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A Case in Point for Choosing Concrete Pipe

RIDGE LINE, INC. vs ADVANCED DRAINAGE SYSTEMS

DISPATCH

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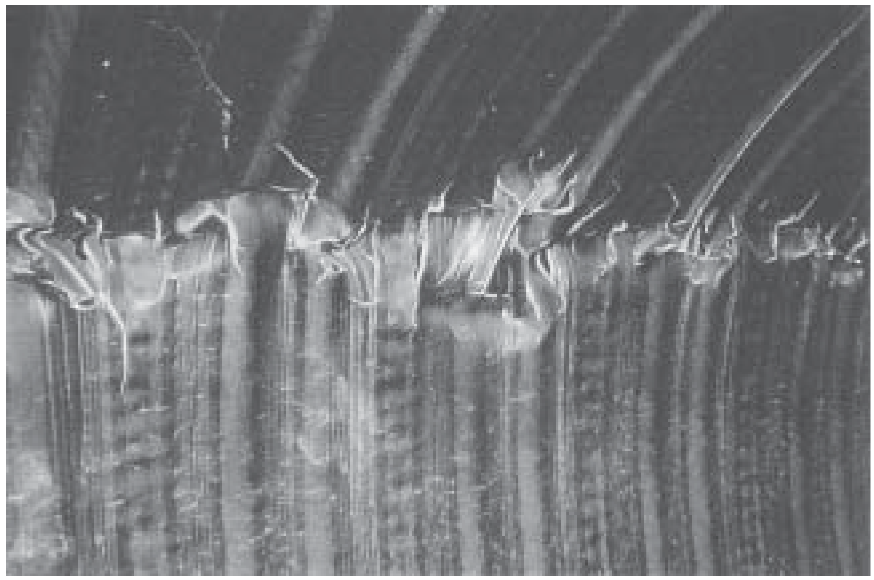
Reinforced concrete pipe has a proven performance history. It has provided, and continues to provide, a reliable structure for the conveyance of effluent in a variety of conditions.

HDPE pipe has a proven performance history as well. It has proven to be insufficient to handle the design and installation requirements that most owners, engineers, and contractors have come to expect from concrete pipe. Time and again individuals who have specified and installed HDPE pipe have come back and inspected the pipe later only to find the installation not meeting expectations. What happens then? Who pays for the repair or replacement of the pipe and the social costs involved?



The case of *Ridge Line, Inc. vs. Advanced Drainage Systems* (ADS), Case No. 2:00 – 1056, in the U.S. District Court of West Virginia is a good example of what the limitations are for HDPE drainage pipe, and how problems resulting from these limitations are addressed when brought to the attention of the HDPE pipe manufacturer. When the pipe starts to fail, several questions arise, including:

- Can you believe the research claims made by the producer?
- Is the producer's profile wall design sufficient to avoid any local failures of the pipe?
- Is the quality of the material in the pipe sufficient?
- Whose fault is it?

This publication will look for the answers to these questions, and reveal how the questions were answered by ADS in *Ridge Line, Inc.vs. ADS*. In this particular case, one may ask if the producer really had the benefit of the consumer in mind when asking him to use their product.

History

In the mid 1990's, Ridge Line, Inc., a developer, retained Triad Engineering to provide geotechnical engineering services for the development of Southridge Centre in Charleston, WV. In designing the storm drainage for this project, Triad Engineering recommended the use of a 48-inch PVC pipe. Instead, Ridge Line chose to use an alternative pipe produced by Advanced Drainage Systems (ADS). Although it did not meet the original specification of Triad Engineering, the ADS pipe was a less expensive substitute.

Six years after installation the pipe was found to be collapsing. The pipe was relined with a 36-inch pipe with grout between the two pipe walls. This resulted in insufficient drainage capacity for the site. Consequently, another pipe must now be installed to compensate for the lost capacity. The developer, Ridge Line, brought suit against ADS, who brought in by way of Third-Party Complaint, both Green Valley Bridge, Inc. and Triad Engineering, Inc.

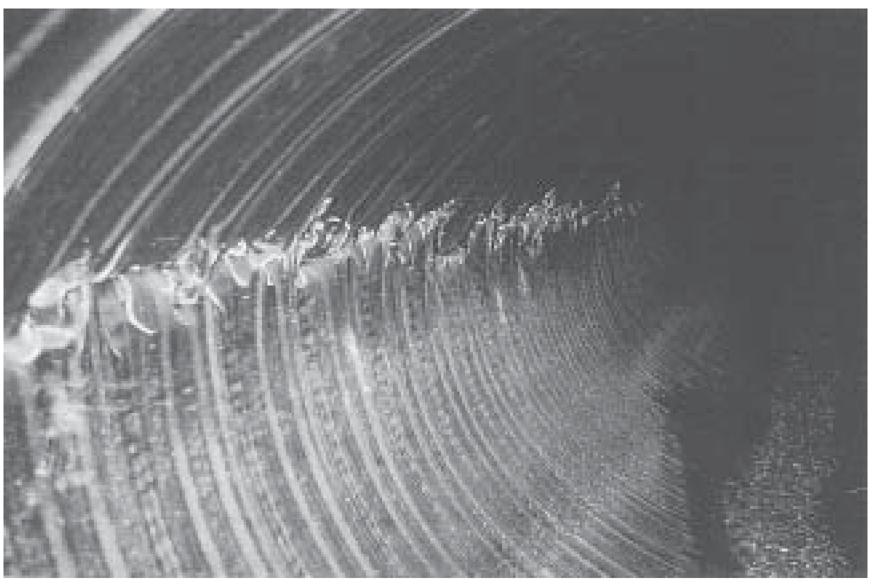
Manufacturer's Claims

The height of fill above the pipe ranged from 17 feet to 35 feet. The ADS product sheet, dated 1995, states that the pipe "has been tested to soil pressures equal to 180 ft. of fill", and lists a maximum cover of 60 feet. When reading the brochures, it is important to know the background information so that one can read between the lines. In this case, the "soil pressures equal to 180 ft of fill" was derived from testing in a soil cell. Many prominent buried pipe researchers have questioned the results from this soil cell test, believing it does not accurately reflect actual field conditions. One might assume that if the pipe could reach 180 feet with quality backfill, certainly it can handle the 35 feet of fill required for this installation. That assumption would be incorrect.

Jim Goddard, Chief Engineer for ADS, testified during his deposition, *"Pipe is pipe. And how you put in pipe is pretty straightforward."* However, when Dr. Glenn Hazen from Ohio University was deposed in support of ADS he had a slightly different opinion. When he was asked, *"Do you believe that there are special installation methods or precautions that need to be taken with the installation of HDPE pipe that does not need to be taken in connection with the installation of concrete, aluminum, or steel pipe of similar styles for similar uses?"* Dr. Hazen replied, *"Yes"*. This question was followed by, *"Can you list for me what you think the special installation methods and precautions are?"* He responded, *"I think that backfill is much more critical for high-density polyethylene pipes. I don't think it is as critical for concrete."*

ADS contends that there were two major contributors to the failure; 1) consolidation of Class IVA backfill that they believed was used, and 2) migration of the Class IVA backfill into the #57 stone that was used up to springline. In his deposition, Goddard stated, *"If I were installing any pipe made for drainage or water or gas, I would never use a IVA material as backfill. Never."*

Many pipe manufacturers claim that their product can be installed like concrete pipe. But this is a false claim.



Profile Wall Design

An assessment of the pipeline failure was performed for Ridge Line by Dr. Ernest Selig. Dr. Selig is a Professor Emeritus at the University of Massachusetts in the Department of Civil and Environmental Engineering and has performed a vast amount of research on buried pipes. He is also former Chairman of Transportation Research Board Committee A2K04 on Soil-Structure Interaction.

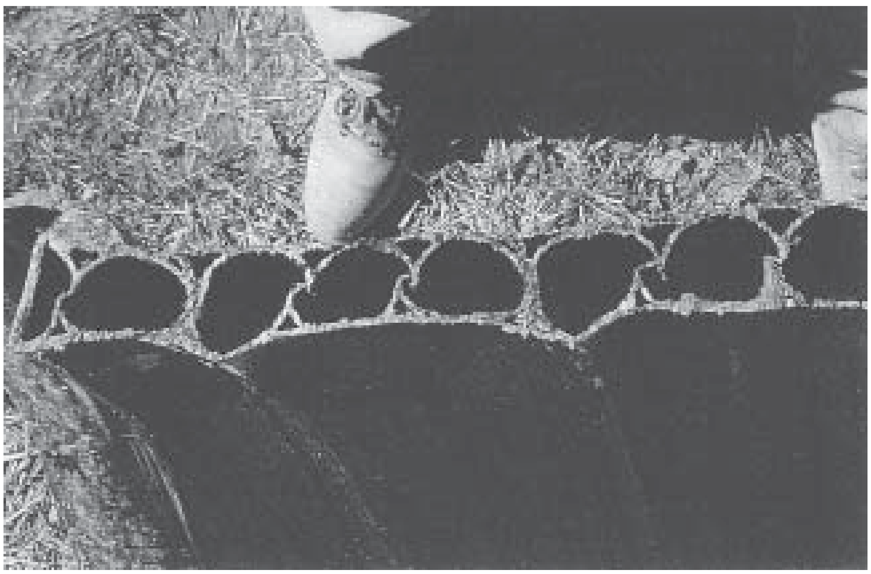
Dr. Selig wrote in his assessment:

"Both ductile tearing and slow crack growth brittle cracking were prominent, accompanied by folding over of the damaged portions of the pipe wall"

Dr. Selig's opinion for the cause of the failure of the pipe was as follows:

"My opinion is that the tubular or honeycomb wall profile used for this HDPE pipe is not suited for its intended use and is inad-

equate for the customer's application. This wall profile is particularly prone to cracking and local buckling of the main load-carrying members. The cracking potential is increased by using a polyethylene material with low crack resistance and by tendency for distortion of the wall profile under loading. The cracking and distortion greatly increase the buckling potential. Furthermore, the polymer material used in the manufacture of this pipe is susceptible to cracking over time. In my opinion the combination of the pipe profile design and the pipe material is the cause of the failure."



Obviously, the pipe wall profile was a key issue in this case. There are a variety of profile configurations available in HDPE drainage pipe, but little if any long-term testing has been performed on these products. While a method for evaluating the wall profile has been incorporated into the AASHTO design code since this pipe was installed, there still does not exist a requirement in M 294 to verify the profile dimensions. Should a designer use unverified properties in their design?

In his deposition, when Dr. Glenn Hazen of Ohio University, testifying for ADS, was asked, *"Are you aware that there have been any manufacturing changes in the pipe of this type from 1995 to the present by anyone?"* He responded, *"What happens in the manufacture of pipe is usually things change from month to month."*

There are a variety of profiles, but what research is behind their development?

<u>Quality of the Material</u>

The second key issue in this case was the pipe's potential for cracking.

In his assessment, Dr. Selig stated:

"Also the tensile stress required to cause failure in the form of cracks in the pipe wall is time-dependent. The lower the tensile stress, the longer the time to failure. The plastic may stretch a lot before failure (termed ductile) or it may deform very little (termed brittle)."

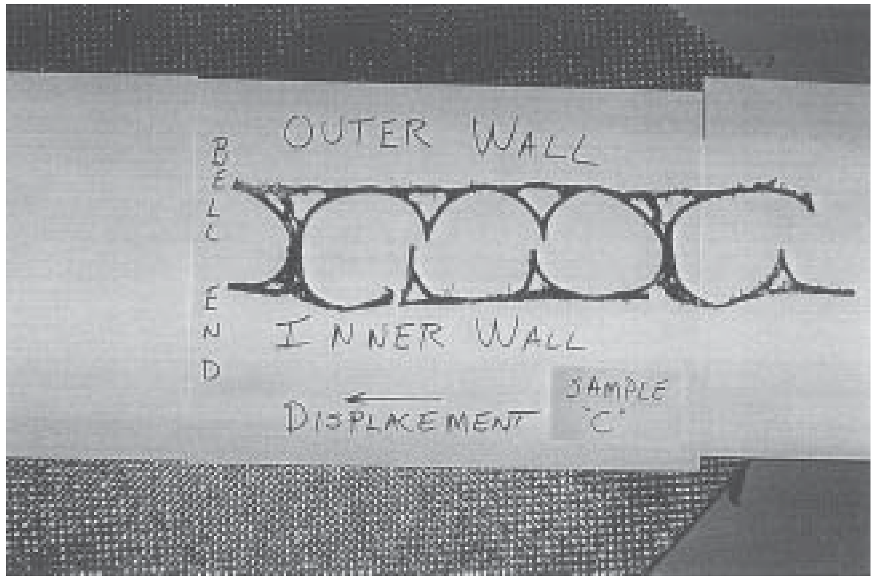
Time-dependent properties of the HDPE resin mean that what you see today, may not be what you see tomorrow.

In the proceedings of the court case, ADS repeatedly stated how a sample of the resin taken from the failed pipe easily passed the current slow-crack growth requirement within AASHTO M 294, "Standard Specification for Corrugated Polyethylene Pipe, 300- to 1200-mm Diameter". Perhaps this is more an indication that the slow-crack growth testing requirements for the product need to be improved, and not that the pipe itself is sound and reliable.

The testing of HDPE pipe is an issue of uncertainty. The current slow-crack growth testing requirement for HDPE pipe produced to the M 294 Specification is based on NCHRP Report 429 which evaluated resin taken from pipe in the field, none of which was over 16 years of age. The slow-crack growth test requires the resin of the pipe be tested to 600 psi in an Igepal solution for 24 hours. The resin taken from the 48-inch HDPE pipe in Charleston was tested in a similar fashion, and the average failure times of the two plaques were

36 and 42 hours. However, according to Dr. Selig, *"...the polymer material used in the manufacture of this pipe is susceptible to cracking over time."* This leads one to question whether or not the current slow crack growth test requirement in M 294 is sufficient.

When asked, *"Besides horizontal and vertical deflection, what other items can lead to cracking and/or product failure for the pipe at issue in this litigation"*, ADS's lawyers responded *"Handling, damage, improper backfill and/or compaction, lack of proper project design or misapplication of the product."* Curiously, the lawyers made no mention of a deficiency in material properties. But the material quality must have some effect, or the slow-crack growth test would not exist.



Do you really want to wait and see if the pipe will crack in the future?

Whose Fault is it?

The developer, Ridge Line, brought suit against ADS as the manufacturer of the pipe. ADS brought both Triad Engineering and the contractor, Green Valley Bridge into the suit as third-party defendants. In seeking to avoid its own liability for its failed product, ADS alleged, *"...any failure of the pipe was the result of poor construction practices and a failure to adhere to the applicable requirements of ADS and ASTM...[T]he actions and omissions of Third-Party Defendants, Green Valley and Triad, were the sole and proximate cause of Plaintiff's alleged injuries."*

With a pipe product made from a material that has questionable attributes, it is interesting that ADS claimed, *"The key to the performance of any flexible conduit, like ADS's HDPE pipe, is the installation, which is a specific, fact by fact, case by case, issue."* Apparently ADS refused to even consider that pipe material may be the problem

Ridge Line requested that ADS admit to the following: *"Inspection of the product in January 2000, showed that the interior walls of the product had numerous defective conditions including but not limited to buckling and cracking."* Rather than owning up to the obvious, ADS responded: *"ADS admits that inspections showed problems with the pipe related to poor construction and installation practices by the contractor and poor oversight by the owner."*

Regardless of who's at fault, it is always going to be the fault of the contractor, engineer, and owner.

How Much Deflection is Too Much?

ADS was asked by Green Valley Bridge, Inc. to *"Explain each and every fact which you believe supports your contention that alleged failure of the Subject Pipe was the result of any negligence or fault of Green Valley Bridge, Inc., or any entity, including Ridge Line, Inc."* One of the statements in their response was, *"Among other things, the pictures of ADS's pipe show that the pipe deflected more than 5%. For a pipe to have such deflection, the surrounding soil would have to compress an equal amount, which means that there was not adequate soil compaction by the contractor."*

5% deflection is an important service limit for this product. Long-term deflection should be checked to ensure this limit is not exceeded. While one may often hear an HDPE salesman say that the deflection limit should be somewhere in the area of 7.5 to 10%, when it comes down to the performance of an actual installation, 5% is where they draw the line.

Mandrel testing flexible pipe to a 5% deflection limit is crucial for the performance of the pipe, and for your own future protection.

What Do You Have to Lose?

The developer lined the failing 48-inch pipe with a 36-inch sleeve, and will now be forced to establish a new easement for an additional pipeline to carry the stormwater flow that can no longer be carried by the original pipe. Just the legal fees alone to create an additional easement for storm water drainage were estimated at the time to be $18,125. The engineering fee for the work was estimated at $9,960. That's over $28,000 dollars, not counting legal fees for the suit, before any construction work to replace the pipe is even initiated. The cost of relining the existing pipe and installing a new one will add significantly to this amount.

You can lose more than just respect when a pipe installation fails.

The case of *Ridge Line, Inc. vs. Advanced Drainage Systems* Inc. brings to light many of the problems that can be associated with using HDPE drainage pipe. Unfortunately, this is not an isolated incident. In response to a request made during the case that ADS supply the names of any other similar claims or lawsuits, the following list of cases was provided for the period between 1996 and August 2001.

Dennis P. Orr v. Advanced Drainage Systems, Inc. et al.,
Case No. 96CV1711, Court of Common Pleas, Mahoning County, Ohio.

Giese Construction Company, Inc. v. Advanced Drainage Systems, Inc.,
Case No. 21007-0397, Iowa District Court for Wright County

Water Works Supply Company, Inc. v. S.B. Ballard, Inc. et al.,
Case No. CL97-3301, Circuit Court of the City of Virginia Beach, Virginia

City of Yuba City v. Valley Engineering, Inc.,
Case No. CVCS97-2704, Superior Court of California, Sacramento County

City of Brawley v. The Choicestone Corp. et al.,
Case No. 9990, Superior Court of California

Douglas Luhnow, et al. v. Eugene Horn et al.,
Fulton County Circuit Court, State of Indiana, Case No. 25C01-9906-CP-195

Groeniger & Company v. EAI International et al.,
Case No. 99AS00928, Superior Court of the State of California, Sacramento County

Granite Construction Company v. Patania Masonry, Inc.,
Case No. CV-140509, Superior Court of California, Santa Cruz County

Iron Valley Golf Club, LLC v. Gregory L. Will et al.,
Case No. 2001:00921, Court of Common Pleas, Lebanon County, Pennsylvania

Bryan White v. Advanced Drainage Systems, Inc., et al.,
Case No. 96CVH06-4238, Court of Common Pleas, Franklin County, Ohio

Larry Cornell v. The Council of Owners Units of Hawaiian Village Condominiums, Inc.,
Case No. Y96-4037, United States District Court of the Northern District of Maryland

Edward Hulme, Inc. v. Dominic P. Massa & Sons, Inc., et al.,
Case No. 29787, State of New York Supreme Court, Wyoming County

Hudson Hardware v. Advanced Drainage Systems, Inc.,
Case No. SC77875, Iowa District Court for Blackhawk County, Small Claims Division

Pacific Water Works Supply Co., Inc. v. Burdine,
Case No. 97-2-00176-2, Superior Court of the State of Washington, Benton County

Installation Problems?

Certainly proper installation is an important requirement for all buried pipes. However, when consistent pipe problems occur because of a pipe's sensitivity to installation, then it really must be considered a material/product problem. An explanation of failure given by Dr. Ernest Selig for the pipe in the case of *Ridge Line, Inc. vs. Advanced Drainage Systems* is as follows.

"Because of the profile wall shape, the load on the pipe from the fill caused high tensile stress concentrations which, together with stress crack sensitive polyethylene, resulted in the initiation of cracks. These cracks continued to grow over time. Local buckling developed in the profile including tubular members with or without the presence of cracks. The buckling would have initiated additional cracks. As the process progressed, tearing and folding of the wall components developed. The presence of cracks in the profile along with buckling would have caused pipe failure to occur at a much lower fill height than would be predicted by the crack analysis and local buckling models alone."

Does this sound like an installation problem?

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