well as back-of-house areas with separate holding and quarantine exhibits.