Heavy Rains Lead to Catastrophic Failure of CMP Culvert Near Buffalo, Texas

American Concrete Pipe Association
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An educational document from the American Concrete Pipe Association for users and specifiers

Heavy rains in May 2011 overwhelmed a 72" four-barrel Corrugated Metal Pipe (CMP) culvert on Texas Farm to Market Road (FM) 2539 near the town of Buffalo in Leon County, Texas. Area management from the Texas Department of Transportation (TxDOT) and local maintenance crews were forced to shut down the road for more than a week while they replaced the metal culvert with reinforced concrete pipe (RCP). Estimated cost of the replacement process: $350,000.

What's more, this is the second time a CMP culvert has failed at this location.

The failure occurred about five miles south of Buffalo on FM 2539, a road that serves a number of rural homes. Given the extensive damage, TxDOT was unable to conduct a full analysis of the root cause of the failure. However, TxDOT employees found sufficient evidence to indicate that the inverts failed, leading to partial collapse of the structure. The resulting restriction of the lines backed up enough water to cause the failure seen in these photographs.

According to the U.S. Corps of Engineers, corrugated metal pipe has a design life of up to 50 years, though the metal pipe industry recommends that a soil analysis be conducted prior to estimating the life cycle. The CMP pipe that failed here was installed in 1986; which means it survived for roughly 25 years, or half its "advertised" lifespan. Unfortunately, agencies like TxDOT across the country are routinely replacing failed CMP systems after only 25 to 40 years of service. CMP culverts often fail catastrophically, resulting in significant property damage and risk to public welfare.

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Ironically, nearby landowners and TxDOT personnel confirmed that the recently failed metal culvert was installed in 1986 as a replacement for a previous CMP culvert that had also failed. Fortunately, for the third culvert installation at this location since the 1980s, TxDOT has opted to replace the failed CMP with reinforced concrete pipe, which has a design life of up to 100 years, according to the U.S. Corps of Engineers. Furthermore, unlike CMP, concrete pipe has a successful history of durability, performance over its service life and minimal risk of structural failure.

Given the repeated problems with the infrastructure around Buffalo, a more thorough investigation of nearby culverts was conducted. Not surprisingly, significant issues were discovered.

The photograph to the right shows a 30" CMP culvert on FM 2539, less than a half mile from the catastrophic failure described above.

While the age of this culvert is unknown, its apparent deteriorated condition suggests that structural failure may be imminent without mitigation.

Now look at the 42" CMP culvert (*below*), which lies underneath the entrance to the Buffalo Ridley Block Operation, a local manufacturer of livestock feed blocks.

It is not only buckling, but it is significantly corroding as well. According to an official at Ridley Block, this visibly compromised culvert was installed in late 1999. After just 12 years, is this culvert already in need of replacement?

While we don't know how much was spent 25 years ago to build the recently failed CMP culvert, we can estimate its replacement cost fairly easily. TxDOT chose to directly replace the four-bbl 72" CMP with four-bbl 72" RCP. With roughly 450 feet of 72" RCP installed, the material cost is about $100,000. Mobilization and installation is estimated at $150,000, and repairing the roadway adds $50,000 or more. Once engineering and administrative expenses are factored in, the total cost is projected at $350,000.

Of course, this does not account for the economic costs associated with the closure of the only paved road into and out of the area. Many of the residents living along FM 2539 were significantly hindered in their ability to enter and leave their property during the event and its aftermath.

And let's not forget that this is the *second* failed CMP culvert at this very same location.

Nothing can be done now about the poor decisions made a quarter-century ago. Had the officials in charge installed concrete pipe the first time, they would not have had to allocate $350,000 or more in scarce funds today. Fortunately, they won't need to worry about replacing the new RCP installation for another 75 to 100 years.

Given the substantial pressures on state budgets driven by the current economy, transportation officials across the country must reconsider how they design and build our infrastructure. Among other things, product lifecycles should be given significant consideration when weighing the costs of alternative materials.