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A Message from the American Concrete Pipe Association

Bulletin No. 118

CMP Failure Closes Canada's Busiest Highway; Confirms Need For Life Cycle Analysis

One of North America's busiest roads was closed when a corrugated steel pipe failed under Highway 401 just outside of Toronto, Ontario. A nearly 3 kilometer (2 mile) stretch of eastbound Highway 401 between James Snow Parkway and Trafalgar Road in Milton, Ontario was closed for the entire evening rush hour due to the failure.

According to an article by the *Toronto Star*, the corrugated steel pipe failure resulted in a sinkhole measuring 2.0 m (6.6 ft.) x 3.0 m (9.8 ft.) x 2.5 m (8.2 ft.) deep in the center lane. The pavement collapsed when water washed away the fill underneath the highway. Apparently, the outlet had been partially blocked, causing the metal pipe to corrode more quickly. After the pipe corroded, the water exited a hole in the top of the pipe, washing out the granular road base.

Many motorists were delayed for hours trying to get into Toronto on Tuesday night, August 9, 2000. Traffic began to slow as the sinkhole first appeared around 5 p.m., and by 6:30 p.m. drivers faced a complete closing of a section of Canada's busiest highway. By 6:00 a.m. the next day, only one lane of traffic was opened with traffic still backed up for several kilometers. However, all lanes of traffic weren't open until around 1 p.m. Wednesday. In addition to the delay to Toronto area motorists, the corrugated steel pipe failure resulted in an overnight repair project by contract maintenance crews for the Ministry of Transportation-Ontario (MTO).

The 750 mm (30-in.) corrugated steel pipe was installed around 1980 as part of a program to construct concrete median barriers on Highway 401. The pipe was intended to provide an outlet for a center median drainage system. According to an Ontario Provincial Police Constable in an article by the *Toronto Star*, "The holes in the drain pipe were about the size of a bowling ball...Every time it rained, and we have had no shortage of that this summer, the water was emptying and washing away at the bed." The MTO has now begun an inspection program of all corrugated steel pipe constructed under the same program of constructing concrete median barriers on Highway 401.

SIMILAR CMP FAILURES ABOUND

- In September 2000, a 15 foot deep sinkhole in Eau Claire, Wisconsin resulted in the drowning death of a 34-year old man whose car plunged into the sinkhole, which was caused by a metal storm sewer pipe failure. "Water seeped out from cracks in the pipe" and undermined the surrounding sediment according to the *Leader-Telegram*. The metal pipe will be replaced with concrete pipe at a cost of about \$800,000. "(The concrete pipe) will be more durable," according to the Eau Claire Public Works Director.

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- In March 1998, an 800 ft. (243 m) long, 70 ft. (21.3 m) deep sinkhole developed at the I-15 and Balboa Avenue interchange in San Diego after the failure of a 13 ft. (3.96 m) diameter steel plate drain pipe. The steel plate drain ruptured after being clogged by rocks and debris during a storm. A pickup truck was swept into the sinkhole, and the two women inside the truck barely escaped with their lives. The total cost of repairing the sinkhole and replacing the metal pipe with a concrete conduit was approximately \$5.2 million.
- In October 1998, sinkholes from a failed 66" (1.67 m) diameter metal pipe caused disruptions on Delaware Highway 4 near Christiana, Delaware. The failed metal pipe caused several sinkholes, including one approximately 25 ft. (7.62 m) deep. The 14-year old corrugated metal pipe was replaced with reinforced concrete pipe. The total cost of repair was over \$325,000.

Due to the performance of concrete pipe, very few studies have been needed to investigate its durability. However, in 1982, the Ohio Department of Transportation published a major report on the results of a ten-year study of more than 1,600 culverts of various materials throughout the state. Of the 519 concrete culverts studied, over 91% were rated in good to excellent condition. In the same report, the predicted life of 16-gage corrugated steel pipe in an environment with neutral environmental conditions was **20 years. This is in stark contrast to the service life of concrete pipe, which is routinely in excess of 100 years.**

On many projects, selection is too often based on initial cost. However, alternate materials with the lowest initial cost may not be the most economical selection for the design life of the project. The service life of the pipe material, along with the initial cost, and replacement costs of the pipe are considerations when performing a life cycle cost analysis based on the project design life. The social cost of detours/delays caused by the replacement of pipe is a major issue. The associated costs to the general public in the form of lost business and inconvenienced homeowners should also be considered.

The American Concrete Pipe Association and the Ontario Concrete Pipe Association have software available to assist project specifiers, engineers and owners with the life cycle cost analysis of different pipe materials. The software, called LCA (Life Cycle Analysis), which is included as part of the PipePac 2000 software, is available on the ACPA web site at www.concretepipe.org, or through members of both associations.