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DIGEST
CONCRETE PRESSURE PIPE

Deteriorating Infrastructure - Congress Prepares to Act - Billions Of Dollars Are At Stake

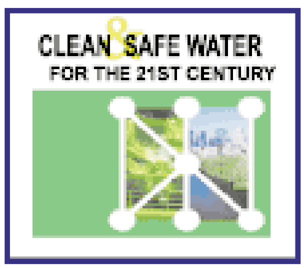
AMERICA'S WATER AND WASTEWATER INFRASTRUCTURE IS DETERIORATING FASTER THAN WE CAN REPLACE IT. ARE YOU PREPARED TO DO SOMETHING ABOUT IT?

If you are reading this, the chances are pretty good that you are involved in some aspect of water or wastewater infrastructure. Yes, the American Concrete Pressure Pipe Association represents manufacturers of Concrete Pressure Pipe. But that pipe connects to treatment plants, pumping plants, transmission lines and cooling water for powerplants. It's everywhere.

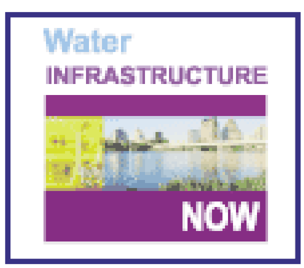
As a water/wastewater professional, you will want to know about the future of funding for your industry's infrastructure.

The needs today are tremendous. Old, perhaps ancient, investments are wearing out. Tuberculated pipes are harboring harmful bacteria. New highways, land uses, population and regulatory agencies are putting increased stresses on pipe lines. Treatment plants and pumping plants, reservoirs and tanks are wearing out. Study after study from the U.S. Environmental Protection Agency to the American Society of Civil Engineers to the American Water Works Association and the Water Infrastructure Network are estimating from $150 billion ($120 billion right now) to $2 trillion is needed during the next 20 years. Is your utility prepared for $2 to $10 billion or more in water/wastewater infrastructure investment? No one is.

If you haven't read them yet, get these two publications, they are available for download from the Association of Metropolitan Sewerage Agencies, www.amsa-cleanwater.org:



CLEAN SAFE WATER FOR THE 21ST CENTURY
Water Infrastructure Network, May, 2000.



WATER INFRASTRUCTURE NOW
Water Infrastructure Network, February, 2000.

The Water Infrastructure Network (WIN) is a coalition of over 20 agencies and professional associations who have contributed their considerable expertise to the development of those reports and to fostering a renewed Federal Government commitment to water and wastewater infrastructure. That is differentiated from design and construction to meet regulatory needs. WIN's objective is replacement and upgrading of old, warn, damaged and ineffective infrastructure. Does that sound like where you are working? Does that sound like what needs to be done? Then get ready to support it. Get the reports. Read and understand them. Become conversant about the infrastructure around you. Tell others about the needs. Write your congressional representative and your senators. To make it easy for you, go to WIN's web site, www.win-water.org and use its draft letters to contact your legislators.

The United States is facing serious problems in its water and wastewater systems. Much of it is over 50 years old and failing every day. Congress is so concerned that three hearings were held recently to receive testimony on the condition of the nation's water/wastewater infrastructure.

Senate Environment and Public Works Committee; Fisheries, Wildlife, and Water Subcommittee; March 27, 2001.

House Transportation and Infrastructure Committee; Environment and Water Resources Subcommittee; March 28, 2001.

House Energy and Commerce Committee; Environment and Hazardous Material Subcommittee; March 28, 2001.

Witnesses, Representatives and Senators agreed that the condition of America's water/wastewater infrastructure is deplorable, that rehabilitating it will be exceedingly expensive and that the Federal Government must do its part to restore the Federal/State/Local partnership that was so effective in the past.

The ASCE published its 2001 Report Card for America's Infrastructure. Drinking Water infrastructure received a score of D. Wastewater infrastructure received a grade of D. The world's leading professionals graded the water/wastewater infrastructure of the world's richest nation as a D. But its true. Just look around you. You know what is happening. ASCE says, "The nation's 54,000 drinking water systems face an annual shortfall of $11 billion needed to replace facilities that are nearing the end of their useful life and to comply with federal water regulations." Also, "The nation's 16,000 wastewater systems face enormous needs. Some sewer systems are 100 years old. Currently, there is a $12 billion annual shortfall in funding for infrastructure needs in this category." While our water utilities are being forced to invest in arduous and inflexible Federal Government mandated regulations, needed investment in the very infrastructure which will allow delivery of safe drinking water and provide for clean streams, rivers and lakes is left to deteriorate and fall apart.

What the water/wastewater professionals in American need to do is support the recommendations in the WIN reports as further supported by AWWA, AMSA, WEF, ACPPA and countless others. **Tell your mayors, governors and National legislative representatives that we cannot be a first rate country with our infrastructure deteriorating toward that of a third-world nation.**

Las Vegas Wins with Concrete Pressure Pipe

Lake Mead, approximately 50 miles from Las Vegas, Nevada, is the main source of fresh water to Las Vegas Valley, and one of the world's largest subaqueous pressure pipelines was installed under Lake Mead's Boulder Harbor.

The original intake structure, Intake No 1, which was built by the Bureau of Reclamation, and the associated water supply system, has been supplying water to the Valley since the early 1960's. The demand for water in Las Vegas has been growing due to tourism expansion and 7% annual residential growth rate. To meet the increased water supply demand, the Southern Nevada Water Authority (SNWA) has embarked on a 2 billion dollars capital improvement plan to expand the existing 400 mgd water supply system. The expansion includes the Lake Mead Intake No. 2 Project, which runs parallel to the original intake.

The 144-inch diameter, 3600 ft. long Reinforced Concrete Cylinder Pipe (RCCP) subaqueous pipeline, the Bay Aqueduct, is part of SNWA's Lake Mead Intake No. 2 Project. The Bay Aqueduct was designed for a nominal flow of 600 mgd with a peak flow of 800 mgd, an internal pressure of 160 psi under normal conditions, an extreme pressure of 300 psi, 80 ft. of external water head and up to 20 feet of soil cover at the banks. This 144-inch diameter RCCP Bay Aqueduct, which runs from Saddle Island to the mainland under Lake Mead's Boulder Harbor, may be the largest subaqueous water pressure pipeline in the world.

CH2M Hill engineers designed the 144-inch diameter RCCP Bay Aqueduct. Because of the demanding design and installation conditions, CH2M Hill and SNWA have only considered the rigid wall RCCP option for this project. Ameron

Triple 144-inch RCCP assembly weighing 180 tons with two temporary bulkheads in the launch way saddles on rails. The assembly is ready to be launched into the water.

The floating assembly was pulled by a tug from the launching site up to the laying barge.

International's Water Transmission Group, manufactured the RCCP at its plant in Rancho Cucamonga, California. Lake Mead Constructors (LMC) installed the subaqueous pipeline.

Special Design Leads to Unique Installation

The 144-inch diameter RCCP was designed in conformance with the AWWA C300 standard and the AWWA M9 Manual with modifications to meet project requirements. The RCCP included the following special features:

- A 5/8 inch thick steel cylinder.
- A deep double-gasketed joint to allow for testing and settlement after installation and dewatering. The joint was designed for a joint lap of 6.5 inches to allow for a minimum straight pull of 2.5 inches and a minimum joint deflection of 1.5 inches.
- Each cylinder and joint ring assembly were hydrostatically tested to 160 psi in the plant.
- Three reinforcing cages, an inside cage in the concrete lining, an intermediate cage over the steel cylinder, and an outer cage.
- A 12-inch thick concrete wall with 6000 psi strength.
- Manufactured and shipped in 16.67 ft. standard lengths weighing 60 tons per section.
- LMC joined three pipe sections together on shore to form 50 ft. long assemblies weighing 180 tons per assembly.
- A special corrugated grout band to allow for grouting the exterior joint space from inside the pipe after dewatering.
- An internal welded butt-strap restraint system installed after dewatering.
- Special color markings in the joint and exterior spring lines of the pipe to establish the limits of the joint stab and backfill limit for the divers during installation.
- Precast concrete saddles for placing over the pipe after backfilling up to the springline to counteract buoyancy after dewatering.

Proof of Design Test

Since the Bay Aqueduct is one of the most critical elements of the new Intake No. 2 Project, qualification testing was required before full-scale production began. Ameron manufactured three 9 ft. long pipe sections in conformance to the project requirements to conduct the structural and hydrostatic joint testing.

Hydrostatic Joint Tests

Two test pipe sections were assembled in the plant with a controlled inside joint gap of 3.75 inches (1.25 inch joint gap in the fully inserted position) to allow a straight 2.5 inch pull. The spigot of the assembled joint had two grooves and two gaskets, which allowed testing between the gaskets through two 1/4 inch tapped holes 180 degrees apart. A water hose and a pressure gauge were connected to the bottom test hole and a connection and bleed valve were connected to the top test hole. The system was pressurized to 45 psi for 10 minutes with no pressure drop.

A portable "power pac" was used to adjust the joint gap. The test was repeated with a 1.25 inch gap on one side and a 2.75 inch gap on the other side for a total deflection of 1.5 inches. The system was pressurized for 8 minutes with no pressure drop. The joint was deflected in additional 1/2 inch increments until the joint leaked when the gasket disengaged from the bell on one side. The total joint deflection was 3 inches before the joint leaked.

The hydrostatic joint testing results verified that the specification requirements of a minimum 2 1/2 inch straight pull and a minimum of 1 1/2 inch deflection were met and exceeded.

Structural Testing

The purpose of the structural testing was to verify the structural and radial tension performance of the pipe. Two test pipe sections were each instrumented with two horizontal and two vertical deflection monitors. In addition, a radial tension monitor was installed at the invert near the bell. The test pipe was positioned in the D-load (3-edge bearing) machine, which is equipped with two hydraulic jacks that press the head beam against the pipe. A data logger was connected to the deflection and radial tension monitors and a pressure transducer was connected to the hydraulic pressure system of the jacks. The data logger would instantaneously

The assembly was positioned in the laying barge.

measure the transducer pressure and corresponding applied load and the vertical and horizontal deflection and radial tension movements of the pipe.

Load/deflection curves indicate that the deflection is in the elastic range up to a load of 20 kips/ft. The 0.01 inch crack was observed at a load of 21 kips/ft. The maximum load which could be applied was 27.5 kips/ft. The apparent radial tension movements up to a load of 20 kips/ft were negligible. The radial tension crack was observed at a load of approximately 20 kips/ft. The theoretical D-load capacity for the test pipe was 15 kips/ft.

Although the 3-edge bearing load (D-load) is a very severe loading condition, the structural tests have verified that the proposed 144-inch RCCP can safely withstand the design loads and validated the design assumptions.

Grout Band Tests

Two of the test pipe sections were assembled and used to test the proposed corrugated steel grout band and gasket assembly. A total of eight trial tests were conducted until the design of the grout band and grout-pumping procedure was finalized and approved. This is the first time for this type of grout band application.

Precast Concrete Saddle Fit Up Test

The test pipe sections were used to check and verify

Installation

Lake Mead Constructors (LMC) installed the Bay Aqueduct in over 80 feet of water with both soil and rock trenching and bedding preparation completed ahead of pipe installation. LMC joined three pipe sections together on land to form 50 ft. long assemblies. The assemblies, with temporary bulkheads attached at both ends, were rolled over by means of a cable and winch set-up to the launch way saddles, and then the assembly was launched through a rail and cable system on a ramp to the water. The assemblies were floated and pulled with a tug to the laying barge. The pipe assembly was picked up with a hoisting frame with one of the bulkheads removed and lowered into place.

The joints were pulled together by pumping water out through the remaining bulkhead to form a vacuum that eased the joint to its final position. The joints were tested during installation and grout bands placed into position. The backfilling was placed up to the pipe springline, at which point large precast concrete saddles were placed over the pipe to counteract buoyancy, and backfilling was completed. After dewatering the line, the exterior joint space was grouted from the interior of the pipe through small grouting nozzles. Interior steel butt-straps were welded across the joint for restraint and shotcrete reinforced with wire mesh was applied over the interior surface of the butt-strap to fill the interior joint spaces.

Bay Aqueduct Completion

The installation and successful testing of the RCCP Bay Aqueduct was completed in December of 1999. The pipeline was hydrostatically tested at 220 psi pressure.

This rugged RCCP subaqueous pipeline met the challenge of very difficult installation conditions. The design and construction versatility of concrete pressure pipe is demonstrated on the Southern Nevada Water Project. Whether its a subaqueous line, a tunnel, or a downtown main, concrete pressure pipe can meet your needs.

Contributed by Henry Bardakjian
Ameron International Corporation

The hoisting frame and saddles were positioned on top of the assembly. One bulkhead would later be removed and the assembly lowered into 90-ft. deep water for installation.