Constructed to Last

Informed considerations for generational wastewater system construction

CONSTRUCTED TO LAST

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CHAMPION FIBERGLASS®

WASTEWATER DIGEST

Executive Summary

Aging, out-of-date and failing wastewater infrastructure is an unfortunate norm for the industry. For decades, investment in the nation's sewers, collection systems and wastewater treatment plants has lagged. Systems are failing, and corrosion is not helping.

This infrastructure is generational. These pipes have decades of life before they begin to fail, but they do fail, especially in environments found in sewers, collection systems and pump stations. The corrosive elements of raw sewage and sludge can damage pipe, valves and equipment. Moreover, those environments can be challenging for struts and pipe supports if those items are not properly maintained or managed. What is usually a matter of public health can become a concern for the safety of the workers maintaining and operating these critical wastewater systems.

Federal funding is beginning to spill out to utilities across the country to address this failing infrastructure, and the U.S. Environmental Protection Agency has placed a lot of emphasis on reaching disadvantaged communities with this funding. It is an opportunity for systems that normally do not have access to these resources to receive them and take a step to evolve and modernize their facilities.

For some wastewater systems, this could mean upgrading their treatment plants with automation tools, digital solutions, and a new SCADA system. For others, constructing new pump stations or replacing force mains will be at the forefront of their efforts. But for the vast majority of utility managers and directors, energy will be spent on rehabilitating old equipment to make it last longer while raising more capital for larger projects down the line.

These are all valid means of improving systems, and solutions exist for all levels of capital expenditure. Within this eBook, we hope you find some nuggets to aid you in the quest for modernization and evolution; from the complex construction projects to the simplicity of coatings and construction materials to outlast corrosion concerns.

CHAMPION STRUT™ IS THE WORKHORSE BEHIND STABLE, SECURE CONDUIT & PIPING SUPPORT SYSTEMS

NONMETALLIC STRENGTH SUPPORTS CONDUIT AND PIPING

Think only metal strut structural systems like Unistrut pipe supports provide strength to stabilize substantial conduit and piping in projects? Think again. Made from pultruded polyester and vinyl ester fiberglass, Champion Strut™ provides durability as well as incorporating a flange design feature that promotes strength and stability.

Champion Strut is a channel framing system that is corrosion-resistant, flame retardant, lightweight yet strong and supportive.

It offers durable structural support for piping and conduit across many highly corrosive applications including wastewater treatment, chemical plants and marinas. It can be used as horizontal and vertical piping support in these projects.

During manufacturing, this pultrusion process results in straight, consistent parts of virtually any length. Parts are internally reinforced with permanently bonded continuous glass fibers, imbuing great tensile strength, compressive strength, flexural strength, short beam shear strength and impact strength than traditional fiberglass strut.

Additionally, Champion Strut's CS-S Series channel profile is designed to allow complete engagement and maximum pull-out strength of channel accessories. The flange design provides more strength compared to traditional fiberglass channel profile flange designs and permits greater torquing of accessories without failure.

HOW DO CHAMPION DUCT® AND CHAMPION STRUT WORK TOGETHER?

The Champion Strut system can be used as a Champion Duct conduit support system which is customizable with multiple channel profiles and parts to fit all types (GRC, PVC, etc.) of conduit installations. The system includes wall mounts, trapeze hanging systems and column loading supports for versatility in constructing conduit and piping support in projects.

Champion Strut is lightweight and can be easily cut and drilled to fit project specifications at the job site. Once installed, accessories such as pipe clamps, piping hangers and clevis hangers that hold and stabilize the conduit are inserted or attached to the strut channel. Contractors typically find that installation with Champion Strut moves swiftly and seamlessly.

DURABILITY SUPPORTS CONDUIT & PIPING ACROSS APPLICATIONS

Not only is nonmetallic Champion Strut strong, it is also durable. As a composite material, fiberglass strut is engineered to handle loads and conditions found in caustic environments. Special UV additives along with a polyester surfacing veil are added to give the components increased UV and corrosion resistance. Additionally it's fire retardant for added protection. It's been used as a hanger and support for piping and conduit in highly corrosive applications including steel mills, rendering facilities, utilities, refineries, petrochemical plants, pulp and paper, desalination facilities, water reclamation facilities, theme parks, aquariums, pools and underground vaults.

CHAMPION STRUT IN STOCK AND READY TO SHIP

Got a project requiring fast procurement? Champion Strut parts are listed online with live inventory counts, so you can see available, on-hand stock. In addition, for even speedier service, all Champion Strut orders ship same or next day. View Champion Strut inventory here.

CORROSION: KNOWING THE ENEMY

Resources in the battle against corrosion?

Corrosion not only threatens water storage tanks, but it can also shorten the life of parts of the water treatment plant and distribution system. Because of the aggressive environment and the presence of hydrogen sulfide gas, wastewater treatment systems fight an even greater battle against corrosion. We most often think about the corrosion of steel, but concrete also corrodes when exposed to aggressive environments. The steel reinforcing bars that give concrete its tensile strength must also be protected to prevent corrosion. Preserving the steel and concrete of water or wastewater assets requires knowing the enemy—corrosion.

The good news is that there are many great resources in the battle against corrosion.

The following information is from Unit 1, "Corrosion and Corrosion Control," of "Fundamentals of Protective Coatings for Industrial Structures (C-1)" from the Society for Protective Coatings (SSPC). Several years ago, SSPC recognized the need to protect concrete from corrosion when it expanded its scope and changed its name from the Steel Structures Painting Council to SSPC: The Society for Protective Coatings.

Based on research by the National Bureau of Standards and the Federal Highway Administration, corrosion of metals in the U.S. costs about 4.2% of the annual gross national product or around $276 billion annually. About one-third of these costs can be avoided by proper use of currently existing corrosion control technology. Corrosion is the chemical or electrochemical reaction between a metal and its environment that results in the loss of the material and its properties. Put more simply, corrosion is steel or concrete reverting back to its natural state. It is not a mere coincidence that the major component of steel—iron ore—looks and is just like rust.

It takes four things to create a corrosion cell: an anode, cathode, metallic path connecting the anode and cathode, and electrolyte. This can be remembered with

the acronym ACME. The common dry cell battery takes advantage of the corrosion process to create electricity.

PREVENTING CORROSION

Every piece of steel contains the first three things—the anode, cathode and metallic path (ACM)—and water, wastewater and even moisture in the air provide the electrolyte (E). The most direct way to prevent corrosion is to put a barrier between the steel or concrete and the electrolyte (i.e., paints, coatings and linings).

Water and wastewater structures should be designed to prevent corrosion by making them easy to paint and repaint. That means reducing or eliminating skip welds, edges and angles, overlapping plates and crevices, inaccessible areas and water traps. Since everything cannot be made perfectly smooth, a good painting specification requires the brush application of a stripe coat to critical locations on steel such as welds, corners and edges. Epoxy coatings (NSF/ANSI 61-certified when in contact with potable water) are the predominant means of creating a barrier on water and wastewater structures; however, environmental regulations and technological innovations have produced barrier solutions based on polyurethane, polyurea and other chemistries.

In addition to barrier protection, zinc-rich primers, which are common on the exterior of steel water storage tanks, take advantage of the corrosion reaction to protect steel. If the coating gets damaged and the steel is exposed, the zinc anode corrodes instead of the steel cathode. Galvanizing protects steel in a similar way.

There are other ways to prevent corrosion. When connecting two dissimilar metal surfaces, such as carbon steel and stainless steel, they need to be isolated (i.e., paint or install a gasket) to prevent creating a corrosion cell. The use of incompatible nuts and bolts can create dangerous corrosion cells.

Like zinc-rich primers, cathodic protection (CP) systems take advantage of the corrosion reaction. CP is appropriate for buried structures like pipes and tank bottoms that are not easily exposed for inspection and repainting. Sometimes, impressed current CP is used in the submersed interior of water storage tanks. When water storage tanks are regularly cleaned and inspected as part of a tank asset preservation program, a CP system is not as critical.

In very aggressive environments, it may be necessary to move away from coated steel and concrete construction to high-tech plastics, fiber-reinforced plastics or expensive corrosion resistant metals such as stainless steel.

Once a better understanding of corrosion is attained, time and resources need to be committed to prevent this enemy from shortening the useful life of water and wastewater assets. As responsible stewards, utility owners need to establish and fund asset preservation programs, including scheduled cleaning, inspections and strategic maintenance, or hire a professional firm to provide these services.

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CHAMPION STRUT'S STRENGTH, DURABILITY SUPPORT A PIER PROJECT

INTRO

Proper lighting is crucial to a safe and successful landing approach in an urban airport setting. For airports near rivers and coasts, lighting sometimes extends to piers. When Washington Metropolitan Area Transit Authority (WMATA) scheduled an upgrade to existing approach lighting at Reagan National Airport, it required an upgrade to electrical conduit systems including support and framing structures holding conduit in place along a Potomac River pier.

CHALLENGE

Installations near water pose a couple of challenges. Water, especially the brackish water found in this environment, can promote deterioration of support structures. Additionally, the sun triggers intense weathering. Also, these scenarios require a support and framing system that is strong and durable for stability to keep the conduit system intact and to protect against impact.

Further, installations over water can be challenging, often occurring from a raft or boat. Careful thought must go into material weight and logistics of how materials will be transported to the project site.

SOLUTION

This project necessitated a framing and support system strong enough to resist corrosion caused by saltwater and a damp environment. Metal support systems would be prone to degradation and rust. But not Champion Strut™.

In manufacturing, Champion Strut's pultrusion process where components are internally reinforced with permanently bonded continuous glass fibers offers ultimate tensile strength, compressive strength, flexural strength, short beam shear strength and impact strength. Additionally, Champion Strut features a broad range of corrosion resistance including saltwater, providing durability to withstand the briny nature of brackish water.

In addition, Champion Strut's fiberglass channels incorporate UV inhibitors and a surfacing veil which improves weather-ability and inhibits degradation from the sun's rays.

When it came time to install along the pier, workers on small rafts appreciated the lighter strut materials that were easy to handle and maneuver into place. Plus, Champion Strut proved easy to field cut and drill, facilitating a smoother, faster installation.

RESULTS

For this project, Champion Strut offered durable, corrosion-resistant framing and support for piping and conduit in a pier/coastal setting. As a composite material manufactured for stability, fiberglass strut is lightweight, strong, and engineered to handle loads and conditions found in caustic environments, such as wet, salty piers like those Reagan National Airport. Corrosion resistant to many chemicals, Champion Strut™ provided durability to withstand the briny nature of brackish salt water.

Installation progressed smoothly, due to light weight and easy field handling and cutting of Champion Strut.

Finally, significant cost savings over metal strut systems, were realized when costs came in at a fraction of the price of metal strut systems.

SPA-1 INFLUENT STRUCTURE REPLACEMENT & IMPROVEMENTS

The city of Surprise, Arizona, worked with GHD and Felix Construction to complete the rehabilitation and improve long-term life cycle and performance of rapidly deteriorating wastewater facilities. Serving a population of 171,684 people within a 45-square-mile area, Surprise uses biological treatment, filtration, and disinfection processes to turn municipal, commercial, and industrial wastewater into quality recycled water. Most of that water is for agricultural irrigation, groundwater recharge, landscape irrigation, and dust control, so the city monitors effluent to ensure that it meets state and federal regulations.

A separate Water Reclamation Facility (WRF) serves each of the city's six Special Planning Areas (SPA). The WRF for SPA-1, at the southernmost limits of Surprise, collects an average of approximately 18 mgd of raw wastewater, at its east and west sides, from gravity sewer pipes that approach the existing influent junction structure. Originally, this meant a 30-inch diameter gravity pipeline from the north and a 48-inch diameter pipeline from the south culminated at the west junction structure prior to conveying wastewater to the headworks via a 54-inch diameter pipeline.

"The ability to bring raw wastewater into a wastewater treatment plant is critical to maintain the compliance and downward treatment of that wastewater," said Frederick Tack, GHD project manager and senior civil engineer. "Proper configuration to promote the right hydraulic and to maintain the right quality of the wastewater is important."

Only nine years into the west influent structure's service life, its gates showed excessive signs of corrosion. Composed of cast-in-place concrete with a corrosion-resistant internal coating, the state of the influent structure showed the surrounding corrosive atmosphere and environment had not been properly quantified or addressed during design and construction. The city began to doubt the viability of the influent structure's remaining life cycle, and began to question the reliability of the facility's capabilities.

GHD delivered the SPA-1 Influent Structure Replacement and Improvements project in two phases. The first provided the complex condition assessment, development of potential project design alternatives, and assisted the city in alternative selection. The second phase entailed moving the selected project into detailed design and assisting with permitting, bidding and construction, and commissioning. All of this required completion

without disruption to service or major environmental impacts while maintaining worker safety and adequate roadway capacity.

The major goals of the project were rehabilitating and/or replacing the influent junction structure and any corresponding components to provide a greater than 30-year life, and to successfully serve the city. This meant GHD addressed each element of the project, including the assessment, through alternative evaluation, design, construction, and O&M.

To evaluate the existing condition of the influent junction structure and associated components, the team navigated significant challenges to safety and schedule availability. Because the structure's gates were mostly inoperable, the team was unable to isolate and drain the structure to conduct an inspection.

The best option was to conduct a high-risk confined space entry given this challenge. Following extensive hydraulic monitoring and analysis to determine low flow conditions, as well as thorough planning for duration, safety, and rescue scenarios, the team identified the ideal time for the inspection. Inspection was approximately 3:00 a.m. to 4:00 a.m. during weekdays, preceded by hours of atmospheric ventilation to create a safe atmosphere for entry. An inspection team was mobilized to complete the internal structural inspections inside the 30-foot-deep structure during open flow.

GHD's inspection results revealed that the lower interior of the structure had experienced significant deterioration. CCTV inspections revealed deterioration of the influent pipelines and manholes feeding the junction structure, which pointed to the need for comprehensive rehabilitation to not only the junction structure, but its component gravity sewer pipelines and manholes.

The chosen solution was to rebuild the junction box with a new configuration, as well as full pipe and manhole replacement. To replace the 90-degree bend through which the flow entered the juncture, GHD designed a 96-inch diameter manhole to accommodate various influent pipe sizes, elevations, and materials that are able to properly combine flows while maintaining minimum self-cleansing velocities.

A solution was provided by Amorock that eliminates corrosion potential via a polymer concrete incorporating resin as the binding agent, along with sand, aggregate, and Fiber Reinforced Polymer (FRP) rebar, to form a polymer concrete structure.

Construction for GHD's design required the complete bypass of the influent raw wastewater flow to the junction structure, pipeline, and manholes. As with any project requiring such an extensive bypass, the team was planning primarily against the risk of sanitary sewer overflow (SSO), which could create severe impacts for the health of the community. To address this risk, GHD and contractor Felix Construction Company collaborated to quantify the level of risk, cost, and schedule, all to provide the right level of confidence in the city prior to executing.

To minimize the potential for SSOs, Felix Construction installed smart covers on two manholes in the collection system to continuously monitor flow levels. Additionally, the temporary bypass system was tested for five consecutive days, which passed without error or issue, to provide the city with the assurance that the system would perform, as well as the consistency of the monitoring. Finally, a 24/7 pump watch was implemented for the entire duration of the bypass (approximately 45 days).

This project required excavating a big hole, one wide and deep enough to demolish the existing structure and then to prepare the foundations and bedding for the new pipe, manholes, and junction structure. The team and Felix Construction had to offset the time and effort to complete that first step — as well as to build then test the temporary bypass — with improved efficiency during the installation, testing, and commissioning of the new project components.

The initial Guaranteed Maximum Price provided by Felix Construction was just shy of $1.16 million, which included contingencies and allowances for project variable costs and unknown or unanticipated conditions. At the conclusion of the project, the final construction cost was a little less than $1.06 million, netting a return of $100,518 to the City. When combined with the effort from GHD, the overall project was planned, designed, and delivered for less than $1.2 million, and was $72,350 less than the budgetary quote developed during Phase 1.

These decisions regarding materials, configuration, and construction methodology resulted in a system with more resilient performance, longer life cycle and less maintenance.

"The city of Surprise, as the owner, definitely went above and beyond to both promote and deliver a level of resiliency that met their needs, both for today and in the future for them and their citizens to be able to sustain wastewater treatment," Tack added.

Project Year: 2021-12-21
Contractor: Felix Construction Co.
Designers: GHD Inc.
Owner: City of Surprise, Arizona
Location: Surprise, Arizona
Cost: $1,198,150
Size: 3,060 gpm

LOWER MERAMEC WASTEWATER TREATMENT PLANT UPGRADE

Replacing ductile iron pipe with stainless steel pipe, couplings, valves and fittings to reduce maintenance.

The Lower Meramec Wastewater Treatment Plant, operated by the Metropolitan St. Louis Sewer District (MSD), sits on 200 acres at the confluence of the Meramec and Mississippi Rivers in South St. Louis County. Wastewater from homes and businesses travel through tunnels and pipes to this facility, which treats an average of 15 million gallons of wastewater each day.

MSD was formed in 1954 to combine 79 regional sewer districts into one regional system for wastewater collection, treatment and disposal. In 2012, MSD, the Environmental Protection Agency and the Missouri Coalition for the Environment together agreed on a plan to spend billions of dollars over a span of a generation to improve water quality, build community rain-scaping, and carry out far-reaching system improvements, including upgrades to aging pipe and facilities.

INFLUENT PUMP STATION UPGRADE

An essential upgrade of the Lower Meramec facility began in 2020. The original ductile iron (DI) pipe installed at the plant had experienced corrosion, and MSD made the decision to replace the DI piping – much of which was 200 feet below grade – with stainless steel (SS) for greater corrosion resistance and longevity. The upgrade to the influent pump station also included installing dehumidifiers and upgrading ductwork to fiberglass. This would improve the ambient conditions and inhibit corrosion. Sealing the concrete walls of the pump station with a special type of waterproofing material would also prevent water ingress. MSD partnered with KCI and Haberberger Mechanical Inc. to carry out the mechanical portion of the upgrades.

The nature of construction projects tends to make successful execution a challenge. Normally, there are multiple companies working side by side in different specialized roles, and there are many parallel moving parts, all of which need to be closely managed. More significantly, the interdependence of events means it is vitally important to ensure every component of the project is moving forward as planned to prevent situations in which planning glitches negatively impact the project schedule.

To achieve success on this project, Haberberger needed more than a product and service provider. The contractor had selected Victaulic solutions to join the new SS piping system, but it wanted a partner that would do more than suggest areas where specific products and services could add value.

"Haberberger sells itself as a quality contractor," said Tim Schneider, Haberberger project manager. "We are the answer men. We don't leave a project with loose ends."

That meant the company needed a partner for this project that would have personnel on site and on call who were as committed to superior execution as Haberberger.

Haberberger selected Victaulic because of its similar approach and high standards for performance.

"They are unparalleled in the pipe, valves, and fittings sector and provided us with the support and solutions we needed for every part of the project," Schneider said.

PROJECT EXECUTION

The Victaulic team was involved from the outset of the Lower Meramec upgrade project. Team members participated in a walkthrough of the plant with the engineers to provide expertise on solutions that would achieve the corrosion resistance requirements and expedite installation.

Among the stainless steel products specified for the pump station were 4-, 6-, and 8-inch grooved couplings, valves, and fittings on the subsurface drain lines. High-pressure pumps feed influent through these lines 200 feet below grade to the 72-inch pipes on the surface that feed the entire plant. Following the walkthrough, the Victaulic Virtual Design and Construction (VDC) team spent a day performing 70 scans of the pump station to create a 3D model for the project.

Because Victaulic was able to provide full Building Information Modeling (BIM) services, Haberberger was relieved of the burden of allocating its own BIM department resources to the upgrade, which enabled the company's in-house experts to work on modeling the new fiberglass ductwork for the project and to continue their work on other active projects while the Lower Meramec work was underway.

Using the 3D model created from the scans, the VDC team created a 10,000-ft view of the entire project. This model allowed them to identify potential issues that could arise with pipe misalignments or interferences and introduce solutions before workers encountered issues in the field. These efficiencies not only expedited construction, they translated into cost reductions on the project.

Drawing on its team of internal experts, Victaulic was able to identify one specific challenge early on in the design process and apply the expertise of its engineers to resolve it. One segment of the project required the piping system to be routed within the confines of a circular station. Taking into account the space constraints and the piping requirements, the VDC team found a way to design the piping system in exact lengths that ensured all the components would align properly. The materials were fabricated and delivered to the site such that they would be ready for installation upon delivery.

The team's ability to not only identify problems but also offer viable solutions changed the dynamic between the companies. Instead of worrying about construction challenges, Harberberger began to rely on the VDC team to function as an extension of its own and to feel confident that the project was progressing following a unified set of objectives.

RESOLVING CHALLENGES

While the overall execution went smoothly, the project was not without its challenges, Schneider said.

"Like all projects, this one threw us some curve balls," he said.

The most challenging "curve ball" with the Lower Meramec upgrade progress was logistics issues caused by the pandemic. Due to varying global restrictions presented by COVID-19, some of the critical components for the project were impacted. Under normal conditions, the restrictions would not have been an issue. However, the shutdowns created by the coronavirus and the subsequent impact on shipping introduced conditions that could have dramatically compromised the timeline.

Realizing the gravity of the situation, Victaulic and Haberberger worked together to develop a stop-gap fix, using temporary spools and couplings that could be installed to allow the plant to continue to function and for construction to move ahead while the delayed components were in transit.

"On a large project with tight deadlines, you only have so much bandwidth," Schneider said, "and it's not possible to solve every problem that comes up by yourself. You need a partner you can trust."

Another challenge arose on this project with the discovery that several 6-inch DI pipe nipples on the bottom of a large header had to be trimmed and grooved in the field on a live fluid influent line before they could be connected to the SS pipe. The

Haberberger team had to find a solution that could be carried out safely with the pipe in service.

Connecting DI and SS meant there was a possibility that the galvanic bond would not be broken, which would create the potential for corrosion down the road at the connection point between the two metals. Victaulic suggested using a proprietary coupling that breaks the galvanic bond when it is installed and introduced Haberberger to a special grooving tool that would enable workers on the site to prepare the DI pipe in the field so the coupling could be installed.

When Haberberger agreed to consider the grooving tool, Victaulic located the tool and sent three experienced installers to the Haberberger Fabrication Facility for training on using it in the field. Together, Haberberger and Victaulic created a makeshift simulation scenario in the shop to allow the installers to practice using the tool in conditions similar to those they would encounter in the field. Even though the newly trained installers were required to use the tool in less than ideal field conditions, they were able to cut the nipple to the right length and field-groove it for reconnection without incident.

"When we use products from other providers, the depth of resource isn't there for this kind of problem-solving," Schneider said.

Exceptional coordination and communication throughout the project allowed Victaulic to take action when issues arose and introduce solutions that ensured construction never slowed down.

BUILDING ON SUCCESS

Having the right partner can mean the difference between meeting the project schedule or missing the construction deadline. In executing this upgrade, Haberberger had found a partner that integrated swiftly with its team, understood the project objectives, and was willing to commit not only its resources but depth of experience to bring solutions. Attention to detail at every stage of the upgrade paved the way for Haberberger to bring the project to a successful conclusion.

"That's what I look for when I have a complicated project," Schneider said. "I want to have the best resources at my disposal."

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RESOURCES

Visit the website for a full list of resources.
championfiberglass.com/resources/

PRODUCTS

Champion Duct®: Lightweight fiberglass conduit with unmatched versatility and strength.
championfiberglass.com/products/champion-duct/

Champion Fiberglass Elbows: Delivering labor-saving, no-burn-through fiberglass elbows, fast.
championfiberglass.com/products/champion-fiberglass-elbows/

Champion Strut is a versatile, high-strength fiberglass framing system that includes a complete line of non-metallic accessories, fasteners, hangers, pipe clamps and channels.
championfiberglass.com/products/champion-strut/

ABOUT CHAMPION FIBERGLASS

Headquartered in Spring, Texas, Champion Fiberglass Inc. is the leading supplier of fiberglass conduit and strut to the industrial, electrical, and mechanical markets. Ours is the most advanced production facility for manufacturing rigid fiberglass conduit in North America, where the company's proprietary high-speed winding process and high-temperature curing ovens are key to the consistency and quality of these versatile products.