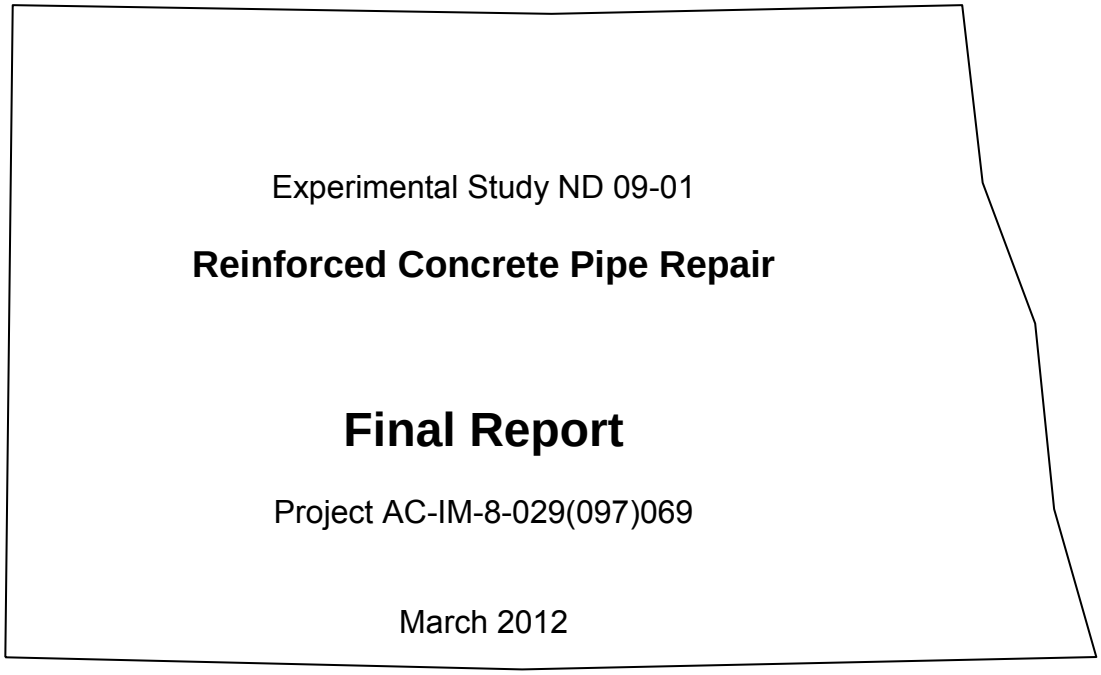
NORTH DAKOTA
DEPARTMENT OF TRANSPORTATION

MATERIALS AND RESEARCH DIVISION



Experimental Study ND 09-01

Reinforced Concrete Pipe Repair

Final Report

Project AC-IM-8-029(097)069

March 2012

Prepared by

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
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Construction Report

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Written by
Andy Mastel

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Disclaimer

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U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

EXPERIMENTAL PROJECT REPORT

EXPERIMENTAL PROJECT

EXPERIMENTAL PROJECT NO. 1 | STATE: ND | YEAR: 2009 | NUMBER: 01 | SUFF:

CONSTRUCTION PROJ NO: AC-IM-8-029(097)069

LOCATION: Cass, 28 County

EVALUATION FUNDING (48): 1 HP&R; 2 x CONSTRUCTION; 3 DEMONSTRATION; 4 IMPLEMENTATION

NEEP NO. (49):

PROPRIETARY FEATURE? (51): Yes / X No

SHORT TITLE

TITLE (52): Reinforced Concrete Pipe Repair

THIS FORM

DATE (140): MO. Dec -- YR. 2011

REPORTING: 1 INITIAL; 2 ANNUAL; 3 X FINAL

KEY WORDS

KEY WORD 1 (145): RCP

KEY WORD 2 (167): Pipe

KEY WORD 3 (189): Pipe Repair

KEY WORD 4 (211): Arch Pipe

UNIQUE WORD (233):

PROPRIETARY FEATURE NAME (255):

CHRONOLOGY

Date Work Plan Approved (277)	Date Feature Constructed: (281)	Evaluation Scheduled Until: (285)	Evaluation Extended Until: (289)	Date Evaluation Terminated: (293)
9/2009	Fall 2009	Summer 2011		

QUANTITY AND COST

QUANTITY OF UNITS (ROUNDED TO WHOLE NUMBERS) (297): 24" - $33.06; 18" - $29.67; 30" - $46.50

UNITS (305): 1 LIN. FT; 2 SY; 3 SY-IN; 4 CY; 5 TON; 6 LBS; 7 EACH; 8 X LUMP SUM

UNIT COST (*Dollars, Cents*) (306):

AVAILABLE EVALUATION REPORTS

CONSTRUCTION (315)	PERFORMANCE	FINAL
X		X

EVALUATION

CONSTRUCTION PROBLEMS (318): 1 NONE; 2 SLIGHT; 3 x MODERATE; 4 SIGNIFICANT; 5 SEVERE

PERFORMANCE (319): 1 EXCELLENT; 2 GOOD; 3 X SATISFACTORY; 4 MARGINAL; 5 UNSATISFACTORY

APPLICATION (320)

1 ADOPTED AS PRIMARY STD.; 2 PERMITTED ALTERNATIVE; 3 ADOPTED CONDITIONALLY; 4 X PENDING; 5 REJECTED; 6 NOT CONSTRUCTED

(Explain in remarks if 3, 4, 5, or 6 is checked)

REMARKS

321 Materials and Research observed three methods of Pipe repair in the Fargo District during the construction season of 2009. One set of twin arch pipes were in need of joint and structural repair. Three contractors came in so that the Department was able to observe several different repair methods.

In 2011 the same set of twin arch pipes were excavated. A plan note was included to allow Materials and Research to observe the excavation process and evaluate the repairs. Some deterioration of joint sealing material was noted; but in general, joints remained sealed and internal repairs were performing as expected. The effectiveness of the expanding foam to fill voids showed mixed results; possibly due to unknown size and location of the voids.

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Final Report
Evaluation of Reinforced Concrete Pipe Repair Strategies
ND 09-01

Purpose and Need

The NDDOT has used reinforced concrete pipe (RCP) extensively in all areas of the state for many years in highway drainage and storm sewer applications. Until recently, a common installation practice for highway drainage applications was to mechanically tie the end section and first 3 sections. The remaining inner pipe segments were “friction fit” groove and lap connections.

Settlement of new embankments and seasonal changes in soil conditions (freeze-thaw action, expansive soils, etc.) exert pressures on pipe, causing it to move within the embankment. The movement of the pipe results in the separation of pipe segments and misalignment on untied pipe segments. The open joints allow for infiltration of fine soils that can eventually result is voids behind the pipe and voids beneath the paved section of roadway.

Removal and relay or replacement of the pipe is often the solution for separated and misaligned pipe. Often times the physical condition of the pipe material would allow for many years of additional service life.

The NDDOT desires to evaluate methods to permanently repair separated and misaligned pipe to avoid the expense of replacement. Repair methods should return the pipe to its intended design function and allow the pipe to remain in place for the manufacturer’s suggested service life.

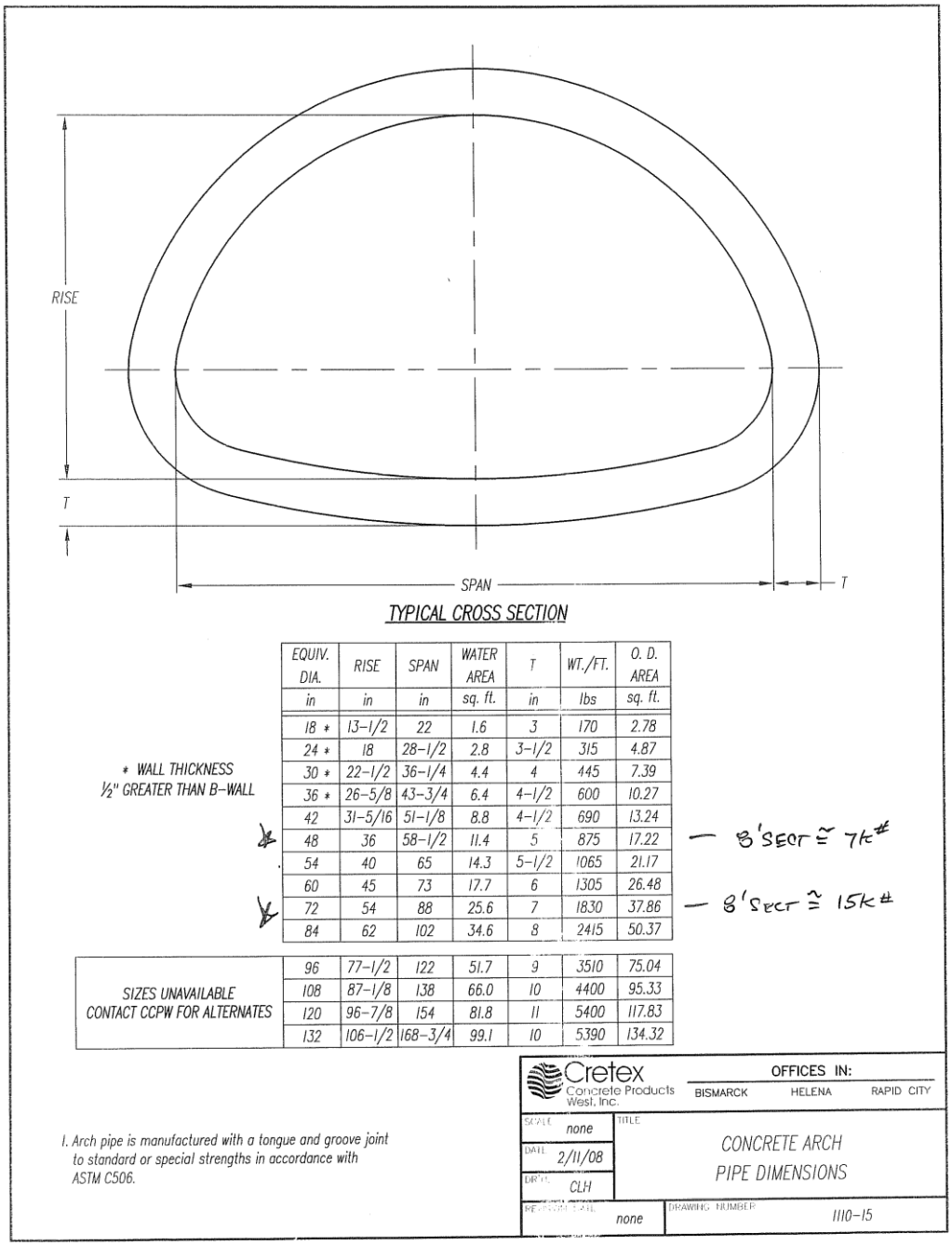
Objective

NDDOT Materials and Research personnel will work with District and pipe industry representatives to select and design potential solutions to the problem. Several products and repair methods will be used and evaluated. The project will be used to evaluate different materials and techniques, and develop cost comparisons for the repair methods.

Location

The evaluation will be conducted on two sections of 88 inch span arch pipe on

Interstate 29 north bound near reference point 75, north of Fargo, ND. These pipes exhibit the conditions described in the above Purpose and Need statement. The design of the arch pipe segments are shown in figure 1 and a map showing the location of the two arch pipes is shown in figure 2 on the next page.



EQUIV. DIA. in	RISE in	SPAN in	WATER AREA sq. ft.	T in	WT./FT. lbs	O. D. AREA sq. ft.
18 *	13-1/2	22	1.6	3	170	2.78
24 *	18	28-1/2	2.8	3-1/2	315	4.87
30 *	22-1/2	36-1/4	4.4	4	445	7.39
36 *	26-5/8	43-3/4	6.4	4-1/2	600	10.27
42	31-5/16	51-1/8	8.8	4-1/2	690	13.24
48	36	58-1/2	11.4	5	875	17.22
54	40	65	14.3	5-1/2	1065	21.17
60	45	73	17.7	6	1305	26.48
72	54	88	25.6	7	1830	37.86
84	62	102	34.6	8	2415	50.37
96	77-1/2	122	51.7	9	3510	75.04
108	87-1/8	138	66.0	10	4400	95.33
120	96-7/8	154	81.8	11	5400	117.83
132	106-1/2	168-3/4	99.1	10	5390	134.32

Figure 1: Cretex Arch Pipe Design (typical)

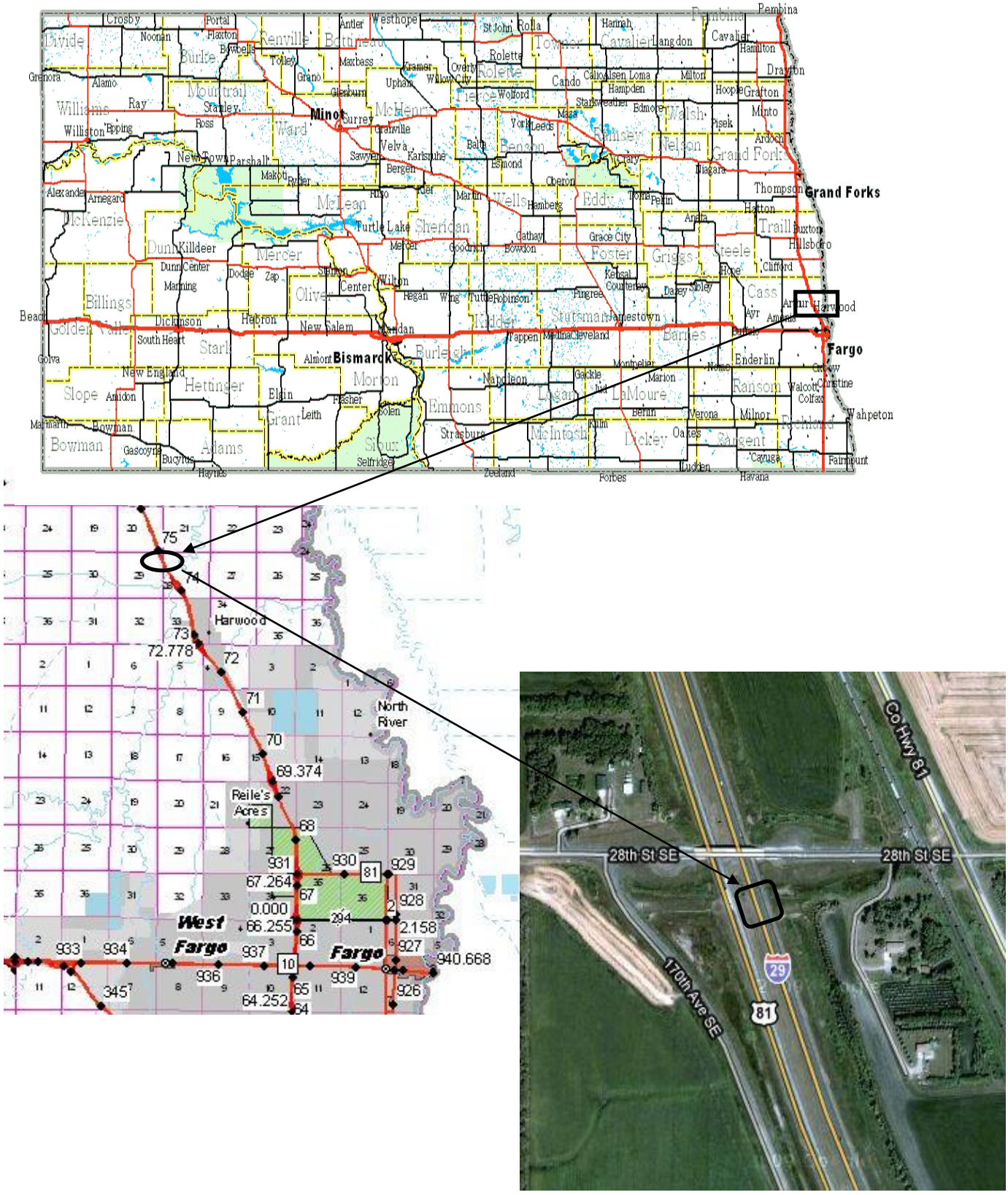


Figure 2: Twin Arch Pipes on Interstate 29 Near RP 75

Representatives from Cretex (concrete pipe manufacturer) conducted an inspection of the southern pipe line and noted the following conditions:

- *Joint #1 - (Female flared end to pipe)3/4 inch gap all around (male end of the first piece of pipe had a portion broken out on the haunch)*
- *Joint #2 - 2 1/2 inch gap from haunch to haunch.*
- *Joint #3 - 2 3/4 inch gap on the top of the pipe and 1 1/2 inch gap on the sides Joint #4 - This joint was tight*
- *Joint #5 - 1 3/4 inch gap on the top and 1 1/4 inch gap on the sides*
- *Joint #6 - 3/4 inch gap from haunch to haunch.*
- *Joint #7 - 3/4 inch gap from haunch to haunch.*
- *Joint #8 - 2 inch gap on the top and 1 inch gap on the sides (Refer to picture 29-001 as to the section of the male end broken out on the south haunch)I could not feel if the male end was broken across the bottom or not (about 8 to 12 inches of mud on bottom.*
- *Joint #9 - This joint was tight*
- *Joint #10 - The male end at this joint was completely gone. There is a 7 inch gap all around the pipe. Refer to picture 29-002 and you can see the male end is gone. Dirt has fallen though this joint into the pipe. Refer to picture 29-003 as to the condition of the 4 foot section that the male end has fallen off. It looks to me like it was over steamed during production and the concrete has surface deterioration.*
- *Joint #11 - 1 1/2 inch gap on top and 1 1/4 inch gap on sides.*
- *Joint #12 - This joint was tight.*
- *Joint #13 - 3/4 inch gap from haunch to haunch.*
- *Joint #14 - 1 1/4 inch gap on top and 3/4 inch gap on sides*
- *Joint #15 - Tight on top and 3/4 inch gap on sides*
- *Joint #16 - Male flared end to pipe-2 3/4 inch gap from haunch to haunch. Refer to picture 20-004 as to the gap and it looks like someone tried to grout the bottom of the pipe.*

The pipe line has anchor holes for tie rods but, it was only tied back three sections. The line was comprised of six foot sections except the middle piece which was a 4 foot.

Photo 1: Depicts terrain at pipe location on I-29, approximately RP 75

Photo 2: Conditions inside pipe, note standing water and algae

Photo 3: Inlet of pipe at roadway median

Photo 4: Condition of separated segment

Photo 5: Condition of Joint #10, missing male section of joint, (inventory reference photo 29-002)

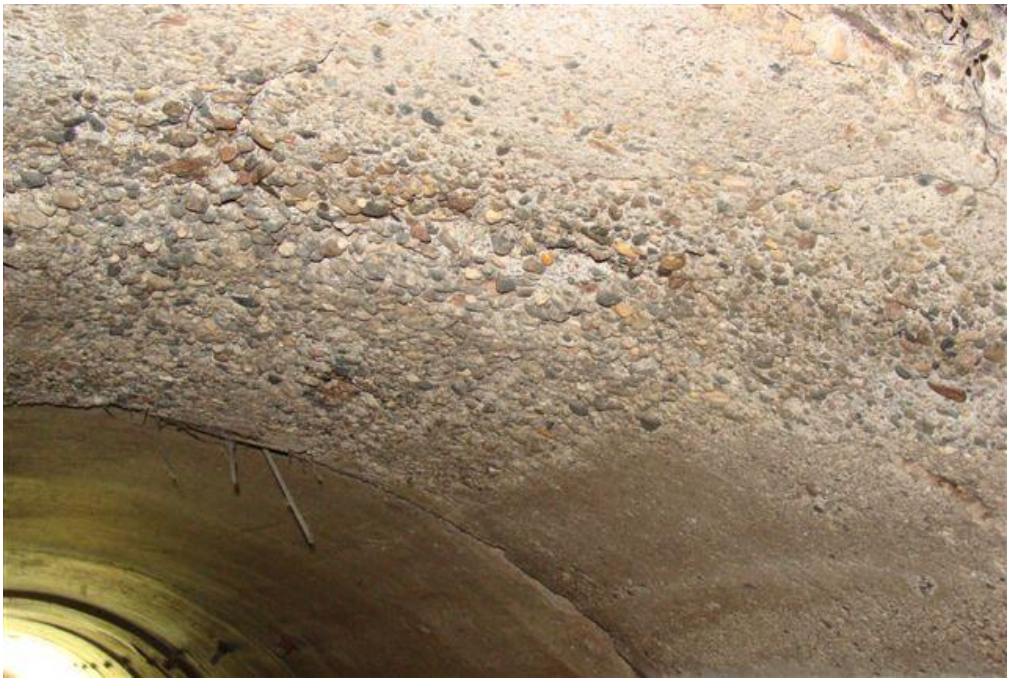


Photo 6: Deteriorated condition of concrete near Joint #10, (inventory reference photo 29-003)

Photo 7: Condition at Joint #14, previous repair (inventory reference photo 29-004)

Design

Materials and methods of repair will be provided by the following:

Cretex, Inc.

- Fill joints with a “Pipe Joint Dry Pack” concrete mix.
- Provide internal ties to Subsurface, Inc.

Subsurface, Inc.

- Build Cofferdam
- Clean out pipes
- Place 900 XLV saturated oakum rope in joints
- Inject 900 XLV behind joints
- Put a surface epoxy on joints when complete.
- Inject 985 Rigid Foam behind pipe for structural support
- Install QuakeWrap under manufacturer representative’s supervision
- Place internal ties between joints in pipe

QuakeWrap, Inc.

- Provide Subsurface with supervision and training for installation of material
- Provide all materials needed for the QuackWrap installation.

Evaluation

M&R will conduct an annual performance evaluation. These pipes are scheduled for replacement on a future project in 2011. At the time of replacement, M&R will observe the removal process and conduct a forensic evaluation of the condition of the pipes and surrounding envelope.

A final report will be written to document the forensic examination and report performance data for the various repair materials and methods.

Construction

Construction started on October 28, 2009. Three contractors were involved with this project: Subsurface Inc., Cretex Inc., and QuakeWrap Inc. The project engineer was Gary Heisler. Materials and Research staff members Andy Mastel and Kyle Evert were present to observe most phases of construction.

A survey of each pipe was conducted by Materials and Research personnel. To easily identify pipe joint locations a number system for the joints was created. The pipes were divided into north and south pipelines. The joints for each pipe were labeled from east to west from 1 to 16. For example on the north pipeline the joint that was farthest to the east side was labeled N1.

At each joint location Materials and Research personnel measured the gap in the joint at the top, bottom, north haunch, and south haunch. A picture was also taken at these locations.

Joint	Top	Bottom	North Haunch	South Haunch	Comments
S1	0.38"	10"	8.0"	5.5"	The male joint was missing haunch to haunch.
S2	0.5"	4.0"	1.5"	3.75"	Joint was misaligned.
S3	2.5"	1.0"	1.5"	1.0"	
S4	1.0"	0.0"	0.0"	0.5"	The bottom of the male end 3.0" in from the joint was showing distress.
S5	2.0"	10.5"	7.0"	7.0"	Male end was in bad condition haunch to haunch.
S6	1.0"	1.0"	1.0"	1.0"	
S7	1.0"	0.5"	1.0"	0.5"	
S8	1.75"	15.0"	0.75"	8.0"	Male end was gone from 5 o' clock to 8 o' clock looking west
S9	0.5"	1.0"	0.5"	0.5"	
S10	7.0"		9.0"	9.0"	Concrete floor 4.0' X 4.0' missing — Male joint was gone.
S11	1.5"		1.0"	2.0"	
S12	0.5"	0.0"	0.0"	0.5"	
S13	0.75"	0.5"	0.75"	1.0"	Male joint was cracked on the bottom and north side of the joint.
S14	1.0"	2.5"	0.5"	1.0"	
S15	0.5"	1.5"	0.75"	1.0"	
S16	0.25"	4.5"	4.0"	3.5"	A fix had been done in the past and was in rough shape.

Table 1: South Pipe Joint measurements

Photo 8: S1 Bottom

Photo 9: S1 North Haunch

Photo 10: S1 South Haunch

Photo 11: S1 Top

Photo 12: S2 bottom

Photo 13: S2 North Haunch

Photo 14: S3 South Haunch

Photo 15: S2 Top

Photo 16: S3 Bottom

Photo 17: S3 North Haunch

Photo 18: S3 South Haunch

Photo 19: S3Top

Photo 20: S4 Bottom

Photo 21: S4 North Haunch

Photo 22: S4 South Haunch

Photo 23: S4 Top

Photo 24: S5 Bottom

Photo 25: S5 North Haunch

Photo 26: S5 South Haunch

Photo 27: S5 Top

Photo 28: S6 Bottom

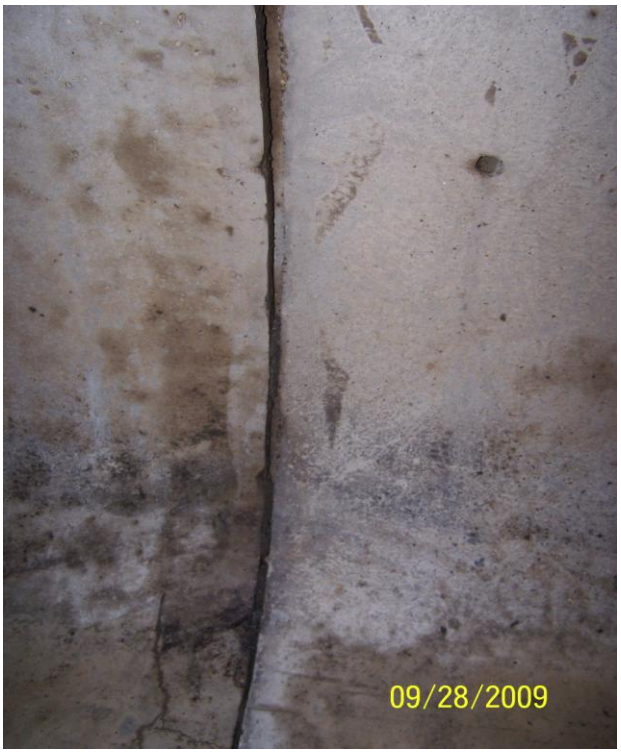


Photo 29: S6 North Haunch

Photo 30: S5 South Haunch

Photo 31: S6 Top

Photo 32: S7 Bottom

Photo 33: S7 North Haunch

Photo 34: S7 South Haunch

Photo 35: S7 Top

Photo 36: S8 Bottom

Photo 37: S8 North Haunch

Photo 38: S8 South Haunch

Photo 39: S8 Top

Photo 40: S9 Bottom

Photo 41: S9 North Haunch

Photo 42: S9 South Haunch

Photo 43: S9 Top

Photo 44: S10 Bottom 1

Photo 45: S10 North Haunch

Photo 46: S10 South Haunch

Photo 47: S10 Top

Photo 48: S11 Bottom

Photo 49: S11 North Haunch

Photo 50: S11 South Haunch

Photo 51: S11 Top

Photo 52: S12 Bottom

Photo 53: S12 North Haunch

Photo 54: S12 South Haunch

Photo 55: S12 Top

Photo 56: S13 Bottom

Photo 57: S13 North Haunch

Photo 58: S13 South Haunch

Photo 59: S13 Top

Photo 60: S14 Bottom

Photo 61: S14 North Haunch

Photo 62: S14 South Haunch

Photo 63: S14 Top

Photo 64: S15 Bottom

Photo 65: S15 North Haunch

Photo 66: S15 South Haunch

Photo 67: S15 Top

Photo 68: S16 Bottom 2

Photo 69: S16 North Haunch

Photo 70: S16 South Haunch

Photo 71: S16 Top

Joint	Top	Bottom	North Haunch	South Haunch	Comments
N1	0.5"	2.25"	1.5"	2.25"	
N2	.25"	1.0"	1.0"	0.75"	
N3	2.0"	11.0"	7.5"	1.5"	The concrete on the male lap was broken on the bottom and north side.
N4	0.0"	0.5"	0.5"	0.0"	
N5	1.75"	1.5"	1.0"	1.5"	
N6	0.5"	0.75"	1.0"	0.5"	
N7	0.75"	0.5"	0.5"	0.5"	
N8	1.0"	0.5"	0.5"	0.5"	
N9	0.5"	9.0"	0.75"	0.75"	The bottom was broke out on the male end in the shape of a half circle with a 9.0" radius.
N10	0.75"	1.5"	1.0"	1.25"	
N11	1.25"	1.0"	1.5"	0.75"	
N12	1.25"	0.5"	0.0"	1.0"	
N13	2.0"	15.0"	3.0"	0.0"	An oval on the bottom was broken out on the male end 28.0" wide.
N14	0.75"	2.5"	1.75"	1.5"	The concrete on the male end was broken out haunch to haunch.
N15	0.5"	2.5"	0.75"	1.75"	
N16	6.0"	5.0"	4.75"	1.0"	Joint was misaligned and separated.

Table 2: North Pipe Joint measurements

Photo 72: N1 Bottom

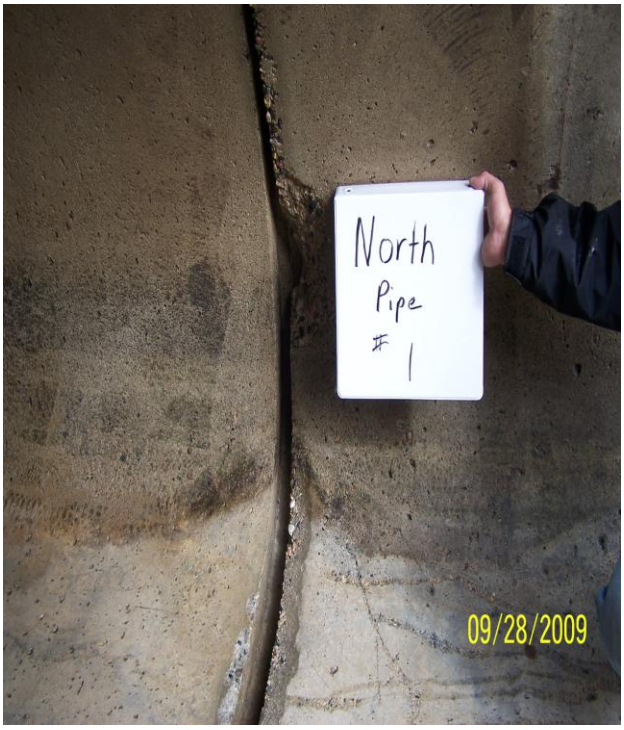


Photo 73: N1 North Haunch

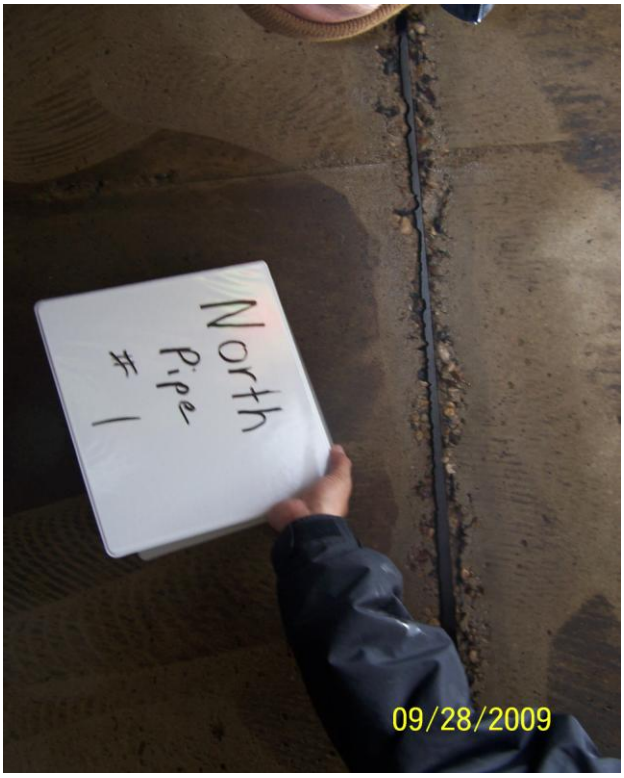


Photo 74: N1 Top

Photo 75: N1 South Haunch

Photo 76: N2 Bottom

Photo 77: S5 North Haunch

Photo 78: N2 Top

Photo 79: N2 South Haunch

Photo 80: N3 Bottom

Photo 81: N3 North Haunch

Photo 82: N3 Top

Photo 83: N3 South Haunch

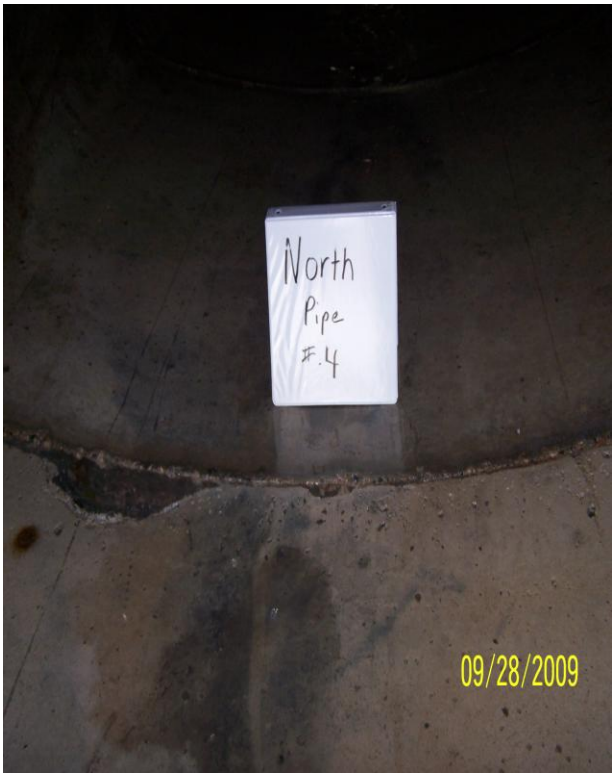


Photo 84: N4 Bottom

Photo 85: N4 North Haunch

Photo 86: N4 South Haunch

Photo 87: N4 Top

Photo 88: N5 Bottom

Photo 89: N5 North Haunch

Photo 90: N5 South Haunch

Photo 91: N5 Top

Photo 92: N6 Bottom

Photo 93: N6 North Haunch

Photo 94: N6 South Haunch

Photo 95: N6 Top

Photo 96: N7 bottom

Photo 97: N7 North Haunch

Photo 98: N7 South Haunch

Photo 99: N7 Top

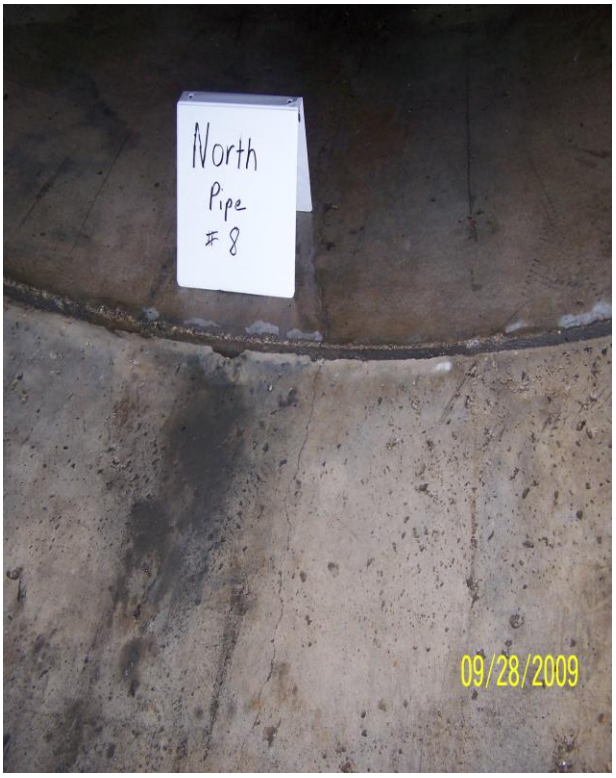


Photo 100: N8 Bottom

Photo 101: N8 North Haunch

Photo 102: N8 South Haunch

Photo 103: N8 Top

Photo 104: N9 Bottom

Photo 105: N9 North Haunch

Photo 106: N9 South Haunch

Photo 107: N9 Top

Photo 108: N10 Bottom

Photo 109: N10 North Haunch

Photo 110: N10 South Haunch

Photo 111: N10 Top

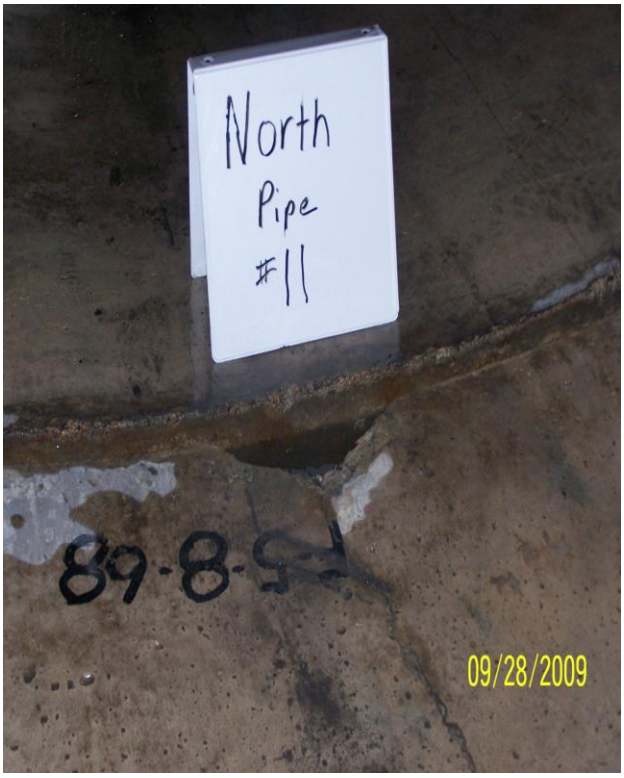


Photo 112: N11 Bottom

Photo 113: N11 North Haunch

Photo 114: N11 South Haunch

Photo 115: N11 Top

Photo 116: N12 Bottom

Photo 117: N12 North Haunch

Photo 118: N12 South Haunch

Photo 119: N12 Top

Photo 120: N13 Bottom

Photo 121: N13 North Haunch

Photo 122: N13 South Haunch

Photo 123: N13 Top

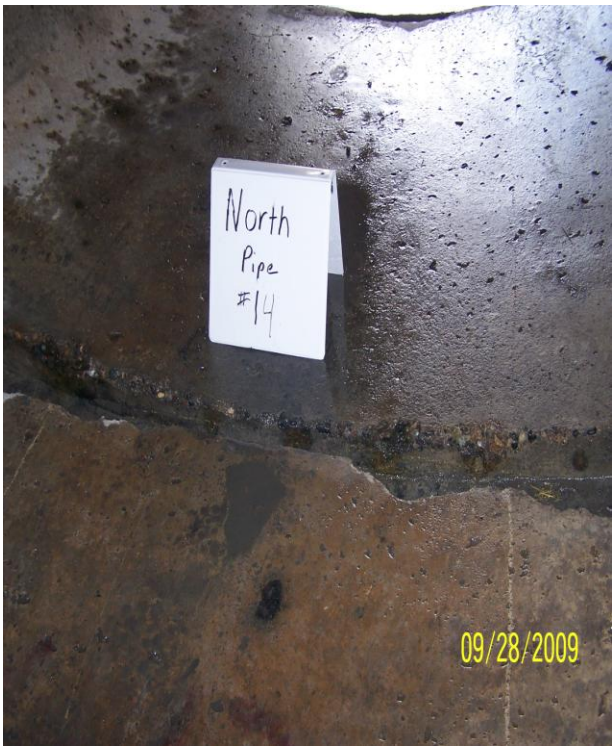


Photo 124: N14 bottom

Photo 125: N14 North Haunch

Photo 126: N14 South Haunch

Photo 127: N14 Top

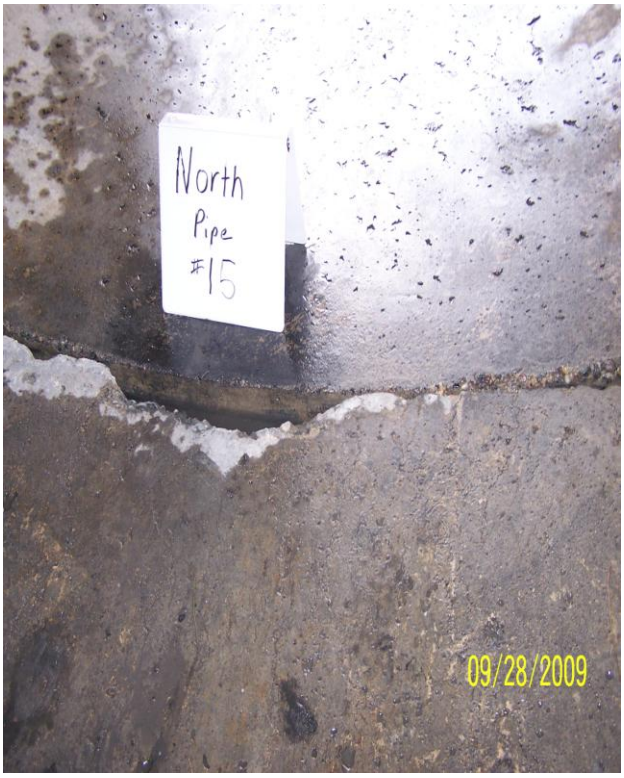


Photo 128: N15 Bottom

Photo 129: N15 North Haunch

Photo 130: N15 South Haunch

Photo 131: N15 Top

Photo 132: N16 Bottom

Photo 133: N16 North Haunch

Photo 134: N16 South Haunch

Photo 135: N16 Top

After the pipes were cleaned out, NDDOT and Subsurface Inc. evaluated the pipes and selected the appropriate repair method for each joint. Table 3 shows who did work on each of the joints and the repair method used. Details of the repair methods used will be discussed throughout the report.

Joint	Contractor (Repair Method)	Joint	Contractor (Repair Method)
S1	Cretex (D.P.M), Subsurface (O.R.F.R.)	N1	Subsurface (O.R.F.R.)
S2	Subsurface (O.R.F.R.)	N2	Subsurface (O.R.F.R.)
S3	Subsurface (O.R.F.R.) + (I.T.)	N3	Subsurface (C.P.+O.R.F.R.) + (I.T.)
S4	Subsurface (C.P.+O.R.F.R.)	N4	Subsurface (O.R.F.R.)
S5	Cretex (D.P.M), Subsurface (O.R.F.R.) + (I.T.)	N5	Subsurface (O.R.F.R.), QuackWrap (W.L.C.F.F.)
S6	Subsurface (O.R.F.R.) + (I.T.)	N6	Subsurface (O.R.F.R.), QuackWrap (W.L.C.F.F.)
S7	Subsurface (O.R.F.R.) + (I.T.)	N7	Subsurface (O.R.F.R.) + (I.T.)
S8	Cretex (D.P.M), Subsurface (O.R.F.R.) + (I.T.)	N8	Subsurface (O.R.F.R.) + (I.T.)
S9	Subsurface (O.R.F.R.) + (I.T.)	N9	Subsurface (C.P.+O.R.F.R.) + (I.T.)
S10	Cretex (R.C.), Subsurface (O.R.F.R.)	N10	Subsurface (O.R.F.R.) + (I.T.)
S11	Cretex (R.C.), Subsurface (O.R.F.R.)	N11	Subsurface (O.R.F.R.), QuackWrap (W.L.F.F.)
S12	Subsurface (O.R.F.R.)	N12	Subsurface (O.R.F.R.), QuackWrap (W.L.F.F.)
S13	Subsurface (C.P.+O.R.F.R.)	N13	Subsurface (C.P.+O.R.F.R.)
S14	Subsurface (O.R.F.R.)	N14	Subsurface (C.P.+O.R.F.R.)
S15	Subsurface (O.R.F.R.)	N15	Subsurface (O.R.F.R.)
S16	Subsurface (C.P.+O.R.F.R.)	N16	Subsurface (C.P.+O.R.F.R.)

Table 3: Contractor and Repair Methods Used

Cretex (D.P.M.) = Dry Pack Method
Cretex (R.C.)= Regular Concrete
Subsurface (O.R.F.R.) = Oakum Rope and Flexible Resin
Subsurface (C.P.+O.R.F.R.) = Concrete Patch + Oakum Rope and Flexible Resin
QuackWrap (W.L.C.F.F.)= Wet Layup using Carbon Fiber Fabric
QuackWrap (W.L.F.F.) = Wet Layup using Fiberglass Fabric
Internal Tie (I.T.) = Internal Tie Was Installed

Cretex Inc.

On 9/30/09 Cretex conducted their repairs to the pipes. Weather did not affect construction on this day.

Cretex filled in the bottom of three separated joints, S1, S5, and S8 with a concrete mix called “joint dry pack.” This is an eight bag mix with a water-cement ratio of 0.30.

Cretex also patched a section of pipe where the concrete floor was missing. This was between joints S10 and S11. The repair area was initially cleaned out using Subsurface's vacuum. Cretex tied wire mesh to the existing steel reinforcement and then filled the missing floor section with concrete. They used a conventional concrete mix that was made at a ready mix plant nearby.

Cretex provided three workers and materials for one day at no cost. Cretex also provided internal joint ties that were used after the rest of the repair methods were completed.

Photo 136: Cretex tied wire mesh to existing steel reinforcement and then filled deteriorated section with concrete

Subsurface Inc.

Subsurface Inc. provided the majority of the labor on this project. They first built the cofferdam, dewatered the pipes, and cleaned them out. Subsurface dealt with cold temperatures and several moisture events. A project timeline in Table 4 is included that shows where the delays occurred. Subsurface pumped water out of the pipes after the moisture events and heated the pipes to remedy the cold conditions.

Subsurface then performed concrete patching where needed. The patching locations were designated by the project engineer and a Subsurface representative. The locations are outlined in Table 3. The repair mortar that Subsurface used was

called Verticote Supreme.

Photo 137: Subsurface did joint rehabilitation with a product called Verticote Supreme

Subsurface then began sealing the joints in the pipes. This was done by soaking oakum rope in a resin called Prime-Flex 900 XLV. The resin is a water-activated flexible foam that expands up to 600%. The saturated rope was dipped into water and immediately placed into the joint. The rope was hand placed and the workers used a putty knife when needed.

The material is fully expanded in about ten minutes and fully cured in fifteen minutes. This was done to every joint in the two pipes, excluding the bottom of the five joints that Cretex performed repairs on.

At this point the inside of the joints were filled with the oakum rope and flexible foam combination and allowed to dry. Subsurface then drilled holes at an angle and injected the outside portions of the joint with the 900 XLV foam which is pictured in Photo 139.

Now the entire joint was filled with flexible foam. However, inside the pipe joints there was excess flexible foam. This was trimmed by means of a reciprocating saw and then ground smooth with a grinder and buffing wheel. On the north pipe a surface epoxy was applied to the joints, except joints N5,N6,N11, and N12, which received QuakeWrap's repair;. The surface epoxy was called Prime Gel 2200 Flexible. Surface

epoxy was not applied to the joints on the south pipeline.

Photo 138: Oakum Rope and 900 XLV Foam expanded in pipe joint.

Photo 139: Subsurface injecting flexible foam

The next step was to inject rigid foam around the outside of these pipes to fill voids. This was done by drilling injection holes with a hammer drill throughout the pipe. Two sets of six holes were drilled in each section, centered and equally spaced around

the inner circumference of the pipe.

The rigid foam called PRIME-FLEX 985 is a two-component rigid foam that expands up to 20 times its original volume.

Photo 140: One half gallon of 985 Rigid Foam after expansion

After all construction was completed Subsurface used internal ties (see Photo 141), which were supplied by Cretex, to tie some pipe joints together. In the south pipe joints 3,5,6,7,8, and 9 had internal ties installed. In the north pipe joints 3,7,8,9, and 10 had internal ties installed. Internal joint ties were not installed to the four joints that received QuakeWrap's repair. All material data sheets for products that Subsurface used are in Appendix B.

Photo 141: Internal pipe tie installed.

QuakeWrap Inc.

A QuakeWrap Inc. representative was onsite to assist and supervise Subsurface with the installation of their product. Subsurface completed the process to seal a joint, which invoved using oakum rope combined with water-activated flexible foam and injecting flexible foam behind the initial seal made by the rope and foam system, prior to installing QuakeWrap's repair method.

Rain and cold weather were factors during the QuakeWrap installation. The QuakeWrap representative stated that the pipe should be completely dry for 24 hours after installation for curing. He stated that he wanted the pipe above freezing at all times. Subsurface rented an enclosed trailer for prepping the materials and kept the pipe heated to minimize the duration for proper cure. A significant moisture event delayed the QuakeWrap installation for nearly four days. After the moisture event the water was pumped out and the pipe had to be completely dry before installation.

The method used was called a wet lay-up method. The installation began by pre-saturating fabric with a resin called QuakeBond^{TM} J300SR. Two types of fabrics were tried on two joints each. One fabric is called TB20C Carbon Fiber and the other is called VB26G Glass Fabric.

The fabric saturating process was done in an onsite job trailer. Resin was also placed on the top of the fabric. Squeegees were then used to spread the Resin and obtain complete saturation. The saturated piece of fabric was placed onto a PVC pipe to transport the saturated fabric into the pipe for installation.

Photo 142: QuakeWrap being saturated before installation

Inside the pipe a tack coat called QuakeBond™ J201TC was placed on the sides and top to hold the fabric up. The saturated fabric was then placed around the pipe. Workers used squeegees to get any wrinkles out of the material. Two layers of fabric were placed on each joint.

The installation of the QuakeWrap product is then allowed to dry. This product needed to be dry for 24 hours to properly cure. All material product data sheets are included in Appendix C.

Photo 143: QuakeBond™ J201TC Tack Coat being installed. Does not need to be placed on the bottom.

Photo 144: QuakeWrap™ TB20C Carbon Fabric being installed

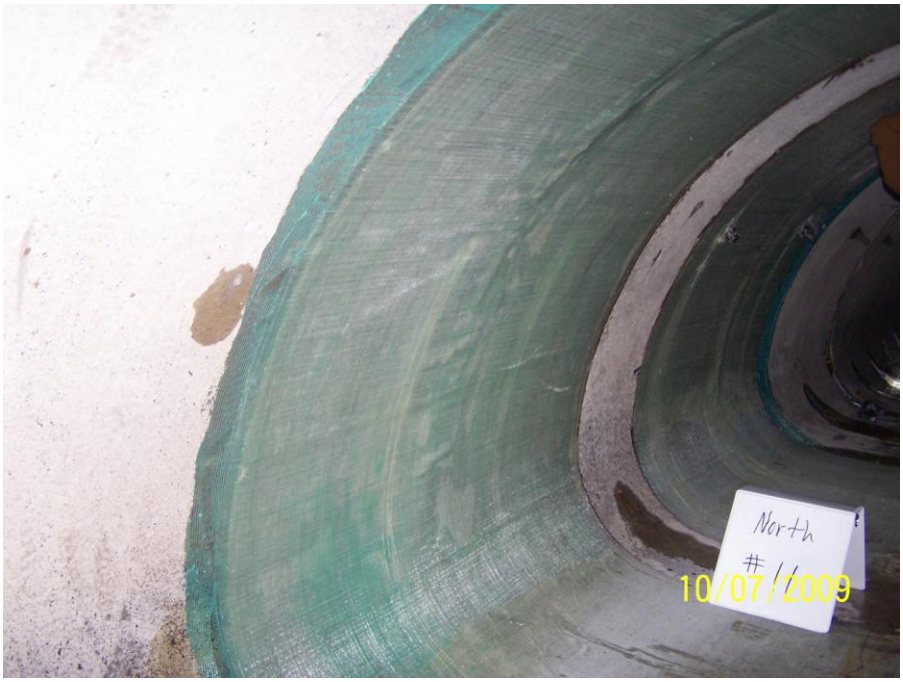


Photo 145: QuakeWrap™ VB26G Glass Fabric installed

Construction Summary

Cretex Inc. performed their dry pack method on three joints. They also used conventional concrete to repair a deteriorated floor. They were on the jobsite for one day with three workers. A summary of the work performed by each contractor is included along with a timeline and weather data for the project duration.

Cretex, Inc.

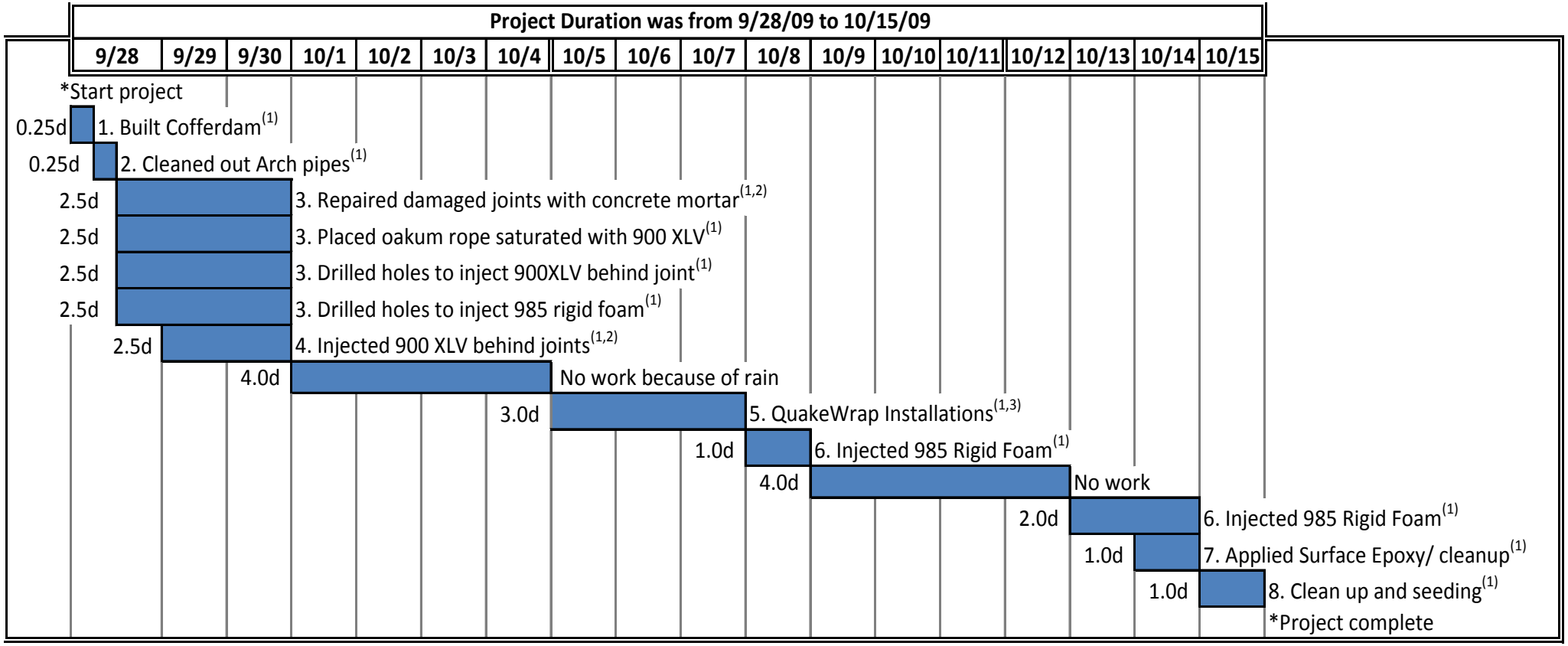
- Filled bottom of three joints with a “Pipe Joint Dry Pack” concrete mix.
- Restored bottom of pipe section with steel reinforcement and a conventional concrete mix.
- Provided internal ties to Subsurface, Inc.
- No cost to the NDDOT

Subsurface, Inc.

- Built a Cofferdam.
- Cleaned out pipes by means of a pressure washer.
- Re-established joints with Verticote Supreme mortar mix where needed. Placed 900 XLV saturated oakum rope in joints.
- Injected 900 XLV behind the joints.
- Put a surface epoxy on the joints on the north pipeline when complete.
- Injected 985 Rigid Foam behind pipe for structural support to fill voids.
- Installed QuakeWrap's products under manufacturer representative's supervision.
- Placed internal ties between joints in pipe except on the joints where QuakeWrap's product was installed.
- The total Subsurface materials and labor was $93,520. The 985 Rigid Foam injection cost was $52,000 of the total cost.

QuakeWrap, Inc.

- Provided Subsurface with supervision and training for the installation of their materials.
- Provided all materials needed for QuakeWrap's repair method.
- The cost of materials and onsite supervision was $18,910.00.



Key

* Project timeline is an approximation of the timeing as each each activity occurred to the best of Materials and Research's knowledge.

*Materials and Research were not onsite at all times.

*activities are listed in chronological order

0.25 d = 0.25 work days

1.0 work day = 10 hours

The Superscripts following each activity represent the contractors for each activity and are listed below:

(1) Subsurface Inc.

(2) Cretex Inc.

(3) QuakeWrap Inc.

Table 4: Project Timeline

Date	Low/High Temperature	Wind speed	Precipitation	Contractors Onsite
9/28/2009	- F	22 to 25	0	Subsurface
9/29/2009	- F	7 to 12	0	Subsurface
9/30/2009	- F	15 to 20	0	Subsurface, Cretex
10/1/2009	F - F	15 to 25	0.45"	
10/2/2009	- F	12 to 23	1.66"	
10/3/2009	- F	10 to 17	0.15"	
10/4/2009	- F	8 to 11	0.02"	Subsurface
10/5/2009	- F	6 to 11	0	Subsurface
10/6/2009	- F	10 to 18	0.21"	Subsurface, QuackeWrap
10/7/2009	- F	12 to 17	0.21"	Subsurface, QuackeWrap
10/8/2009	- F	14 to 16	0.01"	Subsurface, QuackeWrap
10/9/2009	- F	8 to 20	0	
10/10/2009	- F	16 to 20	0	
10/11/2009	F - 3 F	9 to 11	0	
10/12/2009	- F	4 to 10	0.03"	Subsurface
10/13/2009	- F	3 to 6	0	Subsurface
10/14/2009	- F	7 to 13	0.18"	Subsurface
10/15/2009	- F	6 to 11	0.70"	Subsurface

Table 5: Weather data at the Hector International Airport taken from almanac.com

The repairs required for this project were; rehabilitating misaligned or damaged joints, sealing open joints, and filling voids behind the pipe. The following comments relate to construction activities.

The “Dry Pack” method ,that was performed by Cretex, worked only for patching and sealing the bottom portion of the joint. It could not be used above the spring line. Work by others was required to seal the joint above the spring line and fill voids.

Subsurface was able to rehabilitate joints, seal all joints, and fill voids behind the pipe with rigid foam.

The QuakeWrap product required tight joints that were not misaligned. This product did not rehabilitate the joint, seal the joint, or fill voids. Work by others was required before installation. This product does provide structural support and waterproofing of the joint.

This project started October 28, 2009 and was completed on November 15, 2009. The total cost of the pipe repairs was $112,430 plus prime contractor markup of $3,722.90 for a total of $116,152.90. The change order for this

project is included in Appendix E

Pipe Excavation

Photo 146: Northern Improvement removing I-29 arch pipe section.

On June 13, 2011 the twin arch pipes that were repaired in 2009 were excavated in accordance with a plan note that was developed to allow the NDDOT to obtain as much information as possible. The general contractor was Northern Improvement. The plan note 202-PO2 is as follows:

202-P02 REMOVAL OF PIPE AT STATION 3958+00**:** Field Repairs to the 88" x 54", twin arch RCP located near Reference Point 75 were conducted under NDDOT experimental project ND 09-01. The research included experimental methods and materials for the repair of RCP joints on the interior of the pipes and filling of embankment voids on the exterior of the pipes. A forensic evaluation of these experimental features will be conducted by Materials & Research (M&R) in conjunction with the pipe removal and replacement by the Contractor. The M&R evaluation of the pipes will be conducted in two phases:

Phase I: Evaluation of the pipe interior condition

Prior to removal of concrete pavement surfacing, the Contractor shall provide the following

- 48 hour notice will be given to the Project Engineer and M&R prior to the completion of dewatering activities.
- a method to dewater existing pipes and maintain access to the interiors of both pipes for a 48 hour period during normal work days. M&R personnel will be on site to observe conditions inside the pipe.
- all cost of labor, equipment, and material shall be included in the price bid for the "Removal of Pipe-All Types and Sizes".

Phase II.a: Removal of Pavement

During the removal of the pavement, the Contractor shall provide the following;

- 48 hour notice will be given to the Project Engineer and M&R prior to the removal of pavement above the experimental feature and existing pipe.
- a work zone 100 ft each side of the pipes that shall be used by the Contractor and NDDOT during the forensic evaluation.
- a method to remove concrete pavement by lifting with adequately sized equipment that will minimize disruption to the existing subgrade and underlying embankment material at the pipe locations. Construction equipment will not be allowed in the areas where the concrete has been removed. M&R personnel will be on site to observe the conditions below the pavement.
- all cost of labor, equipment, and material relating to pavement removal shall be included in the price bid "Removal of Pavement".

Phase II.b: Evaluation of the embankment and exterior of the pipe.

During the removal of the existing pipes, the Contractor shall provide the following;

- 48 hour notice will be given to the Project Engineer and M&R prior to excavation and removal of experimental feature and existing pipe.
- a smooth edge excavator to remove embankment material surrounding the pipe. M&R personnel will be present during the excavation.
- excavate the pipe embankment material in six (6) inch lifts to allow observation of the embankment layers above and beside the pipes, as directed by the Engineer. M&R personnel will be on site to observe the conditions during the excavation of embankment material.
- a method to maintain access to the exteriors of both pipes during the removal process. The Contractor's embankment removal work may be periodically interrupted for purposes of evaluating and documenting the conditions of the experimental feature.
- all cost of labor, equipment, and material relating to pipe removal and replacement shall be included in the price bid for "Removal of Pipe-All Types and Sizes".

Materials and Research personnel (Andy Mastel and Matt Luger) and a

Subsurface Inc. representative (Kenny Molds) observed the entire excavation of the twin arch pipes. A cofferdam was setup and the pipes were dewatered. The pipes were then cleaned with a broom and shovel.

While inspecting the pipe interior M & R took several photos and looked at each joint and type of repair before excavation. The photos and observations of each type of repair done in 2009 are summarized in the next several pages.

Joint repair using the "Dry Pack Method"

Photo 147: After repair in 2009

Photo 148: Just before excavation in 2011"

The "Dry Pack" concrete mix was still in good condition before excavation. This was an 8 bag mix and can only be installed below the spring line.

Reestablishing the joint with cement mortar

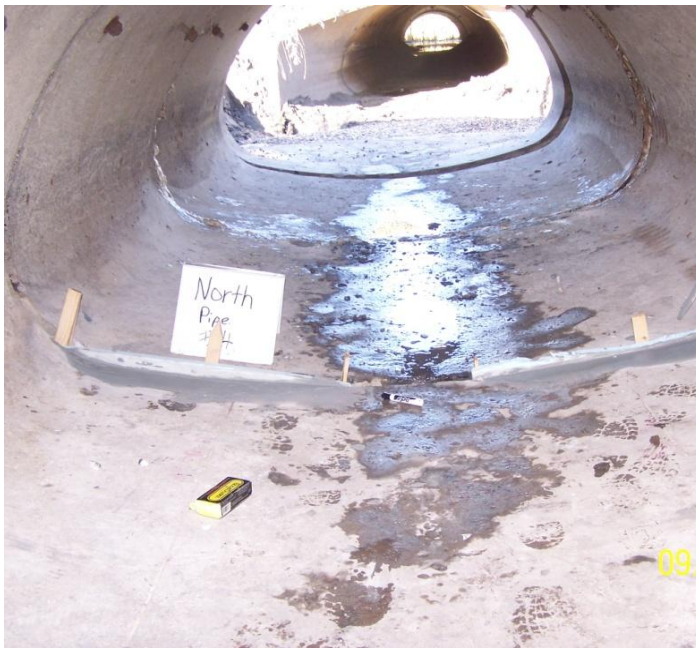


Photo 129: Joint repair in 2009

Photo 150: Joint repair before excavation in 2011

The repairs shown above were done with a mortar patch mix. They were used to reestablish the original joint allowing the contractor to install a flexible seal into the joint. They were in good condition before excavation.

Concrete Floor Repair

Photo 151: Floor repair in 2009

Photo 152: Floor repair in 2011

The concrete floor repair was in good shape before removal. It had been repaired with a standard NDDOT 6 bag mix in 2009.

Joint Sealing with Saturated Oakum Rope and Flexible Foam Injection

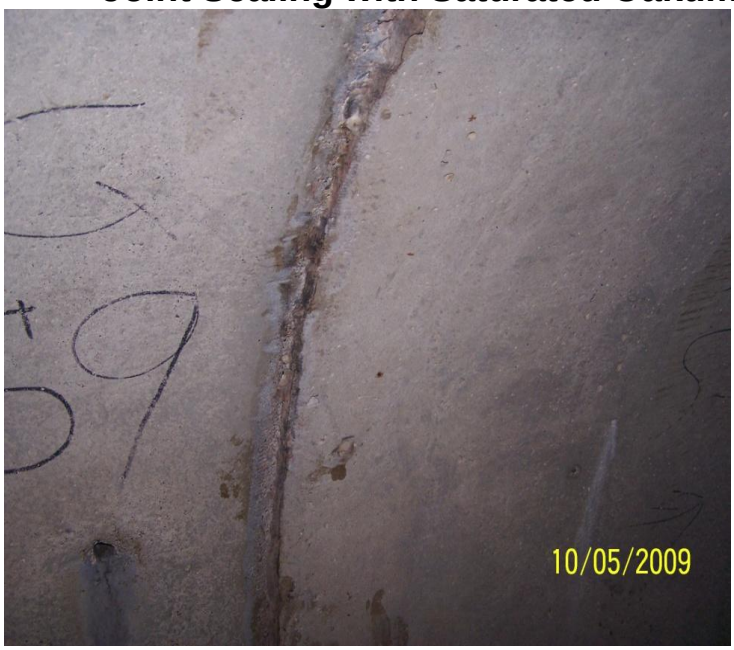


Photo 153: Joint seal in 2009.

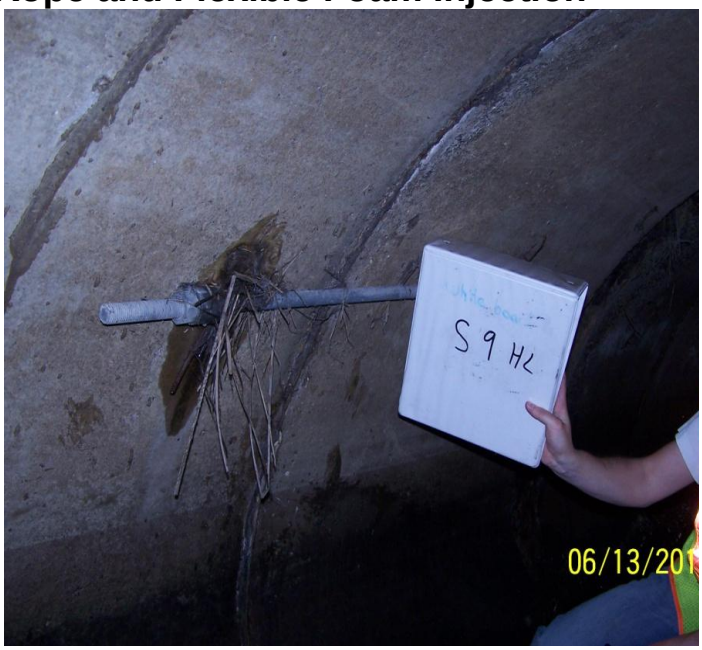


Photo 154: Joint seal in 2011

The joints pictured above were sealed at the time of excavation. The material

had a spongy feel to it. A surface epoxy should be used to ensure longevity.

Below in photo 156 a retrofitted tie bar was installed.

Surface Epoxy

Photo 155: Surface epoxy in 2009

Photo 156: Surface epoxy in 2011

Half of the joints during the pipe repair had a surface epoxy installed. The surface epoxy and concrete did not bond well. Subsurface stated that they have started to use a different product for that portion of their pipe repairs.

Carbon Fiber QuakeWrap

Photo 157: Carbon Fiber in 2009

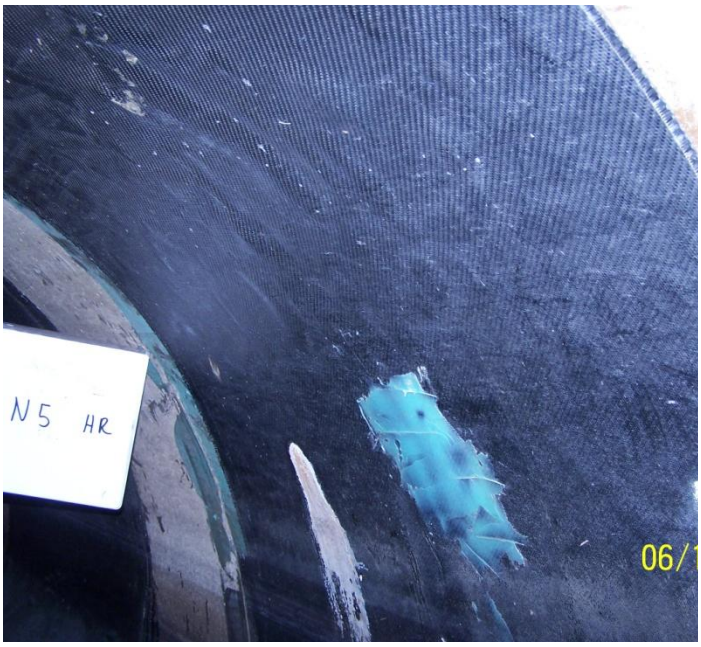


Photo 158: Carbon Fiber in 2011

Fiberglass QuakeWrap

Photo 159: Fiberglass in 2009

Photo 160: Fiberglass in 2011

The QuakeWrap (Carbon Fiber and Fiberglass) bonded to the concrete very well and those joints remained sealed and didn't show any signs of movement.

After the pipe interior inspection was conducted the contractor began to remove the pavement above the pipes. The concrete was cut into 10' x 4' slabs within the experimental work zone. A backhoe was used to remove each slab individually.

Photo 161: Work zone for forensic excavation.

Photo 162: Slabs cut into 10' x 4' slabs to be removed.

Six voids were found directly under the pavement. One of the six was filled with rigid foam, two were partially full, and three did not contain rigid foam. The voids could be described as bowl shaped and are shown on the next four pages.

Photo 163: Void 1 that had been filled with rigid foam.

Photo 164: Backhoe removing concrete slab.

Photo 165: Void 2 directly under the pavement surface.

Photo 166: Void 2 top view shows some rigid foam in void.

Photo 167: Void 3 directly under pavement surface.

Photo 168: Void 4 directly under the pavement that was ¾ full of rigid foam.

Photo 169: Void 5 directly under pavement surface.

Photo 170: Void 6 directly under pavement surface.

The tape in the two Photos below is being pulled over the centerline of each arch pipe. Voids 1,2, and 3 were found over the south pipe.

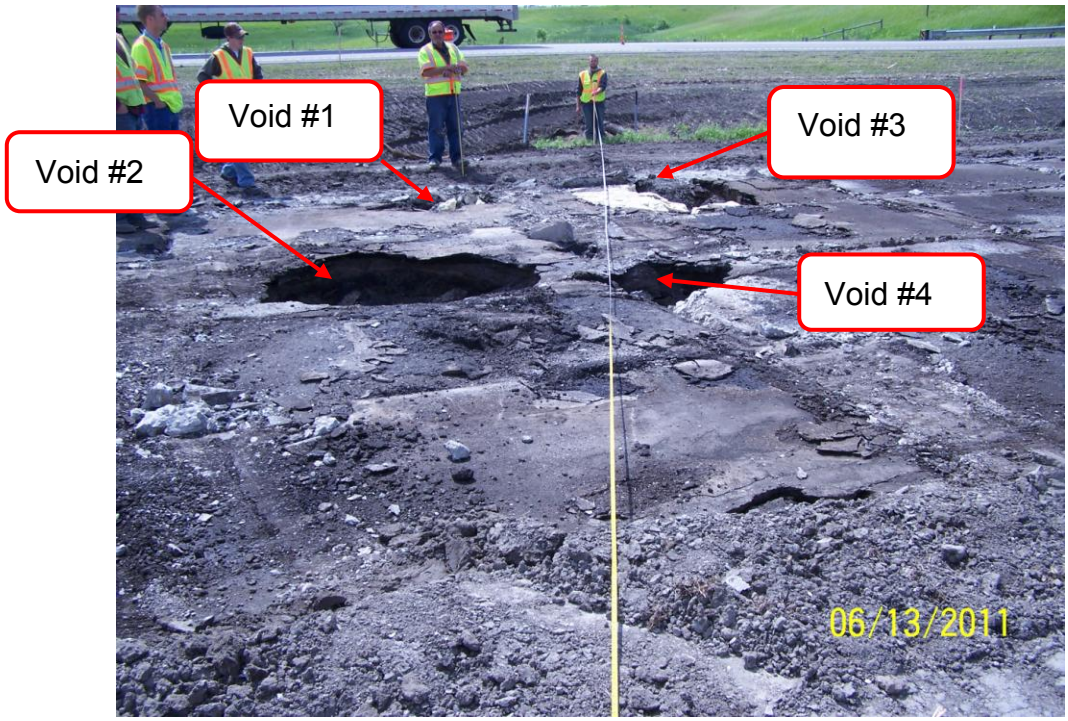


Photo 171: Voids over south pipe after pavement removal.

Voids 4 and 5 were found over the north pipe.

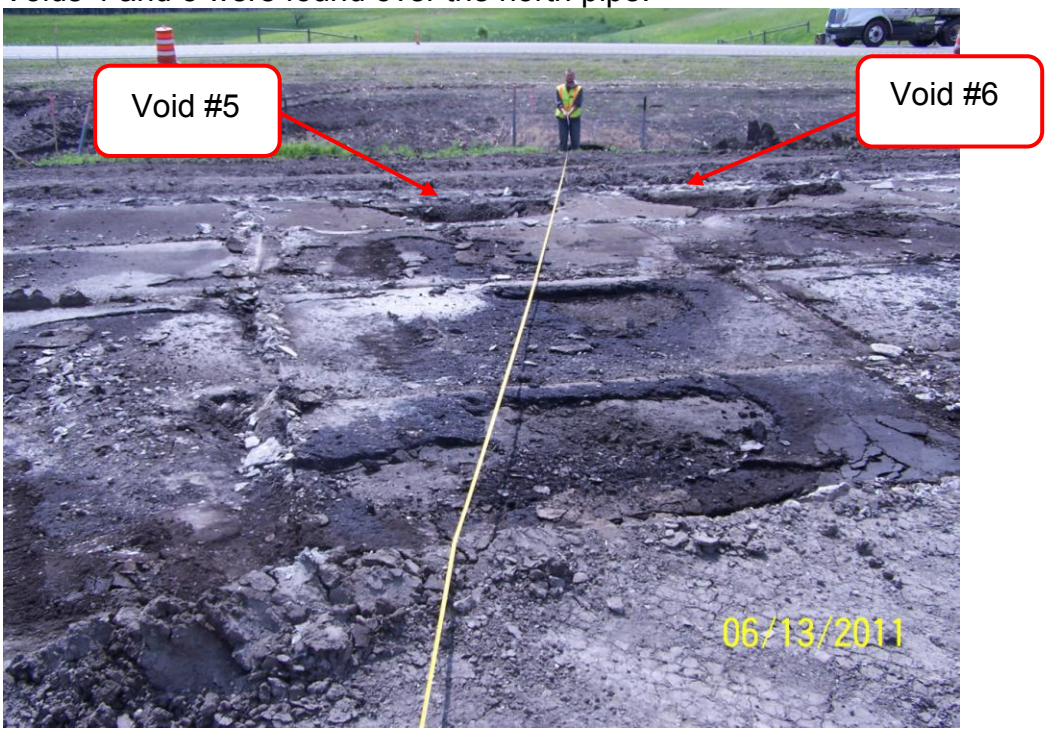


Photo 172: Voids over north pipe after pavement removal.

Approximate volumes of the five voids are in the table below. Voids were calculated by taking the maximum length x maximum width x maximum depth divided by two.

Void #	Distance From CL of pipe (ft)	Max Length (ft)	Max Width (ft)	Max Depth (ft)	Approximate Volume (ft^3)
2	1.25	5	3	3	22.5
3	0	3	2	1	3
4	0	5	4.5	N/A*	N/A*
5	0	4	3	2	12
6	2.25	4	3	2	12

Table 6: Void information

*Void approximately ¾ full of foam.

**Void 1 volume not available.

Northern Improvement then began removal of the embankment and exteriors of the pipes. Materials and Research observed the rigid foam when it was encountered and stopped excavation to observe the condition of the material. Most of the rigid foam was near the top of the pipe. The rigid foam was about the size of a basketball and a handful of areas were found on the north and south pipes.

Photo 173: Rigid foam on the exterior of pipe.

The material that was at the haunch and below formed a thin film on the exterior of the pipe. We did not find any significant amounts of expanded foam below the haunch. The Photo below is a typical example of the area below the haunch after the pipe was removed.

Photo 174: Thin layer of rigid foam found under haunch during excavation.

During the excavation process the sections that had been repaired with QuakeWrap lifted out of the trench together. The backhoe operator commented on how strong the bond was because he couldn't get those sections to separate without breaking the concrete. Photo 176 shows two QuakeWrap sections being removed.

Photo 175: Flexible sealant on the bell side after excavation.

Photo176: Two sections of pipe being held together by QuakeWrap.

Report Summary

Pipe Repairs

Construction started on October 28, 2009. Three contractors were involved with this project: Subsurface Inc., Cretex Inc., and QuakeWrap Inc. The project engineer was Gary Heisler. Materials and Research staff members Andy Mastel and Kyle Evert were present to observe most phases of construction.

The original problem with a lot of NDDOT culverts is they were only tied on the first four sections and have separated since installation causing multiple problems within a pipeline.

The repairs required were; rehabilitating misaligned or damaged joints, sealing open joints, filling voids behind the pipe, and installing internal ties to the pipe segements. The following comments relate to construction activities.

The “Dry Pack Method”, that was performed by Cretex, was used for patching and sealing the bottom portion of the joint. It could not be used above the spring line. Work by others was required to seal the joint above the spring line and fill voids.

Subsurface was able to rehabilitate joints, seal all joints, and fill voids behind the pipe with rigid foam.

The QuakeWrap product required tight joints that were not misaligned. This product did not rehabilitate the joint, seal the joint, or fill voids. Work by others was required before installation. This product does provide structural support and additional waterproofing of the joint.

This project was completed on November 15, 2009. The total cost of the pipe repairs was $112,430 plus prime contractor markup of $3,722.90 for a total of $116,152.90.

Pipe Excavation and Removal

On June 13, 2011 the twin arch pipes that were repaired in 2009 were excavated in accordance with a plan note that was developed to allow the NDDOT to obtain as much information as possible. The general contractor was Northern Improvement.

Materials and Research personnel (Andy Mastel and Matt Luger) and a Subsurface Inc. representative (Kenny Molds) observed the entire excavation of the twin arch pipes.

While inspecting the pipe interior it appeared that all the joints were still sealed. Half of the joints during the pipe repair had a surface epoxy installed. The surface epoxy and concrete did not bond well.

The concrete floor that was repaired in 2009 was still in good condition. Cretex's dry pack repair and Subsurface's mortar patches to rehabilitate the joints were also intact.

The QuakeWrap bonded to the concrete very well and those joints were sealed and didn't show any signs of movement.

Six voids were found directly under the pavement. One of the six was filled with rigid foam, two were partially full, and three did not contain rigid foam. The voids could be described as bowl shaped.

During the embankment excavation Materials and Research observed the rigid foam when it was encountered and stopped excavation to observe the condition of the material. Most of the rigid foam material was near the top of the pipe. The rigid foam material was about the size of a basketball and a handful of areas were found on the north and south pipes.

The material that was at the haunch and below formed a thin film on the exterior of the pipe. We did not find any significant amounts of rigid foam below the haunch.

Recommendations

Flexible foam soaked oakum with injection to seal the joints worked well but a surface epoxy is recommended for longevity. The surface epoxy that was used on this project is not recommended.

The QuakeWrap application requires the joint to be aligned and sealed before installation. This product would work for structural reinforcement if needed but is labor intensive and expensive for a culvert application.

The internal pipe ties should be used on every joint repaired to prevent a pipe from moving.

The rigid foam did not fill some voids under the pavement. Filling voids is very expensive and labor intensive if their locations are unknown. Once the joints are sealed infiltration should stop occurring and additional voids should stop forming. Good

engineering judgment should be used when considering the best method to fill voids..

Appendix A: Cretex Inc. Materials Information

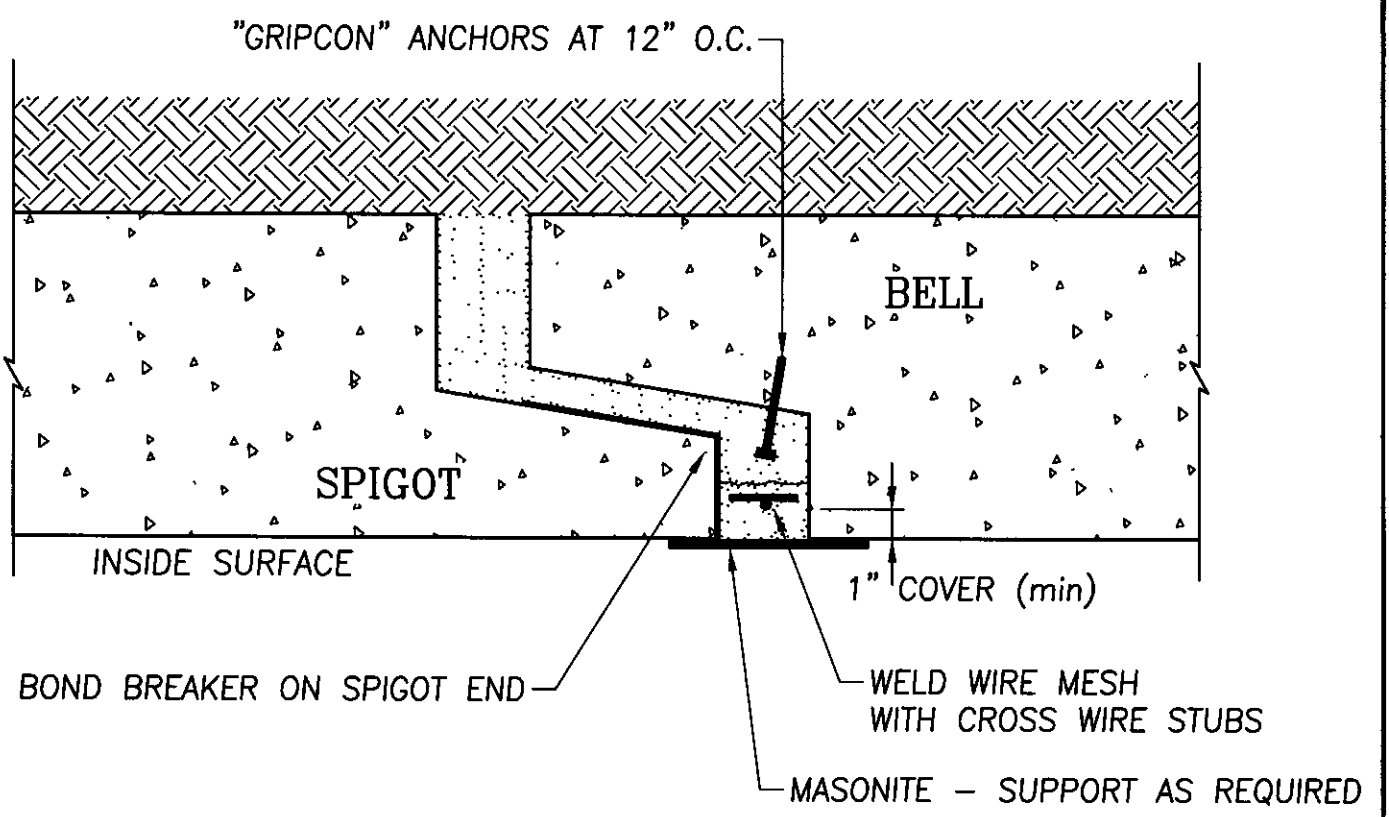
Concrete mix design data for joint dry pack

Mix Designation	Targets (psi)	Date
Pipe Joint Dry Pack	1 Day: psi 28 Day: psi	8/25/2009

Materials	Batch Quantity	Specific Gravity	Cubic Yard Volume	Cubic Yard Quantity, SSD
Cement	750 lbs	3.150	3.8151 ft^3	750 lbs
3/8" Coarse Agg.	1582 lbs	2.694	9.4094 ft^3	1582 lbs
Fine Agg.	1397 lbs	2.660	8.4153 ft^3	1397 lbs
Water	225 lbs	1.000	3.6053 ft^3	225 lbs
Air Content, %	6.5%		1.7550 ft^3	
			27.0000 ft^3	**3953** lbs/yd^3
Fly Ash, %	0%			**146.42** lbs/ft^3
Water Cement Ratio	0.30			
Total Cementitious	750 lbs			750 lbs/yd^3

Admixtures	Quantity per batch	Quantity/ CWT		Cubic Yard Quantity
Plasticizer	38.0 oz	5.1		38.0 oz/yd
Macro Fiber	4.0 lbs	0.5		4.0 lb/yd

Material	Type/Classification	Supplier
Cement	Type II	Local Materials
3/8" Coarse Agg.	Pea Rock	Local Materials
Fine Agg.	Washed Sand	Local Materials
Plasticizer	Quantec PL 490	WR Grace
Macro Fiber	STRUX 90/40	WR Grace



1. *Remove any unsound concrete and thoroughly clean joint.*
2. *Bush Hammer to roughen as much surface as possible on the bell end, apply bond breaker to spigot end.*
3. *Install Gripcon anchors where possible around perimeter of joint at 12"± O.C. and maintain a 1" minimum cover over the anchors.*
4. *Dampen exposed concrete on bell end.*
5. *Pack Mortar (see mixing instructions below) into the joint to a point within 1 1/2" from the inside surface.*
6. *Install circumferencial wire (cut from pipe mesh including the cross wire stubs) to fit into the mortar.*
7. *Complete packing grout from top as required using masonite and bracing to hold the dry-pack mortar in place for a minimum of 4 hours to prevent sagging.*
8. *Trowel smooth all areas that remain exposed.*
9. *Apply curing compound.*
10. *Provisions can be made for a grout coupling if mud jacking is used through the joint.*

Dry-Pack Material - Mixing Instructions:
Batch only as much as can be placed in 1 hour.
Add all dry materials, including fibers to the mixer and mix for 1 minute.
Add QUANTEC PL-490 to mix water. Total water added should be the design water minus the free moisture in the aggregates.
Add mix water/PL-490 mixture and mix for 3 minutes.
Shut off mixer for 3 minutes.
Then mix an additional 2 minutes - target - "Stiff Popcorn Consistency".
If initial mix is too wet or dry, the next batch can be adjusted accordingly.

JOINT DRY-PACK DETAIL

Cretex Concrete Products North, Inc.

WETCAST CONCRETE CYLINDER DATA SHEET – 5000 MIX DESIGN

PROJECT: CONTROL TEST

Date: 09-30-09
Tested By: Scott
Mixer Operator: Dennis

Method of Curing: Outside Box – Tim F.

Mix Design (sacks per yard)

Cement:	1410
Fine Agg:	2440
Course Agg:	3500
Admixtures:	27 oz. Air
	160 oz. Super

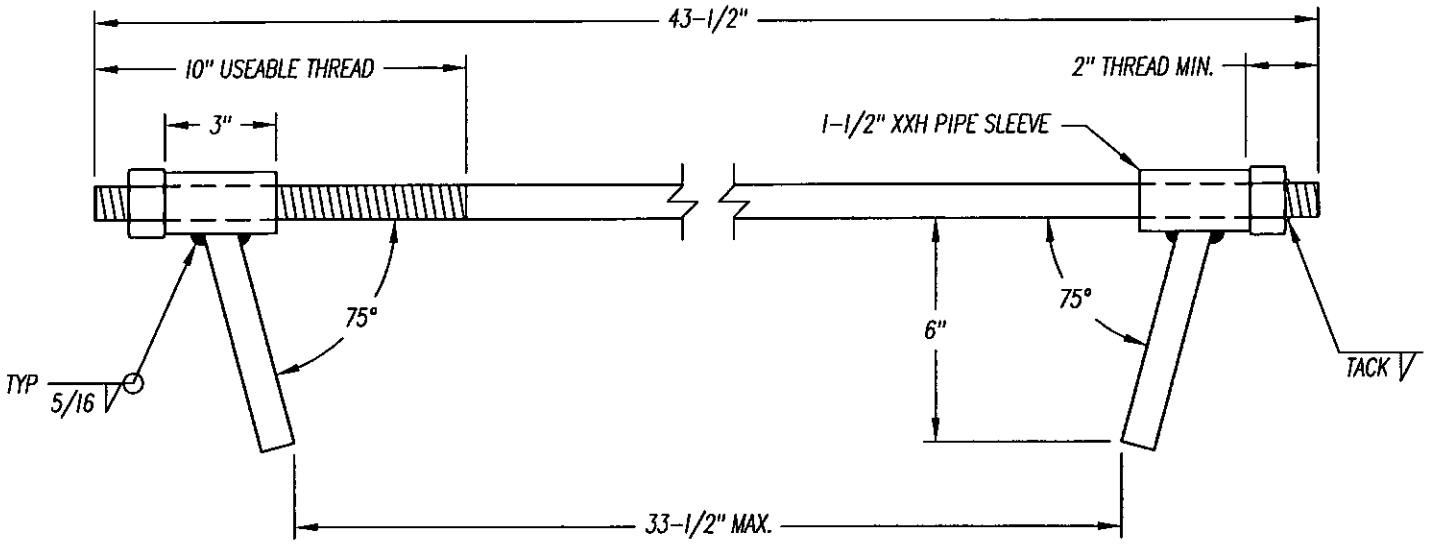
Field Data Compiled By Plant:

Cylinder Number	TF
Slump	5 ½"
Temperature	520
Air Content (%)	6.4%
Unit Weight	142

Compressive Strength Data: Test Method – ASTM C39

	7 Day Break	28 Day Break
Date Tested:	10-07-09	10-28-09
Compressive Strength	4178	5554

1 day - 2125



1. Tie bolts are manufactured from 29/32" diameter material conforming to ASTM A36.
2. Standard 1" diameter threads are rolled on adjusting bolts.
3. Heavy Hex Nuts conform to ASTM A563.
4. The welded pipe sleeve conforms to ASTM A53, Grade B.
5. Welding and weld inspection are done in accordance with AWS/ANSI D1.1-94 Structural Welding Code.
6. Tie bolt assembly is hot dip galvanized in accordance with ASTM A153.

Cretex Concrete Products West, Inc

OFFICES IN: BISMARCK HELENA RAPID CITY

SCALE none	TITLE: ADJUSTABLE HIDDEN TIE BOLT
DATE 6/3/04	
DR'N RTF	
REVISION DATE none	DRAWING NUMBER 1830-10

Appendix B: Subsurface Inc. Materials Information

VERTICOAT SUPREME

ONE PART, MODIFIED, OVERHEAD CONCRETE REPAIR MORTAR

DESCRIPTION

VERTICOAT SUPREME is a one component, microsilica and latex modified, non-sag repair mortar. Formulated to provide protection from corrosion, this cement based product is designed for trowel applied vertical and overhead repairs requiring high performance.

PRIMARY APPLICATIONS

- Vertical and overhead repairs
- Resurfacing of damaged/deteriorated concrete
- Marine structures, tunnels and dams
- Parking structures & bridges
- Parapet walls
- Above and below grade applications

FEATURES/BENEFITS

- One component for easy mixing and handling
- Excellent freeze/thaw resistance for difficult climates
- High bond strength provides excellent adhesion
- Microsilica and latex modified
- Contains an integral corrosion inhibitor
- Low permeability helps protect rebar from corrosion
- Normal setting times increase workability and reduce waste
- Can contribute to LEED points.

TECHNICAL INFORMATION

Typical Engineering Data

Working Time ..... 30 minutes
Set Times 70°F (21°C) ASTM C 266
Initial Set ..... 1 hour
Final Set ..... 2 1/2 hours
Unit Weight ..... 115 lb/ft³ (1836 kg/m³)

Compressive Strength* @ 2.75 qts/50lb/bag
ASTM C 109 modified, 2" (50 mm) cubes

1 day	2,500 psi (17.2 MPa)
3 days	4,000 psi (27.6 MPa)
7 days	5,500 psi (37.9 MPa)
28 days	6,200 psi (42.7 MPa)
56 days	6,700 psi (46.2 MPa)
6 months	7,200 psi (49.6 MPa)

Bond Strength (shear) ASTM C 882 (modified)

1 day	1,000 psi (6.9 MPa)
3 days	1,500 psi (10.3 MPa)
7 days	1,900 psi (13.1 MPa)
28 days	2,100 psi (14.5 MPa)
56 days	2,700 psi (18.6 MPa)

Direct Tensile Bond Strength

1 day	175 psi (1.2 MPa)
7 days	250 psi (1.7 MPa)
28 days	310 psi (2.1 MPa)

Tensile Bond Strength
CAN A23.2-6B (28 days)..... greater than concrete

Flexural Strength* ASTM C 348

1 day	400 psi (2.8 MPa)
3 days	500 psi (3.4 MPa)
28 days	650 psi (4.5 MPa)
56 days	800 psi (5.5 MPa)

Linear Shrinkage* ASTM C 157 50% RH @ 73°F (23°C)

3 days	-0.01%
7 days	-0.01%
14 days	-0.02%
28 days	-0.04%
56 days	-0.05%

Sulfate Resistance* ASTM C 1012

28 days	+0.005%
56 days	+0.009%

Chloride Permeability* ASTM C 1202

7 days	1000 coulombs (very low)
28 days	900 coulombs (very low)
56 days	700 coulombs (very low)

Freeze/Thaw Resistance* ASTM C 666 Procedure A @ 500 cycles Relative Durability Modulus.....100%
* Per ICRI Guideline 03740 "Data Sheet Protocol"

Appearance: VERTICOAT SUPREME is a free flowing powder designed to be mixed with water. After mixing and placing, the color may initially appear darker than the surrounding concrete. While this color will lighten up substantially as the VERTICOAT SUPREME cures and dries out, the repair may always appear somewhat darker than the surrounding concrete. The final finish can be any texture consistent with that expected from concrete and should match the surrounding concrete.

PACKAGING/YIELD

VERTICOAT SUPREME is packaged in 50 lb (22 kg) moisture resistant bags. **Yield:** 0.48 ft³ (0.014 m³) per bag when mixed with 2.75 qt (2.6L) of water.

The Euclid Chemical Company
19218 Redwood Rd. • Cleveland, OH 44110
Phone: [216] 531-9222 • Toll-free: [800] 321-7628 • Fax: [216] 531-9596
www.euclidchemical.com
An RPM Company

Shelf Life

2 years in original, unopened package.

Coverage

One unit of VERTICOAT SUPREME will cover approximately 11.5 ft^2 (1.1 m^2) when placed at an average depth of 1/2" (13mm).

Directions for Use

Surface Preparation: Concrete surfaces must be structurally sound, free of loose or deteriorated concrete and free of dust, dirt, paint, efflorescence, oil and all other contaminants. Mechanically abrade the surface to a minimum depth of 1/4" (6 mm) to achieve a surface profile equal to CSP 7 - 8 in accordance with ICRI Guideline 03732. Properly clean profiled area. **Priming:** Clean and prime exposed steel with DURALPREP AC. Concrete should be primed with a spray or brush coat of DURALPREP AC. Alternately, a Saturated Surface Dry (SSD) concrete surface can be primed with a scrub coat of VERTICOAT SUPREME. The repair must be made before the scrub coat dries out.

Mixing: Small quantities may be mixed with a drill and "jiffy" type mixer. Use a paddle type mortar mixer for large jobs. All materials should be in the proper temperature range of 60°F (16°C) to 90°F (32°C). Add the appropriate amount of water for the batch size 2.5 to 3.0 qt (2.4 to 2.8 L)/bag and then add the dry product. Mix for 3 to 5 minutes. Do not mix more material than can be placed within 20 minutes.

Placement: Place in lifts 1/4" to 2" (6 to 50 mm) thickness. Trowel into place and allow to stiffen before the next lift. If additional lifts are required after material has hardened, cross hatch the surface before proceeding to secure bond for the next lift.

Finishing: Finish the repair material to the desired texture. Do not add additional water to the surface during the finishing operation. If additional liquid is required, use EUCOBAR finishing aid.

Curing and Sealing: Curing is required. Cure with a Euclid Chemical high solids curing, water based compound. (NOTE: A SOLVENT BASED CURING COMPOUND SHOULD NOT BE USED ON THIS PRODUCT.) Under hot, windy or direct sunlight situations, apply a second coat of curing compound after the first has dried. If a curing compound is not desired, wet cure for a minimum of three days.

Clean-Up

Clean tools and equipment with water before the material hardens.

Precautions/Limitations

- Do not allow repairs to freeze until the material has reached a minimum of 1000 psi (7 MPa) compressive strength [approximately 3 days at 40°F (4°C)].
- In adverse temperatures, follow ACI recommendations for hot/cold weather concreting practices.
- Use only potable water for mixing.
- Minimum application thickness 1/4" (6 mm).
- Minimum surface and ambient temperature 45°F (7°C) and rising at time of application.
- For optimum results, condition material to 65°F to 85°F (18°C to 29°C).
- Do not use a solvent based curing compound on this product.
- Store product in a dry place.
- In all cases, consult the Material Safety Data Sheet before use.

" Innovations in Infrastructure Repair Technology"
PRIME RESINS, INC.
OFFICE:(770) 388-0626 / FAX (770) 388-0936
2291 Plunkett Road
Conyers (Atlanta), Georgia 30012

SECTION I - IDENTITY INFORMATION

PRODUCT NAME: **WHITE OAKUM**

MANUFACTURER: **PRIME RESINS, INC.** ADDRESS: 2291 PLUNKETT ROAD	FAMILY/CHEMICAL NAME: OAKUM
CITY: CONYERS (ATLANTA) STATE: GEORGIA ZIP CODE: 30012	
TELEPHONE: (770) 388-0626 FAX: (770) 388-0936	DOT CATEGORY: NOT REGULATED
EMERGENCY: **CHEMTREK (800) 424-9300**	PREPARED BY: ATO WILBERFORCE

SECTION II - HAZARDOUS INGREDIENTS

COMPONENTS:(CHEMICAL IDENTITY);COMMON NAME(S)	LIMITS	CAS NUMBER
THERE IS NO HAZARDOUS COMPONENTS IN THIS PRODUCT.		
INGREDIENTS: JUTE ROVING, HECTORITE AND WATER.		

SECTION III - PHYSICAL DATA

VAPOR PRESSURE:(AIR=1) N\A	BOILING POINT: N/A
VAPOR DENSITY:(AIR=1) N/A	WATER SOLUBILITY: N/A
DENSITY: N/A	SPECIFIC GRAVITY:(H2O=1) N/A

APPEARANCE(SOLID,LIQUID,GAS,COLOR) AND ODOR: ROPE FORM, WHITE IN COLOR, NO ODOR

EVAPORATION RATE(BUTYL ACETATE=1): N/A

SECTION IV - FIRE AND EXPLOSION DATA

FLASH POINT: N/A

EXTINGUISHING MEDIA: CO2-DRY CHEMICAL-FOAM-WATER SPRAY

SPECIAL FIRE FIGHTING PROCEDURES: N/A

UNUSUAL FIRE AND EXPLOSION HAZARDS: JUTE ROVING TREATED WITH WATER AND HECTORITE WILL NOT BURN.

HEALTH 0 **FLAMMABILITY** 1 **REACTIVITY** 0 **PERSONAL PROTECTION** C

SECTION V - REACTIVITY DATA

STABILITY:	STABLE		CONDITIONS TO AVOID: N/A
	UNSTABLE		N/A
HAZARDOUS POLYMERIZATION			
MAY OCCUR			CONDITIONS TO AVOID: N/A
WILL NOT OCCUR			N/A

INCOMPATIBILITY: N/A

HAZARDOUS DECOMPOSITION: N/A

SECTION VI - HEALTH HAZARD DATA

ROUTE(S) OF ENTRY	SKIN	X	INGESTION		EXPOSURE EFFECTS: N/A
	EYES		INHALATION		

ACUTE HAZARDS: NONE

CHRONIC HAZARDS: NONE

EMERGENCY AND FIRST AID PROCEDURES	**EYES: N/A**
	SKIN: CAN BE WASHED OFF WITH MILD SOAP AND WATER.
	INHALATION: N/A
	INGESTION: N/A
	OTHER: NONE

SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE

STEPS TAKEN FOR SPILLS OR RELEASE: THERE IS NO SPILLAGE WITH WHITE OAKUM. IF SOME OF THE POWDER FALLS OFF IT CAN BE SWEPT UP.

WASTE DISPOSAL METHOD: REGULAR DISPOSAL

PRECAUTIONS FOR HANDLING,SHIPPING,STORING,AND OTHER: CARTONS SHOULD BE STACKED FLAT.

WARNING: N/A

SECTION VIII - CONTROL MEASURES

RESPIRATORY PROTECTION: N/A

PROTECTIVE CLOTHING	EYES: SAFETY GLASSES SHOULD BE	CLOTHING: N/A
	GLOVES: IF SO DESIRED.	SHOES: N/A

SECTION IX - REGULATORY INFORMATION

ISSUE DATE: 11/8/95	DOT CLASS: NOT REGULATED	CERCLA STATUS: NOT LISTED
REVISION: 1/17/05	RCRA STATUS: NOT LISTED	TSCA INVENTORY STATUS: NONE

THIS INFORMATION AND RECOMMENDATIONS CONTAINED HEREIN ARE BASED UPON DATA BELIEVED TO BE CORRECT. HOWEVER, NO GUARANTEE OR WARRANTY OF ANY KIND EXPRESSED OR IMPLIED IS MADE WITH RESPECT TO THE INFORMATION CONTAINED HEREIN.

900 XLV

DESCRIPTION AND USES:

Prime-Flex 900XLV is a hydrophilic, liquid polyurethane injection resin designed to seal leaks in concrete and masonry structures. When it contacts water, Prime-Flex 900 XLV expands up to 600% and forms a tough, flexible foam seal that can not be penetrated by water.
Prime Flex 900 XLV has been proven successful in the following applications:

- Hairline Cracks
- Cold Joints
- Manholes
- Concrete Dams
- Foundation walls
- Water Holding Tanks
- Elevator and Service Pits
- Below Grade Parking Decks
- Tunnels (subways and highways)

The uses for the Prime-Flex family of injection resins are limited only by the imagination of the designer or contractor.

ADVANTAGES:

- Single Component (No catalyst required)
- Extremely Flexible
- Very Tough Foam
- Up to 600% Expansion
- Super Low Viscosity For Good Penetration of Cracks

PACKAGING:

- 1 Gallon Pail
- 5 Gallon Pail
- Single Shot Cartridges
- “Quick Mix” Cartridges

TYPICAL PHYSICAL PROPERTIES AT 73°F (23°C):

Appearance		Amber Liquid
Viscosity		250-350 CPS
Weight Per Gallon		8.65 Lbs. Per Gallon
Solids Content	(ASTM D-2834-95)	88%
Induction Time		3 to 4 Minutes
Cure Time		5 to 6 Minutes

CURED FOAM TEST RESULTS*

Tensile Strength	(ASTM D-3574)	450 p.s.i.
Elongation	(ASTM D-3574)	350%
Shrinkage	(ASTM D-1042 / D-756)	Less than 2%
Initial Linear Shrinkage		9%
Tear Resistance	(ASTM D-3574)	21 lbs. / in.
Density	(ASTM D-3574)	610 kg. / m^3 38 lbs. / ft^3

* These results were based on a foam cured under pressure. Properties may vary depending on job conditions.

900 XLV

GENERAL GUIDELINES FOR PRIME-FLEX INJECTION:

This guideline is general in nature and does not address every condition that might be encountered in the field. More specific guidelines for injecting hairline cracks, wide cracks, and expansion joints are available from the On-Line Help Desk at our web site www.primeresins.com or by calling our toll-free technical service number 1-800-321-7212.

1. Drill injection port holes at a 45° angle to intersect the crack at approximately 1/2 the depth of the structure. If possible, the holes should be alternated side to side of the crack. Holes should be spaced between 6" and 24" apart depending on the width of the crack. Typically, the wider the crack, the further apart the ports should be spaced. After drilling the first few holes, clean out the holes as described below.
2. Clean concrete dust residue from the holes by injecting water through a "flush wand" that will reach the back of the hole. Flush until clean water is flowing out of the hole.
3. Insert injection ports into the drilled holes. If using "bang-in" ports, insure they are firmly seated. If using mechanical ports, insert them so the rubber portion is completely below the surface of the concrete and tighten them securely in place. Leave the fittings off the tops of the ports.
4. If a surface seal is required to contain the Prime-Flex in the crack, several materials and methods may be used. See “Prime-Flex Application Techniques” for more complete details.
5. Flush the crack with clean water. Starting at one end of the crack (the lowest end for vertical cracks), put the fitting on the top on the first port and inject clean water into the port at a minimum pressure of 250 p.s.i. Air, water, and debris should flow out of the crack and out of the next port(s). Continue this process until the entire crack has been flushed.
6. Prepare for injection. Begin by removing the fittings from the tops of all ports except the one at the end of the crack (lowest end for vertical cracks). This will be the first port used for injection. Before pumping Prime Flex material, be sure that the pump and hose lines are free of any water. If necessary, thoroughly flush the pump with Prime Flush solvent.
7. Begin pumping at the first port at a pressure of 250 p.s.i. minimum. Increase the pressure at 100 p.s.i. increments as needed to fully penetrate the crack. **Do not exceed the Maximum Safe Operating Pressures for the pump, hoses, or fittings.**
8. If material begins to flow out of the next port, put the connector fitting on that port and continue pumping at the current port. If material flows from subsequent ports, put the connector fitting on those ports and continue pumping at the current port. If it appears that a significant percentage of the material being pumped is simply flowing out of the crack and not traveling along the crack, stop pumping at the current port and move the pump hose to the last port where material flowed out and begin injection at that port. Continue this process until the crack is completely injected.
9. After injection, flush the pump with Prime Flush. Do not leave Prime-Flex resin in the pump or hoses as it will cure and ruin the pump. After cleaning the pump and hoses with Prime Flush, pump motor oil or other lubricant through the pump and hoses. This will increase the life of the hoses and the pump's internal seals.

CAUTION:
Vapor overexposure may cause respiratory irritation, central nervous system depression, and allergic reaction. Provide sufficient ventilation to maintain vapor concentrations below recommended exposure limits. Avoid contact with skin, eyes, and clothing. Wear protective rubber gloves and safety glasses or chemical goggles when handling or dispensing materials. Wash contaminated clothing before reuse. See MSDS for further information.

FIRST AID:

SKIN CONTACT- Wipe off contaminated area and wash with soap and water.
EYE CONTACT- Immediately flush eyes with large amounts of water for 10 minutes. Get medical attention.
INHALATION- Move to fresh air if symptoms occur. If breathing is difficult, seek medical attention.
INGESTION- Seek immediate medical attention.

CLEAN UP:
Use Prime Flush cleaner, M.E.K. or Acetone to clean off equipment. Use soap and water to clean skin.

STORAGE:
Materials must be stored in dry conditions below 80°F(26°). Optimal storage conditions are between 40° and 80°F(4° and 15°C). Under proper conditions, the shelf life is eighteen months in unopened, damage-free containers.

All Prime-Flex materials are manufactured solely by Prime Resins at our Conyers, Georgia plant. Prime Resins has complete control over the quality and availability of the products. If you have any questions or comments about the Prime-Flex products or application techniques you may contact Prime Resins directly at 800-321-7212 or visit www.primeresins.com

FOR INDUSTRIAL USE ONLY **PROTECT FROM MOISTURE**

DO NOT ALLOW PRODUCT TO FREEZE

KEEP OUT OF REACH OF CHILDREN **OBSERVE PRODUCT CAUTIONS**

WARRANTY: Prime Resins warrants its products to be free from manufacturing defects and that products meet the published characteristics when tested in accordance with ASTM and Prime Resins standards. No other warranties by Prime Resins are expressed or implied, including no warranty of merchantability or fitness for a particular purpose. Prime Resins will not be liable for damages of any sort resulting from any claimed breach of warranty. Prime Resins' liability under this warranty is limited to replacement of material or refund of sales price of the material. There are no warranties on any product that has exceeded the "shelf life" or "expiration date" printed on the package label.

TDS-900XLV-7/09

PRIME-FLEX 985

LX10, LX20

DESCRIPTION AND USES:

Prime-Flex 985 is a two-component urethane resin that produces a strong, lightweight, highly cross-linked expanding resin. Prime-Flex 985 can provide significant slab or structural support without the added weight loading of traditional cement grout stabilization. Prime-Flex 985 has excellent flow characteristics and is less moisture sensitive than many polyurethane resins. Common uses include:

- Filling Wet Voids
- Under Slab Stabilization
- Filling Abandoned Pipelines
- Filling Abandoned Storage Tanks
- Sealing Conduits and Raceways

ADVANTAGES:

- Quick Set Time
- Low Viscosity
- Ideal for Wet Condition Applications
- Bonds with Sub Soils

PACKAGING:

- 1 Gallon Unit
- 2 Gallon Units
- 10 Gallon Units
- 100 Gallon Units
- 550 Gallon Bulk Units

TYPICAL PHYSICAL PROPERTIES AT 74°F (23°C)

Viscosity	(Part A) (Part B)	270 cps 280 cps	
Weight per Gallon	(Part A) (Part B)	10.2 lbs. per gallon 8.6 lbs. per gallon	
Mixing Ratio		(1:1) By volume	
Initial Reaction Time		70 seconds	
Set Time		8 Minutes	
Expansion*	**LX10** **LX20**	10:1 20:1	
Compressive Strength	ASTM D-1621	10:1 Expansion 20:1 Expansion	60 psi 40 psi
Density	**LX10** at 4.5 lb density **LX 20** at 2.5 lb density	9216 psf† (64 psi) 4900 psf† (34 psi)	

* Expansion is affected by field conditions. Actual results may vary depending on temperature, mixing equipment and degree of constraint (i.e. pumping into a void caused by slab curling will result in a more dense material).

† Estimates of Allowable Bearing Pressure for Standard Soils:
Cohesive soils - stiff clay = 3,000 - 6,000 psf
Non-cohesive soils - compact sand = 2,000 - 6,000 psf

INSTALLATION METHOD

WARNING:

Prime-Flex 985 expands during its curing process. If the material is injected into totally confined areas, it can generate expansive forces that may damage the structure and could cause personal injury.

Before injecting Prime-Flex 985 into any confined area, insure that open paths exist from the area being injected to the surface of the structure so displaced water, air and excess expanding material can escape.

To provide a pressure-relief path for the expanding material, one or more open holes should be drilled completely from the surface into the void area being injected.

INSTALLATION METHOD:

Prime Resins Prime-Flex 985 is designed to be mixed using a two component pumping system set at a 1:1 mix ratio. The material should be pumped through a static mixer to insure complete blending. Recommended application temperature is between 40^{o} F and 100^{o} F (-18^{o} to 38^{o} C).

-continued on next page-

INSTALLATION METHOD (continued)

Material should be preconditioned to 65°-85° F (18° to 29° C) before use.
SHAKE WELL BEFORE USE. Read and follow all label and safety directions.

Prime Resins recommends that any new concrete being repaired be at least 30 days old.

After mixing, the resin will foam in approximately 70 seconds with an expansion rate of up to 20:1 in volume. The cured resin creates a rigid, closed cell structure which is highly resistant to water and vapor transmission.

When void filling, short bursts of material are recommended to allow for the resin to react, maximize flow, reduce potentially high expansive forces, and reduce the peak exotherm temperature.

SLAB STABILIZATION / SLAB UNDERSEALING

Prime-Flex 985 is ideal for repairing "curled" or "rocking" slabs common in warehouse floors. ***Important***: *It is possible to raise the slab due to the expansive force of the material if relief ports are not drilled. Insure that the resin is delivered in small bursts to minimize this possibility. Do not rush by injecting large amounts of material into the void all in one shot.* Drill 3/8" holes through the slab on both sides of the joint to be repaired or in a grid pattern if excessive voids are identified more than 18" from the joint. Spacing of holes will be dependent on slab thickness and size of void. When finished, the drilled holes should form a "zig-zag" pattern along the joint. If a very small repair is to be made, a minimum of two holes should be drilled. This allows one hole for pumping, and one hole for venting to allow displaced air and excess material to escape. Dispense the Prime-Flex 985 into the first hole and wait a few minutes to allow the resin to migrate under the slab and cure. By observing the material rising out of the drilled holes and joint, you can visualize how far the Prime-Flex 985 has traveled. Next, move to the next open hole and repeat the injection process. Work down the joint and/or grid until complete undersealing of the slab is accomplished. Excess material that cures outside of the joint and holes can be removed by scraping or sanding. Holes can be patched if a finished look is desired.

VOID FILLING

Prime-Flex 985 is commonly used to fill voids. To fill a void, pump Prime-Flex 985 into area to be filled. *Caution:* The mixed resin will begin to expand in approximately one minute. A release hole should be drilled into enclosed structures to allow the expanding resin to escape. Injecting into a closed structure without allowing for pressure release can cause a violent release of pressure and damage to the structure or personal injury.

WARNING: Both "A" and "B" Components can cause irritation to eyes, skin, and respiratory system. Provide ventilation sufficient to maintain vapor concentrations below recommended exposure limits. Vapor overexposure may cause respiratory irritation and allergic reaction. Avoid contact with skin, eyes, and clothing.

Wear protective rubber gloves and safety glasses or chemical goggles when handling or dispensing materials. Wash contaminated clothing before reuse. Consult MSDS for further information.

FIRST AID:

SKIN CONTACT - Remove contaminated clothing. Wash affected areas thoroughly with soap and running water. Consult MSDS for further information.

EYE CONTACT - Immediately flush eyes with running water for a minimum of 15 minutes. Seek Medical Attention. Consult MSDS for further information.

INHALATION - Move to fresh air if symptoms occur. If breathing is difficult, seek medical attention. Consult MSDS for further information.

INGESTION - Do not induce vomiting. If conscious, wash out mouth with water and give 1 or 2 glasses of water to drink. Seek Medical Attention. Consult MSDS for further information.

CLEAN UP: Use Prime Flush cleaner, M.E.K. or Acetone to clean equipment. Use soap and water to clean skin.

STORAGE: Store in dry conditions below 80°F (26°C). Ideal storage conditions are between 40° and 80°F (4° and 15°C). Under proper conditions, the shelf life is twelve months in unopened, damage-free containers.

FOR INDUSTRIAL USE ONLY **PROTECT FROM MOISTURE**
KEEP OUT OF REACH OF CHILDREN **OBSERVE PRODUCT CAUTIONS**

WARRANTY: Prime Resins warrants its products to be free from manufacturing defects and that products meet the published characteristics when tested in accordance with ASTM and Prime Resins standards. No other warranties by Prime Resins are expressed or implied, including no warranty of merchantability or fitness for a particular purpose. Prime Resins will not be liable for damages of any sort resulting from any claimed breach of warranty. Prime Resins' liability under this warranty is limited to replacement of material or refund of sales price of the material. There are no warranties on any product that has exceeded the "shelf life" or "expiration date" printed on the package label.

THP TDS-985-03/07 2M
Prime-Flex 985

PRIME RESINS

"Innovations in Infrastructure Repair Technology"

2291 Plunkett Road • Conyers, Georgia 30012
770-388-0626 / 800-321-7212 • Fax: 770-388-0936 • www.primeresins.com • email: sales@primeresins.com

Prime Gel™ 2200 Flexible

Flexible Multi Purpose Epoxy Gel Adhesive

ADVANTAGES:

- Super smooth non sag paste consistency (no grit)
- Remains flexible down to 40° F.
- Moisture insensitive
- Good Chemical Resistance

CONFORMS TO:

- USDA Approved

PACKAGING:

- 2 Gallon Units
- 10 Gallon Units
- 1:1 "Quick Mix" Cartridges - Case of 10

DESCRIPTION AND USES:

Detailed Description
Prime Gel 2200 is an extremely smooth consistency two component epoxy gel adhesive that won't sag, run or drip in vertical or overhead applications.

Technical Description
Two Component,100% solids, paste consistency, multi-purpose epoxy resin adhesive.

Uses
- General purpose flexible adhesive.
- Bonding materials such as concrete, steel, wood, stone, and masonry.

TEST DATA:

Tensile Strength	ASTM D-638	164
Tensile Modulus of Elasticity	ASTM D-638	154
Tensile Elongation	ASTM D-638	88%
Shore Hardness	A Scale	35 A

PHYSICAL PROPERTIES:

Physical Properties 73° F- Liquid

Consistency	Non Sag Paste
Color	Concrete Gray

Pot Life	60 Grams	1/2 Gallon	Tack Free-1/8"
90° F	30 min	22 min	3 hrs
73° F	35 min	25 min	12-18 hrs
50° F	1 hr, 35 min	43 min	18-24 hrs

COVERAGE:

- 231 cubic inches per gallon
- 370 cubic inches per gallon when mixed 1:1 by volume with Prime Blend Sand.

GENERAL GUIDELINES:

Material Preparation: Store material overnight to precondition to 70º-80º F prior to use.

Mix Ratio: A:B = 1:1 by volume

Mixing Procedures:

Manual Mixing:
Only mix the amount of material that can be used within the pot life. Thoroughly mix materials using a low speed drill with a mixing paddle. Scrape the sides and bottom of the pail while mixing. Note: Larger batches exotherm and set up faster than small batches.

Pump Application:
This product is ideally suited for use with the "Quick Mix" cartridge system. 10 gallon units packaged for use with extruder pump equipment.

Surface Preparation: Surfaces must be clean and free of any dust, oil, grease, curing compounds, or any other contaminates. Mechanical or blast cleaning is recommended whenever possible.

How To Use: For more info, see www.primeresins.com/primepractices.php

Personal Protection: "B" Component contains amines and may cause severe burns upon skin contact for any length of time. Wear Safety Glasses, gloves, avoid skin contact, do not ingest, for professional use only, see Material Safety Data Sheet.

Cleanup: Clean off of skin with soap and water immediately. Cleanup uncured material from tools with Prime Flex Eco Flush.

Environmental Protection: Cured material is environmentally safe. Dispose of in approved landfill. Clean up any spilled liquid material and dispose of according to local, state, and federal guidelines.

First Aid: **Eye Contact:** Immediately flush with large amounts of water. Seek medical attention. **Inhalation:** Move to fresh air if symptoms occur. If breathing is difficult, seek medical attention. **Ingestion:** Seek medical attention immediately. **Skin Contact:** Wipe off contaminated area and wash with soap and water.

Limitations: Cold temperatures will slow down reaction time and increase viscosity. Use at temperatures above 40ºF. Material that is off ratio or not mixed thoroughly will not cure to full strength and may remain tacky indefinitely. Not for use as an exterior joint sealant.

Warranty: Prime Resins warrants its products to be free from manufacturing defects and that products meet the published characteristics when tested in accordance with ASTM and Prime Resins standards. No other warranties by Prime Resins are expressed or implied, including no warranty of merchantability or fitness for a particular purpose. Prime Resins will not be liable for damages of any sort resulting from any claimed breach of warranty. Prime Resins' liability under this warranty is limited to replacement of material or refund of sales price of the material. There are no warranties on any product that has exceeded the "shelf life" or "expiration date" printed on the package label.

Storage: Store in dry environment between 40º and 80º F. Do not allow product to freeze. Shelf Life: 12 months from date of manufacture in unopened containers properly stored. Protect from moisture.

Shipping Information: Shipping Class: Motor Freight Class 60
Hazard Classification: Corrosive Liquid N.O.S. (Mixture of aliphatic and cycloaliphatic amines)

Manufacturer Information: This product is manufactured by Prime Resins under strict quality assurance practices at our Conyers, GA facility.

PRIME RESINS
Injecting Life into Infrastructure
A BARTON INDUSTRIES COMPANY

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24/7 TECH SUPPORT 800-321-7212

Appendix C: QuakeWrap Inc. Materials Information

QuakeWrap, Inc.
2055 E. 17th Street
Tucson, AZ 85719 U.S.A.
Phone: (520) 791-7000
FAX: (520) 791-0600
Toll Free: (866) QuakeWrap [782-5397]
www.QuakeWrap.com

Product Data Sheet
QuakeBond™ J201TC Tack Coat

DESCRIPTION
QuakeBond™ J201TC (Tack Coat) is a two-component high-strength structural epoxy designed for vertical and overhead applications. J201-TC has an immediate high tack consistency, allowing it to hold heavy weight fabrics impregnated with J300-SR Saturating Resin in place during cure. QuakeBond™ J201TC trowels easily and has a long pot life for coverage of large areas. The convenient color-coded ("A" yellow and "B" blue) 2:1 volumetric mix ratio is user friendly. QuakeBond™ J201TC is a 100% solids formulation with low toxicity and low odor during cure.

USE
- Adhesive for bonding external reinforcement to concrete, masonry, wood, stone, steel, etc.
- Structural bonding of carbon laminates, e.g. QuakeWrap™ DU50C.
- Structural bonding of fabrics saturated with QuakeBond™ J300SR resin on vertical and overhead surfaces.
- As a binder for epoxy mortar repairs.

ADVANTAGES
- Long pot life.
- High strength, high modulus, structural paste adhesive.
- Fully compatible and excellent adhesion to QuakeWrap™ DU50C carbon laminate plates and glass or carbon fabrics saturated with QuakeBond™ J300SR resin.
- Paste consistency ideal for vertical and overhead applications.
- Convenient easy mix ratio, (2 volume parts of component "A" with 1 volume part of component "B").
- 100% solvent free.
- Color coded components (Yellow & Blue) to ensure proper mixing control.
- Nearly odor-free.
- Low toxicity during cure.

COVERAGE
Applied at a thickness of 40 mil (1 mm) results in 40 square feet per gallon (1 liter per square meter). Rough and uneven surfaces result in lower yields.

PACKAGING
Component "A" is supplied in 2-gallon (7.58L) containers and component "B" in 1-gallon (3.79L) containers, resulting in 3-gallon kits. Ships DOT non-regulated.

MIXING
Proportion 2 parts component "A" to 1 part component "B" by volume into a clean container. Mix thoroughly for 3 minutes using a paddle at low speed (400-600 rpm) drill until uniform color is achieved. Mix only the quantities that can be used within pot life. DO NOT THIN; solvents will prevent proper cure.

SHELF LIFE
Two years in original, unopened and properly stored containers.

STORAGE CONDITIONS
Store at 45°-100° F (7°-38° C). Avoid freezing.

CERTIFICATE OF COMPLIANCE
- Material Safety Data Sheet (MSDS) will be supplied upon request and is included with each shipment.
- Possesses 0% volatile content per EPA Test Method 24.

SURFACE PREPARATION
Surface must be clean and sound. It may be dry or damp but free from standing water and frost. Remove dust, laitance, grease, curing compounds, impregnations, waxes, foreign particles and other bond inhibiting materials from the surface. Existing uneven surfaces must be filled with an appropriate repair mortar. The adhesive strength of concrete must be verified after surface preparation by random pull-off testing (ACI 503R) at the discretion of the engineer. Minimum tensile strength of 200 psi (1.4 MPa) with concrete substrate failure is required. Blast clean, shot-blast, scarify or use other approved mechanical means to clean the substrate surface. Any sharp edges (i.e. fins, form-marks, etc.) must be ground smooth and flush. Sharp edges must be rounded to a minimum radius of ¾ in. (19 mm).

APPLICATION
Apply QuakeBond™ J201TC onto the substrate with a trowel or spatula to a nominal thickness of approximately 40 mil (1 mm). A notched trowel may be used for this application. Before the epoxy hardens, apply saturated fabric or DU50C strips to the epoxy-coated surface. The external reinforcement must not be disturbed for a minimum of 24 hours.

LIMITATIONS
Minimum application temperature of the epoxy is 40° F (4°C). DO NOT THIN this epoxy with solvents.

FIRST AID
In case of skin contact, wash thoroughly with soap and water. For eye contact, flush immediately. For respiratory problems, remove to fresh air. Wash clothing before reuse. Consult MSDS for detailed information.

CLEANUP
Collect with absorbent material, flush with water. Dispose of in accordance with local disposal regulations. Uncured materials can be removed with approved solvent. Cured materials can only be removed mechanically.

EPOXY PROPERTIES	
Color	Part A is yellow paste Part B is blue paste
Viscosity	Non-sagging thixotropic paste
Pot Life at 77° F (25° C)	90 minutes
Full cure time	48 hours
Density at 68° F (20° C)	Part A: 9.8 lbs/gal (1.18 kg/L) Part B: 9.4 lbs/gal (1.13 kg/L)
Tensile Strength (ASTM D-638) Tensile Modulus (ASTM D-638)	4360 psi (30.06 MPa) 329,000 psi (2268.45 MPa)
Compressive Strength (ASTM D-695) Compressive Modulus (ASTM D-695)	8006 psi (55.2 MPa) 278,900 psi (1923.02 MPa)
Flexural Strength (ASTM D-790) Flexural Modulus (ASTM D-790)	8025 psi (55.33 MPa) 250,100 psi (1724.44 MPa)
Shear Strength (ASTM D-3165)	1453 psi (10.02 MPa)
Water absorption (% gain) in 24 hours	< 1%
Expansion Coefficient [-40° to 0° C] Expansion Coefficient [50° to 175° C]	61.21 $*10^{-6}$ m/m °C 210.58 $*10^{-6}$ m/m °C

KEEP OUT OF REACH OF CHILDREN.
NOT FOR INTERNAL CONSUMPTION.

FOR INDUSTRIAL USE ONLY.
KEEP CONTAINER CLOSED TIGHTLY.

CONSULT MATERIAL SAFETY DATA SHEET FOR MORE INFORMATION.

QuakeWrap, Inc.
2055 E. 17th Street
Tucson, AZ 85719 U.S.A.
Phone: (520) 791-7000
FAX: (520) 791-0600
Toll Free: (866) QuakeWrap [782-5397]
www.QuakeWrap.com

Product Data Sheet

QuakeBond™ J300SR Saturating Resin

DESCRIPTION
QuakeBond™ J300SR (Saturating Resin) is a two-component, high-strength, low-viscosity structural epoxy. The low viscosity and long pot life, with fast cure time is designed for high volume saturating of heavy reinforcement fabrics using our impregnator machine. Combined with carbon or glass reinforcement, J300SR Saturating Resin produces fiber composite laminates with exceptional strength, durability and chemical resistance. The convenient color-coded components and the 2:1 volumetric mix ratio is user friendly. QuakeBond™ J300SR is a 100% solids formulation with low toxicity and low odor during cure.

USE
- Saturating carbon and glass fabrics for structural retrofit applications.
- Adhesive for bonding external reinforcement to concrete, masonry & wood.
- A moisture barrier (water-proofing) system in conjunction with QuakeWrap™ carbon or glass fabrics.
- As a binder for epoxy mortar repairs.

ADVANTAGES
- Long pot life.
- High strength, high modulus, low-viscosity structural adhesive.
- Fully compatible and excellent adhesion to QuakeWrap™ carbon and glass fabrics.
- Convenient easy mix ratio, 2:1 by volume.
- 100% solvent free.
- Color coded components (pigmented syrup & amber liquid) to ensure proper mixing control.
- Nearly odor-free.
- Low toxicity during cure.

COVERAGE
Applied as a saturating resin to a fabric with a density of 24 oz/yd^2 (813 gram /m^2) achieves a yield of 75 square feet per gallon (0.55 liter per square meter). Yield varies slightly for different fabric densities.

PACKAGING
Each of the components is supplied in 55-gallon (208L) drums or 5-gallon (19L) containers, resulting in 165-gallon or 15-gallon kits. Ships DOT non-regulated.

MIXING
Proportion 2 parts component "A" to 1 part component "B" by volume into a clean container. Mix thoroughly for 3 minutes using a paddle at low speed (400-600 rpm) drill until uniform color is achieved. Mix only the quantities that can be used within pot life. DO NOT THIN; solvents will prevent proper cure.

SHELF LIFE
Two years in original, unopened and properly stored containers.

STORAGE CONDITIONS
Store in dry place at 45°-100° F (7°-38° C).

CERTIFICATE OF COMPLIANCE
- Material Safety Data Sheet (MSDS) will be supplied upon request and is included with each shipment.
- Possesses 0% volatile content per EPA Test Method 24.

APPLICATION
Use QuakeBond™ J300SR in conjunction with our saturating machines to impregnate carbon or glass fabrics (wet lay-up process); please contact us for detailed information on operation of saturating machines. For smaller projects, the fabrics may be saturated by hand; pour mixed J300SR onto the fabric and use a trowel or spatula to spread the resin into the fabric; it may be necessary to turn the fabric over and repeat this process, ensuring that the fabric is thoroughly saturated. Use a squeegee to remove excess resin from the fabric before installing the fabric on the structural element. Once the saturated fabric is installed, remove all entrapped air bubbles with gloved hands; a plastic laminating roller can be used as well. Do not disturb installed saturated fabric for 24 hours.

For dry lay-up process, first apply a thin layer (approximately 15 mil.) of J300SR in order to seal the substrate surface and avoid excessive absorption of resin by the substrate once fabric saturation starts. Allow the surface to become tacky and lay-up fabric dry. Apply several coats of J300SR on the fabric using rollers or squeegees until uniform saturation is achieved. Remove any entrapped air as indicated above. If needed, use J201TC tack coat for dry lay-up of heavier fabrics.

LIMITATIONS
Minimum application temperature of the epoxy is 40° F (4°C). DO NOT THIN this epoxy with solvents.

FIRST AID
In case of skin contact, wash thoroughly with soap and water. For eye contact, flush immediately. For respiratory problems, remove to fresh air. Wash clothing before reuse. Consult MSDS for detailed information.

CLEANUP
Collect with absorbent material, flush with water. Dispose of in accordance with local disposal regulations. Uncured materials can be removed with approved solvent. Cured materials can only be removed mechanically.

EPOXY PROPERTIES	
Color	Part A is pigmented syrup Part B is amber liquid
Viscosity Mixed at 77° F (25° C)	1500-1600 cps
Pot Life at 77° F (25° C)	3-4 hours (thin film set time)
Full cure time	48 hours
Density at 68° F (20° C)	Part A: 9.4 lbs/gal (1.13 kg/L) Part B: 8.3 lbs/gal (1.00 kg/L)
Tensile Strength (ASTM D-638) Tensile Modulus (ASTM D-638)	7150 psi (49.3 MPa) 289,300 psi (1995 MPa)
Compressive Strength (ASTM D-695) Compressive Modulus (ASTM D-695)	9490 psi (65.4 MPa) 472,000 psi (3250 MPa)
Flexural Strength (ASTM D-790) Flexural Modulus (ASTM D-790)	11,140 psi (76.8 MPa) 252,400 psi (1740 MPa)
Shear Strength (ASTM D-3165)	Unable to force a shear failure mode; samples fail in tension.
Water absorption (% gain) in 24 hours	< 1%
Expansion Coefficient [-37.4° to 40.1° C] Expansion Coefficient [120° to 222° C]	78 *10^{-6} m/m °C 151.8 *10^{-6} m/m °C

KEEP OUT OF REACH OF CHILDREN.
NOT FOR INTERNAL CONSUMPTION.

FOR INDUSTRIAL USE ONLY.
KEEP CONTAINER CLOSED TIGHTLY.

CONSULT MATERIAL SAFETY DATA SHEET FOR MORE INFORMATION.

The FRP Retrofit Experts

QuakeWrap, Inc.
2055 E. 17th Street
Tucson, AZ 85719 U.S.A.
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Toll Free: (866) QuakeWrap [782-5397]
www.QuakeWrap.com

Product Data Sheet

QuakeWrap™ VB26G Glass Fabric

for Structural Strengthening

DESCRIPTION
QuakeWrap™ VB26G is a high-strength biaxial glass fabric with slightly different strengths in 0° and 90° directions. The fabric is white and is impregnated in the field using QuakeBond™ J300SR Saturating Resin to form a glass fiber reinforced polymer (GFRP) used to strengthen structural elements. The fabric weighs 26 oz/yd^2.

USE
- Increased live load capacity in buildings and bridges, hospital floors, roofs of buildings, etc.
- Seismic retrofit of structural elements such as columns, unreinforced masonry walls, etc.
- Repair of large diameter pipes to achieve strengthening and water-proofing
- Repair of damaged structural components caused by aggressive environments, fire, vehicle impact, aging, etc.
- Changes in structural system: new openings in floors, removal of existing walls, etc.
- Correction of design or construction errors: misplaced reinforcing bars, insufficient structural depth

ADVANTAGES
- Strong and lightweight fabric ideal for confined spaces.
- One application adds strength in two orthogonal directions.
- Used for flexure and shear strengthening as well as confinement.
- Fully compatible and excellent adhesion to QuakeBond™ resins.
- Non-corrosive.
- Versatile; can be wrapped around complex shapes.
- Light weight does not alter mass & dynamic loads on structure.
- Special manufacturing of the fabric makes it very stable & prevents fraying.

PACKAGING
Rolls: 50 in. X 50 yards (1.27 m X 45 m). The fabric can be easily cut in the field to various lengths.

SHELF LIFE
Unlimited shelf life in proper storage conditions.

STORAGE CONDITIONS
Store in dry place at 45°-95° F (7°-35° C).

APPLICATION
Surface must be clean and sound; it may be dry or damp but must be free of standing water and frost. Remove dust, laitance, grease, curing compounds, disintegrated materials and other bond inhibiting materials from the surface. Existing uneven surfaces must be filled with an appropriate repair mortar. The adhesive strength of the substrate must be verified after surface preparation by random pull-off testing (ACI 503R) at the discretion of the engineer. Minimum tensile strength of 200 psi (1.4 MPa) with substrate failure is required.

Blast clean, shot-blast, scarify or use other approved mechanical means to clean the substrate surface. Any sharp edges (i.e. fins, form-marks, etc.) must be ground smooth and flush. Sharp edges must be rounded to a minimum radius of ¾ in. (19 mm). Apply QuakeBond™ J200TC onto the substrate with a trowel or spatula to a nominal thickness of 40 mil (1 mm). A notched trowel may be used for this application.
Saturate QuakeWrap™ VB26G fabric thoroughly with QuakeBond™ J300SR; for more details, refer to the Product Data Sheet for J300SR. Before the epoxies harden, apply saturated fabric to the substrate surface that has been coated with J200TC. Using gloved hands, carefully remove any entrapped air bubbles under the fabric; a plastic laminating roller can be used for this purpose. If required, additional layers of saturated fabric can be directly applied on top of previous layers. Feather the edges of the fabric with QuakeBond™ J200TC.
Installation of QuakeWrap™ fabrics must be performed only by specially trained and approved contractors.
Fabric can be cut to appropriate length using a commercial quality heavy duty scissor. Since dull or worn cutting tools can damage, weaken or fray the fiber, their use should be avoided.

LIMITATIONS
Design calculations must be made and certified by an independent licensed professional engineer. System is a vapor barrier. Concrete should not be encapsulated in areas of freeze/thaw.

CAUTION
QuakeWrap™ VB26G is non-reactive. However, caution must be used when handling since a fine glass dust may be present on the surface. Gloves must therefore be worn to protect against skin irritation. Caution must also be used when cutting the fabric to protect against airborne glass dust generated by the cutting procedure. Use of an appropriate, properly fitted NIOSH approved respirator is recommended.

PROPERTIES OF FABRIC LAMINATED WITH J300SR: *		
	US Units	SI Units
Aerial Weight Fabric Only	26 oz/yd^2	880 g/m^2
Ply Thickness	0.040 in.	1.02 mm
Longitudinal (0°) Direction:		
Tensile Strength	54.2 ksi	373.7 MPa
Tensile Modulus	3,217 ksi	22,180 MPa
Ultimate Elongation	2.1%	2.1%
Breaking Force	2,170 lb/in	380 N/mm
Transverse (90°) Direction:		
Tensile Strength	52.0 ksi	358 MPa
Tensile Modulus	2,700 ksi	18,610 MPa
Ultimate Elongation	1.9%	1.9%
Breaking Force	1,560 lb/in.	273 N/mm

* Results based on tests of two plies of fabrics saturated with J300SR. Data reported represent values for a single ply of fabric.

KEEP OUT OF REACH OF CHILDREN.
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The FRP Retrofit Experts

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www.QuakeWrap.com

Product Data Sheet

TB20C Carbon Fabric

for Structural Strengthening

DESCRIPTION

QuakeWrap™ TB20C is a high-strength biaxial carbon fabric with equal strengths in 0° and 90° directions. The fabric is black and is impregnated in the field using QuakeBond™ J300SR Saturating Resin to form a carbon fiber reinforced polymer (CFRP) used to strengthen structural elements. The fabric weighs 20 oz/yd^2 (677 g/m^2).

USE

- Increased live load capacity in buildings and bridges, hospital floors, roofs of buildings, etc.
- Seismic retrofit of structural elements such as columns, unreinforced masonry walls, etc.
- Repair of large diameter pipes to achieve strengthening and water-proofing
- Repair of damaged structural components caused by aggressive environments, fire, vehicle impact, aging, etc.
- Changes in structural system: new openings in floors, removal of existing walls, etc.
- Correction of design or construction errors: misplaced reinforcing bars, insufficient structural depth

ADVANTAGES

- Very strong and lightweight fabric ideal for confined spaces.
- Used for flexure and shear strengthening as well as confinement.
- Fully compatible and excellent adhesion to QuakeBond™ resins.
- Non-corrosive.
- Versatile; can be wrapped around complex shapes.
- Light weight does not alter mass & dynamic loads on structure.
- Alkali resistant.
- Special manufacturing of the fabric makes it very stable & prevents fraying.

PACKAGING

Rolls: 50 in. X 83 yards (1.27 m X 76 m). The fabric can be easily cut in the field to various lengths.

SHELF LIFE

Unlimited shelf life in proper storage conditions.

STORAGE CONDITIONS

Store in dry place at 45°-95° F (7°-35° C).

APPLICATION

Surface must be clean and sound; it may be dry or damp but must be free of standing water and frost. Remove dust, laitance, grease, curing compounds, disintegrated materials and other bond inhibiting materials from the surface. Existing uneven surfaces must be filled with an appropriate repair mortar. The adhesive strength of the substrate must be verified after surface preparation by random pull-off testing (ACI 503R) at the discretion of the engineer. Minimum tensile strength of 200 psi (1.4 MPa) with substrate failure is required.

Blast clean, shot-blast, scarify or use other approved mechanical means to clean the substrate surface. Any sharp edges (i.e. fins, form-marks, etc.) must be ground smooth and flush. Sharp edges must be rounded to a minimum radius of ¾ in. (19 mm). Apply QuakeBond™ J200TC onto the substrate with a trowel or spatula to a nominal thickness of 40 mil (1 mm). A notched trowel may be used for this application.

Saturate QuakeWrap™ TB20C fabric thoroughly with QuakeBond™ J300SR; for more details, refer to the Product Data Sheet for J300SR. Before the epoxies harden, apply saturated fabric to the substrate surface that has been coated with J200TC. Using gloved hands, carefully remove any entrapped air bubbles under the fabric; a plastic laminating roller can be used for this purpose. If required, additional layers of saturated fabric can be directly applied on top of previous layers. Feather the edges of the fabric with QuakeBond™ J200TC.

Installation of QuakeWrap™ fabrics must be performed only by specially trained and approved contractors.

Fabric can be cut to appropriate length using a commercial quality heavy duty scissor. Since dull or worn cutting tools can damage, weaken or fray the fiber, their use should be avoided.

LIMITATIONS

Design calculations must be made and certified by an independent licensed professional engineer. System is a vapor barrier. Concrete should not be encapsulated in areas of freeze/thaw.

CAUTION

QuakeWrap™ TB20C is non-reactive. However, caution must be used when handling since a fine carbon dust may be present on the surface. Gloves must therefore be worn to protect against skin irritation. Caution must also be used when cutting the fabric to protect against airborne carbon dust generated by the cutting procedure. Use of an appropriate, properly fitted NIOSH approved respirator is recommended.

PROPERTIES OF FIBRIC LAMINATED WITH J300SR: *		
	US Units	SI Units
Aerial Weight	20 oz/yd^2	677 g/m^2
Ply Thickness	0.0499 in.	1.27 mm
Longitudinal (0°) Direction:		
Tensile Strength	45.1 ksi	311 MPa
Tensile Modulus	6,440 ksi	44,400 MPa
Ultimate Elongation	1.0%	1.0%
Breaking Force	2,250 lb/in.	394 N/mm
Transverse (90°) Direction:		
Tensile Strength	45.1 ksi	311 MPa
Tensile Modulus	6,440 ksi	44,400 MPa
Ultimate Elongation	1.0%	1.0%
Breaking Force	2,250 lb/in.	394 N/mm

* Results based on tests of two plies of fabrics saturated with J300SR. Data reported represent values for a single ply of fabric.

KEEP OUT OF REACH OF CHILDREN.
NOT FOR INTERNAL CONSUMPTION.

FOR INDUSTRIAL USE ONLY.
KEEP CONTAINER CLOSED TIGHTLY.

Appendix D: FHWA Memo

MEMO

TO: Gary Goff, FHWA

FROM: Chad M. Orn, ETS Division

DATE: September 3, 2009

SUBJECT: PROJECT NO. IM-8-029(097)069, PCN 16767
NORTH FARGO INTERCHANGE NORTH TO THE SHEYENNE RIVER - NB
REEVALUATION OF CATEX FOR ADDITION OF PIPE REPAIR

The above noted project received a Categorical Exclusion (CATEX) from FHWA on 10/01/2008. The project was bid and awarded in March of 2009. The project consisted of PCC reconstruction from the North Fargo Interchange to the Sheyenne River (NB) and a thin lift overlay (NB/SB) from the Sheyenne River to approximately RP 75.24 (north crossover). Since the award of the project, the severity of holes in the shoulders have been increasing above a double 88" x 54" x 85' RCPA at approximately RP 75.1, see Figure 1 below. Based on concern of the pavement holding up over the pipes and the safety of the traveling public, the NDDOT is looking at processing a change order to rehabilitate the separated joints in the pipes. This section of roadway is currently closed due to head to head traffic on the southbound lanes. The NDDOT is currently looking at trying three different repair strategies in each pipe at the joints.

Figure 1: Holes above RCPAs at approximately RP 75.1

Since the CATEX did not consider any work off the roadway at these pipe locations, the NDDOT is reevaluating the CATEX to include this work. The wetland impacts due to the pipe repair strategies are anticipated to be 0.01 acres of temporary to jurisdictional wetlands. The impacts are due to the installation of temporary dikes at the ends of the pipes to allow dewatering. Sediment control measures will be used near the temporary dikes. The pipes will be rehabbed one at a time. The 404 permit received on 2/12/2009 would be modified to include the new temporary wetland impacts. An office delineation was completed in the winter of 2008 and a jurisdictional determination from the USACE was received on 1/9/2009. A "No Historic Properties Affected" concurrence was received from SHPO on 2/15/2008, which included possible pipe work.

The NDDOT is requesting your concurrence with the above reevaluation.

19/cmo

c: Tom Bold, Materials & Research Division
Kevin Gorder, Fargo District

Appendix E: Arch Pipe Repair Change Order #14

North Dakota Department of Transportation

Change Order

Change Order No: 14

Project: AC-IM-8-029(097)069 PCN: 16767

County: Cass

For: NORTHBOUND PCC RECONSTRUCTION, HBP OVERLAY, CASS CO

Contractor: NORTHERN IMPROVEMENT CO FAR
PO BOX 2846
FARGO, ND 58108-2846

Original Contract Amount:
$9,874,388.40

Date Created: 11/03/2009 Date Approved:

Spec No	Code No	Item of Work	Unit	Orig + or - Previous Chg Quantity	+ or - Quantity	Unit Price	Increase Amount	Decrease Amount
ADDED CONTRACT ITEM								
PARTICIPATING (IM FEDERAL FUNDS)								
714	2	Arch Pipe Joint Repair	L SUM	0 00	1 00	116,152 900	116,152 90	
Net Increase or Decrease to Date			57,309.94 Part		Non-Part	TOTALS	116,152 90	
						NON-PARTICIPITING		
						PARTICIPATING	116,152 90	

Due to This Change, the Contract Time
NO CHANGE

Classification

Administrative Change

EXPLANATION OF CHANGE IN PLAN RECOMMENDED

If the federal funds authorized in the cost participation agreement with the local agency is exceeded and federal funds are not available for this change, the local agency will assume the total cost of this change order

See attached sheets for summary and details

11-19-09
CONTRACTOR DATE

N/A
CITY/COUNTY/OTHER OFFICIAL DATE

N/A
REPRESENTING DATE

Gary R Heesch 11-4-09
(X) Approval Recommended ( ) Approved
PROJECT ENGINEER DATE

11/23/09
(X) Approval Recommended ( ) Approved
DISTRICT ENGINEER DATE

Darcy R. Rosendahl 02 DEC 2009
( ) Approval Recommended (X) Approved
OFFICE OF OPERATIONS DATE

12/2/09

Explanation of Change in Plan
Project IM-8-029(097)069
CO 14P-14C

714-0001 Arch Pipe Joint Repair - In the Spring of 2009 NDDOT Construction forces noticed that there were some severe pot holes and undermining taking place on the shoulder near the location of twin 88"x54" Arch Pipe (Sta. 3957+12). These conditions have been repaired in previous years with NDDOT maintenance forces however the conditions seemed to have deteriorated to a more severe condition this year. This condition raised concerns and thus a decision was made by NDDOT Department Administration to restore the joints of the arch pipe so stability of the pipe sections and roadway in this area could be obtained. It was also decided to try three alternate joint repair methods to accomplish this. Using multiple repairs required involving several different contractors and/or suppliers.

A description of the work involved is attached. The contractors and/or suppliers involved with the different repairs will be Subsurface, Inc. – Cretex – and PipeMedic/QuakeWrap.

Estimates and/or invoices of the work involved are attached.

Summary of repairs below:

PipeMedic/QuakeWrap - $18,910 (Supervision/Training for installation of material, material, travel costs)

Subsurface, Inc. - $41,520 (mobilization, building cofferdams, cleaning, internal joint repair, seeding, erosion blankets, general clean-up)

$52,000 (pressure grouting with 985 resin grout behind the arch pipe (grout injected from inside pipe)

Cretex – no costs (labor and material to complete the repairs – will train Subsurface on how repairs are to be accomplished)

Internal tie bars were supplied by Cretex and installed by Subsurface

Total Costs of all repairs: $112,430 + prime contractor markup ($3722.90) = **$116,152.90**
(10% first $5000 + 3% or $107,430)

Based on the amount of resin grout that was injected on the outside of the pipe the void area that had to be filled was fairly large. The amount of grout injected into the joints and around the pipe equates to around 29.6 CY of void filled.

Documentation of work and materials involved are attached.

QuakeWrap, Inc.

2055 E 17th Street
Tucson, AZ 85719
Phone: +1.520.791.7000
FAX: +1.520.791.0600
www.QuakeWrap.com

INVOICE

Invoice No. 1169

Date 9/28/2009

The FRP Retrofit Experts

Bill To	Ship To
ND-DOT ATTN: Kevin Gorder 503 38th Street Fargo, ND 58103-1198	ND-DOT Gary Heisler 503 38th Street Fargo, ND 58103-1198

Shipping Terms	Ship Via	Sales Rep	P.O. No.
			email
Terms	**Order Submitted By**	**Project**	
Net 30			

QTY	Item	Description	Rate	Amount
1	Field Supervisi...	Supervision and Training of Contractor's Labor Force on Job Site	1,100.00	1,100.00
	Discount	10% Discount on all products.	-4,040.00	-4,040.00
2,071.68	TB20C	QuakeWrap 20-oz Biaxial Carbon Fabric @ 50-inch wide (sq. ft.)	6.33	13,113.73
1,248	VB2610G	QuakeWrap Biaxial Glass Fabric w/ Mat @ 50-inch wide (sq. ft.)	1.97	2,458.56
3	J300SR-15	QuakeBond J300SR (Saturating Resin) - 15 gallon kit	1,019.20333	3,057.61
7	J201TC-3	QuakeBond J201TC (Tack Coat) - 3 gallon kit	224.30	1,570.10
1	Site Visit	Travel and Time to Visit the Construction Site	750.00	750.00
1	Freight		900.00	900.00

1.5% Finance Charge to be added monthly to Invoices over 30 days

By receipt of this Invoice, the purchaser acknowledges that he/she has received and is in full agreement with the Limited Product Warranty Statement for QuakeWrap™ products that is available on the company's website at: www.QuakeWrap.com/warranty.php

Subtotal	$18,910.00
Sales Tax	$0.00
TOTAL	$18,910.00
Previous Payments	$0.00
Balance Due	**$18,910.00**