
Artistic Shotcrete Use in Exhibit Fabrication

By Christopher Foster



The zoological and aquarium industry has been successfully using shotcrete placement within animal habitats for several decades. The flexibility and durability of shotcrete provides natural settings that allow for better animal enrichment over caged habitats. Zoo guests also benefit from viewing animals in a more organic habitat where the animals exhibit their natural behaviors.

There are numerous uses for shotcrete work in exhibit applications including:

- Shotcrete provides naturalistic animal barriers, artistically finished to blend with other naturally landscaped surroundings.

- When properly designed, shotcrete can be used to hide unsightly objects or architectural elements within exhibits.
- Pools, ponds, streams, and other water containment vessels, vital to specific animal habitats, can be built with artistically finished shotcrete.

PROVIDING NATURALISTIC BARRIERS

The long-term durability of shotcrete coupled with the flexibility of artistic finishes provide excellent animal containment in zoo and aquarium exhibits. Containment barriers that house large and potentially dangerous animals need to be structurally sound and escape proof. Shotcrete, along



theme matching shotcrete finishes. This provides a more consistent thematic or exhibit experience. For example, an animal holding building can resemble a rustic field stone cabin that aligns with the habitat's thematic direction. Foundations or other structures can be theme finished with a shotcrete rockwork texture that blends with natural stone placed in the exhibit. In any case, disguising architecture to blend more with natural surroundings has been a key exhibit strategy for decades.

with proper embedded steel reinforcement, provides the containment barriers necessary for safely housing animals within zoos, animal sanctuaries, and aquariums, while also enhancing the visitor experience. Shotcrete placement allows creative opportunities for aesthetically pleasing barrier walls that resemble earthen embankments, rock cliffs, or even themed ruin walls. Likewise, faux shotcrete trees and thematic walls can be used as structural connections for mesh and other fencing used in habitats.

HIDING UNSIGHTLY OBJECTS

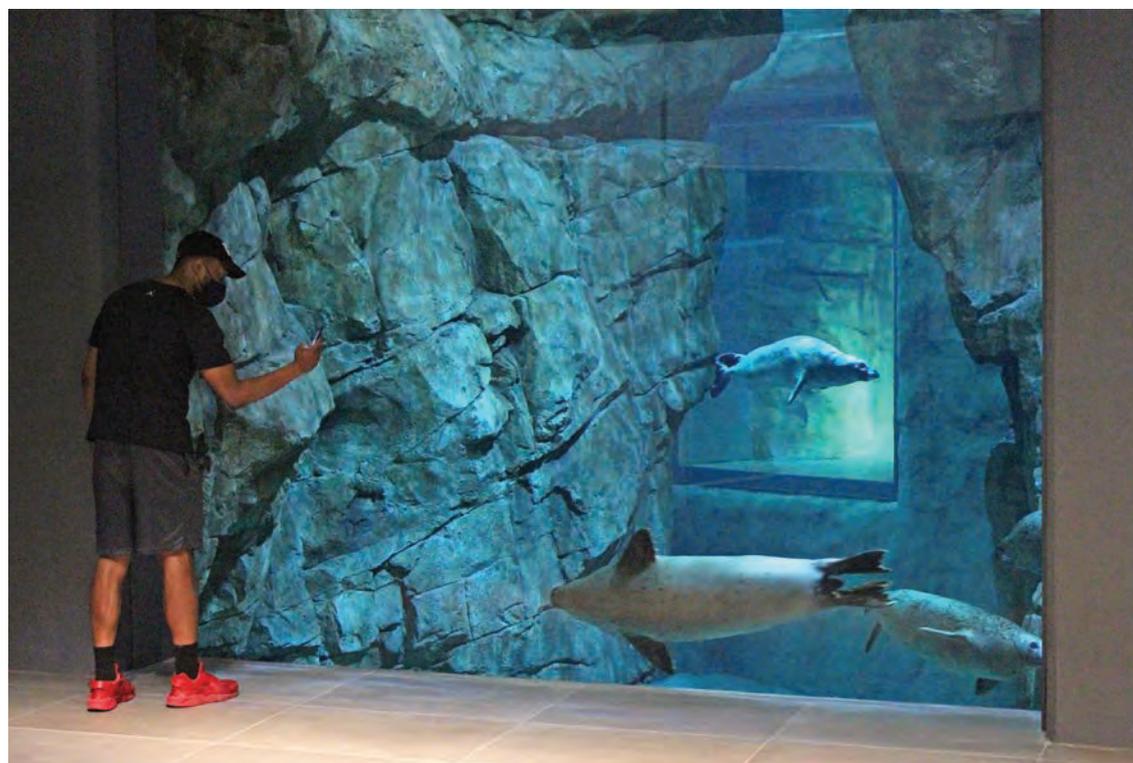
The flexibility of shotcrete applications along with artistic integration provides naturalistic screen walls and structures that can disguise line-of-sight architectural elements. These strategies can be as simple as hiding access doors, piping penetrations, life support systems and pump houses, to concealing back of house walls. Themed shotcrete screen walls are often used to separate view windows from other vantage points to allow for a better guest experience and enhance the “around every corner discovery,” critical to design strategies for immersive experiences.

BLENDING WITH NATURAL SURROUNDINGS

Architectural elements within exhibit spaces can be camouflaged with

WATER ELEMENTS

Artistic shotcrete allows for pond and stream construction that simulates natural waterways. Edging treatments that resemble mud or sand textures create realistic water sources for animal habitats and allow for animal enrichment opportunities, such as foraging within the irregular textures. When coupled with waterproofing and structural details, shotcrete ponds provide a long-term water containment vessel requiring little maintenance over time. Adding more robust structural steel to thickened shotcrete pond features provides support for even the largest animals such as elephants, hippos, and rhinos.





THE PROCESS

Preconstruction/Shop Drawings

Exhibit contractors, like COST, consult with owners, architects, engineers, and contractors during preconstruction phases. These meetings are beneficial for project scoping, pricing, and scheduling. The project stakeholders weigh and critique approaches, materials, and other aspects of specialty exhibit construction to determine the best fabrication and construction methods.

Preconstruction assistance in exhibit projects typically saves time and reduces costs as many of the challenges that occur in developing exhibits are clearly identified early in the project life cycle. Early exploration is even more critical when the design integrates exhibit components with other building structures and trades (for example rockwork attached to walls or water features adjacent to building foundations).

In many cases, shop drawings are required to successfully execute exhibit projects. Shop drawing packages can be as simple as connection details or as complicated as complete water feature mechanical design. Likewise, sealed drawings by a professional engineer for structural assemblies are often required to compliment the shop drawing package. Engineered drawings are typically needed for permitting when theme finishes are attached to retaining walls or to building walls.

Modeling

Oftentimes highly detailed scale models, generally composed of wood, foam, and clay, are built during the preconstruction phase. Physical models are a meticulously detailed, scaled representation of the finished project. In exhibit fabrication, a scale model is generally considered

a better reference tool for architects, designers, contractors, and owners over both 2D and 3D drawings. The physical model allows the project team to make minor and even major adjustments, ensuring the project meets the design intent before exhibit fabrication and construction commences. Preconstruction modeling saves valuable time and dollars over making in-field changes.

Three-dimensional modeling, using software such as Autodesk Revit, is becoming more prevalent in exhibit fabrication projects. Builders often integrate these files within the entire site model. However, there are limitations with 3D models, particularly when presenting organic finishes. Typically, 3D models only enhance, but do not replace the physical model in the zoo and aquarium exhibit fabrication industry.

Fabrication

Prior to shotcrete work commencing on-site, preconstruction work, like steel fabrications, can be built in factory environments. Firms such as COST have used off-site fabrication of steel assemblies and armatures for decades. There are numerous advantages to shop fabrication. Technological improvements such as water jet equipment, bar bending machinery, and CNC equipment offer efficiencies. These advanced systems are revolutionizing the way that highly detailed thematic finishes are constructed for several reasons:

- Provide more accurate feature replications based on computer-generated modeling.
- Off-site fabricated features decrease on-site construction timelines.
- Allow for Just in Time (JIT) deliveries of fabricated panels and pieces.



- Provide quality control checks and balances.
- Increase efficiencies within controlled conditions.

SHOTCRETE SITE CONSTRUCTION

While all the best planning and fabrication technologies aid in a project's success, highly trained artisans and technicians will be the real difference-makers. This is especially true in artistic shotcrete applications. Exhibit projects require more than experienced construction tradesman.

Blending artistry with sound construction methods require passionate and highly capable artists. Educated and trained artisans use their skillsets to deliver realistic and natural theme finishes. Their handwork, sculpting, painting, and aging techniques will be the true test of a project's success.

We often dispatch art teams to the project site during steel erection because the articulation of the steel and backing material dictate the overall shaping of the theme features. The artistic team typically oversees steel armature





setting and they are involved in the shotcrete structural placement. To meet structural requirements, the steel reinforcing bars must be completely encapsulated. Once the structural concrete cures, the artistic team is responsible for applying, carving, and stamping the finish shotcrete layer. Artisans use the approved models, samples, and photographic imagery to capture the texture of the landform they are replicating. Our shotcrete artists use a variety of hand carving tools, but each applies unique skills and techniques to achieve the desired finish.

While carving and finishing is paramount to achieving realistic finishes, paints and other topical applications further enhance the exhibit work. Artists use multiple paints and stains to match colorations found in nature and align with the approved model and samples.

RECENT REFERENCE PROJECTS

COST recently completed the following exhibit projects using artistic shotcrete placement. These overviews on exhibit specifics exemplify how shotcrete delivers superior zoological and aquarium exhibits.

PINNIPED COVE, MARITIME AQUARIUM OF NORWALK

Pinniped Cove is a 160,000-gal (730,000 l) exhibit for Maritime Aquarium's five female harbor seals. The L-shaped exhibit is seven times larger than their previous tank and is the aquarium's largest exhibit project completed in its 33-year history. The exhibit encompasses two levels of the building and allows guests to view the habitat from three sides. The second floor includes above water views that put patrons at eye level with a rustic "fishing shanty" and a

seal demonstration space. The ground floor has under water viewing from floor to ceiling. During three daily educational demonstrations, guests watch the seals plunge 22 ft (6.7 m) deep to the tank bottom. The underwater rockwork provides areas for seals to explore and play.

As the exhibit contractor, COST provided engineered shop drawings, models, and mockups ensuring artistic consistency throughout the project. Both the institution and Seattle-based MIG/Portico reviewed and approved the project tools prior to construction. Once shops, models and samples were approved, the COST team mobilized and installed secondary steel and structural shotcrete based on the engineered drawings. The team carved, colored, and aged finish layers of shotcrete to replicate coastal rock and earthen embankment textures. The artistic package also included a shotcrete deadfall tree and a fishing shack with cedar shingles and lpe wood decking. Two themed decorative wood pilings with faux barnacles were within the exhibit scope.

SOUTH AMERICA'S PANTANAL, HOUSTON ZOO

Houston Zoo's new South America's Pantanal allows patrons to explore regions of Brazil, Paraguay, and Bolivia, without leaving Texas. The exhibit focuses on wetland areas that are home to piranha, giant anaconda, and river otters. Studio Hanson|Roberts designed a unique underwater view space to allow patrons to come face-to-face with the playful and inquisitive otters. Other dry grassland and forest habitats for jaguars, howler monkeys, macaws, and golden lion tamarins were created for the project.

The area covers just over four acres within the zoo and provides numerous vantage points to view the animals in

naturalistic environments. The elevated platforms and view structures provide the visitors with the experience of walking amongst the wetlands and within the eco-lodges found in the Pantanal region.

The project was a collaborative process where the exhibit contractor's artistic team worked alongside the Houston Zoo's team of artisans. Exhibits were developed to maximize construction efficiencies during a condensed project schedule. Both teams of artisans were responsible for specific rockwork and earthen/mud bank finishes, but all worked together to ensure continuity, and a high degree of artistry and authenticity.

COST worked closely with the zoo staff, exhibit designer Studio Hanson|Roberts, and Tellepsen Builders to provide shop drawings and detailed scale models. These models were effective tools to ensure artistic consistency throughout the Pantanal, especially across the multiple art teams. Once approved, COST crews were dispatched to provide secondary steel and structural shotcrete throughout the exhibits. They were also responsible for simulated rockwork and earthen texture finishes in the otter, macaw, and jaguar exhibits, as well as in some common areas.

The same project team is deployed on the new Galapagos zoological exhibit, future home of sea lions, sharks, giant tortoises, and more. This exhibit is scheduled to open in Spring of 2022.

For more information on these projects or using shotcrete in artistic applications, you may visit www.cost-inc.com. ASA is also a great resource for information on the uses and benefits of shotcrete.

BIO

COST has actively used shotcrete placement in zoo and aquarium exhibit fabrication projects since 1957. Our exhibit projects have received numerous awards from the Association of Zoos and Aquariums in addition to a 2020 American Shotcrete Association award in the New Construction Category.



Christopher Foster, VP of Sales and Marketing, and COST's executive and project management teams contributed to this article.

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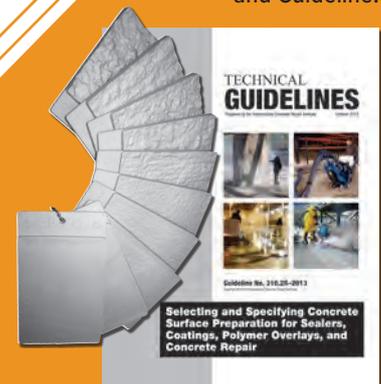
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