Controlled Shear Point Technology Case Study

Deployed on Floating Docks - Pleasant Harbor Marina, Lake Pleasant Arizona

Background

Lake Pleasant is a 10,000 acre, 16 square mile reservoir, located just North East of Phoenix, Arizona. It was originally designed as a water collection and storage basin for the Yavapai watershed, but Lake Pleasant grew significantly when the Colorado River Aqueduct and Waddell Dam was constructed.

It didn't take long for the lake to become a popular destination for boaters, campers, and hikers, as the lake is located close to the general Phoenix population. The Pleasant Harbor Marina was constructed to accommodate the fun seekers, complete with a floating restaurant, 8 dock wings and several hundred floating boat slips ranging from 20 to 90 feet in length. End ties can accommodate even larger vessels.

The unique feature of Lake Pleasant is that it feeds water through a canal system to farms and water users throughout the Arizona desert region, causing water level to fluctuate up to 40 ft in any given 12-month period. Despite such a drastic fluctuation in water level, the lake maintains a healthy average depth of 70 feet with deepest sections topping off at 170 feet.

The docks were constructed similarly to those found in ocean water applications due to the tide-like conditions, caused when water is drained and refilled from the Colorado River Aqueduct. That is, the docking system is constructed so that the floating sections can rise and fall with changes in the water level. An access ramp from the shore is on wheels, allowing it to move up and down freely.

The Problem

Lake Pleasant is situated in a North to South configuration with prevailing winds able to gain significant force before they reach the Southern end of the lake where the marinas are located. Wave heights have been recorded at over 10 feet during storm conditions, placing severe strain on the mooring ties of the docks.

In 2017 and 2018, storms containing micro bursts ripped through the marina causing the dock ties to break free, sending dock sections and boats adrift. Because Pleasant Harbor is a full service Marina, complete with slip side electrical, water, cable TV, and communication circuits, the storms caused significant damage that required careful planning and complete re-construction of the docks themselves, as well as all the connection amenities.

In consideration for re-design of cable TV services and communication circuits consisting of dedicated fiber optic for each slip, as well as the marina office complex, restaurant, fuel dock and other amenities, the project engineers opted for a design which would allow cable connections to flex by as much as 15 feet and provide for catastrophic protection in the event of repeat storm surges.

The Solution

The design team chose the Controlled Shear Point "CSP" for Cable TV and the communication circuits. In addition to strategic placement of CSP modules at each dock extension and at the interface between land and shore, additional modules were placed at all dock flex points.

With shear protection and several feet of stored fiber cable in each CSP module, they offered the flexibility that the engineers were looking for.

In addition to the CSP modules themselves, Cleveland Electric Laboratories, the fiber optic design and installation team, pulled oversized EDPM plastic flex duct through all the docks in preparation for receiving the fiber optic cable.

Since the CSP modules are suitable for use with any type of fiber cable, there were no special requirements for cable to CSP interface. This allowed the installation crew to install the specified fiber cable in such a way that provided for cable movement within and at the end of each of the the duct runs.

By adding cable slack loops to absorb up to 15 feet of the anticipated initial flex movement, the last 6 feet of fiber cable, deemed as emergency breakaway, was easily stored within the CSP module.

Along with providing the emergency slack needed, the CSP module is designed to cleanly cut or shear off the fiber in a controlled enclosure so that a quick and simple splice can be performed in the event of an emergency breakaway.

CSP Design

Cleveland Electric Laboratories played an important role in the design, development and deployment of the CSP Invention, not only for applications such as this, but for any application where cable stress could be a factor. For this reason, they implemented a number of manufacturing techniques that enable the CSP to become a cost effective and useful device for virtually any industry.

The history of fiber optic cable deployment dates back several decades. Originally, small glass fibers only carried individual circuit communications and the critical nature of a single lost circuit due to a broken fiber just wasn't that critical.

However, as the industry continued to evolve and spread out into virtually every form of communication imaginable, the duty and critical nature of a single fiber circuit became far more notable.

A single fiber can now carry multiple circuits ranging from video to audio and of course data. It does this by transmitting different sources of information at different wavelengths. The bottom line, is that a far greater amount of communications is lost these days when a single fiber is cut.

Those who design and engineer fiber optic sub-structures, ingeniously know that the glass fiber is extremely strong when placed under tension without violating the bend radius. So strong in fact, that engineer's often demonstrate the tensile strength of fiber by stretching it extremely tight between their hands.

This is not to say however that the fiber is unbreakable and when it does reach its break point under extreme tension, a very violent shattering effect will occur in multiple locations along the length of the fiber. The primary end to end strength of a fiber comes from the fact that it is drawn lengthwise in a continuous process, creating a lattice glass structure that is linear in nature. When this linear structure breaks under tension, the break will not just occur at the primary break point, but often stretches several hundred feet in either direction of the primary break point.

Additonal Applications

The transportation industry is especially vulnerable to violent fiber breaks due to the fact that many of their interface connections are precariously positioned road-side in signal and node cabinets. To compound the potential for a real disaster, Transportation Industry fiber is often fed from a high fiber count backbone cable, just a few hundred feet across a remote intersection drop cable to the cabinet interface connection. The attachment to the backbone is often accomplished with a process called fusion splicing, where the drop fiber is physically welded to the backbone fiber and sealed in a waterproof case. This essentially creates an immobile hard wired connection between the backbone and the drop cable. The drop cable is then routed through a conduit to the cabinet interface location.

The result of a vehicle impact, which happens thousands of time each year across the United States, is that of catastrophic damage, where the hard wired drop cable is instantly stretched to its breaking point and in some cases is even ripped entirely out of the conduit. With this event, two adverse effects have occurred in regard to the fiber drop cable.

1. The fibers within the drop cable itself will be shattered in multiple locations, requiring total cable replacement, including re-termination of connectors within the cabinet and re-splicing of the new cable to the backbone interface. The conservative estimated cost of a total cable replacement, including materials and labor is $2,500.00 to $3,500.00, if not performed in an emergency situation.

2. The tension applied to a drop cable that is laid between two anchored points often causes the cable to be pulled out of the splice case where there are several other fibers feeding several other points along the path of the fiber backbone. Additionally, it is quite certain that the fiber will also be violently pulled out of the interface cabinet. In this scenario, the damage that occurs can transfer well beyond the drop cable itself and deep into the backbone cable that services other intersections. The estimated cost of destroying backbone cabling and affecting other intersections can easily climb to six figures, but to remain conservative.

FiberShear technology guarantees that all cabling infrastructure remains intact in the event of an accident and enables device restoration to take place within minutes of the equipment being reset. This innovative device was designed to eliminate patch cords, redundant maintenance, and additional failure points, ultimately saving cost.