



### **Traffic Never Stopped: Creative Solution Builds New Box Culvert — From Within!**

The Florida Department of Transportation (FDOT) knew that the big box culvert running under State Road 64, in Manatee County in downtown Bradenton, absolutely had to be replaced or rehabilitated — but how? For structural reasons, replacement seemed like the best choice, but shutting down this major commuting route was ruled out by city, county, *and* state officials. And the culvert itself presented major obstacles to repair since it shares space with several other utilities and is intersected by other large stormwater lines.

At least everyone agreed that *something* had to be done. "We're not even sure how old this culvert is, but the type of rebar used suggests it was built sometime in the '1920s," says Rick Hogue of Stantec Consulting, Inc., who was FDOT's project administrator. "Back then they used whatever water was available when mixing concrete, and it may have had a high salt content." Ninety years later the culvert, which is about 6 feet by 6.75 feet in cross-section by 61 feet long was obviously facing catastrophic failure. There were large cracks, holes, and a generally compromised matrix. Culvert condition were so poor that FDOT's project specifications required solutions that were 'stand alone'; in other words, the existing culvert was judged to have *no* structural integrity.

Replacement would be ideal except for the disruption of traffic during a project that would likely take months. Replacement would also be complicated by the need to maintain connection with the upstream and downstream (60") sixty-inch RCP storm sewers—the culvert is extremely active and handles tidal surge as well as storm activity. To think of digging; well excavation and new replacement was quickly ruled out!

A version of slip-lining was considered where arched pipe would be inserted into the culvert and the voids would be filled with concrete. Maybe in some situations this could have worked but not here. The intersecting utility and stormwater lines presented too many complications. Cutting and adapting of arched pipe sections would take a lot of time and threatened the structural integrity that the project engineers were seeking. A huge consideration was avoiding significant reduction to culvert capacity. Additionally, recognizing this project would take place in downtown Bradenton, maintaining a tight project staging area would minimize the MOT.... It's really all about the people!

With two plausible rehabilitation methods ruled out the FDOT needed ideas. Fortunately, the general contractor, Gibbs & Register Inc. (G&R), had a subcontractor relationship with TV Diversified Inc. (TVD), of Lake Worth, Florida. Working together with TVD business representative John Wilson and his collective, including Hector Meneses and consulting engineer Ron Roche, P.E., a plan was presented that offered the structural

resolution, while minimizing potential downtime and expense for the FDOT. Necessity truly can be the mother of invention and the proposed procedure seemed to be the most suitable alternative. Their proposal involved building a culvert on the inside by spraying an ultra High-Strength mortar, reinforced by Grade 60 metal wire mesh. This solution would easily accommodate the utilities and stormwater lines that crossed through the culvert and would not disrupt traffic or significantly affect the hydraulic flow capacity. No problem with the spray application of a cement casting. This approach has been steadily used successfully in large-diameter *circular* pipe through a process known as centrifugally cast concrete pipe (CCCP), a method developed by AP/M Permaform that relies on a spincaster and high-strength cement grouts to form a new pipe within the old pipe — it's a proven "NO DIG" rehabilitation method. But for the first time in Florida, and possibly anywhere, a similar technique would be applied to a *rectangular* culvert.

### **A Groundbreaking Solution — Without Breaking Ground!**

"Initially it sounded like a great idea..... Maybe too good to be true," says G&R Project Manager Joel Covitz, "But as we worked through the various issues we realized that the biggest hurdle, really, was obtaining approvals." Indeed, with city, state, and county officials all intensely interested in the project, getting approval for an untested solution seemed like a long shot. "FDOT had guidelines and policies for solutions *similar* to this, but not for something *exactly* like this," says Covitz, "In fact, even G&R's engineers had reservations. By moving forward patiently and addressing all their concerns and questions we gradually overcame the concerns and convinced FDOT of its reliability."

The key factor turned out to be the 'stand alone' requirement. FDOT requested that TVD submit a procedure in writing to clarify the proposed project method in Step-By-Step detail. AP/M's engineering consultant generated documented calculations, accompanied by the written procedure which demonstrated that this revolutionary alternative was not only structurally viable, but that calculations for the new culvert structure would exceed moment of capacity without any consideration of load bearing contribution from the original dated culvert structure. With this assurance, FDOT approvals were issued and the project was now ready to move forward. The lone stipulation of Florida DOT was a Technical Special Provision, also certified by a licensed Florida engineer. Engineered features of the culvert design included 18-inch radius top corners to improve overhead load distribution, and 5-inch thick walls — although this thickness actually well exceeded structural requirements, as documented in Mr. Roche's calculations, the FDOT required three (3) inches of cover over the reinforcing metal to reduce the exposure to the daily presence of brackish tidal water.

### **Fast and Straightforward**

T V Diversified utilized X2 60" pneumatic pipe plugs on each end with flow through pipe for their bypass system. This specialty contractor knows Florida and therefore created a control option to deflate and inflate for daily management of storm water flows resulting from tides or sudden rainfall. The existing culvert surface was then pressure washed and loose unsound concrete was chipped away. Voids or cracks were filled and the interior substrate was leveled with MS-10,000/UL, a high-strength cementitious grout. MS-10,000/UL is a stabilizing underlayment, used in conjunction with MS-10,000, the primary material which was applied like unto gunite. These unique High-Tech materials were both developed by AP/M Permaform and their proven reliable track record were an essential component to the success of this project. AP/M's ultra high strength and

corrosion-resistant mortars are based on Portland cement, fortified with micro-silicas and other densifying agents. Graded quartz sands and fibers are added to improve cohesion and flexural strength. They perform well in moist application conditions, and adhere tightly to most surfaces. T V Diversified typically uses MS-10,000 and other AP/M Permaform products on CCCP projects and manhole rehabilitation, which shored up their confidence that these same materials would perform well when spray applied in the SR-64 box culvert. Important to note that AP/M's Permacast MS-10,000 is known to bond well to itself so that multiple layers can be added on successive days without cold joints, enabling TVD to achieve the 5" thick design spec.

With the culvert substrate cleaned and stabilized, the T V Diversified team then built a metal reinforcement cage out of the welded Grade 60 mesh that could be worked with hand tools. This allowed efficient snug fitting of the mesh around utilities, stormwater lines, and other culvert breaches within the existing walls. Depth gauges were set strategically (anchored to the substrate) to verify the minimum 5-inch thickness, specified for the new culvert walls. Multiple layers were applied along with hand troweling to insure material would be worked into the tight spots. Grout test cube samplings were collected daily for quality assurance, along with regular visual inspection of the depth gauges. Just seven days post construction and the cube testing had exceeded the seven-thousand PSI anticipated lab results, while down below ground all appears well when you consider that no signs of shrinkage contraction is visible and the culvert remains smooth and watertight...

### **An Excellent Alternative**

Rick Hogue says that the completed project was a success; "I can't speak for FDOT, but based on this project, and considering timeliness and relative simplicity when compared to replacement, this looks like an excellent alternative." In fact, the total project took less than three weeks to execute with cost containment held around one-third of excavation and replacement. "And," Hogue adds, "There was no impact on traffic whatsoever — drivers largely unaware the sub-contractor team were performing this revolutionary procedure below the roadway."

In many ways this box culvert under State Road 64 in Manatee County was typical of United States infrastructure, most of which is very old and stressed well beyond its original design limits for service life. Replacement would be complicated by difficult access, social impact, traffic disruption and certainly the related high-cost of new construction. The selected method on the other hand, employed innovative processes and materials for a trenchless renewal of a major culvert, completed in record time. The added bonus was the huge savings for the overstressed budgets in today's economy, also common in the State of Florida. It shows that even big government agencies really can be flexible and make things happen when innovative contractors can communicate simply, bringing creative ideas, supported with good engineering and excellent workmanship.

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