Montana Department of Transportation
Research Programs
January 2008

# EXPERIMENTAL PROJECT CONSTRUCTION REPORT

# EVALUATION OF HIGH DENSITY POLYETHYLENE PIPE (HDPE) CULVERT IN A MAINLINE APPLICATION

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| **Location:** | Highway 59 (P-18); C000018, Rosebud County, Glendive District |
| **Project Name:** | Angela North & South |
| **FHWA No.:** | Experimental Project MT 00-09 |
| **Project Number:** | STPP 18-1(9)18 |
| **Type of Project:** | Experimental trial using High Density Polyethylene Pipe (HDPE) culverts in a mainline application |
| **Principal Investigator:** | Craig Abernathy, Experimental Program Manager |

## Objective

The objectives of the experimental project are to look at the installation, performance, and construction as compared with standard metal and concrete pipes. Construction issues include the installation time, manpower, equipment needed, backfilling/compaction, and alignment/floating during the backfilling. Performance issues include deformation of the pipe at several points in time, quality/condition of the joints, resistance to corrosion and abrasion, maintenance (clean out, material buildup, settlement, joint leaks), fluctuation of the pipe flow line and stress cracks from freeze/thaw and other visual distress these products may develop. Inspections will be performed initially and approximately 30 days after construction. Evaluations will then be carried out bi-yearly for four (4) Years with the fifth year as the final analysis of performance.

The potential benefits of this project to be investigated, include greater versatility in pipe choice to satisfy a variety of environmental conditions, lightweight materials, ease of maneuverability without heavy equipment (for smaller diameter pipes), and the possibility of reduced installation costs due to additional competition.

## Experimental Design

Three sizes of diameter pipe will be installed in this project; 750mm (approximately 30"), 900mm (approximately 36") and 1200mm (approximately 48") respectively. The product chosen is the Advanced Drainage System (ADS) N-12WT IB corrugated watertight, and soil-tight smooth interior HDPE pipe.

## Construction

Installation of the HDPE started in May 2007. Research was present to document the various steps of installation. The following information represents the key events in the installation of the various sizes of HDPE; images presented characterize the standard practice of the site installation. This report will be the basis for further evaluations. The supplemental section of this report highlights specific occurrences during the installation.

Image shows the 1200mm pipe as arrived on job site with one of the standard metal flared-end terminal sections (FETS) secured.

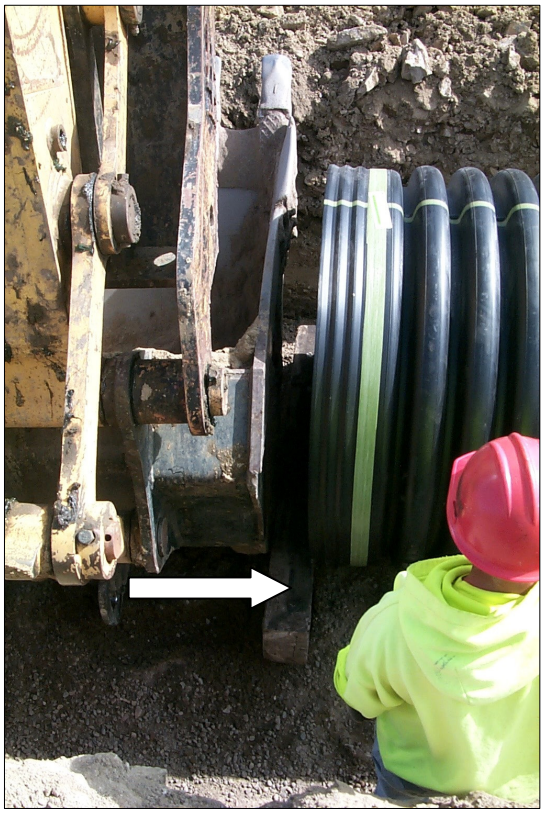
Setting the Grade ↑


Laying of the pipe with excavator and web sling ↑

Applying pipe compound to joint ↑

Using the excavator stick with help of a worker to snap the sections together ↑

For the connecting of the larger diameter HDPE, through trial and error, it was determined to use an 8"x8" tie as a buffer to use the excavating stick and bucket to shove the pipe from the bottom to secure the seal ↑



The pipe is pressed gently at the base and shunted until the seal is met ↑

This image shows that the bedding is minimally disturbed ↑

Cutting the end of the pipe for attaching the FETS ↑

Attached FETS – Contractor noted that the deep corrugation allowed a tight fit to the pipe ↑

It was determined to secure the pipes with rebar and wire harness to the pipe and ground during bedding. The wire was cut prior to the completion of the backfill. ↑ →

Initial placing of bedding material ↑

Bedding was placed at approximate 6” lifts ↑


Bedding was compacted using a Bomag vibratory tamper ↑

A Rammax sheep foots vibratory drum was also used for compaction ↑


Compaction was completed using an Ingersoll Rand SD 40 steel vibratory drum ↑

Example of completed HDPE section ↑

**Supplemental**

**Vent Tube**

During installation there was an issue of the correct alignment of the HDPE with regards to the vent tube. The ADS representative stated that the vent tube indicated by the green stripe which runs along the length of the pipe (a red line has been superimposed next to the stripe for reference) as when placed should, visually, be located at the top of the pipe when set in the bedding (as seen in the left image versus only one top stripe alignment with the image on the right). The vent tube is used in the manufacturing process of the product and not related to any installation criteria and is no more than 5-6 millimeters in diameter located in the interior of the pipe not visible on the exterior. It is only found on HDPE size of 900mm and above. In contacting the ADS Application Engineering staff for a detailed response with this issue, they explained that this is not a critical element in the placement of the pipe. In an extreme case if the vent tube is punctured, it may allow water to migrate into the vent and enter the pipe at the joint under a high hydrostatic event. To their knowledge this has never been a problem, or led to any product failure to date.

**Bell and Spigot Guide**

As part of the installation of the HDPE pipe, the manufacturer molds the word ‘HOME at the area where pipe and spigot meet (as seen with the red circle). This is meant as a guide for installation. It was unsure where the bell section should be in relationship to the ‘HOME’ guide as no information was received from the manufacturer. The ADS Application Engineering staff explained that the target range for placement is where any part of the word is covered by the bell since this is the tolerance range for a proper fit. As you can see from the above image the pipe was in that range. For the other pipe section connections, the tolerance was as above or midway into home. The following are the gap ranges as supplied by ADS; note the following figures are for a straight alignment gap:

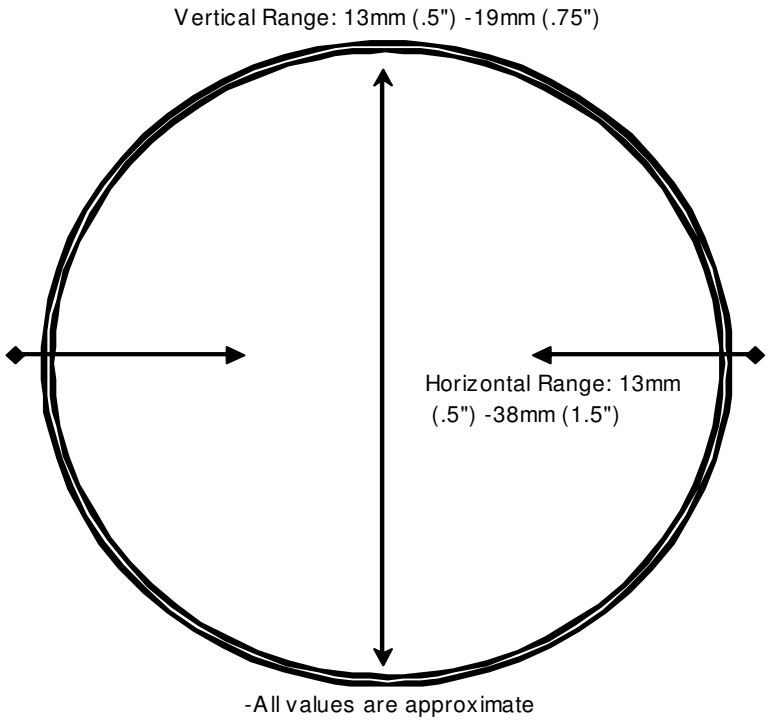
-750mm – 0.9"/23mm

-900mm – 1.4"/35mm

-1200mm – 1.6"/42mm

**Securing the Pipe**

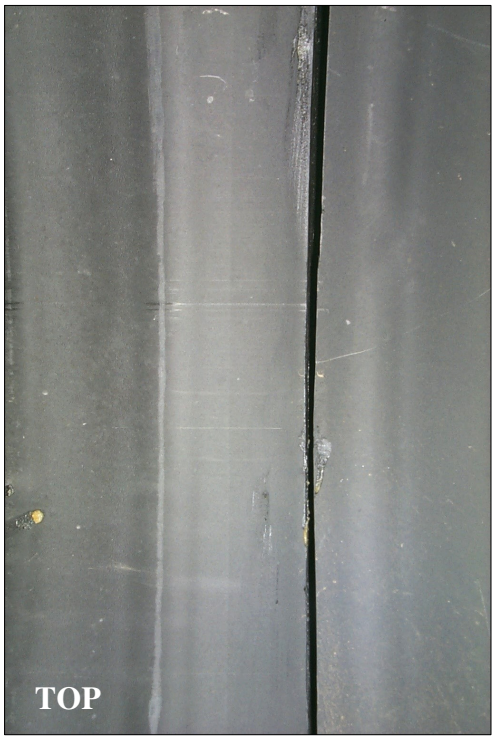
As stated earlier a rebar with a welded washer was used as an anchor to strap the pipe securely during the backfill process to prevent movement. This procedure was selected by the contractor based on his experience with placement of this type of light weight pipe. His reasoning is that the fill, during initial placement, may cause the pipe to float and this was an easy fix to alleviate that condition. Since this is not a standard installation practice for HDPE (as the use of a fabricated hold-down bracket is not mentioned in any ADS installation manual), it is suggested in a future installation, that this procedure not be followed in an effort to determine that not using a bracket will adequately place the pipe.




**Noted Deflection**

During random interior measurements of all of the HDPE pipe, after completion of the compaction phase it was noticed the side walls of the pipes or the horizontal range had compressed on an average of 13mm (.5") – 38mm (1.5") conversely pushing the vertical range of the pipe from 13mm (.5") – 19mm (.75). Visually the end sections of the pipe had a concave aspect which was originally assumed the tightening of the FETS had caused the oval shape at the pipe ends, but subsequent interior measurements confirmed the deflection. It is assumed at this time the compaction phase is responsible for the deflection. Future evaluations will establish base data to ascertain any changes within the pipe over the duration of the experimental analysis.

Note that this deflection did not, based on visual inspection at the time of installation, affect the quality of the bell and spigot connection.





**Interior Seam**

All seam connections were within gap tolerance. All pipe connected easily with an audible ‘snap’ as they were inserted into each other. The 1200mm pipe did display a larger gap at the bottom connection (up to 3/8") within gap tolerance (above images). It is unsure why the disparity of top and bottom gap width. It was speculated that either pressure of the pipe on the bedding may widen the gap or particulates may have entered into the seal at the base inhibiting a tighter fit.

**Deformed Lip at Bell**

One of the 1200mm pipe sections had a deformed end at the bell, most likely from improper shipping. It was easily pushed up by hand and held its shape while the next section was installed. There was no problem with the connection.

## Conclusion

The installation of the three HDPE pipe basically went well, other than the minor issues stated in the supplemental section. Anecdotal comments from Bob Reed, Pipe Forman for MK Weeden stated he felt that the installation time was longer for HDPE than for conventional pipe; that may be attributed to the learning curve with this installation and the added event in using the rebar and wire straps to secure a pipe during backfill. During several site visits by Mr. Reed (Pipe Foreman) after installation, remarked that he was impressed with the way the pipes stayed cleaned due to the smooth interior as compared to a CSP interior. This based on water (assuming runoff) flushing the pipes and not being trapped in the corrugation.

The next evaluation will take place in the month of April 2008, with a subsequent site visit in late fall to complete the annual evaluation. All Reports with this project can be found at: http://www.mdt.mt.gov/research/projects/angela.shtml