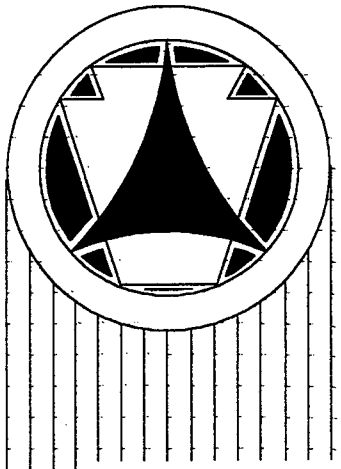

COMMONWEALTH OF PENNSYLVANIA

Department of Transportation

RESEARCH PROJECT No. 93-061

FIBER REINFORCED TREMIE CEMENT CONCRETE STREAMBED PAVING INVESTIGATION

FINAL REPORT

November 1998

Prepared by: William C. Koller,PE
& Wendy Hirosky

PENNSYLVANIA DEPARTMENT OF TRANSPORTATION
ENGINEERING DISTRICT 1-0

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REPORT DOCUMENTATION PAGE

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OMB No. 0704-0188

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	NOVEMBER 1998	Final Report April 1993 to November 1997

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Pennsylvania Department of Transportation
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Bureau of Construction and Materials
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1118 State Street
Harrisburg, PA 17120

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13. Abstract (Maximum 200 words)
This research project evaluated the use of fiber reinforcement in a tremie cement concrete placed in 5 culverts under I-90 Erie County. The fiber reinforced tremie concrete was inspected for 3 years of performance. The overall performance was equal to conventional reinforced Control Culvert and placement is easier and quicker with significant cost savings

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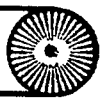
Prescribed by ANSI Std Z39-18



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RESEARCH PROJECT NO. 93-61

FIBER REINFORCED TREMIE CEMENT CONCRETE STREAMBED PAVING INVESTIGATION

FINAL REPORT

NOVEMBER 1998

BY:
WILLIAM C. KOLLER, P.E.
&
WENDY HIROSKY

CONDUCTED BY:

PENNSYLVANIA DEPARTMENT OF TRANSPORTATION

ENGINEERING DISTRICT 1-0 &

ENGINEER TECHNOLOGY & INFORMATION DIVISION
BUREAU OF CONSTRUCTION AND MATERIALS

IN COOPERATION WITH:

U.S. Department of Transportation
Federal Highway Administration

Metric Conversion Factors*

To Convert From:	To:	Multiply By:
Length		
foot (ft)	meter (m)	0.3048
inch (in)	millimeter (mm)	25.4
yard (yd)	meter (m)	0.9144
mile (statute)	kilometer (km)	1.609
Area		
square foot (ft^2)	square meter (m^2)	0.0929
square inch (in^2)	square centimeter (cm^2)	6.451
square yard (yd^2)	square meter (m^2)	0.8361
Volume		
cubic foot (ft^3)	cubic meter (m^3)	0.02832
cubic yard (yd^3)	cubic meter (m^3)	0.00315
gallon (U.S. liquid)	cubic meter (m^3)	0.004546
ounce (U.S. liquid)	cubic centimeter (cm^3)	29.57
Mass		
ounce-mass (avdp)	gram (g)	28.35
pound-mass (avdp)	kilogram (kg)	0.4536
ton (metric)	kilogram (kg)	1000
ton (short, 2000 lbm)	kilogram (kg)	907.2
Density		
pound-mass/cubic foot	kilogram/cubic meter (kg/m^3)	16.02
mass/cubic yard	kilogram/cubic meter (kg/m^3)	0.5933
pound-mass/gallon(U.S.)**	kilogram/cubic meter (kg/m^3)	119.8
pound-mass/gallon(Can.)*	kilogram/cubic meter (kg/m^3)	99.78
Temperature		
deg Celsius (°C)	kelvin (°K)	$t°K = (t°C + 273.15)$
deg Fahrenheit (°F)	kelvin (°K)	$t°K = (t°F + 459.67) / 1.8$
deg Fahrenheit (°F)	deg Celsius (°C)	$t°C = (t°F - 32) / 1.8$

Table of Contents

ABSTRACT

This research project evaluates the performance and construction of fiber reinforcement in tremie concrete mixes in the streambed paving of five arch culverts on Interstate 90 in Erie County. The results will be compared to the streambed paving of another arch culvert paved with reinforced Class A concrete. The construction of all arch culverts occurred during the 1993 and 1994 construction seasons. Yearly inspections were conducted afterward. The arch culverts were originally built in the mid 1960's on erodible shale which did erode over the years to a maximum of four feet below the bottom of the footings. In some cases this erosion was contained to the inside width of the arch culvert in others it eroded below the footings of the arch culverts. These culverts are under 50 to 70 feet of fill and range in length from 355'-626'. This report will compare the construction, cost and performance of the fiber reinforced streambed paving to the conventionally reinforced concrete streambed paving.

INTRODUCTION

The existing conditions in all of the culverts were rated as poor. There was severe erosion at the footings and streambed areas of all of the culverts. See the photographs below and the sketches in Appendix A for examples of this severity. The repair of these culverts was included in the construction contract for the reconstruction of I-90, Section A01.

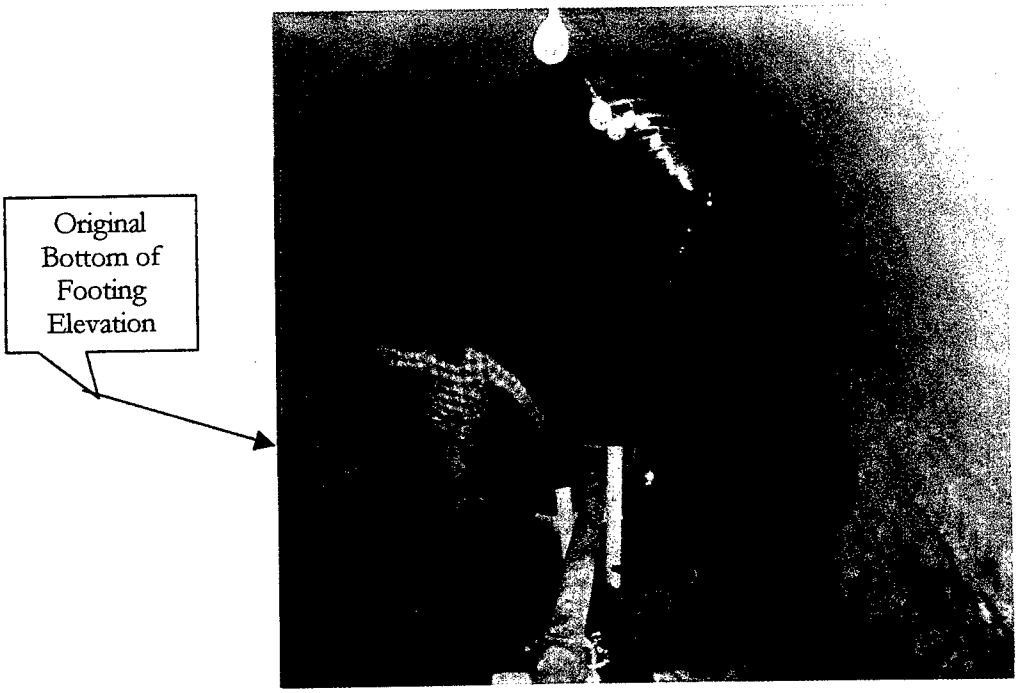


Photo 1: View of existing conditions inside Culvert 3

Photo 2: View of existing conditions inside Culvert 2

Work Objectives: Repair the erosion damage in five arch culverts that carry I-90 over various small streams. This repair should be done in the most cost effective manner. Since the stream bed areas are difficult to access, the ease of construction was a paramount issue. The paving of the streambeds should extend the life of the culverts and deter further erosion. The plan of action as determined by a design consultant was to pave the streambeds using a tremie fiber-reinforced concrete and add scour protection to the culverts. For details on the type of fiber reinforcement used see Appendix B. A control streambed paving was used to compare the results of this research to a typical type of streambed paving.

Locations:

Assign numbers to culverts since most are over unidentified streams or the same stream.

Culvert	BMS Identifier	Length	Avg. Streambed Paving Depth	Structure Number
1	25-0090-0300-1741	570'	4.5'	S-20117
2	25-0090-0304-1909	512'	6.5'	S-20118
3	25-0090-0344-1468	626'	4.5'	S-20119
4	25-0090-0374-1021	356'	5.7'	S-20120
5	25-0090-0400-2297	479'	3.3'	S-20121
Control	25-0090-0440-2529	302'	0.7'	S-20380

See Figure 1 (next page) for the location map of the culverts. All are located on Interstate 90 from Segment 300 to Segment 440 in Erie County.

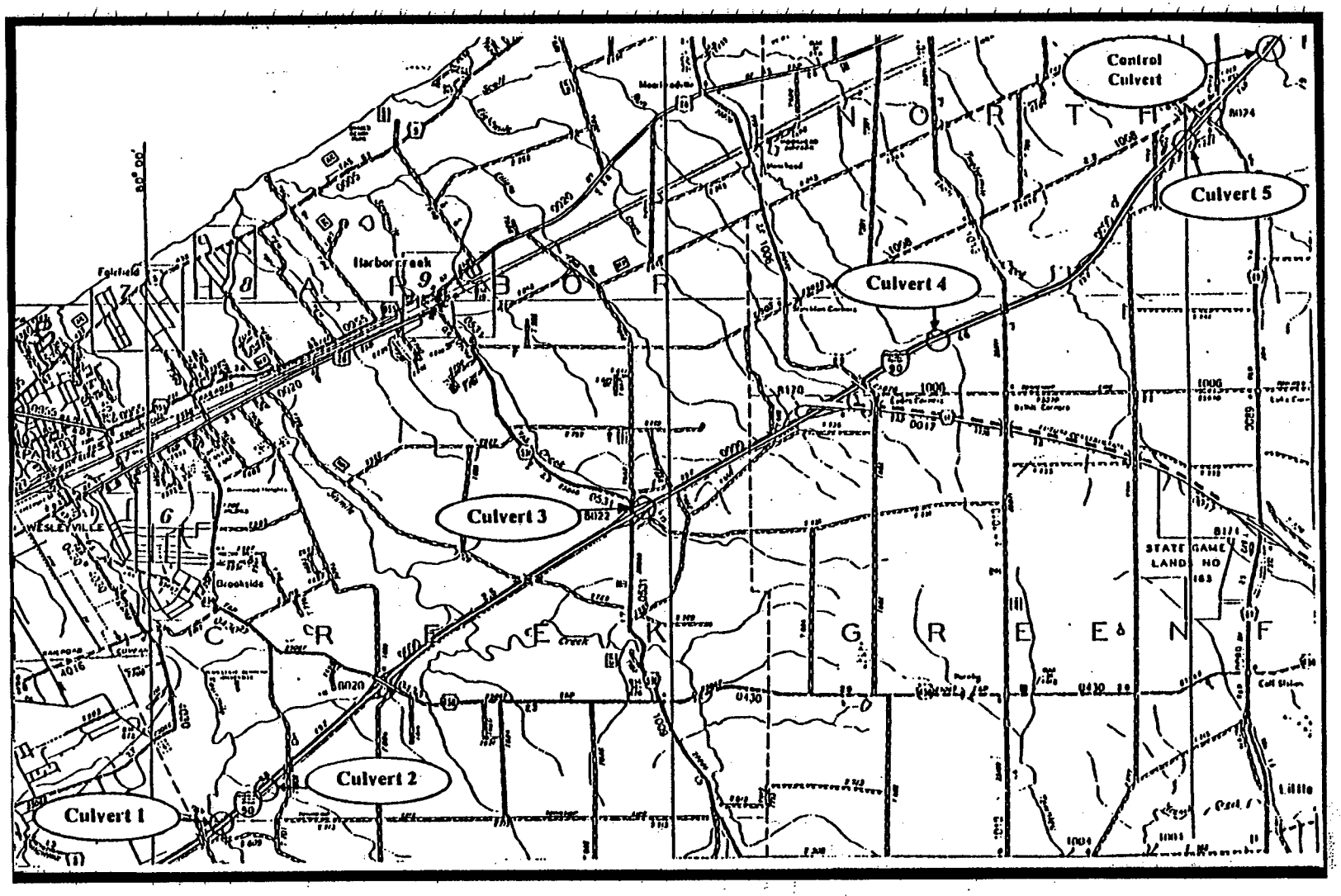


Figure 1 – Location Map

Materials:

Fiber reinforced concrete has been in existence for many years, but not prolifically used by PennDOT. The fibers used during this project are Forta Ultra-Net™ manufactured by Forta Fiber of Grove City, Pennsylvania. The Ultra-Net™ is an extra heavy duty fiber system that offers non-corrosive and 100% Alkali proof protection. It has been designed to reduce concrete shrinkage because of the fiber bonding, see Appendix B for more information. Fiber reinforced concrete should be placed in the same manner as conventional concrete.

CONSTRUCTION SUMMARY

Procedures:

- Clean culverts of debris
- Divert stream from culvert
- Prepare the area for concrete placement
- Place the concrete with hydraulic pump through a slick line (steel pipe used to extend pump hose)
- Monitor with yearly inspections, for Reports see Appendix E

Testing Procedures:

- Concrete air content and slump tested at plant
- Concrete tested on site at point of placement for air and slump
- Compressive tests were performed at 7 and 28 days after placement, for results see Appendix C

Problems:

- The proposed flexural concrete testing was never performed (provision not included in the special provisions of contract.)
- Fibers clogged the slick line during placement due to improper mixing rates. This delayed the placement for up to an hour at times.

COST SUMMARY

Research Arch Culverts: **Total Cost for All Materials**					
Item 5001-0040 Tremie Concrete Fiber Reinforced Culverts					
Culverts	Plan Qty CY	Actual Qty CY	1993 Unit Price $	Plan Cost $	Actual Cost $
1	1236	1152	235	$290,460	$270,720
2	850	800	235	$199,750	$188,000
3	726	654	235	$170,610	$153,690
4	389	335	235	$91,415	$78,725
5	265	209	235	$62,275	$49,115

Control Arch Culvert: **Total Cost for All Materials**					
Item 1001-0010 Class A Concrete					
Culverts	Plan Qty CY/lbs	Actual Qty CY/lbs	1993 Unit Price $	Plan Cost $	Actual Cost $
Control	217	242	300	$65,100	$72,600
Item 1002-0053 Reinforcement Bars					
Control	9175	9169.38	0.80	$7340	$7335.50
Total	-	-	-	$72,440	$91164.50

The per site quantities of the tremie fiber reinforced concrete ranges from 265CY-1236CY. Given that the Control quantity was 217 CY, the unit price would not drop substantially for a greater quantity and all concrete was batched from the same Plant under the same contract. The overall quantity difference would not have affected the difference between concrete types. The unit price for the Class A concrete was more expensive than the tremie fiber reinforced concrete, then adding the cost of steel reinforcing greatly increases the Control Culvert unit price. Using tremie fiber reinforced concrete for all five arch culverts eliminated the need for conventional reinforcement which significantly reduced the amount of construction time necessary. Fiber reinforced concrete was ideal for these culverts due to their lack of accessibility. Some of the culvert inlets and outlets were in locations so remote that the pump hoses could only be extended from the interstate, if possible others were accessed from roadways cut through wooded areas to reach the work areas. This may have increased costs but these costs were absorbed by the contractor and are not reflected in the unit prices of tremie fiber-reinforced concrete. Therefore the use of tremie fiber reinforced concrete for streambed paving is more cost effective than conventional methods.

TESTING

During placement of concrete in arch culverts uncured concrete was tested for air content and slump. Cylinders were also cast at this time, typical size being 6inches in diameter by 12 inches in height. These cylinders were then stripped from their forms after 24 hours and exposed to similar conditions as the streambed paving for 7 or 28 days before testing for compressive strength. The chart in Appendix C shows the results of all tests performed on the concrete. The design criteria for slump and air for fiber reinforced concrete are as follows: air content must fall between 5 and 8 % and the slump range is 6 to 8 inches. For normal Class A Concrete air content requirements fall between 5 and 8 %, and the slump range is 1 to 3 inches. The chart shows that all concrete tests performed demonstrate that the concrete meets these criterion. The 28-Day compressive strength of the fiber reinforced concrete has equal strength to the concrete used in the Control Culvert. Of course the reinforcement bars in the Control Culvert increase the tensile strength of the streambed paving, but tension is not a necessary characteristic for streambed paving.

PERFORMANCE

The streambed pavings held up quite well under the erosive conditions of the streams that flow through them. For more detailed results see the inspection summary chart on the next page and the photographs in Appendix D.

Results of Inspections						
Culvert	1	2	3	4	5	Control
Date of Placement	8/12/94	9/13/93 9/23/93	9/9/93	9/21/93	10/1/93	9/23/94
Rating before Placement	Poor	Severe	Serious	Critical	Serious	Poor
1st Inspection	9/8/94	6/19/94	2/23/94	4/28/94	9/8/94	3/10/95
No. of Cracks & Rating	4 Satisfactory	10 Satisfactory	13 Satisfactory	6 Fair	11 Satisfactory	4 Satisfactory
2nd Inspection	1/3/96	9/94	9/94	9/8/94	7/18/96	8/23/96
No. of Cracks & Rating	8 Satisfactory	10 Satisfactory	13 Satisfactory	6 Fair	11 Satisfactory	4 Satisfactory
3rd Inspection	7/12/96	7/12/96	7/17/96	7/17/96	11/24/97	11/24/97
No. of Cracks & Rating	8 Satisfactory	13 Satisfactory	17 Satisfactory	11 Satisfactory	15 Satisfactory	5 Satisfactory

All of the cracks are transverse in nature. These are surface cracks only and are most likely due to shrinkage. The placement thickness and higher water content of the tremie concrete mix may have been a large factor in the resultant hairline cracking (refer to Appendix F for water cement ratio comparisons.) Most of the cracks are full width, but some are only half width. None of the cracks are extensions of the cracks in the arch culvert walls. The Control Culvert has fewer cracks but this may reflect the lower water content in the concrete mix and the thinner paving thickness.

CONCLUSIONS/RECOMMENDATIONS

The construction techniques used for the control culvert and the five experimental culverts were somewhat similar, both involved pumping of concrete to pave the streambed. The difference between the two was the use of reinforcement, the control culvert used conventional steel reinforcement, which took two and a half days to place, where Culverts 1-5 used fiber-reinforced concrete which totally eliminated the time taken to place the steel reinforcement. The use of fiber-reinforced concrete in Culverts 1-5 reduced their construction time by more than 50%.

The cost of the Culverts 1-5 was considerably less than that of the Control Culvert. The cost of the labor saved by not placing conventional steel reinforcement contributed significantly to reducing the total cost of construction of Culverts 1-5. The sum of the reinforcement and concrete for the Control Culvert exceeds the cost of Culverts 4 and 5 which are longer and have much deeper streambed paving. This difference alone proves that the tremie fiber reinforced concrete culverts were more cost effective than the conventional way of streambed paving.

The concrete testing results show that the tremie fiber reinforced concrete culverts have the same compressive strength as the Control Culvert's Class A concrete. This shows that there is no disadvantage to using fiber reinforced concrete in structure where only compressive strength is needed. It has been documented that fiber reinforcement provides significant flexural strength, which is an added bonus for this application.

The performance of the tremie fiber reinforced concrete streambed pavings have a similar performance rating compared to the conventional reinforced concrete Control Culvert. The inspection reports show surface cracking in all culverts, but more in the fiber reinforced culverts. This may be due to the greater placement thickness and higher water content of the tremie concrete mix.

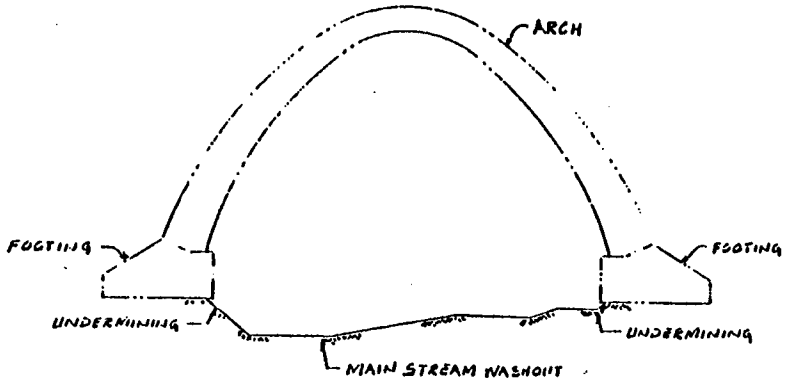
Overall the performance of the tremie fiber reinforced concrete streambed pavings equal to the performance of the conventional reinforced concrete Control Culvert. The Costs of the experimental streambed pavings was much less on a per unit basis. The test results show that the compressive strengths of the fiber reinforced concrete is equal to that of the Class A Concrete. The use of fiber reinforcement for temperature and shrinkage control performs equally when compared to conventional reinforcement, placement is quicker and easier to place and provides a significant cost savings.

These researchers recommend that collated fibrillated polypropylene fibers (see special provision in Appendix G) be approved by the Department for general use.

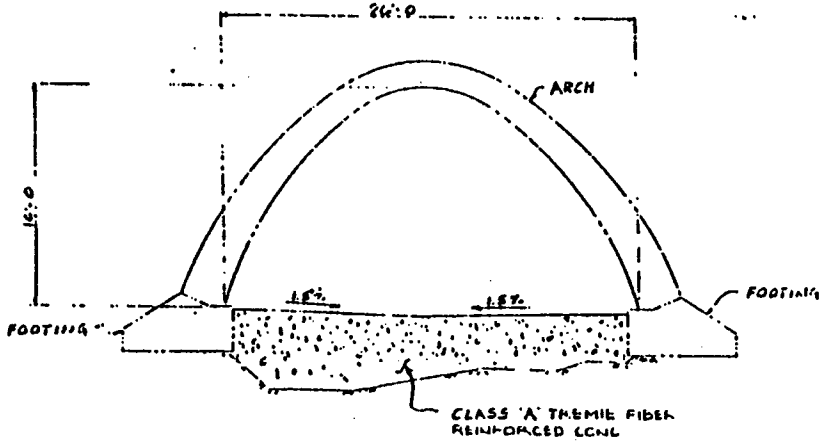
Appendix A

Sketches of Repairs for Culverts, Show Existing Conditions

Culvert 1



EXISTING CULVERT CONDITIONS
SCALE: 1/4" = 1'-0



MAINTAIN A ONE (1) FOOT MINIMUM THICKNESS OF TREMIE FIBER REINFORCED CONCRETE THROUGHOUT THE CULVERT

PROPOSED CULVERT REPAIR
SCALE: 1/4" = 1'-0

Mark	Description	By	Cm
	REVISIONS		

S.R. 0090 PREVIOUSLY KNOWN AS L.R. 2

COMMONWEALTH OF PENNSYLV
DEPARTMENT OF TRANSPORTA

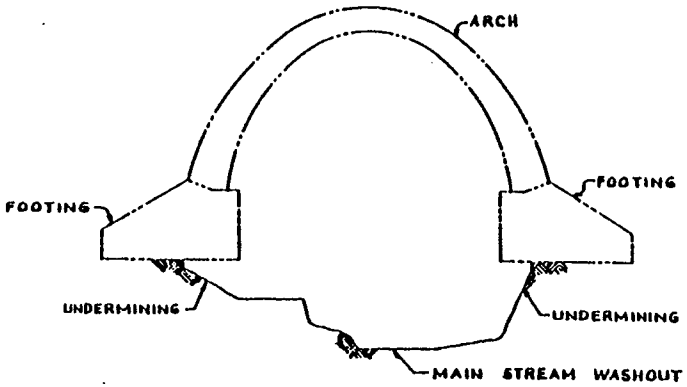
ERIE COUNTY
S.R. 0090 SECTION A
SEGMENT 0300 OFFSET 17
CULVERT ℄ @ STATION 1701+3
UNDER S.R 0090
DRAINAGE CULVERT REHABILIT
CROSS SECTIONS

RECOMMENDED _____
2/16/93

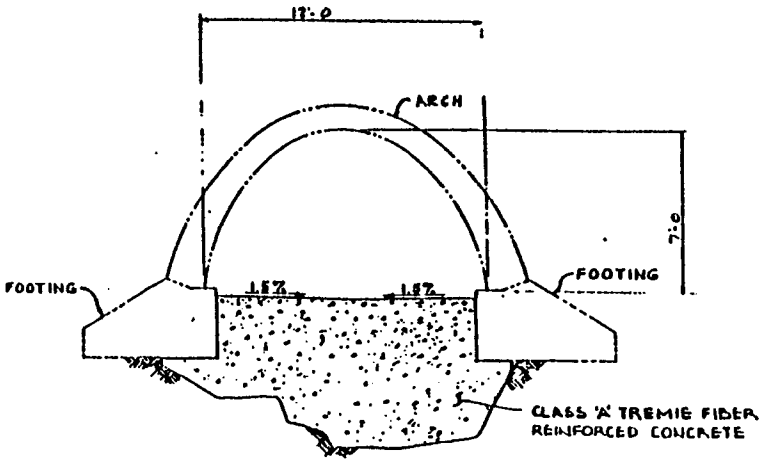
DESIGNED | DRAWN T.H. | CHECKED

PLACED BY _____
ENABLED BY _____

Culvert 2



EXISTING CULVERT CONDITIONS
SCALE : 3/8" = 1'-0



MAINTAIN A ONE (1) FOOT MINIMUM THICKNESS OF TREMIE FIBER REINFORCED CONCRETE THROUGHOUT THE CULVERT

PROPOSED CULVERT REPAIR
SCALE : 3/8" = 1'-0

Mark	Description	By	C
	REVISIONS		

S.R. 0090 PREVIOUSLY KNOWN AS L.R

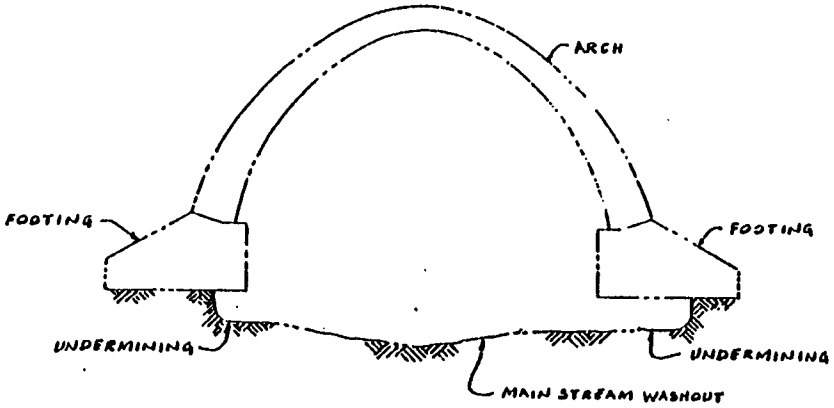
COMMONWEALTH OF PENNSYL
DEPARTMENT OF TRANSPOR

ERIE COUNTY
S.R. 0090 SECTION
SEGMENT 0304 OFFSET
CULVERT @ STATION 172
UNDER S.R. 0090
DRAINAGE CULVERT REHABI
CROSS SECTIONS

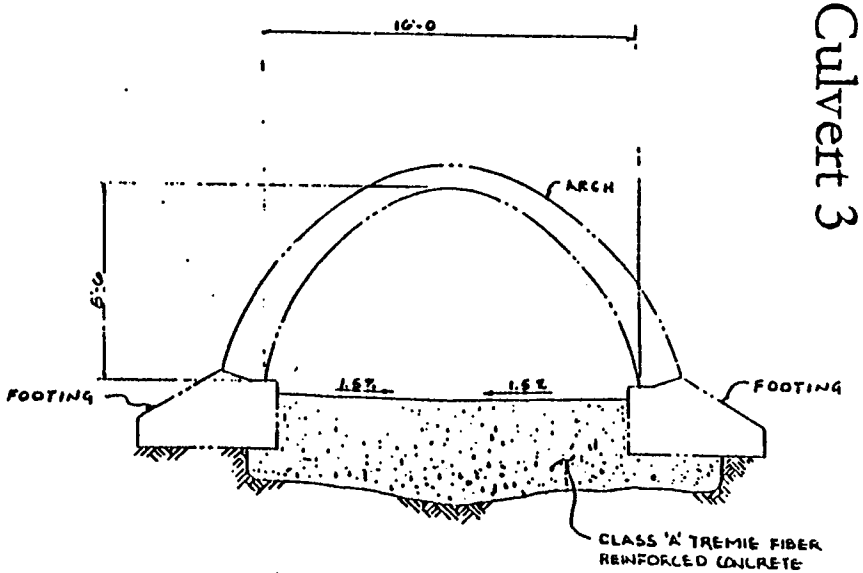
RECOMMENDED _____
3/11/93

DES: N.E.K. | DRG: D.V.K. | CKD: T.H.
TRACED BY: _____
FINALED BY: _____

Culvert 3



EXISTING CULVERT CONDITIONS
SCALE 3/8" = 1'-0



MAINTAIN A ONE (1) FOOT MINIMUM THICKNESS OF TREMIE FIBER REINFORCED CONCRETE THROUGHOUT THE CULVERT

PROPOSED CULVERT REPAIR
SCALE 3/8" = 1'-0

Mark	Description	By	Crm d
	REVISIONS		

AR0090 PREVIOUSLY SHOWN AS L.R. 797

COMMONWEALTH OF PENNSYLVAN
DEPARTMENT OF TRANSPORTATI

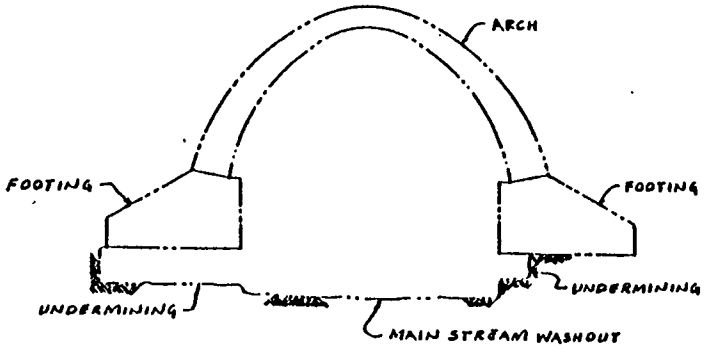
ERIE COUNTY
S.R. 0090 SECTION AO
SEGMENT 0344 OFFSET 1468
CULVERT @ STATION 1934+33.
UNDER S.R. 0090
DRAINAGE CULVERT REHABILITA
CROSS SECTION

RECOMMENDED _____
3/12/93

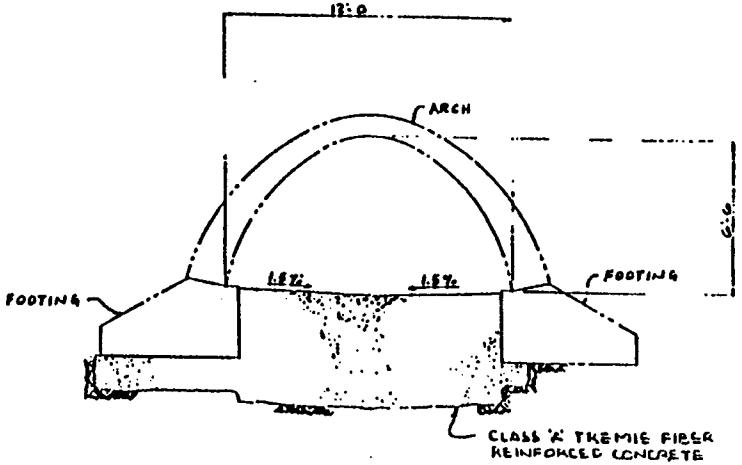
SHEE
S-

DESIGNED W. | DRGI T.H. | CHKD F.S.O
SHEET NO.

Culvert 4



EXISTING CULVERT CONDITIONS
SCALE 3/8" = 1'-0



MAINTAIN A ONE (1) FOOT MINIMUM THICKNESS OF TREMIE FIBER REINFORCED CONCRETE THROUGHOUT THE CULVERT

PROPOSED CULVERT REPAIR
SCALE 3/8" = 1'-0

Mark	Description	By	Chk'd
	REVISIONS		

S.R. 0090 PREVIOUSLY KNOWN AS L.R. 29

COMMONWEALTH OF PENNSYLVA
DEPARTMENT OF TRANSPORTAT

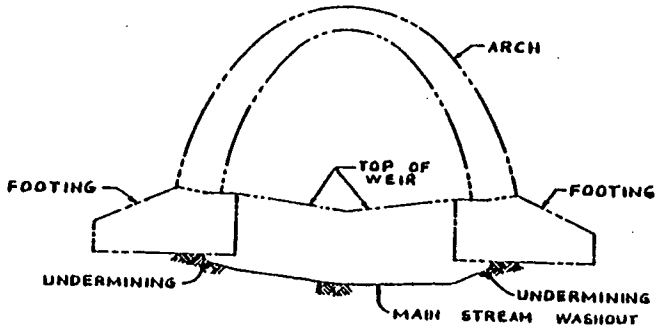
ERIE COUNTY
S.R. 0090 SECTION A
SEGMENT 0374 OFFSET 102
CULVERT @ STATION 2089+
UNDER S.R. 0090
DRAINAGE CULVERT REHABILIT
CROSS SECTIONS

RECOMMENDED _____
3/16/93

SHE

DESIGNED JP | DRAWN JP | CHKD SH
TRACED BY
CHECKED BY

Culvert 5



EXISTING CULVERT CONDITIONS
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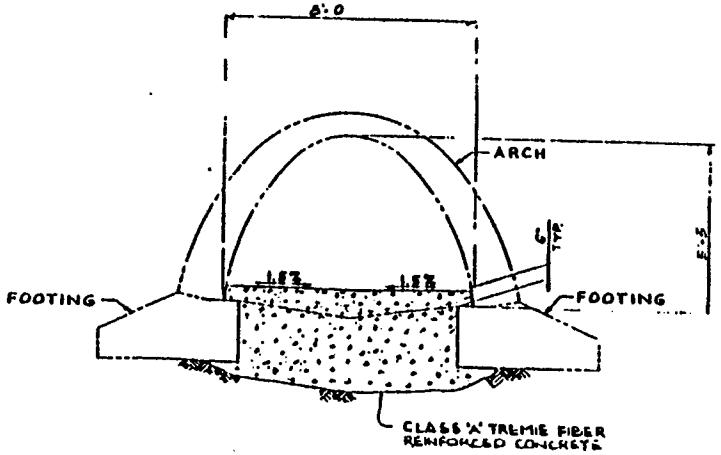


MAINTAIN A ONE (1) FOOT MINIMUM THICKNESS OF TREMIE FIBER REINFORCED CONCRETE THROUGHOUT THE CULVERT

PROPOSED CULVERT REPAIR
SCALE: 1/2" = 1'-0

Mark	Description	By	Chk'd
	REVISIONS		

S.R. 0090 PREVIOUSLY KNOWN AS L.R. 76

COMMONWEALTH OF PENNSYLVA
DEPARTMENT OF TRANSPORTAT
ERIE COUNTY
S.R. 0090 SECTION A(
SEGMENT 0400 OFFSET 22
CULVERT C @ STATION 2234+1
UNDER S.R. 0090
DRAINAGE CULVERT REHABILITA
CROSS SECTIONS

RECOMMENDED _____
3/12/93

SHE
S

DESIGNED D.V.H. | DRCI D.V.H. | CHKD F.R.D.
PLACED BY: _____
FINISHED BY: _____

Appendix B

Literature from Forta Fiber Corp.

FACT-DATA©

MANUFACTURER

FORTA CORPORATION, 100 FORTA Drive, Grove City, PA, U.S.A. 16127-9099
TELEPHONE: 1-800-245-0306 (412) 458-5221; FACSIMILE: (412) 458-8331

GENERAL DESCRIPTION

FORTA® ULTRA-NET™ **is an easy to finish,** color blended, fully oriented, 100% virgin homopolymer polypropylene fibrous reinforcement in a unique twisted-bundle, collated fibrillated (network) form. FORTA® ULTRA-NET™ is used to reduce plastic and hardened concrete shrinkage, improve impact strength, increase fatigue resistance and concrete toughness. This **extra heavy-duty** fiber offers **ULTRA-NETWORKING** power, maximum long term durability, and true secondary/temperature control by incorporating a fibrillated pattern and long length option. Non-corrosive, non-magnetic, and **100% Alkali Proof!**

APPLICATIONS

FORTA® ULTRA-NET™ is mainly used with performance concrete applications such as slab-on-grade, shotcrete, tilt-up panels, architectural/colored concrete, precast - anywhere that optimum fiber performance is required, and where the objective is to control temperature/shrinkage/settlement cracking while improving long-term durability properties. **Requires No Mix Design Or Placement Changes!**

INSTALLATION

Recommended dosage rate of ULTRA-NET™ is **1.6 lbs. per cubic yard (1.0 kg. per cubic meter)** of concrete added directly to the concrete mixing system during, or after, the batching of the other ingredients and mixed at the time and speed recommended by the mixer manufacturer (usually four to five minutes). Contact your local FORTA® representative for alternate dosage rates used in specialty applications.

PHYSICAL PROPERTIES

Material	Virgin Homopolymer Polypropylene
Form	Collated Fibrillated Twisted-Bundle Fiber
Specific Gravity	0.91
Tensile Strength	90-110 ksi. (620-758 MPa)
Lengths	3/4" (19mm), 1-1/2" (38mm) 2-1/4" (57mm), and 2-1/2" (64mm)
Color	Tan
Acid/Alkali Resistance	Excellent
Absorption	Nil
Compliance	A.S.T.M. C-116

AVAILABILITY

FORTA® ULTRA-NET™ can be purchased from FORTA Corporation or an authorized FORTA® products distributor, dealer or representative. Orders are shipped within 24 hours by small package services, commercial carrier, or air freight.

PACKAGING (Plastic or Mixer Ready Bags Available)

	Domestic	International
Bags	1.6 lbs.	1.0 kg
Cartons	20 bags	16 bags
Pallets	20 cartons/400 bags	20 cartons/320 bags

WARRANTY

FORTA® ULTRA-NET™ fiber is warranted to be free of defects and to meet all quality control standards set by the manufacturer. FORTA® has no control over the design, production, placement, or testing of the concrete products in which FORTA® ULTRA-NET™ is incorporated, therefore FORTA Corporation assumes no responsibility for the end products.

FORTA® Specification
ULTRA-NET™

Construction Specifications Institute (C.S.I.) Classifications:

DIVISION 3 - CONCRETE

SECTION 03200 - CONCRETE REINFORCEMENT
SYNTHETIC FIBROUS REINFORCEMENT

I. MATERIAL

ULTRA-NET™ is a synthetic fiber reinforcement that is fully oriented, 100% virgin polypropylene in **twisted bundle,** collated fibrillated (network) form, and **colored to blend** with the hardened concrete. The top-size of the coarse aggregate (per ASTM C-33) shall determine the **choice of fiber length.**

Aggregate Top Size:	1/4" (5mm)	1/2" (13mm)	3/4" (19mm)	1" + (25mm+)
Optimum Fiber Length:	3/4" (19mm)	1-1/2" (38mm)	2-1/4" (57mm)	2-1/2" (64mm)

II. INSTALLATION

ULTRA-NET™ shall be added at the standard rate of **1.6 lbs. per cubic yard (1.0 kg. per cubic meter)** of concrete. Fiber shall be added directly to the concrete mixing system during, or after, the batching of the other concrete ingredients and mixed at mixing speed four to five minutes. Contact your local FORTA® representative for recommended optimum dosage rates used in specialty applications.

III. COMPLIANCE

ULTRA-NET™ **fully complies** with American Society for Testing and Measurement **(A.S.T.M.) C-1116** "Standard Specification for Fiber Reinforced Concrete and Shotcrete," Section 4.1.3, and all applicable national building codes. FORTA® FACT-DATA® sheets and code evaluation reports shall be submitted to verify specification compliance.

IV. SOURCE

The approved product is **FORTA® ULTRA-NET™** as manufactured by FORTA Corporation, Grove City, PA, U.S.A. Telephone: 1-800-245-0306 or (412) 458-5221; Facsimile: (412) 458-8331.

Condensed Specification

Fiber shall be fully oriented, 100% virgin polypropylene, twisted bundle, collated fibrillated fiber, tan in color, ____" (_____mm) long, dosed at 1.6 lbs. per cubic yard (1.0 kg. per cubic meter) of concrete. Fiber shall comply with A.S.T.M. C-1116, 4.1.3 and applicable building codes. The approved product is FORTA® ULTRA-NET™ by FORTA Corporation, Grove City, PA, U.S.A. Phone: 1-800-245-0306 or (412) 458-5221, Fax (412) 458-8331

FORTA CORPORATION

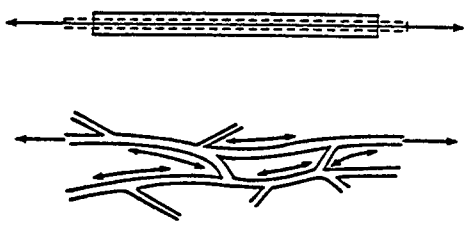
100 FORTA Drive, Grove City, PA 16127-9099

1-800-245-0306 or (412) 458-5221
FAX (412) 458-8331

FORTA®
Common Sense

Though FORTA's technical recommendations regarding synthetic fiber characteristics are based on years of engineering research and scores of concrete projects, much of today's fiber theory also relies on basic common sense for a sound foundation. FORTA® has developed a simple "4-C's" formula to help the specifier and buyer choose the right fiber for any concrete application. By making a decision within each of the FORTA® "4-C's" categories - Configuration, Chemistry, Contents, and Correct length - specifiers will be able to predict the fiber performance level for a given project.

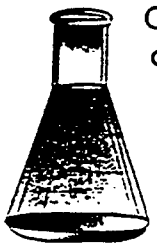
Configuration



The most important criteria to consider is the actual configuration of the fiber. Common sense would suggest that something that is deformed or irregular in shape will anchor within a composite much better than something that is smooth. There are many everyday examples of this function, such as the different shapes of fasteners. A finishing nail is typically thin and very smooth, and doesn't possess the holding power of a heavier, threaded lag bolt. Deformed rebar anchors within concrete much better than smooth rebar. It is this same reasoning that shows us that fibrillated net-like fibers (deformed) anchor much better than monofilament fibers (smooth and round) within the concrete. Under tension, a monofilament fiber tends to stretch like a rubber band and therefore lose its grip or anchor within the concrete matrix. The fiber's ability to anchor naturally determines the capability of the fiber to contribute to short-term and long-term concrete benefits. The ultimate tensile strength of the fiber can only be fully utilized if the fiber anchors in the concrete and does not easily pull out.

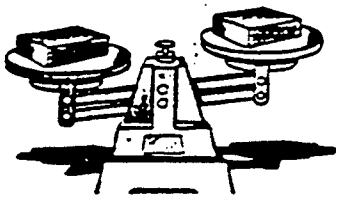
As a result, if the fiber's purpose on a project is simply to control plastic shrinkage cracking during the very early concrete stages, a monofilament fiber configuration will be sufficient. But for additional anchorage benefits after the concrete is *hardened,* the specifier would opt for a fibrillated net configuration to maximize the long-term durability results. The fibrillated net-shape fibers also afford the specifier the opportunity to replace the non-structural wire mesh used to hold concrete cracks together as a secondary/temperature reinforcement.

Chemistry



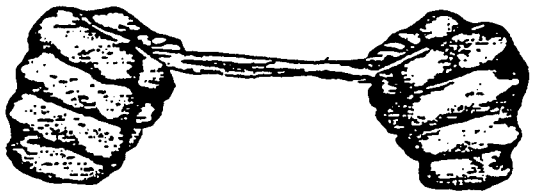
Once the specifier has selected the proper fiber configuration for the job, the fiber chemistry can be chosen. The chemical make-up of the fiber is important if the fiber is expected to hold up in the aggressive alkali environment of Portland cement concrete. For monofilament fibers, the buyer can choose from nylon, which possesses high strength and good resistance to alkali, and polypropylene, which combines strength with an excellent (inert) resistance to alkali. Unlike nylon, polypropylene is hydrophobic (non-absorptive), which makes it an outstanding selection in freeze-thaw environments. For fibrillated-net fibers, only polypropylene is suitable to the fibrillation or slitting manufacturing process. To this point, the specifier/buyer has been able to choose a polypropylene or nylon monofilament fiber for early shrinkage crack reduction, or a polypropylene fibrillated-net fiber for both plastic and hardened shrinkage crack control and wire mesh alternative.

Contents



Though it may sound obvious, using a sufficient quantity of fiber per cubic yard of concrete is an often overlooked and ignored factor. Even the best fiber in the world will fall short on performance if not enough is used to get the job done. After extensive FORTA® research, it became apparent that dosage of fiber is very similar to dosage of many other materials, such as cement - the more you add (up to a point of no return), the more benefits you will obtain. There is an *optimum* dosage level for a particular fiber type to achieve *optimum* results. For polypropylene or nylon monofilament fibers to reduce early shrinkage cracking, 1.0 lbs. per cubic yard (0.6 kg. per cubic meter) is sufficient. For fibrillated polypropylene fibers to act as a true temperature reinforcement, 1.5 lbs. per cubic yard (0.9 kg. per cubic meter) is the standard. Even higher dosages can offer additional benefits to fatigue, toughness, and long-term durability-contact FORTA® engineering for assistance.

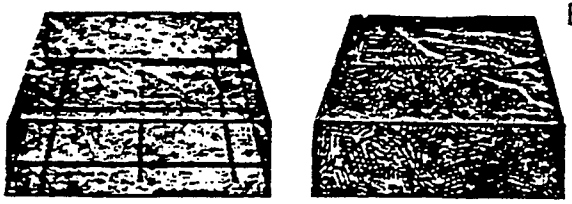
Correct Length



The function of length is very similar to that of fiber configuration with regards to anchorage ability. As with shape, if a short fiber pulls out of the concrete before it fails or breaks, the high tensile strength of the fiber has been wasted. Common sense would suggest that if you attempt to break a short fiber held between your fingers, your fingers most likely slip off, while adding length to the fiber allows for a better grip. This same scenario also plays out within the concrete matrix, reinforcing the value and benefit of longer fiber length. Longer fibers are also better able to wrap around aggregate particles than short fibers, allowing for more crack control within the mortar matrix.

It is important to note that fiber length recommendations vary based on the fiber shape that is chosen. For instance, fiber anchoring ability can be improved by adding to the fiber length of *fibrillated* fibers, however dramatic clumping or balling problems will likely occur if longer monofilament shapes are used. The optimum length for *monofilament* fibers has settled out in the 3/4" (19 mm) range. For standard fibrillated fibers, lengths range from 3/4" (19 mm) up to 1 1/2" (38 mm) with no mixing problems. Even longer lengths of heavy-duty fibrillated fibers up to 2 1/2" (64 mm) may be used if additional manufacturing processes are performed, such as adding an engineered pre-twist to each fiber bundle.

Dollars and Sense



By following the FORTA® "4-C's" formula of fiber characteristics, the project specifier may have selected a 3/4" (19 mm) long polypropylene or nylon monofilament fiber used at 1.0 lbs. per cubic yard (0.6 kg. per cubic meter) of concrete to reduce plastic shrinkage cracking during the concrete's early life. For this performance level, the buyer would expect a U.S. cost of approximately $.015 per square foot per inch of concrete thickness. For the specifier that has chosen longer lengths of fibrillated polypropylene fibers at 1.5 to 1.6 lbs. per cubic yard (0.9 to 1.0 kgs. per cubic meter) as a true temperature reinforcement, the in-place cost would be approximately $.02 to $.025 per square foot per inch of thickness. Though the price of these better performance fibers is slightly higher, the project buyer can subtract the material and placement costs associated with the non-structural wire mesh that these fibers replaced. Naturally, the selection of the fiber type is ultimately in the hands of the project owner who is footing the final bill, however it remains the responsibility of FORTA® and their ready-mix dealers, specifiers and engineers, to offer reliable and common-sense recommendations to allow the buyer to make an educated choice, and receive the best return on their concrete investment.

Appendix C

Summary of Test Results

Appendix C

SUMMARY OFTESTING RESULTS					
CULVERT	Cylinder Series	Air (%)	Slump (Inch)	Compressive Strength PSI	
				7-Day	28-Day
1	T-25	7.20	6.75	*	4280
	T-26	6.30	6.50	4165	Not Avaiable
	T-27	6.10	6.75	*	4474
	T-28	5.90	7.50	*	5067
	T-29	6.80	7.25	*	4350
	T-30	6.80	7.00	Not Avaiable	4978
2	T-10	6.40	7.75	2913	3625
	T-11	7.20	7.75	2865	3608
	T-12	7.20	7.75	3050.5	4085
	T-13	7.30	7.75	2771	3661
	T-14	7.50	7.50	3130	3625
	T-15	7.90	7.00	2547	3404
	T-16	7.00	8.00	3891	4085
	T-17	7.30	7.75	3113	3784
	T-21	6.70	8.00	3299	4200
3	T-1	7.20	7.50	3882	4726
	T-2	7.10	7.00	3520	4270
	T-3	6.20	8.00	3855	5217
	T-4	7.50	7.50	3802	4598
	T-5	5.80	7.50	4147	5244
	T-6	7.20	7.50	3766	3864
	T-7	7.10	7.00	3634	4209
	T-8	6.40	7.75	3351	3926
	T-9	6.40	7.25	3590	4669
4	T-18	6.60	8.00	3395	4120
	T-19	7.80	7.75	3325	4324
	T-20	5.10	8.00	3157	4749
5	T-22	6.80	7.25	2980	3997
	T-23	7.20	6.00	3387	4731
CONTROL	A-25	7.80	2.50	3846	4509
	A-26	6.00	2.00	4191	4713
	A-27	5.30	1.75	*	5244
	A-28	7.60	2.50	3563	3961

*The only results available were Acceptance Testing Results

Acceptance Testing is a controlled curing process in which the cylinders are cured in a water and lime solution. All other cylinders shown above are Quality Control Cylinders, which are exposed to the same conditions as the culvert and give a more accurate compressive strength for the streambed paving.

Appendix D

Photographs: Completed Construction and Inspection Findings

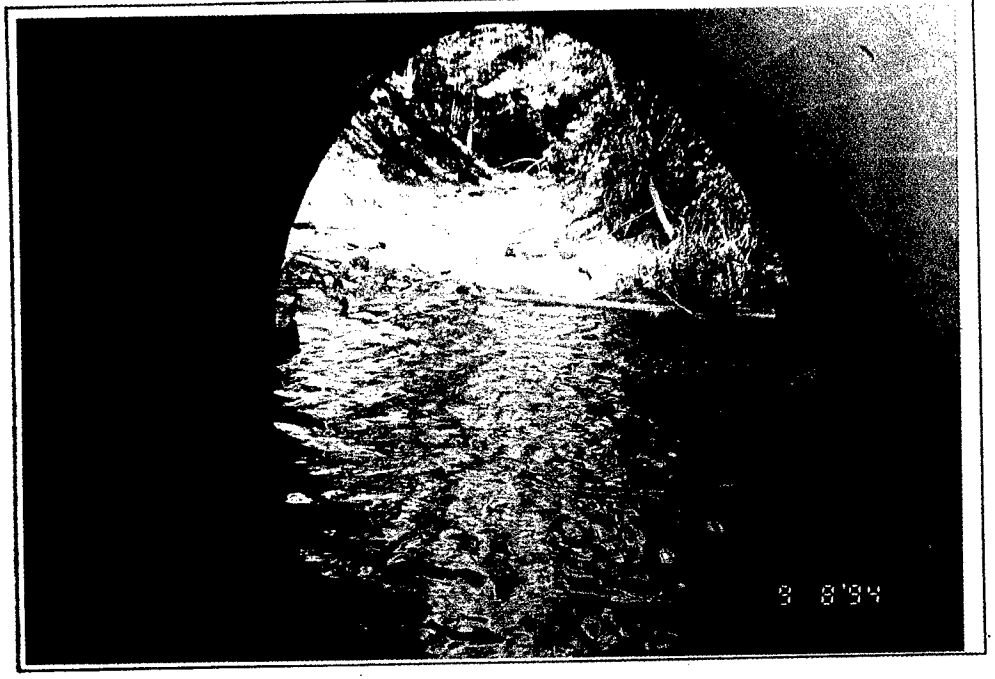
Appendix D

Photographs showing completed culverts and inspection findings.

Photo 3: View of Completed Streambed Paving in Culvert (9/4/93)

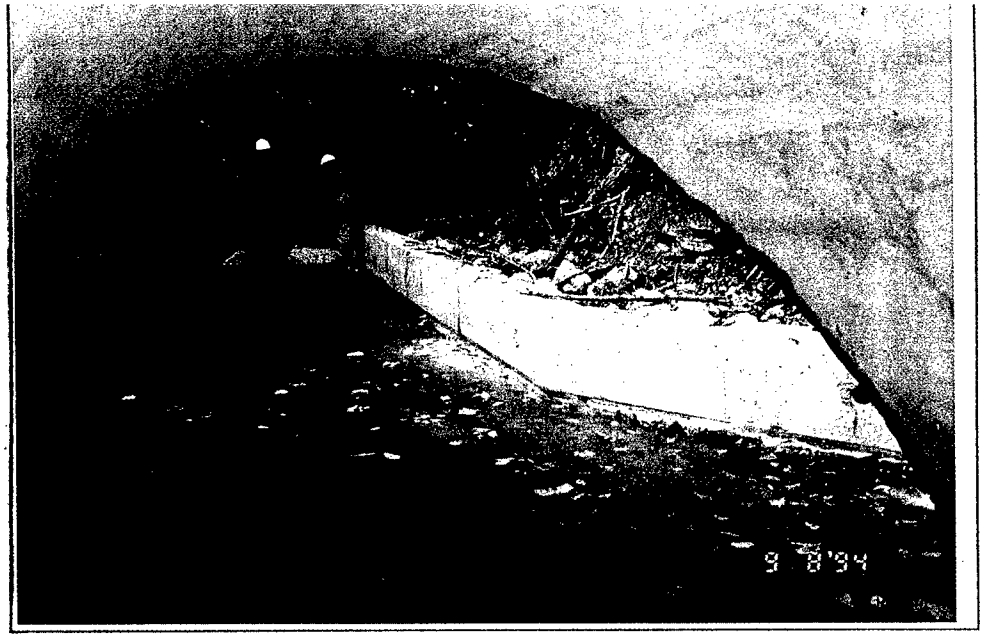
TYPICAL CRACKING

LOOKING U/S - R.C. ARCH

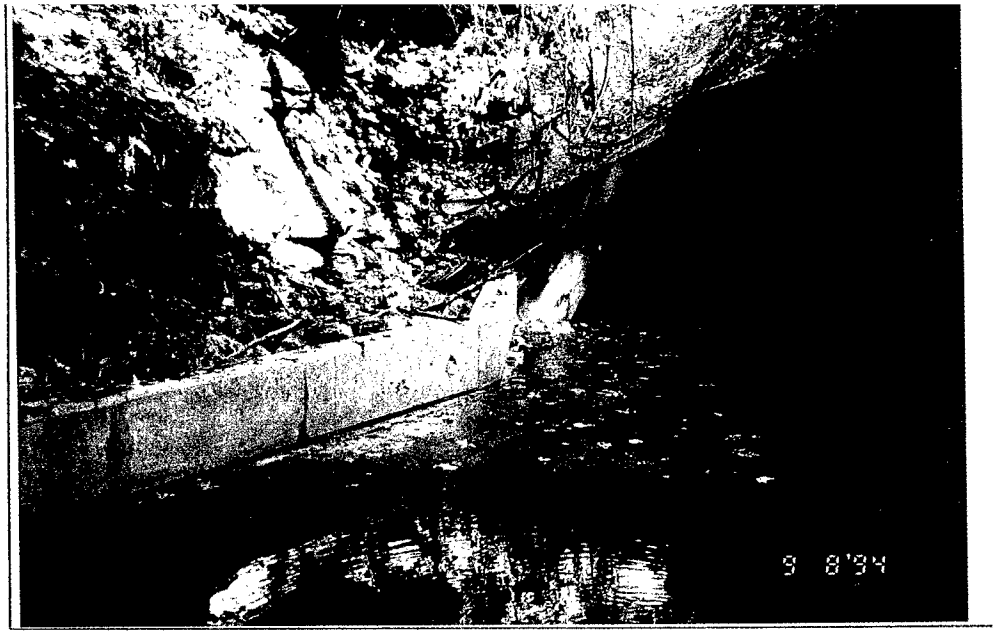


LOOKING OUTLET

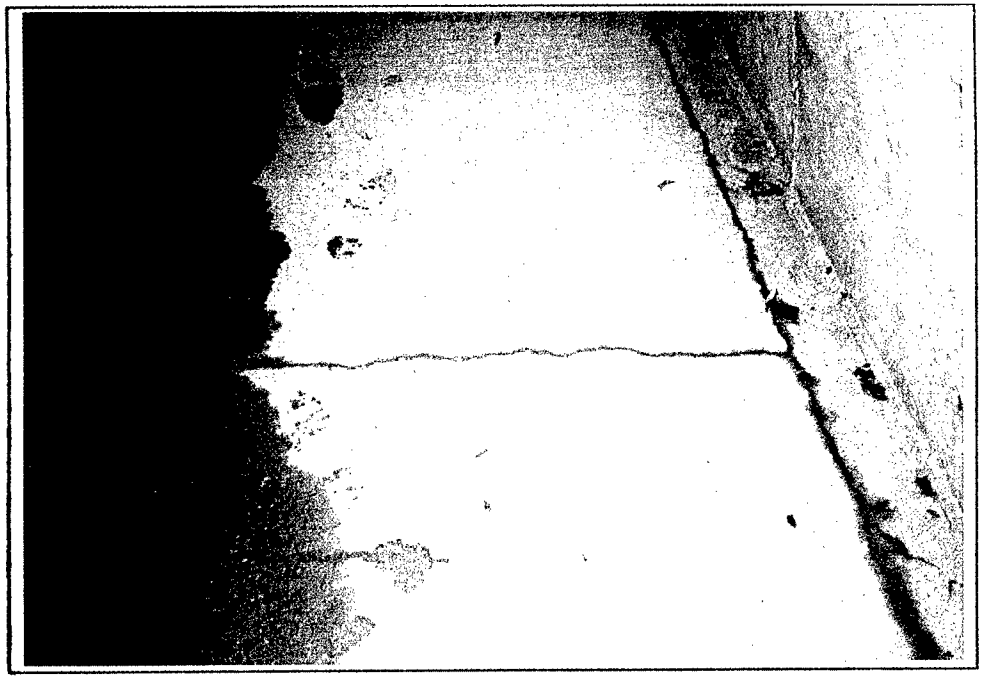
COUNTY ERIE S.R. 0090 SEG. 0374 OFF. _____ DATE 09-08-94



LOOKING @ OUTLET



LOOKING @ OUTLET



TYPICAL CRACK

COUNTY ERIE S. R. 0090 SEG. 0304 OFF. 1909 DATE 09-08-94

Appendix E

Concrete Mix Designs

(Both Tremie Reinforced Concrete and Control Class A Concrete)

(9)

TR-422TA (12-77)

Master

CONCRETE MIX DESIGN FORM

I.D. Numbers CMS 012133
Sheet No. 1 of 2

CLASS Type W/Fiber W/RET CONCRETE
DATE 4/13/94
DISTRICT One
COUNTY Erie

Contractor BECDIR Construction Co.
Route SR0090 Section A01 FA No. OAB- 0901-070
Concrete Producer CORRY CONCRETE INC. Plant CORRY, PA

MATERIAL	TYPE	PRODUCER/LOCATION	S.G.	ABS.	LAB. #
Cement	1-LA	ESSROC			
FIBER	2¼" CR	FORTA FIBER CORP. GROVE CITY, PA			
Fine Aggregate	A	HASBROUCK SAND & GRAVEL	2.59	2.07	92-36423
Coarse Aggregate	#57	ALLEGHENY MINERAL CORP.	2.72	.37	93-030-40
Water		Well Water			
Admixture-AEA	MICRO	MASTER BUILDERS INC.	9.4	oz./c.y. (As required)	
POLY HEED RETARDER	997 100XR	MASTER BUILDERS INC. MASTER BUILDERS INC.	30 15	oz./c.y. (As required)	

STRENGTH DATA BASED ON .50 W/C RATIO TAKEN FROM WORKSHEET DATED 8/6/93

Compr. Str.:	7	days	5031	avg. psi	days	avg. psi	% Solids Used: 53
							F.M. 2.93

CONCRETE MIX SUMMARY (One Cubic Yard) by PENN DOT Method

Mix No.	Trial	ADJ #1		
W/C Ratio, by Wt.	.50	.49		
Cement, lbs.	706	706		
Pozzolan, lbs.				
Water, lbs.	352	344		
Coarse Agg. (S.S.D), lbs.	1765	1765		
_____, lbs.				
Fine Agg. (S.S.D.), lbs.	907	926		
Total, lbs.	3730	3741		
Unit Weight, lbs./C.F.	138.15	138.56		
Water, gals.	42.4	41.5		
Mortar Content, C.F.	16.6	16.6		
At Pt. of Placement:				
Slump	7	In. 7		
Air	7.0	" 6.5		

Designed by Bruce Nelson Title Pres. Date 4/12/94
Reviewed for Contractor Dan Bly Title Project Mgr Date 4/13/94
Plant Supervisor J.A. BAUGHMAN Date APR 15 1994
Asst. Construction Engineer _____ Date _____
Materials Engineer D.A. ADSIT Date APR 15 1994
District Engineer L.E. KYLER Date APR 15 1994

MIX DESIGN WORKSHEET

District _____ Date 4/13/94

Concrete Producer CORRY CONCRETE INC. Project or Plant _____
Mix Design by PENN DOT Method _____

Square Screen Analysis % Passing

Screen Sizes	1½	1	1/2	3/8	#4	#8	#16	#30	#50	#100
F.A.				100	100	90	64	34	13	5
# 57	100	98	48		3.1	1.8				
									F.M.	2.5

Maximum Density 95.5 P.C.F., S.S.D. % Solids (PDT only) _____
S.G. Factor of Slag _____ Volume of C.A. 10.

TRIAL MIX

W/C RATIO .50

Wt./Volume Calculations:

Cement	7½	Bags x 0.478	=	3.59 C.F. x	13.15 x 62.4	= 706
Pozzolan			=	C.F. x	1 x 62.4	=
C.A.	#57		=	10.4 C.F. x	2.72 x 62.4	= 1765
Water	42.4	Gals. x 0.133	=	5.64 C.F. x	62.4	= 352
6½ % Air =	27.0	x .065	=	1.76 C.F.		
			Sub-total	21.39 C.F.		
F.A. =	27.00	— 21.39	=	5.61 C.F.		
Weight of F.A.	5.61	x 2.59 x 62.4				= 907
Totals/C.Y. =	42.4	Gals.		27.00 C.F.		3730

Temperature: Concrete 74° F Air 68° F 139.7 #/C.F. Actua
Initial: Slump 8½ in. Air Content 6.7 % Unit Wt 138.15 #/C.F. Calcu
At Point of Placement: Slump 7 in. Air Content 7.0 % Mortar Content 16.6

Strength	Days	1	2	Avg.	Days	1	2	Avg
Compressive	7	5040	5022	5031				
Compressive								

MIX NO. _____ ADJUSTED

W/C RATIO .49

Wt/Volume Calculations:

Cement	7½	Bags x 0.478	=	3.59 C.F. x	13.15 x 62.4	= 706
Pozzolan			=	C.F. x	1 x 62.4	=
C.A.	#57		=	10.4 C.F. x	2.72 x 62.4	= 1765
Water	41.5	Gals. x 0.133	=	5.52 C.F. x	62.4	= 344
6½ % Air =	27.0	x .065	=	1.76 C.F.		
			Sub-total	21.27 C.F.		
F.A. =	27.00	— 21.27	=	5.73 C.F.		
Weight of F.A.	5.73	x 2.59 x 62.4				= 926
Totals/C.Y. =	41.5	Gals.		27.00 C.F.		3741

At Point of Placement:
Slump 7 In. Air Content 6½ % Calc. Unit Weight 138.56 #/C.F. Mortar Content 16.6

TR-4221A (12-77)

CONCRETE MIX DESIGN FORM

I.D. Numbers MASTER DESIGN
Sheet No. 1 of 1

CLASS A W/Reducer CONCRETE
DATE 4/13/94
DISTRICT 1-0
COUNTY ERIE

Contractor Lincoln Const. Co
Route SR 0090 Section A01
Concrete Producer CORRY CONCRETE INC.

FA No. OAB-0901-070
Plant CORRY, PA

MATERIAL	TYPE	PRODUCER-LOCATION	S.G.	ABS.	LAB. #
Cement	1	KOSMOS CEMENT COMPANY			
Pozzolan					
Fine Aggregate	A	HASBROUCK SAND & GRAVEL CO.	2.59	2.07	92-36423
Coarse Aggregate	#57	ALLEGHENY MINERAL CORP.	2.72	.37	93-030-4
Water		Well water			
Admixture-AEA	MICRO	MASTER BUILDERS	6.9 oz/c.y. (As required)		
Reducer	997	MASTER BUILDERS	31.3 oz/c.y. (As required)		

STRENGTH DATA BASED ON .48 W/C RATIO TAKEN FROM WORKSHEET DATED 3/19/92

Compr. Str.: 7 days 3634 avg. psi 28 days 4785 avg. psi % Solids Used For workability 50 F.M. 2.89

CONCRETE MIX SUMMARY (One Cubic Yard) by PENN DOT Method

Mix No.	Trial	#1
W/C Ratio, by Wt.	.48	.46
Cement, lbs.	588	588
Pozzolan, lbs.		
Water, lbs.	281	270
Coarse Agg. (S.S.D), lbs.	1838	1838
_____ lbs.		
Fine Agg. (S.S.D.), lbs.	1117	1147
Total, lbs.	3824	3843
Unit Weight, lbs./C.F.	141.6	142.33
Water, gals.	33.9	32.5
Mortar Content, C.F.	16.17	16.17
At Pt. of Placement:		
Slump	3½ in.	1-3 in.
Air	7.8 %	6½

Designed by _____ Title Engr. Date 4/12/94
Reviewed for Contractor _____ Title Inspector Date 4/13/94
Plant Supervisor J.A. BAUGHMAN Date APR 15 1994
Asst. Construction Engineer _____ Date APR 15 1994
Materials Engineer D.A. ADSIT Date
District Engineer L.E. KYLER Date APR 15 1994

MIX DESIGN WORKSHEET

District 1-0

Date 4/13/94

Concrete Producer CORRY CONCRETE INC. Project or Plant CORRY, PA

Mix Design by PENN DOT Method

Square Screen Analysis % Passing

Screen Sizes	1½	1	1/2	3/8	#4	#8	#16	#30	#50	#100
F.A.				100	100	90	64	37	14	6
#57	100	98	51		6.2	3.0				
									F.M	2.89

Maximum Density 95.5 P.C.F., S.S.D. % Solids (PDT only) 56

S.G. Factor of Slag Volume of C.A. 10.83

TRIAL MIX

W C RATIO .48 by W

Wt./Volume Calculations:

Cement	6½ Bags x 0.478	= 2.99	C.F. x	13.15 x 62.4	=	588 lb
Pozzolan		=	C.F. x	1 x 62.4	=	lb
C.A.	#57	= 10.83	C.F. x	12.72 x 62.4	=	1838 lb
Water	33.9 Gals. x 0.133	= 4.51	C.F. x	62.4	=	281 lb
6½ % Air =	27.0 x .065	= 1.76	C.F.			
		Sub-total 20.09	C.F.			
F.A. =	27.00 - 20.09	= 6.91	C.F.		=	1117 lb
Weight of F.A.	6.91 x 2.59 x 62.4					
		27.00	C.F.			3824 lb

Totals/C.Y. = 33.9 Gals.

Temperature: Concrete 58° F Air 35° F 139.0 #/C.F. Actual

Initial: Slump 5.0 in. Air Content 8.3 % Unit Wt. 141.6 #/C.F. Calculat

At Point of Placement: Slump 3½ in. Air Content 7.8 % Mortar Content 16.17 C

Strength	Days	1	2	Avg.
Compressive	7	3572	3696	3634
Compressive	28	4935	4634	4785

Days	1	2	Avg.

MIX NO. #1 (ADJUSTED)

W C RATIO .46 by

Wt./Volume Calculations:

Cement	6½ Bags x 0.478	= 2.99	C.F. x	13.15 x 62.4	=	588 lb
Pozzolan		=	C.F. x	1 x 62.4	=	lb
C.A.	#57	= 10.83	C.F. x	12.72 x 62.4	=	1838 lb
Water	32.5 Gals. x 0.133	= 4.32	C.F. x	62.4	=	270 lb
6.5% Air =	27.0 x .065	= 1.76	C.F.			
		Sub-total 19.9	C.F.			
F.A. =	27.00 - 19.9	= 7.1	C.F.		=	1147 lb
Weight of F.A.	7.1 x 2.59 x 62.4					
		27.00	C.F.			3843 lb

Totals/C.Y. = 32.5 Gals

At Point of Placement:

Slump 2½ in. Air Content 6½ % Calc. Unit Weight 142.33 #/C.F. Mortar Content 16.17

Appendix F

Excerpts of Inspection Reports

Code Translations from
PennDOT Bureau of Design Bridge Management System Coding Manual, Oct 1993 Edition, Pub 100A

CONDITION RATING CODES

Condition Rating Codes Used For the Following Fields

In order to promote uniformity between inspectors, these guidelines will be used to rate and code items E14, E15, E16, E17, E18, E20, E21, and E22.

Condition ratings are used to describe the existing in-place structure as compared to the as-built condition.

Condition codes are properly used when they provide an overall characterization of the general condition of the entire component being rated.

Conversely, they are improperly used if they attempt to describe localized or nominally occurring instances of deterioration or disrepair. Correct assignment of a condition code must, therefore, consider both the severity of the deterioration or disrepair and the extent to which it is widespread throughout the component being rated.

The load carrying capacity will not be used in evaluating condition items. The fact that a bridge was designed for less than the current legal loads and may be posted shall have no influence upon condition ratings.

Portions of bridges that are being supported or strengthened by temporary members will be rated based on their actual condition; that is, the temporary members are not considered in the rating of the item. (See item A27, Temporary Structure Designation, page 14, for the definition of a temporary bridge).

Completed bridges not yet open to traffic, if rated, shall be coded as if open to traffic.

Even if the bridge is closed, rate each item without being influenced to the fact that the bridge is closed.

The determination of which of the following ratings apply to each of the items will be based on an evaluation of all the relevant factors and information included in the detailed inspection reports. The rating chosen for each of these items will, in effect, be a composite of all of the relevant factors.

It should be recognized that this will require judgement, particularly for those items where the ratings seem not to apply. There are unique situations, but again, it is expected that some judgement will be used.

RATING CODES

N - Not Applicable

9 - Excellent Condition

8 - Very Good Condition - No problems noted.

7 - Good Condition - Some minor problems.

6 - Satisfactory Condition - Structural elements show some minor deterioration.

5 - Fair Condition - All primary structural elements are sound but may have minor section loss, cracking, spalling or scour.

4 - Poor Condition - Advanced section loss, deterioration, spalling or scour.

3 - Serious Condition - Loss of section, deterioration, spalling, or scour may have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.

2 - Critical Condition - Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored, it may be necessary to close the bridge until corrective action is taken.

1 - "Imminent" Failure Condition - Major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic but corrective action may put back in light service.

0 - Failed Condition - Out of service - beyond corrective action.

REFERENCE: FHWA's Recording and Coding Guide for the Structural Inventory and Appraisal of the Nation's Bridges (FHWA Green Book).

APPRAISAL RATING CODES

Appraisal Rating Codes Used For the Following Fields

The intention of the "Appraisal" Section is to evaluate a bridge in relation to the highway system and functional classification of which the bridge is a part. The individual deficiencies in the various rated items need to be evaluated as to how they affect the bridge as a unit. The structure, then, would be compared to a new one built to the Department's current standards for that particular type of road. On this basis, it is not always necessary to use the highest standard, but, it is not recommended to use unduly low standards. It is recommended that AASHTO Standards be followed for establishing a design, minimum adequate and intolerable categories, unless the Department's approved criteria differ from those in the AASHTO guides.

Those portions of bridges that are being supported or strengthened by temporary members will be rated based on their actual condition, i.e., the temporary members are not considered in the rating of the item. The determination of which of the above ratings apply to each of the items will be based on an evaluation of all the relevant factors and information that are included in the detailed inspection reports. The rating chosen for each item will, in effect, be a composite of all of the relevant factors. It should be recognized that this will require judgement, particularly for those items where the ratings seem not to apply. It is recognized that there are unique situations, but, again, it is expected that some judgement will be used.

APPRAISAL RATING CODES

N - Not applicable

9 - Condition superior to present desirable criteria

8 - Condition equal to present desirable criteria

7 - Condition better than present minimum criteria

6 - Condition equal to present minimum criteria

5 - Condition somewhat better than minimum adequacy to tolerate being left in place as is

4 - Condition meeting minimum tolerable limits to be left in place as is

3 - Basically intolerable condition requiring high priority of corrective action

2 - Basically intolerable condition requiring high priority of replacement

1 - Immediate repair necessary to put back in service

0 - Immediate replacement necessary to put back in service (Bridge Closed)

Culvert 1

Culvert 1

D-448F (5-91) PAGE 3 STRUCTURE ID [215] [0|0|0|0] [4|3|0|0] [1|1|7|4|1|1] INSP. DATE 1-31-96

E21 CHANNEL/CHANNEL PROTECTION - COND. RATING [5]. Details on Pages _____

Channel Alignment Good

Scour MINOR OUTLET - 12' W/ RIPRAP ROCK PROTECTION

Embank Erosion MODERATE - HEAVY

Chan./Emb. Protection TRACE RIPRAP & 2-7 ROCK O/S

Deans MINOR DEBRIS & LIGHT DRIFTWOOD

Vegetation RURAL - WOODED & BRUSH

Highwater Mark UNKNOWN

Streambed Material SHALE & COBBLES

E22 CULVERTS - Cond. Rating [6]. Details on Pages _____ Length 570 LF. 26

Barrel - HAIR-LINE CRACKS W/ LIGHT - MOD REF STAINS. - MINOR JOINT SPALLS W/ WEST 1/2 OF 4 C TAP - 3' x 6" x 6" - BOTTOM HAS SEVERAL CRACKS OPEN 1/4"

Settlement NONE DETECTED

Headwall WEATHERED - MOSTLY COVERED W/ ICE

Wings EAST PT. HAS 2 DIA. CRKS W/ LIGHT STAINING.

Debris MINOR ROCK DEPOSITS.

E23 EST. REMAINING LIFE [215] Comments _____

E24 STRUCTURAL CONDITION - Appraisal Rating [6]. Details on Pages _____

E25 DECK GEOMETRY - Appraisal Rating [N]. ADT: 2549 ADTT: 764 C-C: —

E26 UNDERCLEAR - VERT. & LATERAL - Appraisal Rating [N]. MIN. VERT. 99.99 LAT. 00

E27 WATERWAY ADEQUACY - Appraisal Rating [9]

E28 APPR. RDWY. ALIGNMENT - Appraisal Rating [N]

E29A TRAFFIC SAFETY FEATURES

Bridge Railing [5] Transitions [9] Appr. Guiderail [9] Appr. Guiderail Transition [6]

Comments _____

E29 BRIDGE POST [9]

Recalculate IR/OR: Yes ☐ No ☒ Calculation Attached: Yes ☐ No ☒

E30 IR [112|15] [2|3|6] [9|2|9] E31 OR [1|1|3|0] [2|5|4] [9|4|5]

E29A W06 SCOUR CRITICAL RATING [6] Based on: ☐ Observed Scour ☐ Scour Calculation

W-11A-4

E01 NEXT INSP. FREQ. [2|4] E03 EQUIP. NEXT INSP. [ ]

E04 SPEC. INSP. TYPE [ ] E05 BY DATE [0|1|1|9|8|]

Remarks _____

11/17/97 D01
PROGRAM ID: P4575130
SCREEN: "AE"

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE MANAGEMENT SYSTEM

PAGE NO: 1
REPORT ID: BMSIS180

Culvert 1

SR ID: 250090030001741

BMS INSPECTION DATA

* = MIN. INFORMATION REQUIRED BY FHWA

NBIS FQ: 24 INSP BY: 1 FLINS: N EQUP: SP INSP: BY DATE: 0798 HVPL: N

* DATE INSP	INSP TP	INSP BY	INSP MAN-HOUR ENG	RIG	OFF	CRAN HR	INSPECTION COST ENG	RIG	OFFICE	NAME CONSULTANT	HIRED BY
071296	4	S	0003		000.5					WCK & GRS	
013196	2	B	0003		000.5					BTS & EAA	
090894	4	S	0001		000.5					WCK & GRS	
011394	2	S	0006		000.5					FAZ & BTS	
011592	2	S	0006		000.5					GRS & BTS	
010390	2	Z	0006		000.5					FAZ & BTS	

* APPR SLAB	* APPR RDWY	DK WS	* DECK	* SUP STR	PAINT	* SUB STR	* CHAN	* CUL	* REM LIFE	* STR CON	* DK GM	* UN CL	* WAT WAY	* APR ALGN	* SAFE FEAT	* BRDG POST	* SCR CR
N	N	N	N	N	NN	N	5	6	25	6	N	N	9	N	8886	9	6
N	N	N	N	N	NN	N	5	6	25	6	N	N	9	N	8886	8	6
N	N	N	N	N	NN	N	6	6	25	6	N	N	9	N	8886	8	6
N	N	N	N	N	NN	N	4	4	10	4	N	N	9	N	8886	8	6
N	N	N	N	N	NN	N	4	4	10	4	N	N	9	N	8886	8	6
N	N	N	N	N	NN	N	4	5	17	5	N	N	9	N	8888	6	

* INV RATING LOADS 1	2	3	4	5	LF	* OPR RATING LOADS 1	2	3	4	5	LF	RT MT	TYP MEM	FAT CAT	LOD TYP	STR RNG	ASHTO SPECS	ASHTO MANUAL
199	299	899			NNN	199	299	899			NNN	7						
125	236	828				130	254	845				7						
125	236	828				130	254	845										
125	236	828				130	254	845										
125	236	828																

Culvert 2

Culvert 2

(5-91) PAGE 3 STRUCTURE ID [illegible] INSP. DATE 07-19-96

E21 CHANNEL/CHANNEL PROTECTION - COND. RATING [7]. Details on Pages

Channel Alignment GOOD

Scour [illegible]

Embank Erosion [illegible]

Chan./Emb. Protection [illegible]

Debris N

Vegetation [illegible]

Highwater Mark LOW

Streambed Material [illegible]

E22 CULVERTS - Cond. Rating [6], Details on Pages ____ Length 512' L.F. 10'

Barrel MINOR ENCIRCLING CRACKS W/ [illegible] - STR'M. DAVING HAS 13 TEARS. FULL [illegible] CRACKS - SEE CHART

Settlement N

Headwall GOOD VERT LIGHT CRACKING @ INLET

Wings GOOD : US LT - FULL HT. OPEN VERT. CRACK @ FIXED END - DS RT - LIGHT [illegible] CRACKING 1 SMALL SPALL @ FREE END.

Debris N

E23 EST. REMAINING LIFE [25] Comments

E24 STRUCTURAL CONDITION - Appraisal Rating [6], Details on Pages

E25 DECK GEOMETRY - Appraisal Rating [N]. ADT: —— ADTT: —— C-C: ——

E26 UNDERCLEAR - VERT. & LATERAL - Appraisal Rating [N]. MIN. VERT. —— LAT. ——

E27 WATERWAY ADEQUACY - Appraisal Rating [9].

E28 APPR. RDWY. ALIGNMENT - Appraisal Rating [N].

E28A TRAFFIC SAFETY FEATURES

Bridge Railing [2] Transitions [2] Appr. Guiderail [2] Appr. Guiderail Transition [2]

Comments MINOR DAMAGE

E29 BRIDGE POST [2]

Recalculate IR/OR: Yes ☐ No ☒ Calculation Attached:

E30 IR [illegible] E31 OR [illegible]

E29A WO6 SCOUR CRITICAL RATING [6] Based on ☒ Observed

[illegible]

E01 NEXT INSP. FREQ. [24] E03 EQUIP. NEXT INSP. [ ]

E04 SPEC. INSP. TYPE [ ] E05 BY DATE [07/98]

Remarks N

D466FA (12-89)

Page 1/1

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION

BRIDGE MANAGEMENT SYSTEM
BRIDGE INSPECTION REPORT

A01 STRUCTURE IDENTIFICATION NUMBER [illegible]

SPECIAL INSPECTION - CULVERT REHAB

REMARKS : FULL INSPECTION DONE 6/94 NOTED 10 TRANSV[ERSE] CRACKS IN STR'M. DAVING AT THIS TIME 15 C[RACKS] WERE DETECTED

DATE	STR'M DAVING CRACKS
6/94	10
9/94	15
7/96	13 Marked w/ paint

11/17/97 D01
PROGRAM ID: P4575130
SCREEN: *AE*

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE MANAGEMENT SYSTEM

PAGE NO: 1
REPORT ID: BMSI5180

Culvert 2
SR ID: 250090030419O9

BMS INSPECTION DATA
* = MIN. INFORMATION REQUIRED BY FHWA

NBIS FQ: 24 INSP BY: 1 FLINS: N EQUP: SP INSP: BY DATE: 0798 HVPL: N

* DATE INSP	INSP TP	INSP BY	INSP MAN-HOUR ENG	RIG	OFF	CRAN HR	INSPECTION COST ENG	RIG	OFFICE	NAME CONSULTANT	HIRED BY
071296	2	S	0006		000.5					WCK & GRS	
090894	4	S	0001		000.5					WCK & GRS	
061694	2	S	0006		000.5					RBS & BTS	
032393	2	Z	0006		000.5					FAZ & BTS	
040692	4	Z	0008		000.5					BTS & FAZ	
012291	2	Z	0004		000.5					FAZ & BTS	

* APPR SLAB	* APPR RDWY	DK WS	* DECK	* SUP STR	PAINT	* SUB STR	* CHAN	* CUL	* REM LIFE	* STR CON	* DK GM	* UN CL	* WAT WAY	* APR ALGN	* SAFE FEAT	* BRDG POST	* SCR CR
N	N	N	N	N	NN	N	7	6	25	6	N	N	9	N	8888	9	6
N	N	N	N	N	NN	N	6	6	25	6	N	N	9	N	8886	8	6
N	N	N	N	N	NN	N	6	6	25	6	N	N	9	N	8886	8	6
N	N	N	N	N	NN	N	3	3	05	3	N	N	9	N	8886	8	6
N	N	N	N	N	NN	N	3	3	05	3	N	N	9	N	8876	8	2
N	N	N	N	N	NN	N	3	3	05	3	N	N	9	N	8888	6	2

* INV RATING LOADS 1	2	3	4	5	LF	* OPR RATING LOADS 1	2	3	4	5	LF	RT NT	TYP MEM	FAT CAT	LOD TYP	STR RNG	ASHTO SPECS	ASHTO MANUAL
199	299	899			NNN	199	299	899			NNN	7					54	
120	236	837				130	254	845									54	
120	236	837				130	254	845									54	
120	236	837				130	254	845									54	
120	236	837				130	254	845									54	
120	236	837				130	254	845									54	

Culvert 3

Culvert 3

D-408F (5-91) PAGE 3 STRUCTURE ID [BR] [0090] [0494] [1416] INSP. DATE 07-12-96

[21] CHANNEL/CHANNEL PROTECTION - COND. RATING [7]. Details on Pages _____

Channel Alignment FAIR

Scour N

Embank Erosion MINOR -/S

Chan./Emb. Protection LARGE ROCK TO PREVENT

Debris CABLES AND FENCE ACROSS OUTLET. ALL HEAD OF PARTIALLY VISIBLE

Vegetation LIGHT

Highwater Mark NONE

Streambed Material STONE BOULDERS

[22] CULVERTS - Cond. Rating [6], Details on Pages _____ Length 62.6' L.F. 15'

Barrel ENCIRCLING CRACKS W/ LIME AND RUST STAINS - STRM DAVING HAS 17 TRANSVERSE CRACKS SEE CHART

Settlement N

Headwall GOOD

Wings EAST: CRACKING W/ LIME (MINOR) WEST: MINOR HOLE DOWNSTREAM

Debris N

[23] EST. REMAINING LIFE [2 15] Comments _____

[24] STRUCTURAL CONDITION - Appraisal Rating [6], Details on Pages _____

[25] DECK GEOMETRY - Appraisal Rating [N], ADT: — ADTT: — C-C: —

[26] UNDERCLEAR - VERT. & LATERAL - Appraisal Rating [N], MIN. VERT. — LAT. —

[27] WATERWAY ADEQUACY - Appraisal Rating [9], _____

[28] APPR. RDWY. ALIGNMENT - Appraisal Rating [N], _____

[28A] TRAFFIC SAFETY FEATURES

Bridge Railing [2] Transitions [2] Appr. Guiderail [9]

Comments N

[29] BRIDGE POST [3] _____

Recalculate IR/OR: Yes ☐ No ☒ Calculation Attached: Y

[30] IR [1 1 2 0] [2 1 2 0] [3 2 1 0] [E31] OR [11]

[29A] [WC6] SCOUR CRITICAL RATING [7] Based on ☒ Observed ☐ Calc.

[31] NEXT INSP. FREQ. [2 4] [E03] EQUIP. NEXT INSP. [ ]

[41] SPEC. INSP. TYPE [ ] [E05] BY DATE [0 7 1 0 9 8]

Remarks N

Page 1/1

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION

BRIDGE MANAGEMENT SYSTEM
BRIDGE INSPECTION REPORT

ART STRUCTURE IDENTIFICATION NUMBER
[BR] [0090] [0494] [1416]

SPECIAL INSPECTION - CHANGE 24-MAR

Remarks: STREAM BED DAVING BEING CHECKED FOR CRACKING. MOST RECENT INSPECTION DONE 6/96 W/ THIRTEEN TRANSVERSE CRACKS NOTED. THIS INSPECT DETECTED THREE ADDITIONAL CRACKS FOR TOTAL NOW OF SIXTEEN. CHANNEL BEING UP GRADED FROM 5 TO 7 NO SCOUR.

Recommendations: NONE

DATE	STR'M DAVING CRACKS	Comments
5/86	13	
6/92	16	
7/96	17	14 FULL WIDTH CRACKS 3 HALF WIDTH CRACKS IN DAVING NOTED ALSO W/ENCIRCLING CRACKS @ W.C.K. 1 & 3

11/17/97 D01
PROGRAM ID: P4575130
SCREEN: *AE*

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE MANAGEMENT SYSTEM

PAGE NO: 1
REPORT ID: BMSI5180

Culvert 3

SR ID: 25009003441468

BMS INSPECTION DATA

* = MIN. INFORMATION REQUIRED BY FHWA

NBIS FQ: 24 INSP BY: 1 FLINS: N EQUP: SP INSP: BY DATE: 0798 HVPL: N

* DATE INSP	INSP TP	INSP BY	INSP MAN-HOUR ENG	RIG	OFF	CRAN HR	INSPECTION COST ENG	RIG	OFFICE	NAME CONSULTANT	HIRED BY
071296	2	S	0005		000.5					WCK & GRS	
090894	4	S	0001		000.5					WCK & GRS	
022394	2	S	0007		000.5					GRS & BTS	
011392	2	Z	0003		000.5					FAZ & BTS	
011491	2	P	0005		000.5					TDF & GRS	
013089	2	R	0003		000.5					TAR & BTS	

* APPR SLAB	* APPR RDWY	DK WS	* DECK	* SUP STR	PAINT	* SUB STR	* CHAN	* CUL	* REM LIFE	* STR CON	* DK GM	* UN CL	* WAT WAY	* APR ALGN	* SAFE FEAT	* BRDG POST	* SCR CR
N	N	N	N	N	NN	N	7	6	25	6	N	N	9	N	8876	9	6
N	N	N	N	N	NN	N	7	6	25	6	N	N	9	N	8876	8	6
N	N	N	N	N	NN	N	5	6	25	6	N	N	9	N	8876	8	6
N	N	N	N	N	NN	N	3	3	05	3	N	N	9	N	8886	8	6
N	N	N	N	N	NN	N	3	3	05	3	N	N	9	N	8888	7	2
N	N	N	N	N	NN	N	4	3	05	3	N	N	9	N	8888	6	

* INV RATING LOADS 1	2	3	4	5	LF	* OPR RATING LOADS 1	2	3	4	5	LF	RT MT	TYP MEM	FAT CAT	LOD TYP	STR RNG	ASHTO SPECS	ASHTO MANUAL
199	299	899			NNN	199	299	899			NNN	7					54	
120	236	830				130	254	845									54	
120	236	830				130	254	845									54	
120	236	830				130	254	845										

Culvert 4

D-468F (5-91) PAGE 3 STRUCTURE ID [illegible] INSP. DATE [illegible]

E27 CHANNEL/CHANNEL PROTECTION - COND. RATING [illegible]. Details on Pages _____

Channel Alignment [illegible]

Scour [illegible]

Embank Erosion [illegible]

Chan./Emb. Protection ROCK - STABLE

Debris COLLISION DAMAGE DEBRIS

Vegetation WOODS

Highwater Mark [illegible]

Streambed Material SHALE GRAVEL

E22 CULVERTS - Cond. Rating [illegible]. Details on Pages _____ Length 365' LF. 121

Barrel EXISTING CRACKS - SOME SPALL AND EXPOSED REBAR - SEE PAGE 2 FOR STORM DAMAGE - MINOR SCALING SMALL AREA

Settlement N

Headwall MINOR WET CRACKS W/ LIME AND RUST STAINS

Wings NO SIGNIFICANT PROBLEMS - 1 WING HAS SMALL AREA OF SPALL

Debris COL. DAM. DEBRIS (MINOR SPALL) VISIBLE MARKS

E23 EST. REMAINING LIFE [illegible] Comments _____

E24 STRUCTURAL CONDITION - Appraisal Rating [illegible]. Details on Pages _____

E25 DECK GEOMETRY - Appraisal Rating [illegible]. ADT: [illegible] ADTT: [illegible] C-C: [illegible]

E25I UNDERCLEAR - VERT. & LATERAL - Appraisal Rating [illegible]. MIN. VERT. [illegible] LAT. [illegible]

E27 WATERWAY ADEQUACY - Appraisal Rating [illegible]

E28I APPR. RDWY. ALIGNMENT - Appraisal Rating [illegible]

E28AI TRAFFIC SAFETY FEATURES

Bridge Railing [illegible] Transitions [illegible] Appr. Guiderail [illegible] Appr. Guiderail Transition [illegible]

Comments SEVERE DAMAGE TO ?

E29 BRIDGE POST [illegible]

Recalculate IR/OR: Yes ☐ No ☒ Calculation Attached: Yes ☐ No ☒

E30 IR [illegible] E31 OR [illegible]

E29A W06 SCOUR CRITICAL RATING [illegible] Based on ☒ Observed Scour ☐ Scour Calculation

E01 NEXT INSP. FREQ. [illegible] E03 EQUIP. NEXT INSP. [illegible]

E04 SPEC. INSP. TYPE [illegible] E05 BY DATE [illegible]

Remarks N/

11/17/97 D01
PROGRAM ID: P4575130
SCREEN: *AE*

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE MANAGEMENT SYSTEM

PAGE NO: 1
REPORT ID: BMSI5100

Culvert 4
SR ID: 25009003741021

BMS INSPECTION DATA
* = MIN. INFORMATION REQUIRED BY FHWA

NBIS FQ: 24 INSP BY: 1 FLINS: N EQUP: SP INSP: BY DATE: 0798 HVPL: N

* DATE INSP	INSP TP	INSP BY	INSP MAN-HOUR ENG	RIG	OFF	CRAN HR	INSPECTION COST ENG	RIG	OFFICE	NAME CONSULTANT	HIRED BY
071896	2	K	0003		000.5					WCK & GRS	
090894	4	S	0002		000.5					GRS & WCK	
042894	2	Z	0005		000.5					FAZ & BTS	
031593	4	Z	0004		000.5					FAZ & BTS	
033092	2	S	0009		000.5					GRS & RGW	
012291	2	Z	0003		000.5					FAZ & BTS	

* APPR SLAB	* APPR RDWY	DK WS	* DECK	* SUP STR	PAINT	* SUB STR	* CHAN	* CUL	* REM LIFE	* STR CON	* DK GM	* UN CL	* WAT WAY	* APR ALGN	* SAFE FEAT	* BRDG POST	* SCR CR
N	N	N	N	N	NN	N	7	6	25	6	N	N	9	N	8876	8	6
N	N	N	N	N	NN	N	5	5	17	5	N	N	9	N	8886	8	6
N	N	N	N	N	NN	N	5	5	17	5	N	N	9	N	8886	8	6
N	N	N	N	N	NN	N	3	2	01	2	N	N	9	N	8886	8	6
N	N	N	N	N	NN	N	3	2	01	3	2	N	9	N	8886	8	6
N	N	N	N	N	NN	N	3	3	05	3	N	N	9	N	8888	7	2

* INV RATING LOADS 1	2	3	4	5	LF	* OPR RATING LOADS 1	2	3	4	5	LF	RT MT	TYP MEM	FAT CAT	LOD TYP	STR RNG	ASHTO SPECS	ASHTO MANUAL
199	299	899			NNN	199	299	899			NNN	5					54	
120	236	830				130	254	845									54	
120	236	830				130	254	845									54	
120	236	830				130	254	845									54	
120	236	830				130	254	845									54	
120	236	830				130	254	845									54	

Culvert 5

Culvert 5

D-468F (5-91) PAGE 3 STRUCTURE ID [illegible] INSP. DATE [illegible]

E21 CHANNEL/CHANNEL PROTECTION - COND. RATING [illegible], Details on Pages _____

Channel Alignment [illegible]

Scour ADVANCED SCOUR [illegible] BULK HEAD - POOL IS 15'LX 9'WX2' D AND U/S DISPLACED PREVIOUSLY PLACED ROCK - SEE PHOTOS

Embank Erosion [illegible] U/S

Chan./Emb. Protection SEE SCOUR

Debris MINOR GRAVEL SHALE DEPOSITION U/S

Vegetation WOODS

Highwater Mark LINK

Streambed Material SHALE GRAVEL

E22 CULVERTS - Cond. Rating [illegible], Details on Pages _____ Length 47?' L.F. 31'

Barrel ENCIRCLING CRACKS W/ [illegible] FOR STR'M PAVING

Settlement N

Headwall MINOR VERT CRACKS W/ [illegible] AND RUST STAINS ALSO MINOR SCALING

Wings [illegible]

Debris N

E23 EST. REMAINING LIFE [illegible] Comments _____

E24 STRUCTURAL CONDITION - Appraisal Rating [illegible], Details on Pages _____

E25 DECK GEOMETRY - Appraisal Rating [illegible], ADT: [illegible] ADTT: [illegible] C-C: [illegible]

E26 UNDERCLEAR - VERT. & LATERAL - Appraisal Rating [illegible], MIN. VERT. _____ LAT. _____

E27 WATERWAY ADEQUACY - Appraisal Rating [illegible], [illegible]

E28 APPR. RDWY. ALIGNMENT - Appraisal Rating [illegible]

E28A TRAFFIC SAFETY FEATURES

Bridge Railing [illegible] Transitions [illegible] Appr. Guiderail [illegible] Appr. Guiderail Transition [illegible]

Comments N

E29 BRIDGE POST [illegible]

Recalculate IR/OR: Yes ☐ No ☒ Calculation Attached: Yes ☐ No ☒

E30 IR [illegible] E31 OR [illegible]

E29A W06 SCOUR CRITICAL RATING [illegible] Based on ☒ Observed Scour ☐ Scour Calculation

[illegible]

E01 NEXT INSP. FREQ. [illegible] E03 EQUIP. NEXT INSP. [illegible]

E04 SPEC. INSP. TYPE [illegible] E05 BY DATE [illegible]

Remarks N

D-468FA (12-88)

Page _____

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION

BRIDGE MANAGEMENT SYSTEM
BRIDGE INSPECTION REPORT

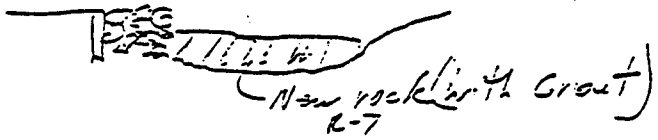
AGT STRUCTURE IDENTIFICATION NUMBER

25	60190	54010	25217

— 11 full width Cracks, some @ 10-ft and regularly spaced in the 1/3 - the middle to last 1/4 toward the outlet. Cracks may be associated with the baffles that formed the original bottom. Cracks start at the 3rd joint in from each end

Recommendations:

1. Armor the outlet scour hole with Rock - low priority



Ratings: -/-/ Fair

Insp. Frequency: 24mo (7/98)

By W.C. Koller, P.E.
G.R. Spence

7/18/96

11/17/97 D01 COMMONWEALTH OF PENNSYLVANIA PAGE NO: 1
PROGRAM ID: P4575130 DEPARTMENT OF TRANSPORTATION REPORT ID: BMSI5180
SCREEN: "AE" BRIDGE MANAGEMENT SYSTEM

Culvert 5

SR ID: 25009004002297 BMS INSPECTION DATA

* = MIN. INFORMATION REQUIRED BY FHWA

NBIS FQ: 24 INSP BY: 1 FLINS: N EQUP: SP INSP: BY DATE: 0798 HVPL: N

* DATE INSP	INSP TP	BY	INSP MAN-HOUR ENG	RIG	OFF	CRAN HR	INSPECTION COST ENG	RIG	OFFICE	NAME CONSULTANT	HIRED BY
071096	2	K	0005		000.5						
090894	2	S	0002		000.5					WCK & GRS	
020893	2	Z	0004		000.5					GRS & WCK	
030891	2	S	0005		000.5					FAZ & BTS	
032289	2	Z	0007		000.5					TBS & BTS	
031987	2	Z	0005		000.5					FAZ & GRS	
										FAZ & GRS	

* APPR SLAB	* APPR RDWY	DK WS	* DECK	* SUP STR	PAINT	* SUB STR	* CHAN	* CUL	* REM LIFE	* STR CON	* DK GM	* UN CL	* WAT WAY	* APR ALGN	* SAFE FEAT	* BRDG POST	* SCR CR
N	N	N	N	N	NN	N	6	5	17	6	N	N	9	N	8888	8	6
N	N	N	N	N	NN	N	7	6	25	6	N	N	9	N	8887	8	6
N	N	N	N	N	NN	N	3	3	05	3	N	N	9	N	8887	8	6
N	N	N	N	N	NN	N	3	3	05	3	N	N	9	N	8888	7	3
N	N	N	N	N	NN	N	3	3	05	3	N	N	9	N	8888	6	
N	N	N	N	N	NN	N	4	4	10	3	N	N	3	N		6	

* INV RATING LOADS 1	2	3	4	5	LF	* OPR RATING LOADS 1	2	3	4	5	LF	RT MT	TYP MEM	FAT CAT	LOD TYP	STR RNG	ASHTO SPECS	ASHTO MANUAL
199	299	899			NNN	199	299	899			NNN	5					54	
120	236	828				130	254	845									54	
120	236	828				130	254	845									54	
120	236	828				130	254	845									54	
120	236	828				130	254	845									54	
236	236					254	254										54	

Control Culvert

D-468F (5-91) PAGE 3 STRUCTURE ID [3][5][0][1][9][1][3][4][5][2][5][1][9] INSP. DATE 8/23/96

E21 CHANNEL/CHANNEL PROTECTION - COND. RATING [5]. Details on Pages _____
Channel Alignment FLOW - TO S.E. AT WING - R.C. COUNTERMEASURES ARE IN PLACE
Scour STR. PAVING SCOUR 4" AT INLET & 12" AT OUTLET
Embank Erosion NONE
Chan./Emb. Protection R-6 AT ALL WINGS + UPSTREAM BANKS (SEE PHOTOS)
Debris MINOR COBBLE & GRAVEL DEBRIS UPSTREAM
Vegetation GRASS FIELDS & WOODS
Highwater Mark UNKNOWN
Streambed Material COBBLES & GRAVEL
E22 CULVERTS - Cond. Rating [6], Details on Pages _____ Length 302' LF. 18'
Barrel SEV. SPALLING CRACKS W/EFF., SEV. DIA. CRACKS, (1' JOINT OPEN 1", (1) JOINT HAS INCOMPLETE SPALLING, STR. PAVING HAS 2 LONG. CRACKS (SEE CHART)
Settlement NONE
Headwall WEATHERED - GOOD - INLET HEADWALL HAS 3 LIGHT VERT. CRACKS W/EFF.
Wings S.E. ST. WING (ORIGINAL) HAS 1 P.P. CRACK W/EFF. ALL OTHERS NO VISIBLE PROBLEMS
Debris NONE
E23 EST. REMAINING LIFE [25] Comments _____
E24 STRUCTURAL CONDITION - Appraisal Rating [6], Details on Pages _____
E25 DECK GEOMETRY - Appraisal Rating [N], ADT: _____ ADTT: _____ C-C: _____
E26 UNDERCLEAR - VERT. & LATERAL - Appraisal Rating [N], MIN. VERT. _____ LAT. _____
E27 WATERWAY ADEQUACY - Appraisal Rating [9]
E28 APPR. RDWY. ALIGNMENT - Appraisal Rating [N]
E29A TRAFFIC SAFETY FEATURES
Bridge Railing [3] Transitions [8] Appr. Guiderail [X] Appr. Guiderail Transition [X]
Comments _____
E29 BRIDGE POST [X]
Recalculate IR/OR: Yes ☐ No. [X] Calculation Attached: Yes ☐ No. [X]
E30 IR [1][2][5] [2][4][5] [2][3][0] E31 OR [1][3][5] [2][4][5] [5][4][5]
E29A W06 SCOUR CRITICAL RATING [6] Based on: ☒ Observed Scour ☐ Scour Calculation
W/A: 4
E01 NEXT INSP. FREQ. [24] E03 EQUIP. NEXT INSP. [ ]
E04 SPEC. INSP. TYPE [ ] E05 BY DATE [08][97]
Remarks _____

11/17/97 D01 COMMONWEALTH OF PENNSYLVANIA PAGE NO: 1
PROGRAM ID: P4575130 DEPARTMENT OF TRANSPORTATION REPORT ID: BMSI5180
SCREEN: "AE" BRIDGE MANAGEMENT SYSTEM

Control Culvert BMS INSPECTION DATA
SR ID: 250090044025 29

* = MIN. INFORMATION REQUIRED BY FHWA

NBIS FQ: 24 INSP BY: 1 FLINS: N EQUP: SP INSP: BY DATE: 0898 HVPL: N

* DATE INSP	INSP TP	INSP BY	INSP MAN-HOUR ENG	RIG	OFF	CRAN HR	INSPECTION COST ENG	RIG	OFFICE	NAME CONSULTANT	HIRED BY
082396	2	S	0005		000.5					GRS & EAA	
031095	2	S	0003		000.5					GRS & MJM	
031593	2	Z	0006		000.5					FAZ & BTS	
032091	2	P	0005		000.5					TDP & GRS	
022889	2	R	0002		000.5					TAR & BTS	
031987	2	Z	0003		000.5					FAZ & GRS	

* APPR SLAB	* APPR RDWY	* DK WS	* DECK	* SUP STR	PAINT	* SUB STR	* CHAN	* CUL	* REM LIFE	* STR CON	* DK GM	* UN CL	* WAT WAY	* APR ALGN	* SAFE FEAT	* BRDG POST	* SCR CR
N	N	N	N	N	NN	N	5	6	25	6	N	N	9	N	0000	8	6
N	N	N	N	N	NN	N	7	6	25	6	N	N	9	N	0000	8	6
N	N	N	N	N	NN	N	3	4	10	4	N	N	9	N	0000	8	6
N	N	N	N	N	NN	N	3	3	05	3	N	N	9	N	0000	6	3
N	N	N	N	N	NN	N	4	4	10	3	N	N	9	N	0000	6	
N	N	N	N	N	NN	N	4	4	10	3	N	N	3	N		6	

* INV RATING LOADS 1	2	3	4	5	LF	* OPR RATING LOADS 1	2	3	4	5	LF	RT MT	TYP MEM	FAT CAT	LOD TYP	STR RNG	ASHTO SPECS	ASHTO MANUAL
199	299	899			NNN	199	299	899			NNN	5						
125	245	830				135	265	845				7					54	
125	245	830				135	265	845									54	
236						254											54	

Appendix G

Special Provision for Fiber Reinforced Tremie Cement Concrete

(Item 5001-0040, SR 0090-A01)

SR 90-A01 Erie Co

Provide single lane closures on SR 0090, as required, in accordance with Publication 203, "Work Zone Traffic Control", for work along the interstate at the SR 0430 bridge structure and at each culvert.

Utilize figures 18, 21 and 22 of Publication 203 as the minimum traffic control requirements while this work is performed. Properly index arrow panels after placement.

Four arrow panels have been specified for use. If additional arrow panels are utilized, they will not be measured [illegible] be considered incidental to Item 0901-0001.

Remove or cover conflicting existing signs and work zone signs when not in use. Turning of barricade mounted signs is not permitted.

Notify the District Community Relations Coordinator and the District Special Hauling Permits Unit two weeks in advance of the start of construction. Verify the actual start one day in advance.

Work crew vehicles may be parked at the outside edge of shoulders during working hours. Furnish and install Department-approved non-metallic drums to delineate and protect the vehicles. Remove drums from shoulder areas during all non-working hours. Do not park vehicles at any intersection or interchange location that could obstruct eight distance or pose a hazard to the traveling public. A1 A1 A1 A1 A1 A1

ITEM 5001-0040 - TREMIE CEMENT CONCRETE FIBER REINFORCED

In accordance with Section 1001 and as follows.

Revise Section 1001.2(j) by adding the following bullets:

o Low range water reducing admixtures - Type A - AASHTO M 194-90 (ASTM C494-90)

o Flyash - Type C - ASTM C618-91

o Collated fibrillated (connected screen) polypropylene (CFP) pretwisted bundles, 2-1/2" in length. Incorporate fibers at a rate of 1.6 pounds per cubic yard.

ITEM [illegible] - REMOVAL OF PORTION OF EXISTING BRIDGE

Remove the entire superstructure, substructures, and appurtenances, except do not remove or damage the existing piling.

Submit a proposed method of removal and design calculations to the District Bridge Engineer showing the removal methods used as specified in Section 1018.3(a). Include a debris protective system that protects the interstate below the structure.

Repair or replace any portion of the existing piling damaged or removed beyond the indicated removal limits to the satisfaction of the Engineer at no cost to the Department.