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Changes	Project Sum-82-0.00
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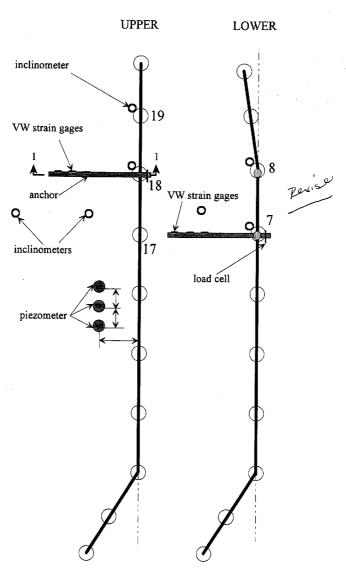


Fig.3 Plan view

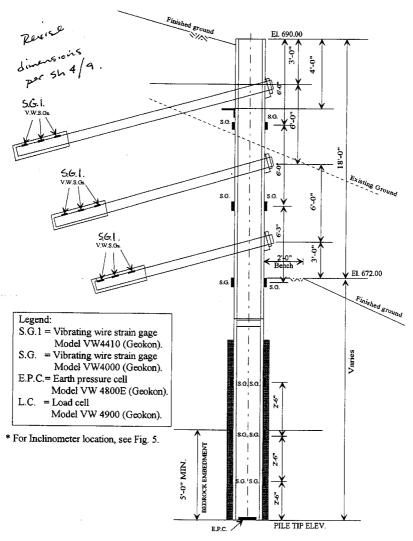


Fig.4 Cross section 1-1



# **Inter-Office Communication**

January 8, 2001

To:

**ODOT Project Liaison** 

From:

Jill Martindale; Division of Planning

Subject:

Final Report/Executive Summary on ODOT Research Study

The enclosed Final Report and Executive Summary is for your information. If extra copies of the Executive Summary or of the Final Report are needed, please contact me at (614) 466-8173, or a copy may be borrowed by contacting the ODOT Central Office Library at (614) 466-7680. Thank you.

JJM Encl.



### INSTRUMENTATION AND MONITORING OF TIEBACK WALL ON SUM82 AT BTECKSVILLE

State Job No. 14648(Q)

Report No.: FHWA/OH-2000/015

FOR COPIES OF THIS REPORT, CONTACT:
Ohlo Department of Transportation, Mr. Roger L. Green, (614) 275-1381, rgreen@dd.state.on.us

EXECUTIVE SUMMARY

The instrumentation. manifering the Coverber of the Cover the Cuyahoga valley National Recreation Area (CVNRA) Valley railroad in the vicinity of the State Route 82 bridge over the railroad and the Cuyahoga River, Brecksville, Ohio constitutes the main work of this project. Slope movements on the western wall of the Cuyahoga River valley were noticed, extending excessively to the north and south of the State Route 82 bridge centerline. Slope movements were also occurring within the 80 feet wide bridge right-of-way portion of the embankment. ODOT has conducted an independent investigation of this area and developed plans using tieback walls to stabilize the slope movements.

The objectives of this study were to: (a) develop and carry out an instrumentation and monitoring plan for the tieback wall to be constructed on the state Rt. 82, in Brecksville, Ohio (Project No. SUM-82-0.00), (b) plan and carry out load test of tiebacks in shale to determine the loadcarrying capacity, load transfer mechanism, and the water effect, (c) plan and carry out creep tests of tiebacks to gain better insight on the time-dependent creep and stress relaxation behavior of tiebacks installed in shale, (d) document the construction sequence and the measured tieback wall responses. (e) monitor tieback wall performance at least for a year after the wall construction is complete. (f) perform a detailed analysis of measured data from the load test results and the monitoring data of instrumented walls, (g) investigate the interrelationships among the magnitude and distribution of the earth pressures, the tieback lock-off loads, the friction between the wall and the backfill, the pile hearing, and the magnitude and nature of ground movements, and (h) to provide recommendations for improved design methods for tieback walls with permanent anchors in shale.

All the elements of the studied tieback wall were provided with instrumentation including strain gages, inclinometers, load cells, and peizometers. The data gathered from all sensors and gages were analyzed, and utilized to validate the developed tieback computer program, and evaluate the present analysis methods.

Based on the comparisons of the existing "Earth Pressure Diagram" analysis methods, it was found that these methods result in considerable discrepancies with measured diagrams. The moments measured along the soldier pile were best fitted when a moment was introduced at the anchor-pile point.

A Finite Element Method (FEM) program, PLAXIS, was employed to perform a numerical simulation of the construction of the tieback walls utilizing the inclinometers' readings in the early stage of construction. Then the deduced soil parameters were fixed in the subsequent analysis of various construction stages to accommodate the stress-path dependency of the soil response. The close agreements between the measured and the simulation lend strong support to the validity of the FEM analysis techniques.

Finally, a finite element program developed for the purpose of tieback wall analysis and design was introduced. This program was shown to provide a good predictive and analytic tool for analyzing the structural behavior of the tieback wall, accommodating for the combined effects of construction stage and anchor prestressing. This program is also capable of simulating the anchor-soil response. The anchor-soil model was described and verified and shown to be powerful in both forward and backward calculations encountered in the anchor-soil system.

of Akron

DEPT. OF CIVIL ENGINEERING The University of Akron

Akron, Ohio 44325-3905

FAX: (330) 972-6020 TEL: (330)-972-7286

DATE:	6	/30	/9	9	

To: Gene Geiger ODOT

FAX #: (614) 2.75 - 1318

From: Jamal Nusairat

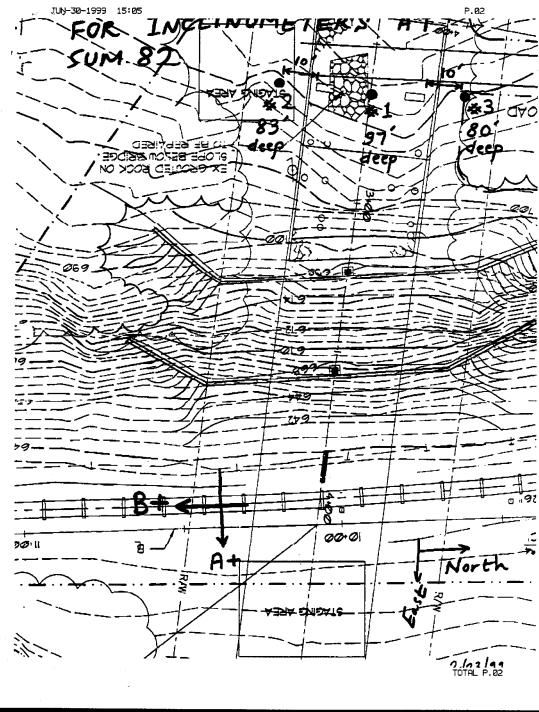
The attached map shows the locations of the inclinometers. Top elevation for All three inclinometers were 3

above original grade.

Cover sheet + \_\_\_\_ pages

James

Thanks



Ohio Department of Transportation 1600 West Broad Street, Room 2033 Columbus, Ohio 43223

### Attn. Mr. EUGENE GEIGER

PROJECT:

CUYAHOGA VALLEY NATIONAL RECREATION AREA Valley railway - slope stabilization under SR 82 bridge

### Subject: Inclinometer Readings till 6/16/1999

Gene,

Attached is a copy of the Seventh set of reduced inclinometer readings from inclinometers 2 and 3 as located in the attached plan and the set from inclinometer 1. The center inclinometer # 1 initial reading was taken 2/16/99 with the second reading from # 2 and #3.

The readings from inclinometer # 1 show no further movement at a depth of 34 feet since May 13/1999. Inclinometer # 2 shows no movement at a depth of 28 to 30 feet since May 13/1999. Inclinometer # 3 shows little increase in the movement in the top 15 feet in the down slope direction.

The initial reading from the inclinometers behind the soldier beams have been taken and all the 4 inclinometers are OK. All the gages installed are working fine and we will be mounting them to the datalogger after they install the concrete boxes in place.

Next reading will be taken after they finish putting the panels and backfill behind them.

Please contact us if you have any questions.

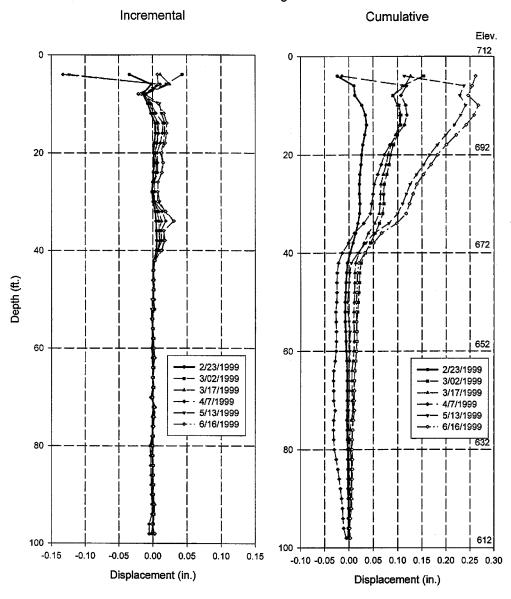
Sincerely;

Jamal Nusairat, Ph.D., P.E. Research Associate Civil Engineering Department The University of Akron Akron, OH 44325-3905 Tel. (330) 972-7364 Fax. (330) 972-6020 E-mail: njamal@uakron.edu

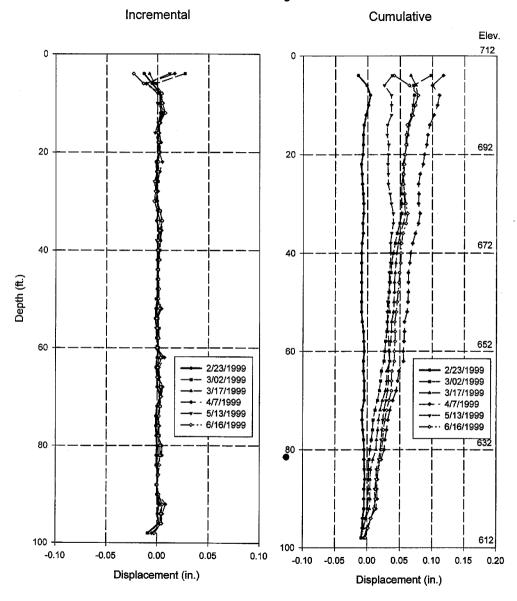
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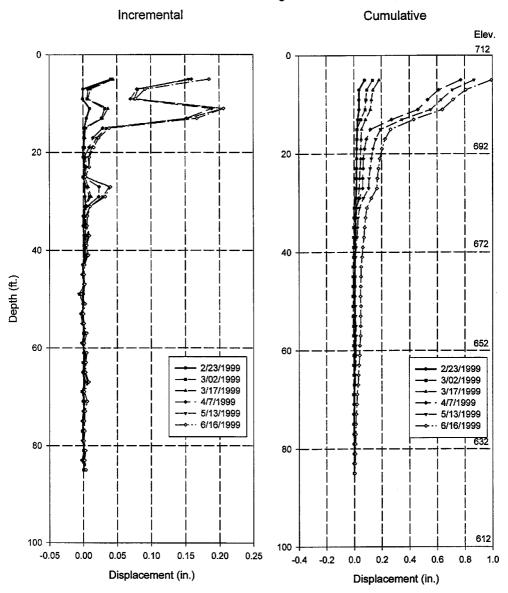
## SUM.82 Project: Inclimometer # 1 Displacement in the A + Direction Downslope (River direction) Base Line reading 2/16/1999



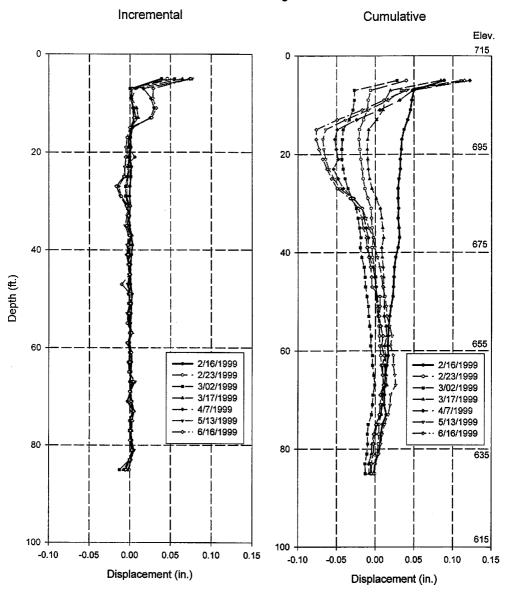
SUM.82 Project: Inclimometer # 1 Displacement in the B + Direction Downslope (River direction) Base Line reading 2/16/1999



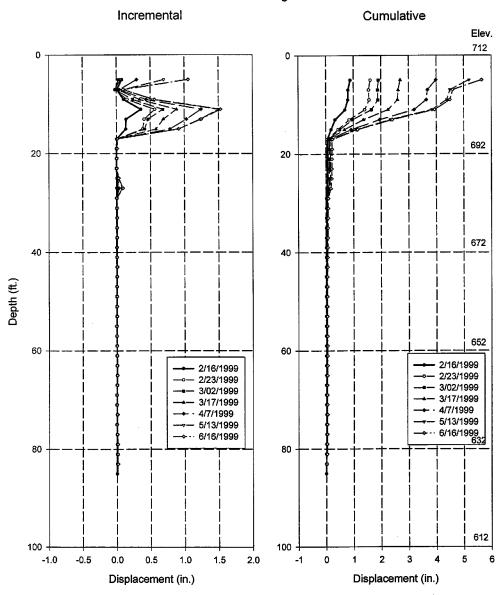
## SUM.82 Project: Inclimometer # 2 Displacement in the A + Direction Downslope (River direction) Base Line reading 2/16/1999



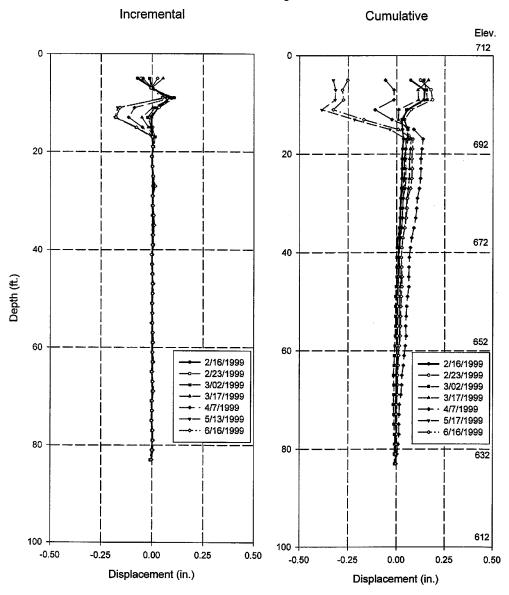
SUM.82 Project: Inclimometer # 2 Displacement in the B + Direction Downslope (River direction) Base Line reading 2/9/1999



SUM.82 Project: Inclimometer # 3 Displacement in the A + Direction Downslope (River direction) Base Line reading 2/9/1999



SUM.82 Project: Inclimometer # 3 Displacement in the B + Direction Downslope (River direction) Base Line reading 2/9/1999





NATIONAL ENGINEERING & CONTRACTING COMPANY 12608 ALAMEDA DRIVE STRONGSVILLE, OHIO 44136 PH (440) 238-3331 / FAX (440) 238-9114



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### SURFACEPREPARATION

Clean all surfaces. Joint walls must be sound, clean, dry, frost-free, and free of oil and grease. Guring compound residues and any other foreign matter must be thoroughly removed. Install bond breaker tape or backer rod to prevent bond at base of joint.

Priming is not usually necessary. Most substrates only require priming if testing indicates a need or where sealant will be subjected to water immersion after cure. Consult Sikaflex Primer Technical Data Sheet or Technical Service for additional information on priming.

## APPLICATION

Recommended application temperatures: 40-100 F. For oold weather application, condition units at approximately 70 F: remove prior to using.

For best performance, Sikaflex-1a should be gunned into joint when joint slot is at mid-point of its designed expansion and

Place nozzle of gun into bottom of the joint and fill entire joint. Keep the nozzle in the sealant, continue on with a steady flow of sealant preceding the nozzle to avoid air entragment.

Avoid overlapping of sealant to eliminate entrapment of air. Tool as required. Joint dimension should allow for 1/4 inch minimum and 1/2 inch maximum thickness for sealant. Proper design is 2:1 width to depth ratio.

For use in horizontal joints in traffic areas, the absolute minimum depth of the sealant is 1/2 in, and closed cell backer rod is recommended. Tool as necessary, dry or with clean water.

### LIMITATIONS

- ▲ Allow 1-week cure at standard conditions when using Sikatlex-1a in total water immersion situations and prior to painting.
- . When overcoating with water, oil and rubber based paints, compatibility and adhesion testing is essential.
- Avoid exposure to high levels of chiprine. (Maximum continuous level is 5ppm of chlorine.)
- Maximum depth of sealant must not exceed 1/2 in.; minimum depth is 1/4 in.
- Maximum expansion and contraction should not exceed 25% of average joint width
- Do not cure in the presence of curing silicone sealants.
- Avoid contact with alcohol and other solvent cleaners during cure.
- ▲ Do not apply when moisture-vaportransmission condition exists from the substrate as this can cause bubbling within the sealant.
- A Use opened cartridges and uni-pac sausages the same day.
- When applying sealant, avoid air-entrapment.
- Since system is moisture-cured, permit sufficient exposure to air.
- ▲ White color tands to yellow slightly when exposed to ultra-violet rays
- ▲ The ultimate performance of Sikeflex-1a depends on good joint design and proper application with joint surfaces properly prepared.
- The depth of sealent in horizontal joints subject to traffic is 1/2 in.
- Do not tool with detergent or soap solutions

### **COMBUSTIBLE**

Keep away from open flames and high heat. Contains xylene; avoid breathing vapors. Use with adequate ventilation,

Avoid skin and eye contact. Use of NIOSH/ MSHA approved organic vapor respirator, safety goggles, and chemical-resistant gloves recommended. Remove contaminated ciothing and shoes.

### FIRST AID

In case of skin contact, wash thoroughly with soap and water. For eye contact, flush immediately with plenty of water for at least 15 minutes; contact physician. Wash clothing before re-use. Discard contaminated shoes.

### CLEAN UP

Uncured material can be removed with approved solvent. Cured material can only be removed mechanically. For spillage, collect, absorb, and dispose of in accordance with current, applicable tocal, state, and lederal regulations.

Oralt, Sike and Sikeliex are registered trademarks. Made in USA. Printed in USA. September, 1997.

## KEEP CONTAINER TIGHTLY CLOSED NOT FOR INTERNAL CONSUMPTION

### KEEP OUT OF REACH OF CHILDREN FOR INDUSTRIAL USE ONLY CONSULT MATERIAL SAFETY DATA SHEET FOR MORE INFORMATION

SIKA WHÄRANTS ITS PRODUCTS TO BE FARE OF MANUFACTURING DETECTS AND THAT THEY WILL MEET SIKA'S CURRENT FURL SHED PHYSICAL PRODERTIES WHEN APPLIED IN ACCORDANCE WITH BIKA'S DIRECTIONS AND INSTED IN ACCORDANCE WITH ACTIVA AND SIKA'S TANDARDS. THEM ARE NO OTHER MARRANTES BY BRACK OF ANY MATURE WHATENDEST, BUTCHEST, BUT

### 1-800-933-SIKA NATIONWIDE

### Regional Information and Sales Centers

For the location of your nearest Sika sales office, contact your regional center.

USA Headquarters 201 Polito Avenue Lyndhurst, NJ 07071 Phone: 1-800-933-7452 Ear-201-033-7326

Eastern Region 14 Summit Place Suite 201 Branford, CT 06405 Phone: 203-488-7706 Fax: 203-488-7790

Central Region 2190 Gladstone Court Suite A Glendale Heights, IL 60139 Phone: 630-924-7900

Fax: 630-924-8508

Western Region 12767 East Imperial Hwy Santa Fc Springs, CA 90670 Phone: 562-941-0231 Fax: 562-941-4762

# ONALITY ACHIEVENEN

# Sikaflex®-1a

## One part polyurethane, elastomeric sealant/adhesive

### DESCRIPTION

Sikaflex-1a is a premium-grade, highperformance, moisture-cured, 1-component, polyurethane-based, non-sag elastomeric sealant. Meets Federal specification TT-S-00230C, Type II. Class A. Meets ASTM C-920, Type S, Grade NS, Class 25; Canadian standard CAN/CGSB 19.13-M87.

### WHERE TO USE

- . Designed for all types of joints where maximum depth of sealant will not exceed 1/2 in.
- A Excellent for small joints and fillets, windows, door frames, regiets. fiashing, and many construction adhesive applications.
- Suitable for vertical and horizontal joints; readily placeable at 40 F.
- Has many applications as an elastic adhesive between materials with dissimilar coefficients of expansion.

### **ADVANTAGES**

- Eliminates time, effort, and equipment for mixing, filling cartridges, pre-heating or thawing, and cleaning of equipment.
- Fast tack-free and final cure times.
- . High elasticity cures to a tough, durable, flexible consistency with exceptional cut and tear-resistance.
- ▲ Stress relaxation.
- Excellent adhesion bonds to most construction materials without a primer.
- Excellent resistance to aging, weather-Proven in tough climates around the
- world.
- ▲ USDA-approved.
- Odorless, non-staining.
- A Jet fuel resistant.
- NSF-approved for potable water contact.
- ▲ Urethane-based; suggested by EPA for radon reduction.
- Paintable with water-, oil- and rubberbased paints.
- ▲ Capable of ±25% joint movement.

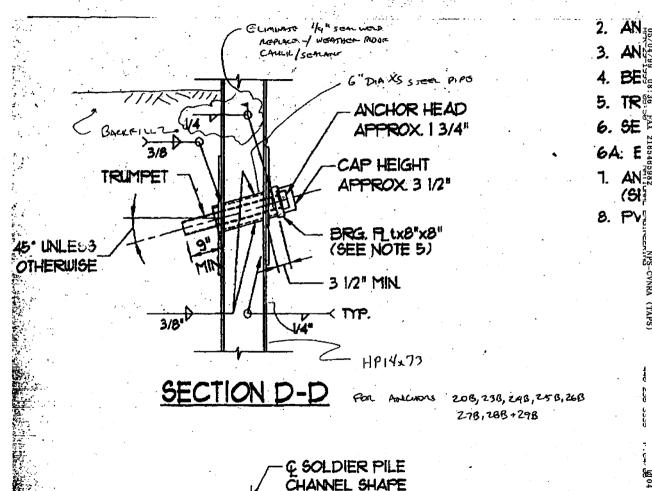
### COVERAGE

10.3 fl. oz. cartridge seals 12.4 lineai ft. of 1/2 x 1/4 in. joint. 20 fl. oz. uni-pac seusage seals 24 lineal fi. of 1/2 x 1/2 in. joint.

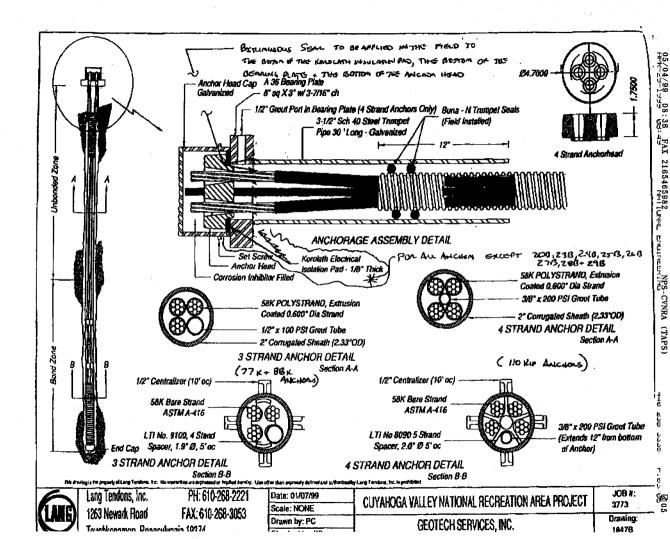
**PACKAGING** 

Disposable 10.3 fl. oz., moisture-proof composite cartridges, 24/case; and unipac sausages, 20 fi. oz., 20/carton.

SHELFLIFE	10.3 fi.oz. cartridges	12 months		
<del> </del>	20 II.oz. uni-pac sausages	12 months		
STORAGE CONDITIONS	Store at 40-95F (4-35C). Condition material to 65-76F before			
	using.			
COLORS	White, colonial white, aluminum gray, limestone, black, dark bronze, capitol lan. Special architectural colors on request.			
APPLICATION TEMPERATURE	40 to 100F. Sealant should be installed when joint is at midrange of its anticipated movement.			
SERVICE RANGE	-40 to 170F			
CURING RATE	Tack-free time	4 hours (TT-S-00230C)		
	Tack-free to touch	3 hours		
	Final cure	4 to 7 days		
TEAR STRENGTH	TEAR STRENGTH (ASTM D-624) 50 lb./ir.			
SHORE A HARDNE 21 day	ESS (ASTM D-2240) 40±5			
	+020			
	TIES (ASTM D-412)			
21 day	Tensile Stress	200 psi (1.37MPa)		
	Elongation at Break	500%		
	Modulus of Elasticity 25%	35 psi (0.24 MPa)		
	50%	60 psi (0.41 MPa)		
	100%	85 psi (0.59 MPa)		
ADHESION IN PEEL (TT-8-00230C, ASTM C 794)				
Substrate		nesion Loss		
Concrete	20 lb	C%		
Aluminum	20 10	0%		
Glass	20 lb	0% .		
WEATHERING RESISTANCE	Excellent			
CHEMICAL RESISTANCE	Good resistance to water, diluted acids, and diluted alkalines. Consuit Technical Service for specific data.			



FULL LENGTH



### ---- ---- I

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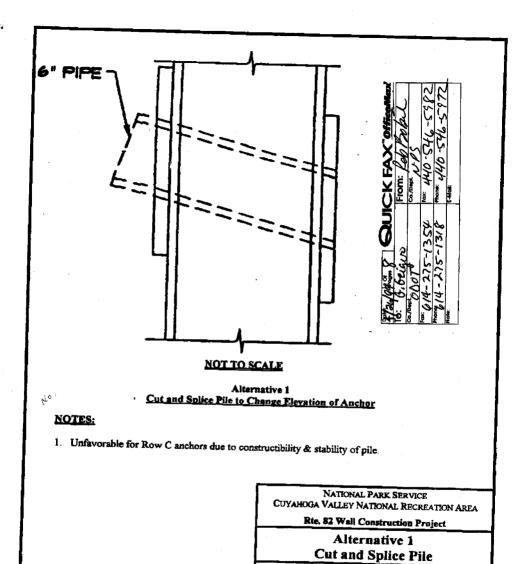
# NATIONAL ENGINEERING AND CONTRACTING COMPANY

## CONDITION REPORT

1	DATE	-
-	04/29/99	
Г	REPORT NO.	
١	008 - REV No.1	
7	SPEC LIEM NO.	

CONTRACT NO. PROJECT NAME: NPS CONTRACT No. 1443CX616098008 SPECTEM NO. 9852 VALLEY RAIL WAY SLOPE STABILIZATION UNDER S.R. 82 BRIDGE 02220-34 Welding REPORT RESPONSE CATEGORY (CIRCLE ONE) A) IMMEDIATE B) EARLIEST CONVENIENCE C) INFO ONLY

DESCRIPTION OF CONDITION FOUND:	<u> </u>		
Per Dwg. No. 5 of 9, Section D-D, a 1/4" seal weld is to be applied	ed at the joint of the bea	ring plate and the 6" XS pipe t	tube.
At Pile No. 20B, 23B, 24B, 25B, 26B, 27B, 28B & 29B, the koi			
and the 6" tube. As an alternative to applying tension to the stra			
National proposes to trim the korolath pad to the perimeter of th			
National proposes to use Sika Products Sikaflex-1a as the sealer			
your information.			
For the other pilings, the korolath will be installed between the	bearing plate and the an	chor head as per the attached s	ketch.
RECOMMENDED ACTION:			
Please advise if this is acceptable.			
AREA MGR/SUPERINTENDENT: El Chych		₹/29 <i>19</i> 4 date: 0 <del>4/28/99</del>	<del>Ĵ</del>
OWNER RESPONSE:			
	•		
OWNER REP SIGNATURE:		DATE:	
DISTRIBUTION: Estimating, Scheduling, Job Corneg, Document Custodian	Cost Code Rep'd: Yes	No Cost Code No.	



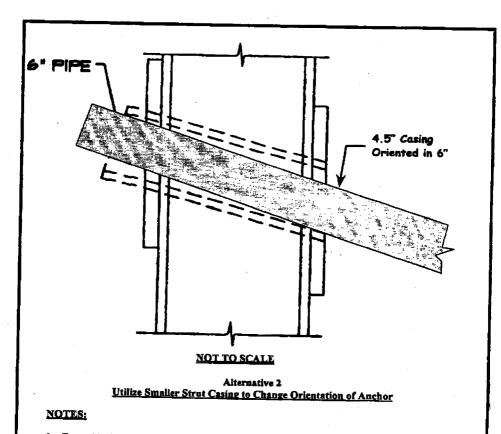
**April 1999** 

Figure 1

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OK 2,4,5,

7 6.87



1. Favorable for most anchors, will provided additional clearance utilizing existing equipment

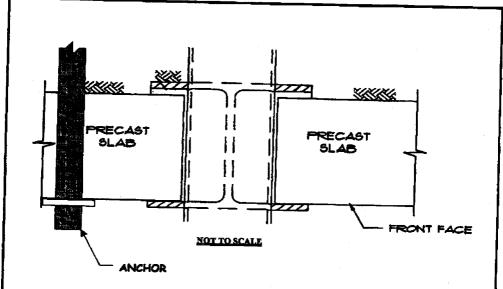
2. Casing section will have to be evaluated against buckling.

NATIONAL PARK SERVICE
CUYAHOGA VALLEY NATIONAL RECREATION AREA
Rte. 82 Wall Construction Project

Alternative 2
Utilize Strut Smaller Casing

April 1999

Figure 2



Alternative 3
Offset Anchor and Use Concrete Wailer

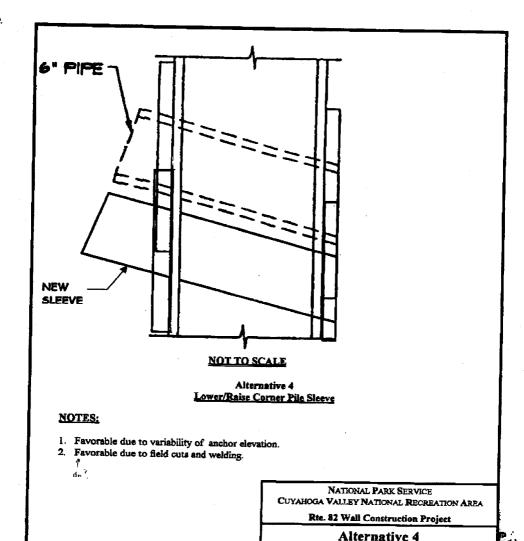
- 1. Concrete waler must be designed.
- 2. Pile flange must be evaluated for bending.

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CUYAHOGA VALLEY NATIONAL RECREATION
Ree. 82 Wall Construction Project

Alternative 3
Offset Anchor/Concrete Wailer

April 1999

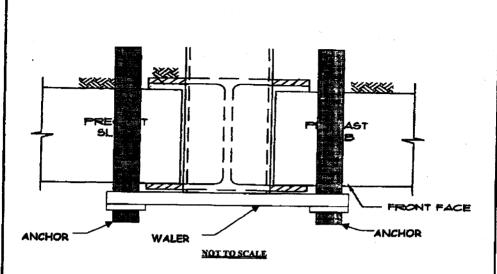
Figure 3



Lower/Raise Sleeve

Figure 4

**April 1999** 



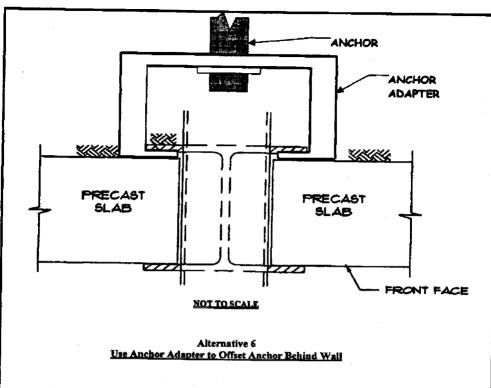
Alternative 5
<u>Use Two Offset Anchors and Wailer</u>

- 1. Unfavorable due to added cost of using two anchors instead of one.
- 2. Elevation of anchors variable.

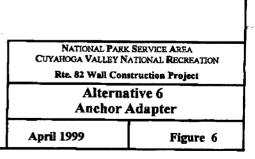
NATIONAL PARK SERVICE
CUYAHOGA VALLEY NATIONAL RECREATION AREA
Rte. 82 Well Construction Project

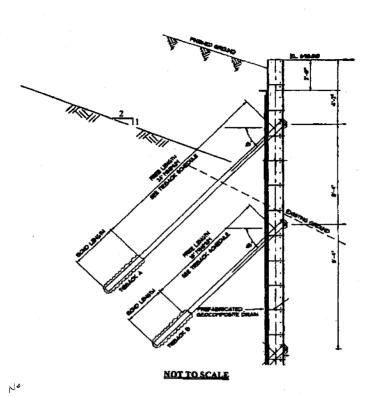
Alternative 5
Offset Anchors with Wailer

April 1999 Figure 5



- Requires a prefabricated adapter.
   Facilitates installation at variable elevation.





Alternative 7 Eliminate Upper Auchor Row on Upper Wall

1. 2.

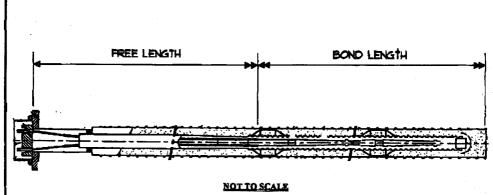
NATIONAL PARK SERVICE AREA CUYAHOGA VALLEY NATIONAL RECREATION

Rte. 82 Wall Construction Project

Alternative 7 **Eliminate Upper Anchor Row** 

**April 1999** 

Figure 7



## Alternative 8 Adjust Free/Bond Length

## NOTES:

- 1. Evaluate shortening bond/free lengths to minimize potential interference.
- 2. May be most effective on lower rows.

NATIONAL PARK SERVICE AREA **CUYAHOGA VALLEY NATIONAL RECREATION** 

Rte. 82 Wall Construction Project

Alternative 8 Adjust Free/Bond Length

**April 1999** 

Figure 8



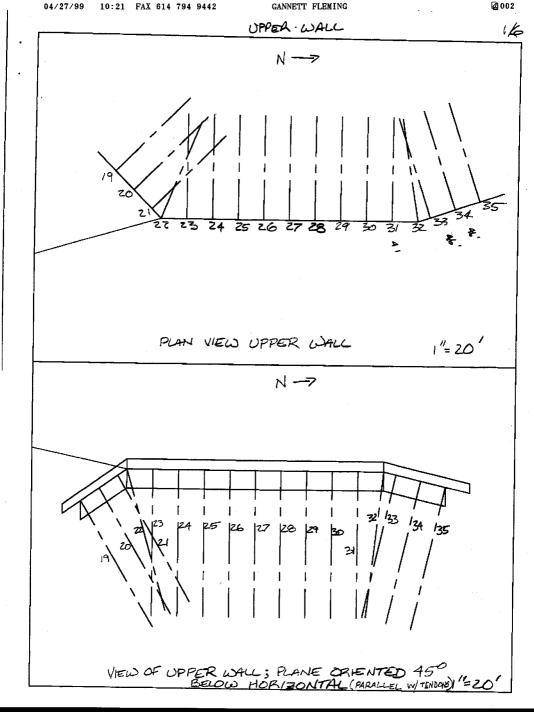
## FACSIMILE TRANSMITTAL

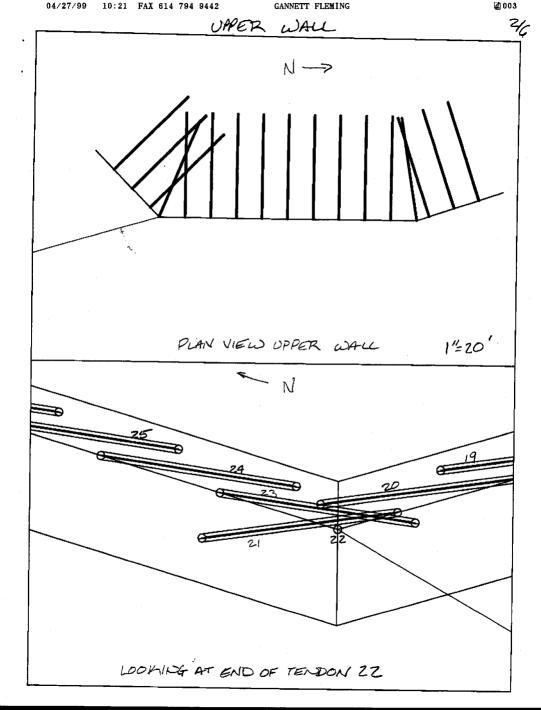
# Gannett Fleming Engineers and Architects, P.C.

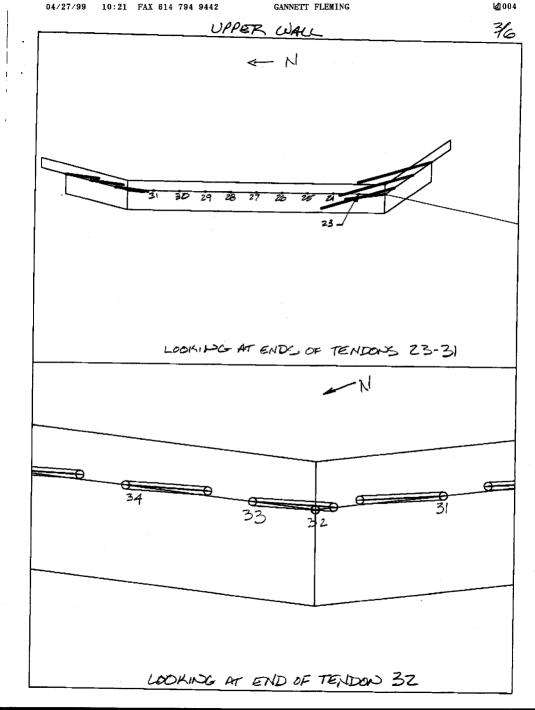
Blendonview Office Park 5015 Pine Creek Drive Columbus, OH 43081

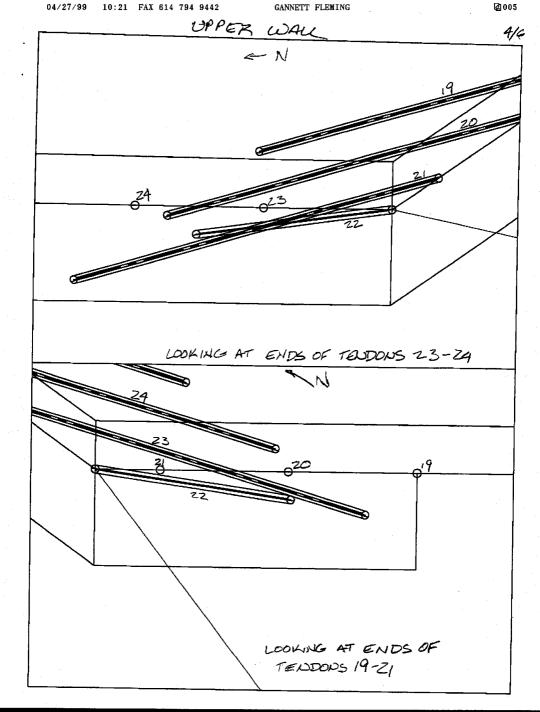
Fax: 614-794-9442	Telephone: 614-794-9424
To: GENE GEIGER (Name of Individual)	Date: 27AR 99
ODOT (Name of Company)	GF Job No.:
From: ROXOL (Name of Individual)	No. of Pages: 13
Telephone No. of FAX Machine: 275-	
Title of Job:	,
Comments:  GENE,  PLOASE CALL WITH A	NY QUESTIONS.
CONFIDENTIAL NOTICE: The documents accompanying	

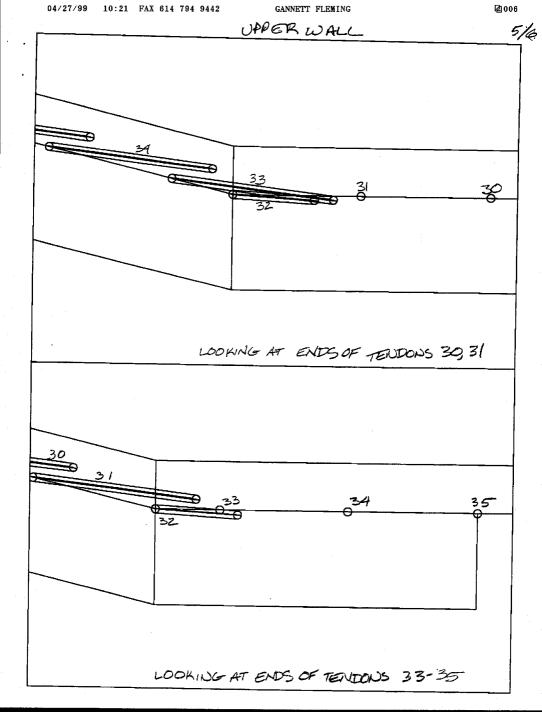
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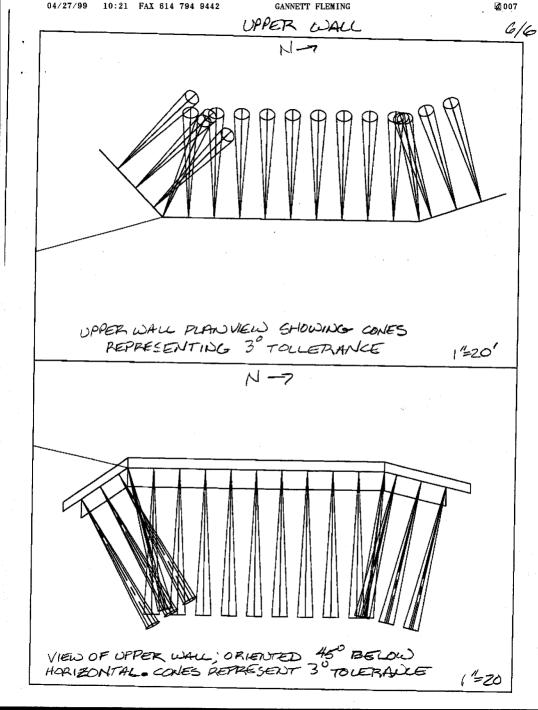


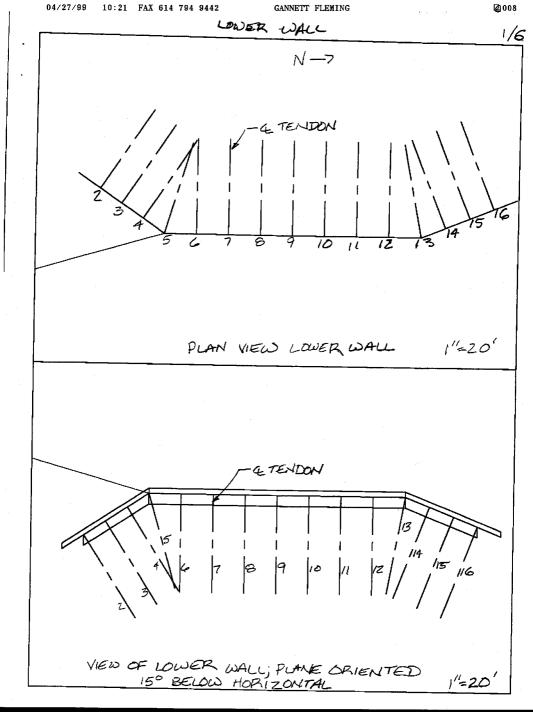


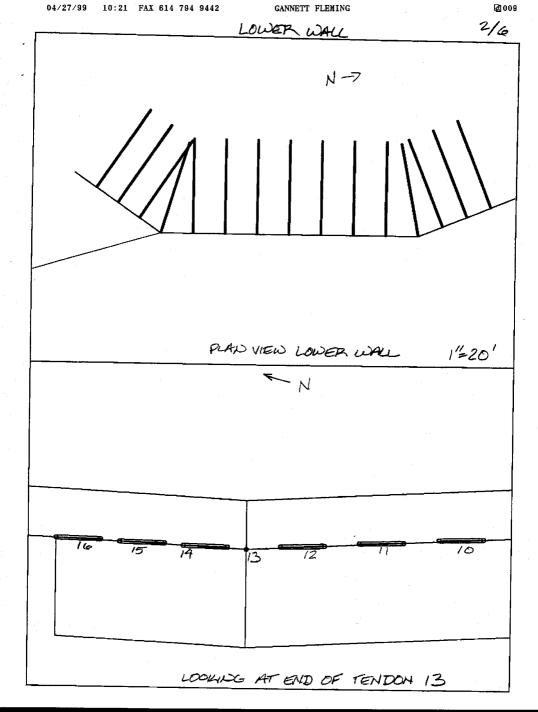


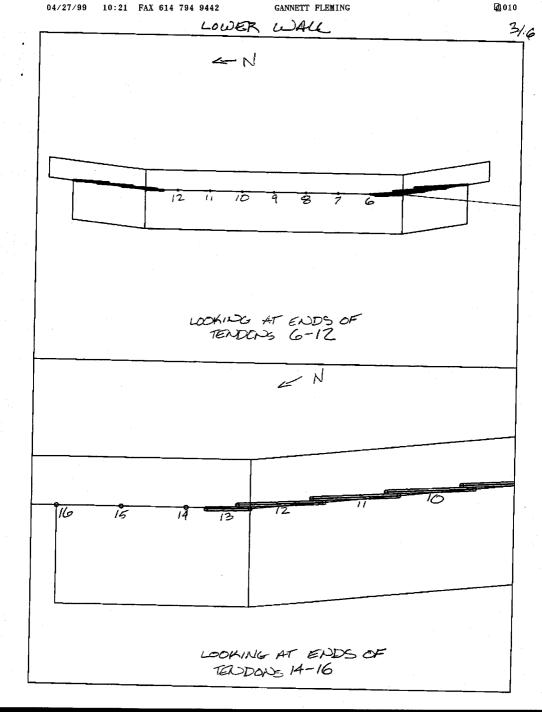


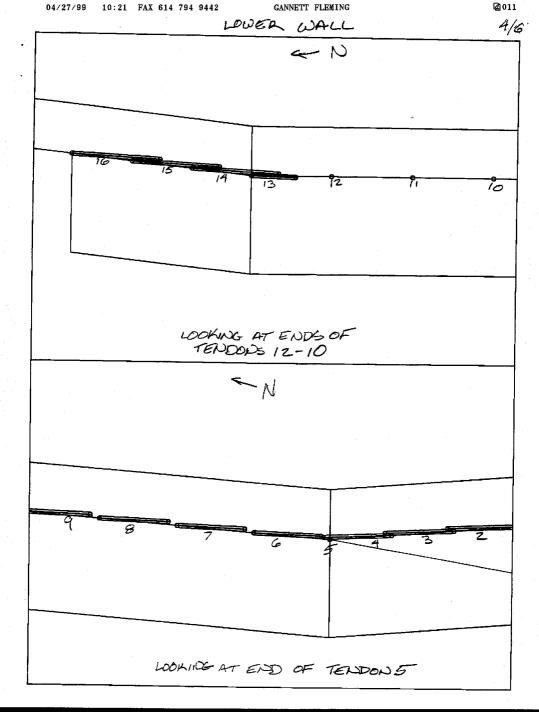


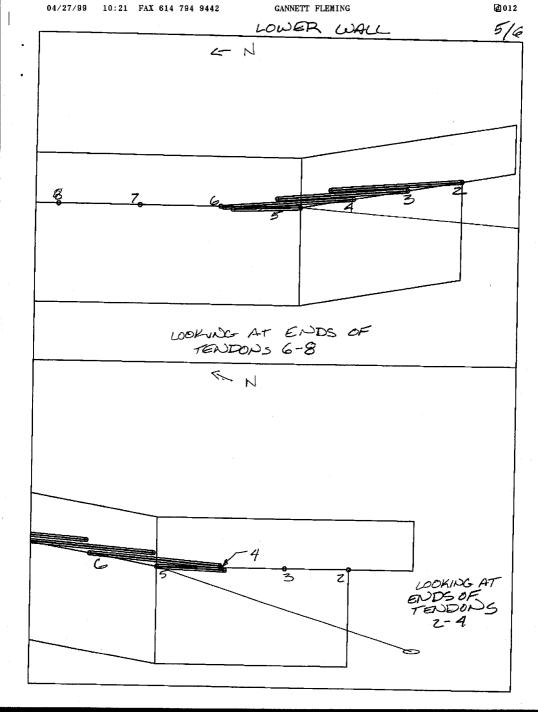


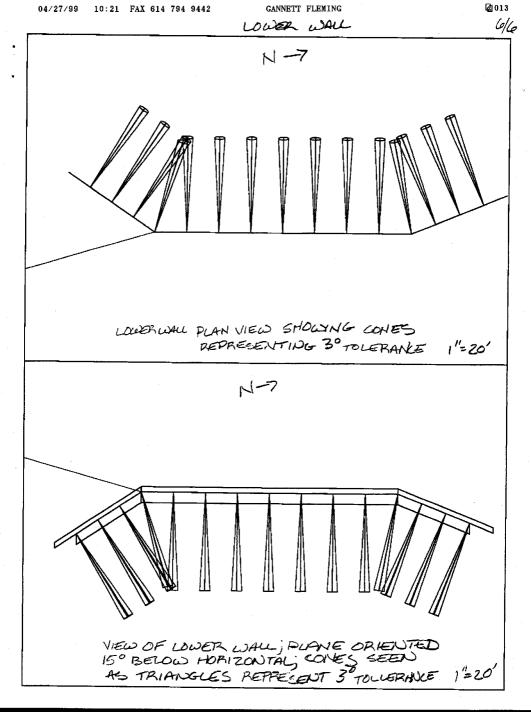












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MAR-29-1999 11:40

National Engineering and Contracting Company 12508 Alameda Drive / Strongsville, Ohio 44136 (440) 238-3331 FAX (440) 238-3335

March 29, 1999

National Serial No. 9852-3023

National Park Service Cuyahoga Valley National Recreational Area 15610 Vaughn Road Brocksville, Ohio 44141

Attention: Ms. Je

Ms. Joyce Stumbo

Administrative Contracting Officer

Reference:

Contract No. 1443CX616098008

Valley Railway – Slope Stabilization Under S.R. 82 Bridge

CP-07 – Revised Wali Procedure – Resolution Proposal

NATIONAL ENGINEERING

#### Dear Ms. Stumbo:

Based on the discussions that were held between the NPS and National Engineering on Merch 26, 1999. National Engineering is willing to resume construction immediately at no change (i.e. increase and/or decrease) in Contract price for the issues that have been addressed in CP-07. This proposal supercedes the proposal that was submitted on March 24, 1999 (National Documents Serial No. 9852-3020, -3021 and -3022) and is based on the following conditions:

- National Engineering will build the Upper and Lower Walls using the procedure dated March 24, 1999 (National Document Serial No. 9852-3022).
- The Project Completion date is revised to August 13, 1999 at no additional cost to either party. This would include the costs related to the suspension of work on March 22, 1999 and the costs due to the extension of the Project duration to August 13, 1999.
- If the NPS requires that the 12" half round pipe is to be installed over each 5-1/2" dia. pipe compression strut, the half-round pipe will be added at an additional cost of \$250.00 per strut. National Engineering assumes that the half round pipe was required in the procedure that is presented in the Contract Documents to provide protection to the tieback anchors while backfill material is placed over the anchors. With the proposed procedure, a majority of the fill material will be in place prior to the installation of the anchor. This would eliminate the need to provide the half-round pipe for protection. The Engineer-in-Charge has also expressed concern that the placement of the half-round pipe over the anchors will provide a location to trap air and moisture above the anchor, thereby creating an environment that would be conducive to corrossion.

This proposal is being submitted in the spirit of cooperation in order to mitigate the impact of this entire situation. Due to the costs that are being incurred by National Engineering as a result to the suspension of work, this proposal is valid for only three calendar days from the date of this letter. National Engineering is willing to proceed with work immediately upon receipt of written concurrence from the NPS with the understanding that a Contract Modification would be issued at a later date.

National Engineering appreciates the afforts and cooperation of all parties in resolving this matter. Since time is of the essence, please contact the undersigned immediately should you require any additional information.

OPTIONAL PORNI 89 (7-90)

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Page 544-5914

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National Engineering and Contracting Company

National Serial No. 9852-3023 NPS - Slope Stabilization @ S.R. 82 CP-07 - Resolution of Proposal

03/29/99 Page No. 2

Yery Truly Yours,

NATIONAL ENGINEERING & CONTRACTING COMPANY Ehrt Chy

Edmund Chrzenowski Contracts Administrator

Cc:

Contract File 9852 (B2) W Grate

S. Febus

File CP-07 D. Hoover Field



National Engineering and Contracting Company 12608 Alameda Drive / Strongsville, Ohio 44136 (440) 238-3331 FAX (440) 238-3335

March 24, 1999

National Serial No. 9852-3022

National Park Service Cuyahoga Valley National Recreational Area 15610 Vaughn Road Brecksville, Ohio 44141

Attention:

Ms. Joyce Stumbo

Administrative Contracting Officer

Reference:

Contract No. 1443CX616098008

Valley Railway - Slope Stabilization Under S.R. 82 Bridge

CP-07 - Evaluation of Wall Design - Revised Procedure Analysis & Impact

#### Dear Ms. Stumbo:

Since mid-January, several meetings and pieces of correspondence have transpired between the National Park Service, National Engineering and the associated parties concerning the design of the retaining walls and the corresponding difficulties that have been identified with developing a construction sequence to facilitate the design. This document is being furnished to summarize the construction procedure that is being proposed by National Engineering and it's subcontractors in order to address those difficulties and to streamline the construction process in order to make-up time that has been lost due to this matter. It is being submitted in conjunction with the two other letters from National Engineering, Serial No. 9852-3020 and -3021. This document includes the latest construction procedure, a detailed analysis of the cost revisions and a revised schedule. This package is being provided as requested per the NPS letters dated March 5, 1999 and March 23, 1999.

It is hoped that several issues will be resolved with the acceptance and implementation of this package. This includes:

- Elimination of the overloading of the precast lagging when the tiebacks are loaded with the loads that are applied during the creep, performance and proof tests. Based on the discussions and analyses, it has been confirmed that the lagging was designed for the final loading conditions only. The design did not take into account the effects of construction loads and sequencing. Even if the specified procedure is to be followed, the potential exists for overloading the precast lagging with the test loads. Acceptance of this procedure would eliminate the need to redesign the lagging to accommodate the test loading.
- Resolve the addition of compression struts for the middle row of the Upper Wall due to the existing profile being
  found to be different from the profile shown in the Contract Drawings. This matter was initially addressed in
  National Engineering Condition Report No. 3, dated January 5, 1999.
- Use of the 5-1/2" dia. casing pipe drilled into the rock, in lieu of the compression struts shown in the Contract
  Drawings, in order to eliminate the concerns that have been raised about the ability of the compression struts, as
  detailed in the Contract Plans, to adequately restrain the exposed H-piling from deflecting towards the slope as
  the tieback anchors are being loaded.

12 QU	ICK FAX OfficeMax
TO: GENE GELGERE	From: Cop Popel
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National Serial No. 9852-3022 NPS – Slope Stabilization @ S.R. 82 CP-07 – Revised Procedure of Construction 03/24/99 Page No. 2

The revised procedure that is provided within this document includes the following items:

Procedure Item No. 1 National Engineering's revised procedure dated March 24, 1999. This procedure supercedes the previous procedures that were submitted on January 29, 1999 and February 22. The procedure provided herein, including the associated sketches, consists of eight (8) pages.

Procedure Item No. 2 AWK Engineering, Inc. letter dated March 9, 1999. This document addresses it's review of the procedures. This document is two (2) pages long.

Procedure Item No. 3 National Engineering calculations to analyze the loading of the H-piling while the lagging & backfill are being placed in the fill areas. This consists of three (3) pages.

Procedure Item No. 4 AWK Engineering, Inc. Analysis dated 3/18/99 and titled "Overstress Evaluation –
Construction Load Condition Installation of Upper Anchor Rows for Upper Tier Wall and Lower Tier
Wall". This consists of twenty (20) pages.

This proposal addresses the following changes to the Project scope of work:

- Construct the walls utilizing the procedure dated March 24, 1999.
- Use of 5-1/2" casing pipe in lieu of the 8" compression strut detailed in the Contract Plans for the upper rows of both walls. The 5-1/2" casing will be spun 6'-8' into the rock, depending on the design load for the corresponding tie-back. For the upper row of the upper wall, the casing pipe will be 45' - 50' long, while the plan length for the compression strut was anticipated to be 20' minimum in length.
- Addition of the use of the 5-1/2" casing pipe as compression struts for the middle row of the upper wall.
- Install precast lagging panels four (4) ft. in height instead of two (2) ft. as was originally submitted. This allows
  the precast fabricator to take advantage of their standard panel sizes. A credit is offered by the vendor for their
  savings in labor. It is anticipated that this change would reduce the production time from eight (8) weeks to four
  (4) weeks, after final release for production.

The cost proposal is broken into two separate analyses. The first (CP-07a) addresses the comparison in costs for installing the compression struts as per plan vs. the installation of the 5-1/2" dia. casing pipe for the upper rows of both walls. Proposal CP-07a does not include furnishing & installing 12" half round pipe over the 5-1/2" casing pipe. The second summary, CP-07b, addresses the cost changes to add the compression struts for the middle row of the upper wall, the credit to use four ft. high precast panels in lieu of the two ft. high panels and the costs for AWK to analyze the original design of the wall. Based on the Contract Documents, AWK Engineering, acting as the Engineer-in-Charge, is responsible for overseeing the tieback work and verifying the results of the tieback testing. The Engineer-in-Charge is not responsible to review and validate the design of the wall system as specified in the Contract Documents. Based on the questions raised concerning the loading of the lagging, AWK did have to evaluate the wall system. National considers that evaluation to be outside of the scope of work and is compensable. AWK's evaluation resulted in the issuance of their letter dated February 2, 1999. This letter was transmitted to the NPS via National Engineering's letter dated February 3, 1999. Serial No. 9852-3012.

Had the procedures that are listed in the Contract Drawings been followed implicitly, the concern about overstressing previously locked off anchors would have applied the same as with National's procedure. Per the Contract Plan procedure for a "fill" condition, fill and lagging can be installed up to a tie-back. The tie-back can then be installed, tested and locked-off and then the fill above it can be placed. Prior to that tie being loaded, the tie-back below it would be loaded, tested, locked-off and then subjected to the surcharge of the fill above it up to the next anchor, thereby subjecting the lower tie-back to the same overstressing condition as was identified in National's procedure. The same sort of condition would occur in a "cut" condition as the lagging & backfill is being placed between an upper tie-back that is locked-off and the next tie-back down. The additional cost for AWK to analyze the overstressing of the middle row anchors for the upper wall and the lower row of the lower wall is not included with this document due to the time that is available. National considers this analysis to be an additional cost as well. The costs for the evaluation will be submitted at a later date.

National Serial No. 9852-3022 NPS - Slope Stabilization @ S.R. 82 CP-07 - Revised Procedure of Construction 03/24/99 Page No. 3

The net impact of these two cost analyses is:

1.) Change the compression struts from the Contract Plan to the 5-1/2" dia. casing. \$(-14,086.00)
2.) Add middle row of struts, use four \( \overline{\chi} \) panels, Engineer's analysis of original design. \$\frac{12,298.00}{2,298.00}

Net Change = \$(- 1,788.00)

Also enclosed with this proposal is one copy of the revised Project Schedule. The schedule has been modified to include the revised procedure and the fabrication of the precast panels in four ft. units. With regards to impact that this matter has on the Project Schedule, the anticipated completion date is August 6, 1999, assuming that agreement to this proposal is made by March 26, 1999. The bulk of the impact is the delay of the fabrication of the precast. The panels were originally released for fabrication on January 13, 1999. The precast vendor put the production on hold on January 28, 1999, based on questions raised by National Engineering about the design capacity of the lagging. National concurred with the vendor's decision and made the NPS aware of this via the modified procedure that was provided to the NPS on January 29, 1999. Production is still on hold pending the resolution of this proposal. If the four ft. panels are utilized, the panels should be available within four weeks of final release. If the two foot panels are required, a total of eight weeks will be required after release. The additional four weeks would subsequently push the completion of the Project four weeks later to September 3, 1999.

National Engineering maintains the position that this entire issue evolved around the fact that the precast lagging as designed in the Contract Documents can not support the loading due to construction, even when the procedures delineated in the Contract Documents are followed precisely. This fact was not readily apparent in the Contract Documents and could not be reasonably determined at the time of bid. Specifically, the design as specified by the NPS would not meet its intended purpose. Accordingly, the specifications are defective. The NPS, by providing the contractor with specifications for performing work, implicitly warrants that compliance with these specifications will produce a satisfactory result. Therefore, the contractor is not liable if it performs in accordance with the defective specifications, and, as a result, produces an unsuitable product or service. In addition, the NPS is liable for any increased costs or delay incurred by the Contractor in trying to meet the defective specifications. The development of revised procedures in order to address this issue led to further evaluation of the wall system design by all parties involved. As this analysis evolved, other issues also became part of the evaluation. The other issues include the need to add compression struts in the middle row of the upper wall since the actual site conditions varied from the conditions that were identified in the Contract Drawings, and, concerns about the performance of the compression struts as detailed in the Contract Drawings.

This proposal addresses only the direct costs of the modifications. Because of the development and evaluation of revised procedures to accommodate the design of the precast lagging, and the resultant delay to the fabrication of the lagging, the project duration is being extended until at least August 6. This is an extension of time eighty (80) calendar days to complete this Project. Based on previous discussions, and in an effort to resolve this matter, National is willing to assume the delay costs through the date of June 25, 1999. National requests that the NPS assume responsibility for the additional delay costs from June 26 through the end of the Project.

This proposal is based on the actual General & Administration calculations that were utilized and approved for a project that National had completed for the Greater Cleveland Regional Transit Authority (GCRTA). Change orders for this Project were based on the Federal Acquisition Regulations, Subchapter e, General Contracting Requirements, Part 31 — Contract Financing. National offers this as a point of reference for establishing a mutually agreeable procedure for calculating the overhead and profit for extra work.

In summary, National Engineering requests that a Contract Modification be issued in the amount of (-\$ 1,788.00), and the Contract completion be extended by eighty (80) calendar days. The delay costs will be addressed under separate correspondence and modification. As noted in other discussions, National Engineering is willing to proceed with the work immediately and to continue to work with the NPS concurrently to resolve the cost and schedule issues in order to mitigate the impact of this matter. This Change Proposal is being furnished in accordance with Federal

Procedure Iron No. 1

# CUYAHOGA VALLEY NATIONAL RECREATION AREA NATIONAL PARK SERVICE CONTRACT No. 1443CX616098008 REVISED PROCEDURE FOR CONSTRUCTING TIE-BACK WALLS

#### March 24, 1999

The following procedures are being submitted based on the actual conditions that have been identified at the jobsite. These procedures supercede the procedures dated January 29, 1999, February 22, 1999 and March 9, 1999.

#### A.) UPPER WALL

- Drill hole and place steel pile section. Place Class C concrete and lean concrete to proposed elevations.
- Access bench is established at approx. elevation 684+/-.
  - a.) For the middle row of tieback anchors in "fill" conditions:

Drill tiebacks @ elevation 685.5. In fill areas, Geotech will pre-drill hole and advance the 5-1/2" dia. steel pipe with internal threaded joints to bedrock. The pipe will be drilled approximately six (6) feet into the rock (for tiebacks loaded to 77k). This drill length may be modified based on the results of the Failure Tests. Geotech's drill mast will be supported by National's crane at the proper elevation. The drill mast will be clamped to the east flange of the piling for lateral stability. The power pack for the drill will be set on the bench, remote from the drill mast. The tiebacks will be installed and grouted. After the grout has cured for a minimum of three (3) days, the ties will be loaded and tested as specification Specification Section No. 02220. The tiebacks will be loaded against the casing pipe instead of against the H-piling. The tiebacks will be locked off @ 90% of design load as per specification. After the tiebacks are locked off, the lock-off shim plates will be installed and welded into place. This will eliminate applying the test loads to the H-piling.

Note that the 5-1/2" pipe casing will be used in lieu of the compression strut detail that is illustrated on Contract Drawing Sheet 3 of 9. If the pipe casing is exposed greater than 6 ft. in the fill area, the exposed section will be braced with additional supports and/ or pipe collars. The bracing will remain in place until the backfill is brought up to the elevation of the bracing.

Care must be taken to ensure that casing pipe is drilled into bedrock that is beyond the excavation zone of the bridge piers.

b.) For tieback anchors that are located in "Cut" Conditions:

The tiebacks will be installed as specified, using the 5-1/2" pipe as casing. The pipe will not have to be drilled into the rock as in the "Fill" conditions.

Upon the completion of the testing of the ties at elevation 685.5, drilling operation will be moved to the LOWER ROW, LOWER WALL. Soil will be excavated from the Upper Wall from the middle row (Elev. 685.5) to the lower row of tiebacks (Elev. 677.17). Temporary lagging will be installed between the piling. A single row of 3" thick full-dimensioned hardwood lagging will be installed in the top six (6) ft. (Elev. 685.5 – 679.5). A double row of 3" thick full-dimensioned hardwood lagging will be installed from Elev. 679.5 to 677,0. National intends to remove the temporary lagging as the backfill is placed. However, if the field conditions will not safely permit that, the temporary lagging will then be left in place. If additional clearance is required between the temporary and permanent lagging, hardwood blocking will be placed between the temporary lagging and the H-piling. The excavated material will either be stockpiled on site, or used as suitable backfill for the lower wall. See Step B-3.

National Park Service
Cuyahoga Valley National Recreation Area
National Serial No. 9852-3022
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03/24/99 Page No. 2

#### B. LOWER WALL

- The H-piling will have already been drilled & cast in place as per plan. The bench is currently graded
  @ elev. 647+/-.
- The drill mast and power pack will be set on the bench. Geotech will install tieback anchors on lower
  row, elevation 648.25. Load and test the anchors as per Specification 02220. As noted in A-2, the
  tiebacks will be locked off @ 90% of design load as per specification.. These tieback anchors are all
  located in "Cut" conditions.
- 3. Excavate to bottom of lagging. The excavation has been field verified to be all in shale rock. No temporary lagging will be installed. Install underdrains. Proceed with installing permanent lagging, drainage fabric up to the elevation of the finish grade in front of the wall, elevation 645.00. Commence with the placement of fill behind the permanent lagging. If the clearance between the existing slope and the back of the piling is less than four ft., pea gravel will be used for backfill. If the clearance is greater than four ft., suitable material from the site excavation will be used for backfill. The material will be a varying combination of clay and shale. The material will comply with Specification Section 02225-2.2.C Suitable Backfill (BF). Obtain backfill material by excavating UPPER WALL beams to elevation of the lower row of tieback anchors (elev. 676.0).
- 4. Proceed with lagging installation and backfill of the LOWER WALL up to, elevation 658.+/-. Based on the analysis, dated 3/18/99, that was performed by the Engineer-in-Charge, AWK Consulting Engineers, (Procedure Item No. 4) the fill can be placed up to elevation 658.5 without overstressing the HP14 x 73 piling or the lower row of tieback anchors.
- 5. Install upper anchors. All tiebacks have been identified to be in "Fill" areas. Anchor locations are to be pre-drilled and 5-1/2" casing pipe is to be spun to approximate embedment of eight (8) ft. into rock (for 88k and 110k anchors). Geotech's drill mast will be supported by National's crane at the proper elevation. The drill mast will be clamped to the east flange of the piling for lateral stability. The power pack for the drill will be set on the bench, remote from the drill mast. Install anchors & grout. After min. three day cure, the ties will be loaded and tested as specified in Specification Section No. 02220. The tiebacks will be loaded against the casing pipe instead of against the H-piling. The tiebacks will be locked off @ 90% of design load as per specification. After the tiebacks are locked off, the lock-off shim plates will be installed and welded into place. This will eliminate applying the test loads to the H-piling.

If more than six (6) ft. of the 5-1/2" casing pipe is exposed in fill, the casing is to be braced. The bracing will remain in place until the backfill is brought up to the elevation of the bracing.

As an alternate to installing the lateral bracing for the 5-1/2" dia. casing, install the top row of anchors with the 5-1/2" dia. casing after the fill is brought to elevation 658.0. Install the anchor heads and the lock-off shims. Apply an alignment load of 5 - 10 kips to the tiebacks to seat the lock-off shims. Continue placing the fill to elevation 661.0 - 661.5. Test and lock-off the anchors.

 Once the tieback anchors are complete, finish the installation of the remaining lagging, drainage and backfill.

#### C. UPPER WALL

Move drilling rig to the UPPER WALL, LOWER ROW of tieback anchors. The H-piling will have been excavated to approx. elevation 675.0. The drill power pack and drill mast will be set on the bench @ elev. 675.0. The tieback anchors at elevation 677.17 will then be installed, loaded, tested and locked—off as noted

National Park Service
Cuyahoga Valley National Recreation Area
National Serial No. 9852-3022
Revised Procedure for Construction

03/24/99 Page No. 3

above. The tiebacks will be installed as specified, using the 5-1/2" pipe as casing. The pipe will not have to be drilled into the rock as in the "Fill" conditions.

- 1. Upon completion of the lower tieback anchors, the piling will be excavated to the bottom of lagging elevation 671.57. Temporary lagging will be installed as required. The permanent perforated drainage will be installed. The permanent lagging will be installed, working in varying lifts across the wall. As the permanent lagging is being installed, the drainage fabric will be installed as well. The ends of the permanent lagging will be grouted in place. Initially, install the permanent lagging to be above the finished grade elevation of 676.00. Place the backfill In front of the permanent lagging up to the finish elevation of 676.00. National intends to remove any temporary lagging that is installed as the backfill operation proceeds. Commence with the placement of backfill behind the permanent lagging. If the clearance between the existing slope and the back of the piling is less than four ft., pea gravel will be used for backfill. If the clearance is greater than four ft., suitable material from the site excavation will be used for backfill. The material will be a varying combination of clay and shale. The material will comply with Specification Section 02225-2.2.C.—Suitable Backfill (BF).
- 2. Based on the analysis, dated 3/18/99, that was performed by the Engineer-in-Charge, AWK Consulting Engineers, (Procedure Item No. 4), the fill can be placed up to elevation 690.5 without overstressing the HP14 x 73 piling or the middle row of tieback anchors. The lagging/ drainage/ backfill installation will proceed up to elevation 690.0 690.5. The installation of the 5-1/2" dia. casing pipe and the tiebacks for the upper row will then commence. These tiebacks are all located in "Fill" conditions. The tieback anchors will be installed using the 5-1/2" dia. steel pipe casing in the same manner as for the middle tiebacks. The pipe casing will be drilled six (6) feet +/- into the bedrock. The tieback anchors will be installed and grouted. After three days of cure, the ties will be loaded and tested as specified in Specification Section No. 02220. The tiebacks will be loaded against the casing pipe instead of against the H-piling. The tiebacks will be locked off @ 90% of design load as per specification. After the tiebacks are locked off, the lock-off shim plates will be installed and welded into place. This will eliminate applying the test loads to the H-piling.

Complete the installation of the tiebacks for the upper row within one month of the start of fill placement.

3. The lagging, drainage and backfill will then be completed to the top of wall as per Contract Documents.

NOTE: Depending on the progress of the backfilling, National may elect to install the tiebacks on the UPPER WALL, LOWER ROW, before the tiebacks on the LOWER WALL, UPPER ROW are installed.

National Park Service Cuyahoga Valley National Recreation Area National Serial No. 9852-3022 Revised Procedure for Construction

03/24/99 Page No. 4

#### NOTE:

- 1. This procedure is being submitted as an alternate to the procedure that is described in the Contract Drawings. This alternate procedure is based on the actual conditions that have been identified after National Engineering mobilized the site. As identified in Condition Report No. 3 and National's memo dated January 20, 1999, the existing slope varies from what is shown in the Contract Drawings. This results in compression struts being required in the middle row of the upper wall. Per information that is presented in the Contract Drawings, compression struts would have been required in the upper rows of both walls only. The net result is to increase the quantity of struts that will be needed over what could have been developed from the Contract Drawings. The quantity of 5-1/2" pipe that would have to be drilled into the rock for structural resistance for the middle row would be considered extra to the scope of work. The quantity of 5-1/2" pipe that would be used for casing would be considered part of the Contract.
- 2. Based on field inspection of the in-situ material, Geotech's engineer has stated that the encased pipe for the compression strut will not be able to develop any frictional resistance unless the casing is drilled and grouted into the bed rock. In addition, the compression strut, as detailed in the Contract Drawings, would not be stable laterally when the tieback is loaded. It is the opinion of AWK Engineers, Geotech and National Engineering that given this differing condition, the most feasible method to install the tiebacks in the fill situations is to use the 5-1/2" steel pipe casing drilled into the bedrock as presented in this procedure. Since this modification is the result of differing site conditions, it is the opinion of National Engineering that the cost to furnish and install the 5-1/2" steel pipe casing into the bedrock, less the length that replaces the original plan compression strut, is extra to the Contract.
- 3. As a final note, by using the 5-1/2" dia. casing pipe drilled into the rock, the test-loading of the tiebacks is transferred via the pipe casing directly to the rock. This eliminates any transfer of test-loading to the H-piling and the precast lagging. Therefore, the precast lagging will not be subject to any of the loads generated in excess of the long-term design loads. The precast lagging does not have to be re-designed to accommodate the test loads.
- 4. Per the NPS letter dated 3/23/99, the 12" half-round pipe covers are to be installed on top of the compression struts as per the Contract Drawings. Please note that the Engineer-in-Charge has expressed concern that the half-round pipe will provide an area that will trap moisture and air between the half-round pipe and the compression strut. This would create a potential for additional corrosion for the tie-back anchors. The Engineer-in-Charge stated that the need for including the half-round pipe as a bridge over the compression strut is addressed with the revised procedure since the casing pipe and the tie-back anchors would be installed after the fill is in place. The Engineer-in-Charge felt that the requirement for the half-round pipe should be reviewed further.

IP ADD'L CLEARANCE IS REQUIRED FOR THE PLACEMENT OF BACKFILL BETWEEN THE TEMPORERY LAGGING + THE PERMANENT BOTHERS THE TEMP. LAGGING . THE H. PILING,

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(ELEN. 6855 - 679-5)

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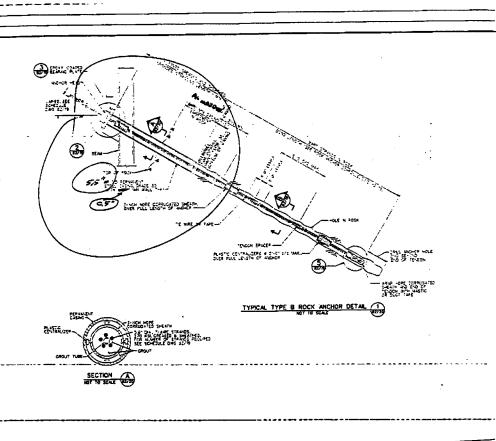
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PROJECT NO.

Paperson By AWK FOR COMPRESSION STRUSS



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NPS-CVNRA (TAPS)

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Fax 614-275-1354	From: 440-546-5982
Phone 64-275-13/8	E-Modi:

OVERSTRESS EVALUATION CONSTRUCTION LOAD CONDITION

> INSTALLATION OF UPPER MUCHOR ROWS

> > FOR

UPPER TIER WALL AND LOWER TIER WALL

VALLEY RAILWAY-SLOPE STABILIZATION UNDER SR. 82 BRIPGE TASK OFFER NO. 83

> CUYAHOGA YALLEY NATIONAL RECREATION AREA

#### ENCLOSURES:

- REFERENCE SHEETS SHT. RI THRU RIO

- ATTACHMENT A SHT. AI THRU AG

- ATTACHMENT B

- ATTACHMENT C SHT. CL TARUCT

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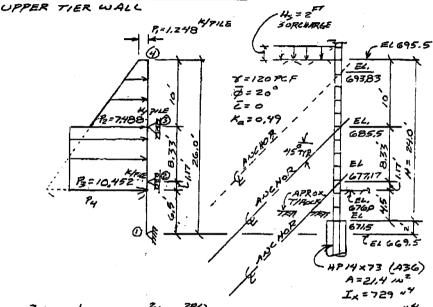
AWK CONSULTING ENGINEERS	JUB
PITTSBURGH, PENNSYLVANIA	SLOP
(412) 829-8331	

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SLOPE	STABILIZATION	J

SHT. BI THRU BY

CHECK FOR OVERSTRESS DUE TO CONSTRUCTION LOADING (UPPER TIER WALL)
WITH MIDDLE; BOTTOM ROW ANCHORS INSTALLED; LOCKED OFF,
EXCAVATION TO FINAL GRADE (EL, GTG.O), AND
FILL IS PLACED BEHIND WALL TO EL, GTS.S (16' ABOVE
HIDDLE ROW)
TOP ROW ANCHOR NOT INSTALLED YET.

## TYPICAL SECTION F PRESSURE PIAGRAM



 $K_A = TAN^2(45 - 9/2) = TAN^2(45 - 29/2) = 0.490$   $I_V = 261^{114}$ CONSIDER  $K_{H}$  FOR DESIGN = 1.33  $K_{H}$  TO ACCOUNT  $S_X = 107^{113}$ FOR LOADING DUE TO FILLING FROM MIDDLE  $d = 13.61^{11}$ ANCHOR TO TOP ANCHOR ROWS.  $\Rightarrow K_{H} = (133)(0.49) = t_F = 0.505^{11}$ 

COMPOTE MAGNITUPE OF LOAD BASED ON TRIAGULAR PRESSURE DISTRIBUTION USING KA

HOWEVER, MIDDLE ANCHOR ROW WILL LIMIT WALL
RETATION. THUS, ASSUME A UNIFORM DISTRIBUTED
LOAD BELOW THE MIDDLE ROW.

FOR ANALYSIS, ASSUME A PIN 2 FT. BELOW TOP OF ROCK SOCKET. (CONSERVATIVE)

NOTE: 3-3TRAND TENDOUS, O.6" & 58.6 - GUTS, WILL BE INSTALLED -ALL ROWS FOR OPPER TIER WALL

AWK CONSULTING ENGINEERS	JOB	DATE: 3/7/49		SHT, Z	
PITTSBURGH, PENNSYLVANIA	SLOPE STABILIZATION	BY:	DRG.	CH. MCM	
(412) 823-8331		JOB	NO. 99	018	

## \_\_ 03/26/99 10:33 FAX 2165465982 NPS-CVNRA (TAPS) COMPUTE LATERAL EARTH LOADS ON PILING (88'92) P, = KHYH3 (8'5%) P,=(0.65)(0.12)(2)(8) = 1.248 KIPILE@B'42 P= P, + K, 8 (10) (8 %) Pz=1,248+ (0,65)(0,12)(10)(8) P2=1,248+6,24 = 7,488 KIPUEQ8 4 P3 = P2+P4 WHERE Py = P2+ Ky & (8,33+1,17) (5 %) Py = 7,408 + 6.65) 6,12) (9,5) (2) Py = 7.488+ 5,928 Py = 13.416 K). P3 = 7.488 + 13.416 = 10,452 KIPLE@8'96 TOTAL LATERAL LOAD FOR CONSTRUCTION = 1.248 + 7.488 (10) + (10.452)(9.5) = 43,68+99.294=142,974 KIPLERBY (TRIAL 1) ANALYZE WITH STAADS

BASED ON SÉRVICE LOAD DESIGN MMAX = 166,4 -KIPILE M36 00 35 BE=1.0 (AASH TO 181 3,22.)A) VMAX = GZ,69 K/PILE BEE ATTACHMENT A) NOTE LET BE = 1.0 TO ESMIPUTE
REACTIONS Smax = 0,477 @ EL. 695,5

SUPPORT REACTIONS @45° HOR. 150,4 × >> 77 ~ 6000 MIDDLE ROW ANCHOR 106,37 36.56 K 51.7K BOTTOM ROW ANCHOR 0,05\* PIN @ DRILLED SHAFT

P= DESIGN LOAD = 77:0 FOR ALL ANCHERS-UPPERTIER RMISSIBLE LOAD (ANCHOR) MAXIMUM PERMISSIBLE LOAD = 1.33 P (AS PER SPECIFICATION SECTION OZZZO, PARA 1-5-17) (347.4) 1.33 P= (.33) (77.0) = 102.4 KIPS (INCLINED AT 45° (724 KHOR)

**AWK CONSULTING ENGINEERS** PITTSBURGH, PENNSYLVANIA (412) 823-8331

BOL CUNBA SLOPE STABILIZATION DATE: 3//9 SHT. 3 CH. MCM ΣPC,

JOB NO. 990/8

MULMED

SECTION 02220

TIE BACK ANCHORS

#### 1-1-12 Bituminous Seal:

A. The binuminous seal is used to seal the surfaces between the concrete, bearing plate insulation, bearing plate, and the anchor head so as to prevent moisture from reaching and corroding the presuressing steel.

#### 1-5-13 Trumpet

A. The trumper consists of one or more pipes. The trumpet protects the upper end of the cenden and prevents grout from entering the porous drainage system.

#### 1-5-14 Anchor Grout (Primary Grout):

A. Material that is injected into the tieback hole to cover the anchor length of the tendons and provide the medium for transmitting the tieback load to the bedrock within the anchor length.

#### 1-5-15 Secondary Grout:

A. Material that is injected into the neback hole to cover the unbonded length of the tendons to provide corrosion protection.

#### 1-3-16 Jacking Length:

A. The length of the prescressing steel which is located on the jacking side of the final anchor head position and is tensioned during the stressing of the tieback.

#### 1-5-17 Unbonded Testing Length (Stressing Length):

A. The sum of the unbonded length and the jacking length which is equal to the length of the presuressing steel that is free to elongate clastically during stressing.

#### 1-5-18 Tieback Design Load:

A. The load for which the tieback is designed. The tieback design load is the actual tension force on the tieback that will provide equilibrium to the wall system at the maximum loading condition.

#### 1-5-19 Maximum Permissible Load:

A. The maximum permissible load is the maximum load that may be applied to the tieback during any stage of the work. This load is 1.33 times the tieback design load unless a lower load is noted on the drawings.

#### 1-5-20 Preliminary Loads:

A. Freliminary loads are loads, less than the lock-off load, that may be required due to staged construction. Where required, preliminary loads are noted on the drawings.

#### 1-3-21 Proof Load:

A. The largest load applied to the tieback when stressing the tendons during a load test. This load is a defined percentage increase in the tieback design load.

REF; PROJECT SPECIFICATIONS

SHT. 4

### REANALYZE W/ TOP OF FILL@ EL 690.5 (5 FT. LOWER) TOP/FILL IS 3.33-BELOW EL. OF TOP/ANCHOR (TRIAL 2) P, = 1.248 K/P1LE B = 1,248 + (0,65) (0,12) (5) (8) P2 = 1.248 + 3,12 = 4.368 FILE P3 = 4.368+ 5.928 P3 = 4.368 + 2.964 = 7.332 KIPILE MHAX = 114.4 I-K/PILE (SEE ATTACHMENST B) VMAX = 43.63 K/PILE SMAX = 0.334 @ EL.690,5 CHECK TENDON OVERSTRESS SUPPORT REACTIONS へしししんしきラ 1014 C1024 OK MIDDLE ROW ANCHOR 36,9 K Z6,08 K LOWER ROW ANCHOR -0,05 PIN @ PRILLED SHAFT CHECK PILE BENDMIG AND SHEAR WHERE & = 0.55 Fy (AASHTO TBL. 10.32.1A) TARU MITERINI f, =(0.55)(36) = 20 KS/ 1994. (SEE, SAT, 6 \$7) Sareon = (14.4)(12") = 68,6"3 NOTE BE = 1.0 USED TO COMPUTE MAN SXAUAIL = 107"3>>68.6 OK SERVICE COAD DESIGN fu = Vnan = 43.63 = 2.04 KS) ACTUAL BE=1.3 TO DESIGN PILE BUTALLOW 33% OVERSTRESS FOR TEMP, LOADMG - THIS WILL OFFIET USE OF BE=10 Fu = 0.33 Fy = 633/(36)= 12 K31 ( AASHTO TBL 10.32. JA) 5>>fu 0K

STRESS LEVEL (% 49.73) = 1014 ×100 = 58% < 70% OK JOB AWK CONSULTING ENGINEERS CUNRA SLOPE STABILIZATION BY: PITTSBURGH, PENNSYLVANIA

CHECK TENDON STRESS LEVEL

DATE: 3/2/99 SHT.

(412) 823-8331

DRG CH. MC M JOB NO. 990/8

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#### Part C SERVICE LOAD DESIGN METHOD

#### **ALLOWABLE STRESS DESIGN**

#### 10.31 SCOPE

Allowable stress design is the standard design method for all structure types. It is a method for proportioning structural members using design loads and forces, allowable stresses, and design limitations for the appropriate material under service conditions.

#### 10.32 ALLOWABLE STRESSES

#### 10.32.1 Steel

Allowable stresses for steel shall be as specified in Table 10.32.1A.

#### 10.32.2 Weld Metal

Unless otherwise specified, the yield point and ultimate strength of weld metal shall be equal to or greater than minimum specified value of the base metal. Allowable stresses on the effective areas of weld metal shall be as follows:

#### **Butt Welds**

The same as the base metal joined, except in the case of joining metals of different yields when the lower yield material shall govera.

Fillet Welds

$$F_{\nu} = 0.27 F_{\mu}$$
 (10-12)

#### where

P<sub>v</sub> = allowable basic shear stress;

F<sub>u</sub> = tensile strength of the electrode classification but not greater than the tensile strength of the connected part.

When detailing fillet welds for quenched and tempered steels—the designer may use electrode classifications with strengths less than the base metal provided that this requirement is clearly specified on the plans.

#### Plug Welds

 $F_{\nu}=12,400$  psi for resistance to shear stresses only, where

F. = allowable basic shear atress.

## 10.32.3 Fasteners (Rivets and Bolts)

Allowable stresses for fasteners shall be as listed in Tables 10.32.3.A and 10.32.3.B, and the allowable force on a slip-critical connection shall be as provided by Article 10.32.3.2.1.

#### IO.32.3.1 General

10.32.3.1.1 In proportioning fasteners for shear or tension, the cross sectional area based upon the nominal diameter shall be used except as otherwise noted.

10.32.3.12 The effective bearing area of a fastener shall be its diameter multiplied by the thickness of the metal on which it bears. In metal less than 3/8 inch thick, countersunk fasteners shall not be assumed to carry stress. In metal 3/8 inch thick and over, one-half of the depth of countersink shall be omitted in calculating the bearing area.

10.32.3.1.3 In determining whether the bolt threads are excluded from the shear planes of the contact surfaces, thread length of boirs shall be calculated as two thread pitches greater than the specified thread length as an allowance for thread run out.

10.32.3.1.4 In bearing-type connections, pull-out shear in a plate should be investigated between the end of the plate and the end row of fasteners. (See Table 10.32.3B, footnote h.)

10.32.3.1.5 All bohs except high-strength bolts, tensioned to the requirements of Division II. Table 11.5A or Table 11.5B, shall have single self-locking nuts or double nuts.

10.32.3.1.6 Joints, utilizing high-strength bolts, required to resist shear between their connected parts are designated as either slip-critical (See Article 10.24.1.4) or bearing-type connections. Shear connections subjected to stress reversal, or where slippage would be undestrable, shall be slip-critical connections. Potential slip of joints should be investigated at intermediate load stages especially those joints located in composite regions.

REF, STAUDARD SPECERCATIONS FOR HIGHWAY BRIDGES ISTHED, THRU INTERIM 1994 (445HTC)

5HT. 6

10.32.3.1,6

TARKE 10.32.14	Allowable Stresses-	Structural Steel (1	n nounds	ner sonare inch)

TABLE 16.32.1.	A Allow	able Strewes	—Structural	Steel (In pou	ads per square	inch)	
Туре		Structural Carbon Stoci		krength loy Steel	Quenched and Tempered Low-Alloy Steel	Quenched a	id Strength and Tempered of Steel
AASHTO Designation 6.8		M270 Grade 36	M270 Grade 50	M270 Grade 50W	M270 Grade 70W		270 100/100W
Equivalent ASTM Designation <sup>a</sup>		A709 Grade 36	A709 Grade 50	A709 Grade 50W	A709 Grade 70W		
Thickness of Plates		Up to 4 io. iocl	Up to 4 in. incl.	Up to 4 in. incl.	Up to 4 in. incl.	Up to 2 1/2 in. incl.	Over 2 1/2 in. to 4 in. incl.
Shupes		All Groups	All Groups	All Groups	Not Applicable	Not Ap	plicable
Axial tension in members with no	0.5 <b>5F</b> ,	20,000	27,000	27,000	38,000	Not Ap	pticable
holes for eigh strength bults or rivets. Use net section when member has any open holes larger than [ 1/4 inch diameter such as perforations.	0.4 <b>6P</b> .		Not Applicab	le		51,000	46,000
for high strength boths or rivers and tension in extreme fiber of rolled shapes girders, and bulk-up sections subject to bending. Satisfy both Gross and Net Section criterion.	Grossi Section 0.55F <sub>y</sub>	20,000	27,000	27,000	38,000	Not Ap	plicable
	Net Section 0.50F <sub>4</sub>	29,000	32,500	35,000	45,000	Not Ap	plicable
	Net Section 0.46F <sub>n</sub>		Not Applicable	l <b>e</b>		\$1,000	46,000
Axial compression, gross section: stiffeners of plate girders. Compres- sion in splice material, gross section		20,000	27,000	27,000	38,000	55,000	49,000
Compression in extreme fibers of rolled shapes girders and built-up sec- cious, subject to beading, gross sec- ion, when compression flange is: A) Supported laterally its full length by embedeness in concrete B) Partially supported or is ussupport	~	20,000}	27,000	27,000	38,000	55,000	49,000
$F_b = \frac{50 \times 10^4 C_b}{S_m} \left( \frac{I_m}{I_m} \right) \sqrt{0.772} \frac{I}{I_m} +$	- 9.87 (d)	≤ 0.55F <sub>y</sub>					

C<sub>b</sub> = 1.75 + 1.05 (M/M<sub>2</sub>) + 0.3 (M/M<sub>2</sub>)<sup>2</sup> ≤ 2.3 where M<sub>i</sub> is the smaller and M<sub>2</sub> the larger end moment in the unbraced segment of the beam; M/M<sub>i</sub> is positive when the moments cause reverse curvature and negative when bent in single curvature.
C<sub>a</sub> = 1.0 for unbraced cantilevers and for members where the moment within a significant portion of the unbraced segment is greater than or equal to the larger of the segment and moments.

Compression in concentrically loaded columns

with  $C_c = (2\pi^2 E/F_p)^{1/2} =$  126.1 107.0 107.0 90.4 75.7 79.8 when  $KL/r \le C$ .

$$E_{\nu} = \frac{P_{\nu}}{ES} \left[ 1 - \frac{(KL/t)^2 F_{\nu}}{4\pi^2 E} \right] = \frac{16,980 - 23,580 - 23,580 - 33,020 - 47,170 - 42,450 - 0.53(KL/t)^2 1.03(KL/t)^2 1.03(KL/t)^2 2.02(KL/t)^2 4.12(KL/t)^2 3.33(KL/t)^2 1.03(KL/t)^2 1.03(KL/t)^2 3.33(KL/t)^2 3.33(KL/t)^2 1.03(KL/t)^2 3.33(KL/t)^2 3.33($$

REF. STANDARD SPECIFICATIONS FOR MIGHWAY BRIDGES, 15 TH. ED. THRU INTERIM 1994 (AASHTA)

DIVISION !-- DESIGN

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TABLE 10.32.1A Allowable Stresses—Structural Size! (In pounds per square inch) (continued)

1ABLE (U.32-1A Allowable Stresses—Structural Sheel (In pounds per square Inch)				(continued)			
Type	•	Structural Carbon Steel		Strength loy Steel	Quenched and Tempered Low-Alloy Steel	Quenched a	eld Strength and Tempered y Steel
when KL/r > C <sub>r</sub>							
$F_{a} = \frac{\pi^{2}E}{ES.(KL/t)^{2}} =$			135,000,74 (KL/r) <sup>2</sup>	<u> </u>			
with FS. = 2.12		<b>~~</b>					
Shear in girder webs, gross section {	F, = 0.33F,	12,020	17,000	17.000	23,000	33,000	30,000
Bearing on milled stiffeners and other steel parts in contact (rivets and bolts excluded)		29,000	40,000	40,000	56,000	80,000	72.000
Stress in extreme fiber of pins4	0.80F,	29,000	40,000	40,000	56,000	80,000	72,000
Shear in pins	F, = 0.40F,	14,000	20,000	20,000	28,000	40.000	36,000
Bearing on pins not subject to rotation <sup>8</sup>	0.80F,	29,000	40,000	40,000	56,000	80,000	72,000
Bearing on pins subject to rotation (such as used in rockers and hinger)	0.40F,	14,000	20,000	20,000	28,000	40,000	36,000
Bearing on connected material at Low Carbon Steel Boht (ASTM A307), Turned Beht, Ribbed Bohs, and Rivets (ASTM A502 Grades 1 and 2)— Governed by Table 10.32.3A							

<sup>\*</sup> For the use of larger C, values, see Structural Stability Research Council Guide to Stability Design Criteria for Metal Structures, 3rd Ed., pg. 135. If cover places are used, the allowable static stress at the point of theoretical cutoff shall be as determined by the formula.

- depth of girder, in

= [(bt'), + (bt'), + Dt'] where b and I represent the flange width and thickness of the compression and textion flange, respectively (in.\*).

= section modulus with respect to compression flance (in. 1).

E = modulus of clasticity of steel = governing radius of gyration

- actual unbraced length

= effective length factor (see Appendix C)

FS. = factor of safety = 2.12

For graphic representation of these formulas, see Appendix C.

For proper representation of these amounts, we appeared to the format of the following reference: "Sugmenting format," American Institute of Stoci Controction, Institute 5, No. 1, and October 1972, Volume 5, No. 4; and "Stoci Sunctures," by William McCuire, 1968, Prentice-Hall, Inc., Englowed Cliffs, New Jersey, For members with eccentric londing, see Article 10.36.

4 See also Article 10.32.4.

\* Except for the mandatory notch tenginess and weldsbilly requirements, the ASTM designations are similar to the AASHTO designations. Steels meeting the AASHTO requirements are proquelified for use in welded bridges.

Quenched and tempered alloy steel structural shapes and semaless mechanical tubing meeting all mechanical and chemical requirements of A
709 Grades 100/100W except that the specified maximum tensile strength resp be 140,000 ps; for structural shapes and 145,000 ps; for securical mechanical taking, shall be considered as A 709 Grades 100/100W steel.

<sup>4</sup> This shall apply to pine used primerily in axially loaded members, such as trust members and cable adjusting links. It shall not apply to pine used in members having rotation caused by expansion or deflection.

M 270 Gz. 36 and A 709 Gz. 36 ses equivalent to M 123 and A 36
 M 270 Gz. 50 and A 709 Gz. 50 sez equivalent to M 1223 Gz. 50 and A 572 Gz. 50
 M 270 Gz. 50W and A 709 Gz. 50W zez equivalent to M 223 Gz. 50 and A 588

M 270 Gr. 75W and A 709 Gr. 70W are equivalent to A 852

M ZTO GE 100/100W and A 709 GE 100/100W are equivalent to M 2M4 and A 514

When the area of holes deducted for high strength bolts or rivels is more than 15 percent of the gross area, that area in excess of 15 percent shall be deducted from the gross area in excess of 15 percent shall be deducted from the gross area to determining stress on the gross section. In determining gross section, any open holes larger than 1 1M such diameter, such as performines, thall be deduced.

REF. STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, ISTH, ED. THRU INTERIM 1994 (AASNTO)

5HY, 8

(SEE SHT. RY)

CHECK BEARING - BETWEEN ANCHOR BEARMY TO AND

6" BEXT, STR. PIPE (453)

PIPE Fy = 35 KS1 Fy = 60 K51 0.0, = 6.625" 5.0, = 5.761" 4441 = 0.432"

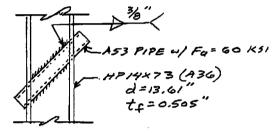
4966 = 0.432 A = 8.40"

Fp = 0,80 Fy = (0,80) (35) = 28 KS1

fp = PMAX = 101.4 - FROM SHT. 5

fp=12,1 KS1 << 28 OF

## CHECK WELD - BETWEEN 6" PIPE AND PILE WEB



SECTION VIEW

ヘンアミ

LENGTH OF WELD = (+) (VZ) (13,61-2(0,505)) = 71,3" SAY 70"

f = WELD STRESS = 101.4
(0.375)(50)

= 101.4 = 5.45 KS1

Fv=0,27 Fv = 6,27)(60) = 16,2 KS1

FL>> fu OK (SEE 3 HT. G)

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PITTSBURGH, PENNSYLVANIA
(412) 823-8331

JOB CUNRA SLOPE STABILIZATION DATE: 3/9/9 SHT. 9
BY: 0/4 CH. 1/W

JOB NO. 990/8

DETERMINE MAX ONBRACED LEDGTH, L., PERMITTED FOR STRESSING TOP FOW ANCHORS 5.5" & CASING DURING S CONSTRUCTOR LES TH CASUNG PROPERTIES 5.5" O.D. 0.364" THK. WALL Fy = 80 X51 EL. 693,837 I.D. = 5,5 - 2(0,304) BEARING R JUST ENBERRED I,D. = 4.892" A = 7/4 (5.5-4.812) 5,5"0.D. CASING LATERAL اكترام G"P EX. STR. PIPE A= 4.96 "2 SL EEVE Support. HPMX73 5ミヒアルム) VIEW PALL = YBDD (AASHTO TBL 3,22,1A) 7=1.3, B=1.0 ALLOW 30% OVERSTRESS FOR FEMP ASSUME K=2,0 404D I. PALL = D  $C_{c} = \sqrt{\frac{2\pi^{2}E}{F_{u}}} = \sqrt{\frac{2\pi^{2}(29000)}{90}}$ FOR KLEC,  $F_{cr} = F_{y} \int 1 - \frac{\left(\frac{K_{L}}{r}\right)^{2} F_{y}}{4 \pi^{2} E} \qquad \frac{\left(AASHTO 10-151\right)}{STREASTN DESIGNATIONS APPROPRIATE OF THE PROPERTY OF THE$ IF KL = Cc = 84,6, (L = 84,6(1.81) = 77.8"=6,5 =7) THEN For = 80 \[ 1 - \frac{(84.6)(80)}{477^2(2900)} \] = 39,99 \[ \frac{857}{2900} \] Pu = 0.85 A Fer = (0.85) (4,96) (39,97)=168,6 AAS NTO 10-150 TEST LOAD = 1.33 P = 1.33 (77.0) = 102,4 < 168.6 05 JOB

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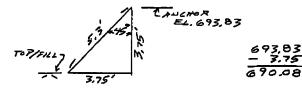
CVN RA SLOPE STABILIZATION

DATE: 7/8/99	SHT.
BY: PRG	CH. MCM
JOB NO. 9	1018

FOR 
$$\frac{KL}{T} > C_{C_{J}}$$
 $F_{CT} = \frac{D^{2}E}{\left(\frac{KL}{T}\right)^{2}}$ 
 $F_{CT} = \frac{D^{2}E}{\left(\frac{KL}{T}\right)^{2}}$ 
 $F_{CT} = \frac{D^{2}E}{D^{2}E}$ 
 $F_{CT} = \frac{D^{2}E}{D^{2}E}$ 
 $\frac{KL}{T} = \frac{D^{2}E}{F_{CTMM}}$ 
 $F_{HUS} = \frac{D^{2}E}{E_{CMM}}$ 
 $F_{US} = \frac{D^{2}E}{E_{CMM}}$ 
 $F_{US} = \frac{D^{2}E}{D^{2}E}$ 
 $F_{US} =$ 

ASSUME ) FT. INCLINED FROM FACE/PILE
TO BEARING R

: , MAX, INCLINED LENGTH PERMITTED
TO TOP/FILL = 8.3-1-2 = 5.3 FT



THUS, SET TOP/FILL AT OR ABOVE EL. 690, 1

AWK CONSULTING ENGINEERS PITTSBURGH, PENNSYLVANIA (412) 823-8331 SLOPE STABILIZATION

DATE: 3/4/9 SHT. 1/
BY: 28/9 CH. MCM

JOB NO. 990/8

CONCLUSION

- OVERSTRESS CHECK - CONSTRUCTION LOADING
W/ FILL PLACED AT <u>UPPER TIER WALL</u>
BOTTOM FMIDDLE ANCHOR ROWS
MISTALLED AND LOCKED OFF
(TOP ANCHOR ROW NOT INSTALLED)

ASSUME EXCAVATION IN FRONT OF WALL (LOW SIDE) IS COMPLETE AND BACKFILLED TO FINAL GROUND SURFACE (EL. 676,0) PRIOR TO PLACEMENT OF FILL BEHIND WALL.

FILL TO BETWEEN EL. 690,0 AND G90,5
BEHIND WALL. THEN INSTALL
5,5" O.D. CASING THROUGH FILL FOR
TOP ROW OF ANCHORS. TNSTALL TEST
AND LOCKOFF TOP ROW OF ANCHORS.
PLACE FILL TO FINAL GROUND
SURFACE BEHIND WALL, COMPLETE
ANCHOR MISTALLATION (FORTOP ROW)
WITHIN IMMITH OF START OF
FILL PLACEMENT.

AWK CONSULTING ENGINEERS PITTSBURGH, PENNSYLVANIA (412) 823-8331 JOB CYNRA SLOPE STABUIZATION DATE: 3/9/9 SHT. 12

BY: DR4 CH. MCV

JOB NO. 990/8

CHECK FOR OVERSTRESS DUE TO CONSTRUCTION LOADING

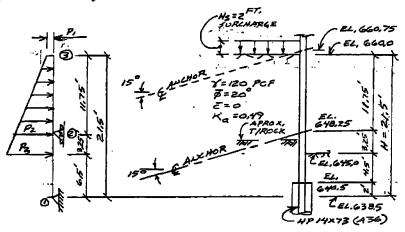
(LOWER TIER WALL)

WITH BOTTOM ROW ANCHORS INSTALLED FLOCKED OFF,
EXCAVATION TO FINAL GRADE (EL. 6459), AND . FT.
FILL IS PLACED BEHIND WALL TO EL. 6.60.0 (11.75)
ABOVE BOTTOM ROW)

TOP ROW NOT INSTALLED YET.

#### TYPICAL SECTION AND PRESSURE DIAGRAM

(LOWER TIER WALL)



FOR AWALYSIS, ASSUME A PIN 2 FT. BELOW TOP OF ROCK SOCKET (CONSERVATINE)

NOTE: 4 STRAND TENDONS O.6" \$ 58.6" = 60.75,

COMPUTE LATERAL EARTH PRESSURE LUADS ON PILING DE &

LET Ky FOR DESIGN = 1.33 Kg TO ACCOUNT

FOR LOADING DUE TO FILLING BEHIND WALL

AWK CONSULTING ENGINEERS PITTSBURGH, PENNSYLVANIA (412) 823-8331 CVNTA . SLOPE STABILIZATION

DATE: 7/3/49 SHT. 13
BY: DRG CH. MCM

JOB NO. 790/8 .

FOR CONSTR, CONDITION = 1.248+ 10.608 (3.25+11.75) TOTAL LATERAL LOAD = (5,928) (15) = 88,92 K/PKE@8'% ANALYZE WITH STAADS (TRIALS) MMAX = 254.9 (SEE ATTACHMENT C) VMAX = 57.7 KIPILE SMAX = 1.31 @ EL 660,0 SUPPORT REACTIONS BOTTOM ROW ANCHOR -zas<sup>k</sup> PIN @ PRILLED SHAFT P=DESIGN LOAD = 110 K FOR ALL LOCATIONS WITH Z ROWS OF ANCHORS /LOWER TIER WALL) SMELE ROW OF ANCHORS (ONLY) USED AT END TRANSITIONS FOR LOWER TIER WALL - NOT SIGNIFICANT.

MAXIMUM PERMISSI BLE LOAD (ANCHOR)

MAXIMUM PERMISSIBLE COAD = 1.33 P = 1.33 (110) = 146,3 K

CHECK TENDON OVERSTRESS

113.6 (FROM ABOUE) < 146.3 E

ENECK PILE BENDING AND SHEAR  $5_{\text{REQD}} = \frac{(254,9)(124)}{2} = 152.9^{**}$ 

5x AVAIL = 107" << 152,9 NO. 600D

fr = Umax = 57.7 = 2.7 KSI <<12 KSI OK

AWK CONSULTING ENGINEERS PITTSBURGH, PENNSYLVANIA (412) 823-8331

JOB CWKA SLOPE STABILIZATION DATE: 3/9/9 SHT. 14 286 CH. M. J. JOB NO. 990/8

# REANALYZE WY TOP OF FILL () EL. G58,25 (175 FT. LOWER) P,= 1,248 KIPILE (10 FT ABOVE LOWER ANCHOR) (TRIAL 4)

P2 = 1,248 + (0,65)(0,12)(10)(8)

Pe= 1,248 + 6,24 = 7,488 KIPILE

P3=7.488+2.028=9.5/6

ANALYZE WITH STAAD3 (TRIAL4)

MMAX = 166.4 1- KIPILE

VMAX = 43,68 K/PILE

\_\_\_\_\_

SMAX \* 0.654" @ EL. 658.25

SUPPORT REACTIONS

NELIAED

(SEE ATTACHMENT D)

BOTTON ROW ANCHOR 83,59 86,5 PIN @ DRILLED SHAFT -12,28 -

772 6 771-220 311111

CHECK TENDON OVERSTRESS

MAXIMUM PERMISSIBLE LOAD = 146.3 >> 86.5 OK

CHECK PILE BENDING AND SHEAR

SXREQ'D = 166.4(12) = 99.8"3

SKAVA16 = 107" > 99.8 OK

fu = 43.68 = 2.04 FS/

F, = 0.33 F, = (0.33)(36) = 12 >> 2.04 OF CHECK BEARING BETW. ANCHOR BEARING R AND 6" PITE SLEEVE

Fp = 28 KS/ (FROM SHT.9)

fp = 86.5 = 10,3 KS1 << 28 OK

CHECK WELD BETWEEN 6" OF PIPE AND PILE WEB

LENGTH OF WELD = 4 ( 13.61 - 2 (0.505))

fv = \frac{\text{86.5}}{\text{15.375/2}(50)} = \frac{6.52}{\text{K5}} << Fv OK

AWK CONSULTING ENGINEERS
PITTSBURGH, PENNSYLVANIA
(412) 823-8331

IOB CVNZA SLAPE STABILIZATION DATE: 7,459 SHT. 15
BY: 226 CH. MCM
JOB NO. 9 90/8

## DETERMINE MAK CHERACED LENGTH, LO PERMITTED FOR 5.5" & CASING DURING STRESSING TOP ROW ANCHORS

FROM SHT, 10

AWK CONSULTING ENGINEERS PITTSBURGH, PENNSYLVANIA (412) 823-8331

JOB CYNRA SLOPE STABILIZATION DATE: 7/2/9 SHT. 16

CH.MC.M JOB NO. 990/8

#### CONCLUSION

OVERSTRESS CHECK \_ CONSTRUCTION LOADING OF FILL PLACED AT LOWER TIER WALL

BOTTOM ANCHOR MISTALLED SLOCKED OFF

ASSUME EXCAVATION IN FRONT OF WALL (LOW SIDE) IS COMPLETE AND BACKFILLED TO FINAL GROUND SURFACE (EL, 645.0) PRIOR TO PLACEMENT OF FILL BEHIND WALL.

FILL TO BETWEEN EL. 658.0 AND 658.5

BEHIND WALL, THEN MITTALL 5.5"O.D.

CASING THRU FILL FOR TOP ROW

OF ANCHORS, PROVIPE LATERAL BRACMIC,

FOR 5.5"O.D. CASING SO THAT L. & G FT.

INSTALL TEST AND LOCK-OFF TOP ROW

OF ANCHORS, PLACE FILL TO FINAL GROUND

SURFACE BEHIND WALL, COMPLETE

ANCHOR MISTALLATION (FOR TOP ROW)

WITHIN I MONTH OF START OF

FILL PLACEMENT.

AS AN ALTERNATE INSTALLATION SEQUENCE

(TO ELIMINATE THE NEED FOR LATERAL

BRACING OF 5.5 O.D. CASING AT TOP ROW

OF ANCHORS)

INSTALL TOP ROW OF ANCHORS

WITH 5.5" O.D. CASING AFTER FILLING TO

EL. GSB AS INDRATED ABOVE, HOWEVER,

INSTALL BUCKOR HEADS AND SEAT STRESMIG

WEPGES AT 5 TO 10 KIP ALIGNMENT LOAD.

AFTER SEATING STRESSING WEPGES CONTINUE

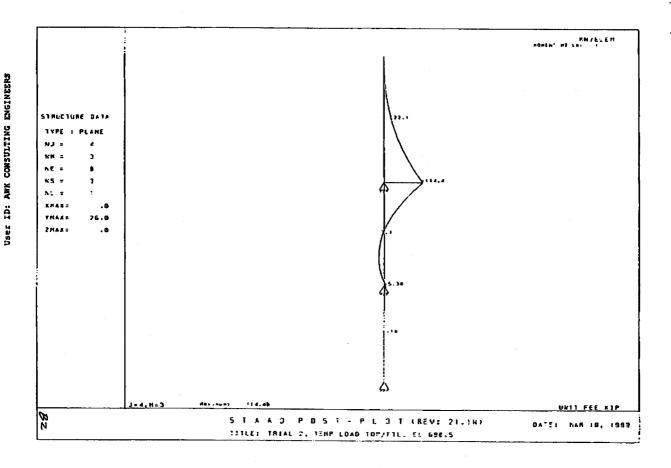
PLACING FILL TO BETWEEN EL. GGLO AND

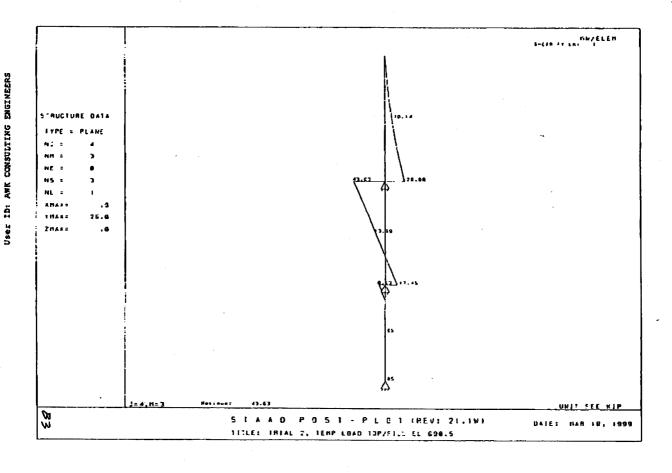
GGLS. AFTER PLACING FILL TO EL. GGLO, TEST

AND LOCK-OFF TOP ROW OF ANCHORS

AWK CONSULTING ENGINEERS PITTSBURGH, PENNSYLVANIA (412) 823-8331 JOB CULIRA SLOPE STABILIZATION DATE: 3/2/49 SHT. 17/7
BY: PRG CH. MC M

JOB NO. 99018 .





User ID: AWK CONSULTING ENGINEERS

NO.	COM	PAGES	FILE	DURATION	X∕R	IDENTIFICATION	DATE	TIME	DIAGNOSTIC
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03	OK	003	071	00:01'10	RCV	614 885 3341	MAR-17	11:44	0150270377000
04	OK	001	072	00:00'59	RCU		MAR-17	16:02	0110260230000
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12	DΚ	001	080	00:01'13	RCV		MAR-19	15:25	0110260472000
13	OK	001	Ø81	00:00,50	RCU	2019867886	MAR-21	04:50	0150270377000
14	OK	005	Ø82	00:05'28	RCU	3607095588	MAR-22	15:23	0150270317000
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16	OK	002	084	00:00'40	RCV	6142629387	MAR-23	12:06	0150270337000
17	OK	003/003	085	00:02'07	XMT	<b>913193851555</b>	MAR-23	15:51	C8044B0337000
18	OK	001	<b>086</b>	00:01'22	RCV		MAR-23	16:10	C0142B0537000
19	OΚ	001	087	00:00'42	RCU		MAR-24	09:08	0110270077000
20	OK	002	Ø88	00:01'07	RCU		MAR-24	09:26	0110270A77000
21	OK	001	089	00:01'01	RCU	Via Fax	MAR-25	01:23	0150270257000
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32	OK	001/001	100	00:01'09	XMT	<b>2</b> 916096551475	MAR-26	11:00	2840470A37000

-ODOT OFFICE OF R & D -



NATIONAL ENGINEERING & CONTRACTING COMPANY 12608 ALAMEDA DRIVE STRONGSVILLE, OHIO 44136 PH (440) 238-3331 / FAX (440) 238-9114



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Comprehensive Pavement Evaluation and Management Systems
Environmental Audits/Hazardous Waste Investigation

Pavement Design - Construction Inspection
Geotechnical and Structural Engineering

March 9, 1999

Mr. Ed Chrzenowski National Engineering & Contracting Company 12608 Alameda Drive Strongsville, OH 44136

> RE: Review and Response to Various Questions Two-Tier Tieback Wall System Vallay Raliway Slope Stabilization Project Cuyahoga Valley National Recreation Area AWK Project No. 99018

Dear Mr. Chrzanowski:

The following are items discussed with you by telephone on March 8, 1999:

- Deflection of the HP14X73 for the 10-ft. cantilever condition is within acceptable limits.
- 2. We (AWK) have reviewed the temporary cantilever condition and agree that 10-ft. is an appropriate limit for maximum height of backfill placement. The 10-ft. cantilever is based upon a horizontal backfill condition which will only occur for a temporary duration while constructing the wall. It is our opinion that the backfilling operation and subsequent installation of the upper anchors should be limited to being accomplished within one month of commencement of the backfilling. Otherwise, the above assumption may not remain valid.
- The maximum unbraced length of the 5.5-inch anchor casing should be limited to 6 ft. This is based on a 5.5-inch O.D., Gr. 80, 0.304-inch thick wall casing.
- 4. We suggest reducing the F<sub>b</sub> of the wood lagging to 1,500 psi from 2,000 psi. This is based on our experience in obtaining lagging to meet this requirement. The lagging thickness should be increased to 4 inches to coincide with the reduction in the allowable bending stress.

Bent\_by: AWK CONSULTING ENGINEERS INC 4128238987;

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Mr. Ed Chrzanowski National Engineering & Contracting Company

March 9, 1999

5. We caution you not to reduce the embedment length of the 5.5-inch diameter casing in bedrock. However, the demonstration test results will confirm or refute the required casing embedment into rock. We suggest an 8-ft. minimum casing embedment into bedrock for the 100 kip and 88 kip anchors (lower wall) and 6-ft. minimum casing embedment into bedrock for the 77 kip anchors (upper wall).

Should you require additional information please call.

Donald & Treen

Sincerely.

AWK Consulting Engineers, Inc.

Donald R. Green, P.E. Project Manager

DRG/Ifr C:\Project\9901a\NECCIV

## CUYAHOGA VALLEY NATIONAL RECREATION AREA NATIONAL PARK SERVICE CONTRACT No. 1443CX616098008 REVISED PROCEDURE FOR CONSTRUCTING TIE-BACK WALLS

### March 9, 1999

The following procedures are being submitted based on the actual conditions that have been identified at the jobsite. These procedures supercede the procedures dated January 29, 1999 and February 22, 1999.

### A.) UPPER WALL

- 1. Drill hole and place steel pile section. Place Class C concrete and lean concrete to proposed elevation.
- Access bench is established at approx. elevation 684+/-.

a.) For tieback anchors that are located in "Fill" Conditions:

Drill tiebacks @ elevation 685.5 (middle row). In fill areas, Geotech will pre-drill hole and advance the 5-1/2" dia. attel pipe with internal threaded joints to bedrock. The pipe will be drilled approximately six (6) feet into the rock (for tiebacks loaded to 77k). This drill length may be modified based on the results of the Failure Tests. Geotech's drill mast will be supported by National's crane at the proper elevation. The drill mast will be clamped to the east flange of the pilling for lateral stability. The power pack for the drill will be set on the bench, remote from the drill mast. The tiebacks will be installed and grouted. After the grout has cured for a minimum of three (3) days, the ties will be loaded and testad as specified in Specification Section No. 02220. The tiebacks will be loaded against the casing pipe instead of against the H-pilling. The tiebacks will be locked off @ 90% of design load as per specification. After the tiebacks are locked off, the wedge plates will be installed and welded into place. This will eliminate applying the test loads to the H-pilling.

Note that the 5-1/2" pipe casing will be used in lieu of the compression strut detail that is illustrated on Contract Drawing Sheet 3 of 9. If the pipe casing is exposed greater than 6 ft, in the fill area, the exposed section will be braced with additional supports and/ or pipe collars. The bracing will remain in place until the backfull is brought up to the elevation of the bracing.

Care must be taken to ensure that casing pipe is drilled into bedrock that is beyond the excavation zone of the bridge piers.

b.) For tieback anchors that are located in "Cut" Conditions:

The tiebacks will be installed as specified, using the 5-1/2" pipe as casing. The pipe will not have to be drilled into the rock as in the "Fill" conditions.

Upon the completion of the testing of the ties at elevation 685.5, drilling operation will be moved to the LOWER ROW, LOWER WALL. Soil will be excavated from the Upper Wall from the middle row (Elev. 685.5) to the lower row of tiebacks (Elev. 677.17). Temporary lagging will be installed between the piling. A single row of 3" thick full-dimensioned hardwood lagging will be installed in the top six (6) ft. (Elev. 685.5 – 679.5). A double row of 3" thick full-dimensioned hardwood lagging will be installed from Elev. 679.5 to 677.0. National intends to remove the temporary lagging as the backfill is placed. However, if the filed conditions will not safely permit that, the temporary lagging will then be left in place. If additional clearance is required between the temporary and permanent lagging, hardwood blocking will be placed between the temporary lagging and the H-piling. The excavated material will either be stockpiled on site, or used as suitable backfill for the lower wall. See Step B-3.

National Park Service Cuyahoga Valley National Recreation Area National Serial No. 9852-30?? Revised Procedure for Construction

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#### B. LOWER WALL

- The H-piling will have already been drilled & cast in place as per plan. The bench is currently graded
  @ elev. 647+/-.
- The drill mast and power pack will be set on the bench. Geotech will install tieback anchors on lower
  row, elevation 648.25. Load and test the anchors as per Specification 02220. As noted in A-2, the
  tiebacks will be locked off @ 90% of design load as per specification.. These tieback anchors are all
  located in "Cut" conditions.
- 3. Excavate to bottom of lagging. The excavation has been field verified to be all in shale rock. No temporary lagging will be installed. Install underdrains. Proceed with installing permanent lagging, drainage fabric & backfill. If the clearance between the existing slope and the back of the piling is less than four ft. pea gravel will be used for backfill. If the clearance is greater than four ft., suitable material from the site excavation will be used for backfill. The material will be a varying combination of clay and shale. The material will comply with Specification Section 02225-2.2.C Suitable Backfill (BF). Obtain backfill material by excavating UPPER WALL beams to elevation of the lower row of tieback anchors (elev. 676.0).
- Proceed with lagging installation and backfill of the LOWER WALL up to, elevation 658.+/. Based
  on the attached analysis of the HP14x73, the piling can support ten ft. of cantillevered loading due to
  the backfill.
- 5. Install upper anchors. All tiebacks have been identified to be in "Fill" areas. Anchor locations are to be pre-drilled and 5-1/2" casing pipe is to be spun to approximate embedment of eight (8) ft. Into rock (for 88k and 110k anchors). Geotech's drill mast will be supported by National's crane at the proper elevation. The drill mast will be clamped to the east flange of the pilling for lateral stability. The power pack for the drill will be set on the bench, remote from the drill mast. Install anchors & grout. After min. three day cure, the ties will be loaded and tested as specification in Specification Section No. 02220. The tiebacks will be loaded against the casing pipe instead of against the H-pilling. The tiebacks will be locked off @ 90% of design load as per specification. After the tiebacks are locked off, the wedge plates will be installed and welded into place. This will eliminate applying the test loads to the H-pilling.

If more than six (6) ft. of the 5-1/2" casing pipe is exposed in fill, the casing is to be braced. The bracing will remain in place until the backfill is brought up to the elevation of the bracing.

 Once the tieback anchors are complete, finish the installation of the remaining lagging, drainage and backfill.

#### C. UPPER WALL

Move drilling rig to the UPPER WALL, LOWER ROW of tieback anchors. The H-piling will have been excavated to approx. elevation 675.0. The drill power pack and drill mast will be set on the bench @ elev. 675.0. The tiebacks anchors at elevation 677.17 will then be installed, loaded, tested and locked-off as noted above. The tiebacks will be installed as specified, using the 5-1/2" pipe as casing. The pipe will not have to be drilled into the rock as in the "Fill" conditions.

1. Upon completion of the lower tieback anchors, the piling will be excavated to the bottom of lagging elevation 671.57. Temporary lagging will be installed as required. The permanent perforated drainage will be installed. The permanent lagging will be installed, working in varying lifts across the wall. National intends to remove any temporary lagging that is installed as the backfill operation proceeds. As the permanent lagging is being installed, the drainage fabric will be installed as well. The ends of the

National Park Service Cuyahoga Valley National Recreation Area National Serial No. 9852-3077 Revisad Procedure for Construction

03/09/99 Page No. 3

permanent lagging will be ground in place. If the clearance between the existing slope and the back of the piling is less than four ft., pea gravel will be used for backfill. If the clearance is greater than four ft., suitable material from the site excavation will be used for backfill. The material will be a varying combination of clay and shale. The material will comply with Specification Section 02225-2.2.C — Suitable Backfill (BF).

- 2. Based on the enclosed calculations, the HP14x73 piling is capable of supporting the cantilevered loading from the middle row of tlebacks (Elev. 685.5) to the upper row of tlebacks (Elev. 693.83). The lagging/drainage/backfill installation will proceed up to the elevation of the top row of tleback anchors, elevation 693.83. These tlebacks are all located in "Fill" conditions. The tleback anchors will be installed using the 5-1/2" dia. stael pipe casing in the same manner as for the middle tlebacks. The pipe casing will be drilled six (6) feet +/- into the bedrock. The tieback anchors will be installed and grouted, after three days of cure, the ties will be loaded and tested as specified in Specification Section No. 02220. The tiebacks will be loaded against the casing pipe instead of against the H-piling. The tiebacks will be locked off @ 90% of design load as per specification. After the tiebacks are locked off, the wedge plates will be installed and welded into place. This will eliminate applying the test loads to the H-piling.
- 3. The lagging, drainage and backfill will then be completed to the top of wall as per Contract Documents.

NOTE: Depending on the progress of the backfilling, National may elect to install the tiebacks on the UPPER WALL, LOWER ROW, before the tiebacks on the LOWER WALL, UPPER ROW are installed.

STAGGET AND MAN ALL

National Park Service
Cuyahoga Velley National Recreation Area
National Serial No. 9852-30??
Revised Procedure for Construction

03/09/99 Page No. 4

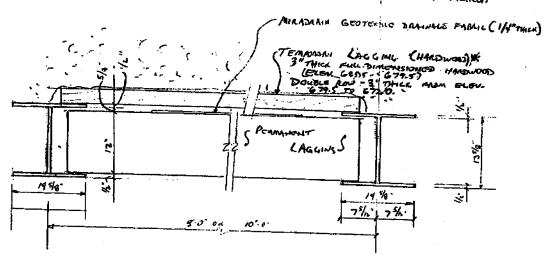
### NOTE:

- 1. This procedure is being submitted as an alternate to the procedure that is described in the Contract Drawings. This atternate procedure is based on the actual conditions that have been identified after National Engineering mobilized the site. As identified in Condition Report No. 3 and National's memo dated January 20, 1999, the existing slope varies from what is shown in the Contract Drawings. This results in compression struts being required in the middle row of the upper wall. Per information that is presented in the Contract Drawings, compression struts would have been required in the upper rows of both walls only. The net result is to increase the quantity of struts that will be needed over what could have been developed from the Contract Drawings. The quantity of 5-1/2" pipe that would have to be drilled into the rock for structural resistance for the middle row would be considered extra to the acope of work. The quantity of 5-1/2" pipe that would be used for casing would be considered part of the Contract.
- 2. Based on field inspection of the in-aim material, Geotech's engineer has stated that the encased pipe for the compression strut will not be able to develop any frictional resistance unless the casing is drilled and grouted into the bed rock. In addition, the compression strut, as detailed in the Contract Drawings, would not be stable laterally when the tieback is loaded. It is the opinion of AWK Engineers, Geotech and National Engineering that given this differing condition, the most feasible method to install the tiebacks in the fill situations is to use the 5-1/2" steel pipe casing drilled into the bedrock as presented in this procedure. Since this modification is the result of differing site conditions, it is the opinion of National Engineering that the cost to furnish and install the 5-1/2" steel pipe casing into the bedrock, less the length that replaces the original plan compression strut, is extra to the Contract.
- 3. As a final note, by using the 5-1/2" dia. casing pipe drilled into the rock, the test-loading of the tiebacks is transferred via the pipe casing directly to the rock. This eliminates any transfer of test-loading to the H-piling and the precast lagging. Therefore, the precast lagging will not be subject to any of the loads generated in excess of the long-term design loads. The precast lagging does not have to be re-designed to accommodate the test loads.

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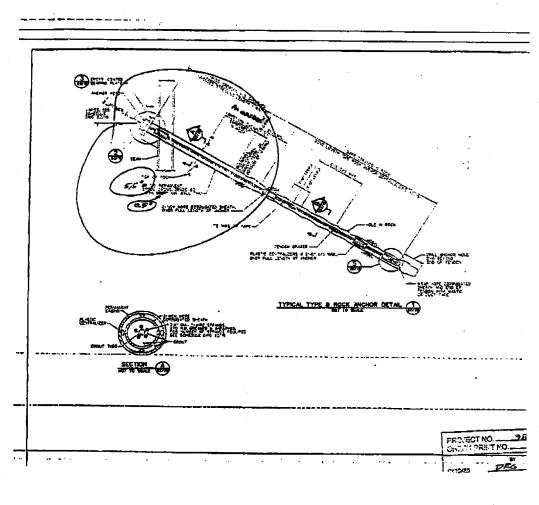
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NATIONAL ENGINEERING & CONTRACTING COMPANY 12608 ALAMEDA DRIVE STRONGSVILLE, OHIO 44136 PH (440) 238-3331 / FAX (440) 238-9114



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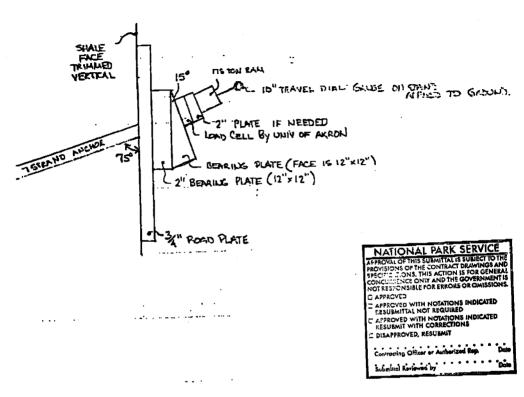
# NATIONAL PARK SERVICE Cuyahoga Valley National Recreation Area 15610 Vaughn Road Brecksville, OH 44141

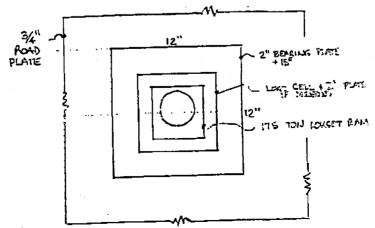
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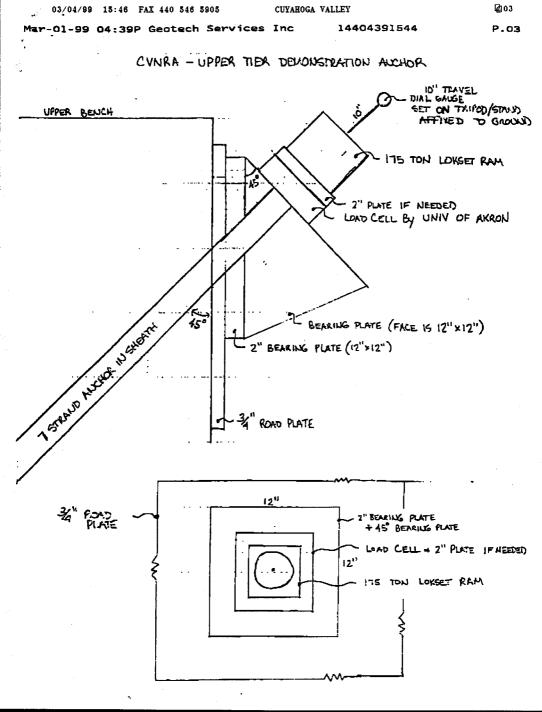
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IF THERE IS A PROBLEM, PLEASE CALL (440)546-5903.
SUPERINTENDENT'S OFFICE FACSIMILE MACHINE NO: (440)546-5905.

CVNRA - LOWER TIER DEMONSTRATION FIXHOR







CUYAHOGA VALLEY

Mar-01-99 04:39P Geotech Services Inc 14404391544

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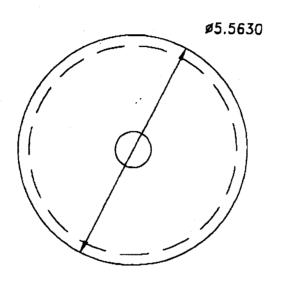
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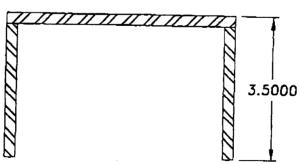
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GEOTECH SERVICES - CYNRA ANCHORS

DWG #

Drawn by: PC Checked by: JK





### OHIO DEPARTMENT OF TRANSPORTATION

District 4 705 Oakwood St Ravenna, Ohio 44266 (330)-297-0801



Bob Taft Governor

DATE: Wednesday, February 24, 1999

National Park Service Cuyahoga Valley National Recreational Area 15610 Vaughn Road Brecksville, Ohio 44141

Attention: Ms. Joyce Stumbo

Administrative Contracting Officer

SUBJECT: Slope Stabilization Under SR 82 Bridge (SUM-82-0.00)

Response to contractor's review of Wall Design

Dear Ms. Stumbo:

On February 19, 1999 a conference call was conducted with the following people to discuss the above subject: Robert Bobel, NPS; John Kenny, Gannett Fleming; Gene Geiger, Frank Martin, Antony Pamer, Neal Miesle, all with ODOT. We have reviewed Mr. Robert Bobel's memorandum dated February 9, 1999 along with the attached letters from National Engineering and Contracting Company and AWK Consulting Engineers, Inc. that were faxed on February 10, 1999. Our response to AWK's comments are as follows:

- 1) Design Pressure: The walls as designed are adequate. The walls were designed as two separate systems. The design pressure for the pre-cast lagging is correct as shown on the plans for the final service pressure. The contractor is responsible for any sheeting and shoring to prevent over stressing of the lagging during the construction (i.e. temporary lagging for the full height of the wall).
- 2) Temporary Loads Due to Staged Construction: ODOT feels that these loads were incorporated into the original design based on specified construction sequence (top down construction). The contractor is to provide calculations for the revised sequence of construction showing that the wall components are adequate. These calculations should also include the temporary lagging, including size and grade of hardwood planking or plates. In the contractor's revised procedure dated January 25, 1999, please clarify if the temporary lagging is to be left in place or to be removed.
- 3) Global Wall Stability: ODOT feels that this item is not a concern, and was addressed in previous discussions with the National Park Service.

An Equal Opportunity Employe	ľ
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Ms. Joyce Stumbo Administrative Contracting Officer National Park Service Cuyahoga Valley National Recreational Area

SUBJECT: Slope Stabilization Under SR 82 Bridge (SUM-82-0.00) Response to contractor's review of Wall Design

An additional item that was discussed in the revised procedure for constructing tie-back walls, dated January 25, 1999 is the use of the 5 1/2" pipe casing in lieu of the compression strut detail as shown on Sheet 3 of 9 of the plans. A detailed cost and time analysis needs to be provided by the contractor to facilitate further review of this issue. Also, in the fax submittal titled 'CVNRA-Demonstration Anchors', ODOT feels the bearing plates should be clearly detailed and dimensioned. ODOT feels the road plate (3/4" x 4' x 8') should be used for the lower tier failure test also as a precautionary measure.

Please notify this office if any additional information is necessary. My phone number is (330) 297-0801 ext 347. My e-mail address is <a href="mailto:nmiesle@odot.dot.ohio.gov">nmiesle@odot.dot.ohio.gov</a>.

Respectfully,

Joseph K. Paradise, P.E. District Production Administrator

Neal C. Miesle, P.E. District Four Production

### DRD/JKP/ncm enclosures

- c. D. Dreger
  - J. Paradise
  - F. Martin
  - T. Pamer B. Bilgin
  - E. Geiger
  - R. Bobel
  - J. Kenny
  - file

## FAX COVER SHEET

### OHIO DEPT. OF TRANSPORTATION

DISTRICT 4 705 OAKWOOD ST. RAVENNA, OHIO 44266 FAX: 330-297-7886

TO: Gen Geiger PE Geotechnical Engineering
TO: <u>Gen Geiger PE Geotechnical Engineering</u> FAX: (614) 275-1354
FROM: Neal Miesle PE, ODOT D-4
SUBJECT: SUM- 82-0,00 TIE BACK WALL QUESTION
THIS TRANSMISSION HAS <u>2/</u> PAGES INCLUDING THE COVER.
IF YOU HAVE ANY TROUBLE WITH THIS TRANSMISSION PLEASE CALL 330-297-0801 EXT. 347
REMARKS: Hard copy to follow due to quality of the originals.

## UNITED STATES GOVERNMENT MEMORANDUM

Date: February 9, 1999

To: John Kenny, Garnett-Fleming Bulent Bilgin, ODOT D-4

Frum: Rob Bobel, Cuyahoga Valley NRA

I am faxing a letter from National Engineering and Contracting Co. along with the attached letter from their consultant AWK regarding concerns expressed about the design of the wall.

Please contact me at your excliest convince to discuss this matter and to develop a response. I understand John Kenny will be on vacation starting February 10 but I fiel we should respond as soon as possible to avoid any delays to the project.

Please call if you have questions.

Post-IP Fax Note 7671	2/10/99 Pages 20
To Frank Martin	From Bulent Bilgin
Ca/Dept.	Ca.
145 x 1080 x 92-08 25 0001	Phone #
FEE 330-297-1848	Fex 0

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National Engineering and Contracting Company 12808 Alameda Drive / Strongsville, Ohio 44138 (440) 238-3331 FAX (440) 238-3335

February 3, 1999

National Serial No. 9852-3012

National Park Service Cuyahoga Valley National Recreational Area 15610 Vaughn Road Brecksville, Ohio 44141

Attention:

Ms. Jovee Stumbo

Administrative Contracting Officer

Reference:

Contract No. 1443CX616098008

Valley Railway - Slope Stabilization Under S.R. \$2 Bridge

Review of Wall Design

#### Dear Ms. Stumbo:

Based on discussions that have taken place during meetings between the National Park Service, National Engineering and the associated parties, National Engineering has asked the Engineer-in-Charge for Geotech Services, Inc. to review the construction procedures and the resultant loading conditions that would be applied to the wall components. The National Park Service furnished National Engineering with a copy of Environmental Dasign Group's original calculations for the wall. National Engineering transmitted those calculations to the Engineer-in-Charge, AWK Consulting Engineers, Inc.(AWK). AWK has performed a currony review of the construction procedures and of the original design. AWK has advised National of several points of concern about the wall as designed in the Contract Documents and the Impact of the construction procedures on the wall design. This includes items such as the design pressure, temporary loads and the global stability of the resining system. The concerns about the procedures apply to both the original construction procedures that are identified in the Contract Documents and the modified construction procedures that have been proposed by National Engineering. AWK's concerns have been addressed in their letter dated February 2, 1999. A copy of that letter with strachments is included with this document.

AWK identifies issues that must be reviewed with the National Park Service, ODOT and Gannett —
Flaming to ensure that the wall as currently designed meets its intended purpose. It would probably be
most expedient to schedule a meeting between all parties once everyone has had an opportunity to review
this document. Please advise of your concurrence, and, as to the earliest time such a meeting can be
arranged.

For the interim, National Engineering is proceeding with the contract work unless formal direction is given otherwise. Currently, the inclinometers are being installed and National Engineering will begin installing the steel pilling for the upper wall on Friday, February 5. Geotech should begin work on the Failure Test on Monday, February 8, 1999.

The impact that these matters may have on the Project Schedule and the Project Scope of Work is unknown as of this time. This notice is being furnished in accordance with FAR Section 52.236-2 - Differing Site Conditions and Section 52.243-4 Changes.

### National Engineering and Contracting Company

National Serial No. 9852-3012 NPS - Slope Stabilization @ S.R. 82 Review of Wall Design 02/03/99 Page No. 2

Please connect me to discuss any additional questions that you may have.

Very Truly Yours,

NATIONAL ENGINEERING & CONTRACTING COMPANY

Edmund Chrzanowski Contracts Administrator

Enel.

Ç

Contract File 9852 (B2) w/1

/1 File 02220 w/1 Field w/1

D. Hoover w/i Mr. Rob Bobel, NPS w/l

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Feb 03-99 10:33A Geotech Services Inc

25203 BROADMAY AVE.

CLEVELAND, OH 44145

440-439-5821 460-439-1544-565

	TO: NATIVAL ENGINERING
	ATTENTION: ET) CHRZANOWK/
	FROM: JOHN MEDOWAL
	DATE: 2-3-99
	SUBJECT: CVNLA
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Tas:	ED,
	PLENSE REFOR TO THE FOLLOWING PAGES
	THAT DISCUSS DOW BARBU'S ANALYSIS
	OF THE TIEBACKS AT CVURA.
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Feb-03-99 10:33A Gentach Services Inc

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CONSULTING ENGINEERS, INC.

Comprehensive Foverment Evaluation and Management Systems Environmental Audita/Hapardous Waste Investigation Personneré Design - Construction inspection Geoleganical and Structural Engineering

February 2, 1999

Mr. John McDonneil Ocourch Services, Inc. 25705 Broadway Avenue Cieveland, Ohio 44146

Currenty Review of Wall Design Calculations Re: Two-Tier Tieback Wall System Valley Raliway Stape Stabilization Project Cuyahoga Valley National Recreation Area AWK Project No. 99002

Dear Mr. McDonneil:

At the request of Mr. Es Chresnowski of Nedoual Engineering and Contracting Company (NECC), we have performed a cursory review of the subject calculations to evaluate the impact of sugar construction loads on well performance. The subject calculations constant friend (3) shorts of calculations completed by Environmental Design Group (EDG), arached. It is our opinion that additional culculations for wall during are required prior to commencement of wall construction to evalues the wall's performance.

For your leformation, we have emched the following:

- a. Design calculations completed by Environmental Design Group (Sheets A1, A2 and A3).
- b. Excerpts about anchored wall design criteria obtained from the American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Highway Bridges, 15° Edition including Interim Revisions Through 1994 (Sheets A4
- c. Excerpts about apparent earth pressure loads, referenced to AASHTO Figure 5.7.2A on Sheet A?, obmised from the "Soil Mechanics in Engineering Practice" written by Karl Torraghi and Balph Peak (T&P), Second Edition dated 1967 (Sheen A10 through A14).

Comment from our cutsory review follow:

1. Decles Products: It is our opinion that the design pressure of 751 pat/st on Sneet A2, based on a height of 22 feet, is one low for the wall system. The design height for the tiered wall system should be based on the combined beight of both the upper and lower walls. With the top of upper well at \$1 695 and honors of lagging for the lower well at \$1 640, we estimate a combined wall beight equal to 58 feet. The pressure should be increased to compensate for a

Fab-03-99 10:34A Geotech Services Inc Sent by: Aux Consultinu Engineers Live Statement,

14404391544 P.03

Page 2

Mr. John McDonnell Oursery Review of Wall Design Calculations Valley Reliway Stope Subilization Project February 2, 1999

reduction in passive pressure in front of the walls, due to a sloping ground surface below the wall system. In addition, the pressure should be increased to account for bydrostatic loads, if wall system. In addition of a vertical drainage tayer behind the wall may not be sufficient to completely eliminate segage pressure at noted by T&P on Shoets A11 and A14. Since the nombined beight of 5% feet is greater than the design beight of 22 feet, the sound pressure on the wall will exceed the design pressure used by EDG.

- Temporary Loads Due to Staged Construction: The design calculations do not include stability analyses for intermediate stages of construction as specified by AASHTO on Sheet AP. Thus, additional calculations are required to evaluate the inspect of temporary loads during journmediate stages of construction.
- 3. Global Wall Stability: The design extentations do not lockeds an analysis of plobal wall stability. Since a landslide occurred in close premisely to the proposed wall location, it is AWK's opinion that the stope is a marginally stable ground must. The actual pressure may be greater than that estimated by the procedure used by EDG due to slope instability as noted by greater than that estimated by the procedure used by EDG due to slope instability as noted by AASHTO on Shart A6: It is AWK's opinion that a slope stability analysis analysis, are procedure used by EDG for assimating the design amazure, will meat or except arranges derived from a release stability analysis.
- It is our opinion that additional analyses for well design are required prior to commessement of well construction to evaluate the well's performance. Upon your notice to proceed, AVK would be pleased to complete the analyses. Please will us if you have any questions or comments.

Stocerely.

AWK CONSULTING ENGINEERS, INC.

Donald R. Green, P.E. Project Manager

DRG:drg Enclasures - Sheets Al divouse Al4

FEB 17 '99 10:34 FR PLANNING DESIGN 216 297 7886 TO 16142751354 P.08/08 P.04 14404391544 FED-03-99 10:34A Geotech Services Inc Sent by: ANK CONSULTING ENGINEERS INC AADESESS -> MMK COMMUNITIES ENGINEERS INC) PROS E Special 1/80/88 8:57AM; JAH-38-1999 89157 7671 <u>S.n. 82</u>0 " Robert EDG Т. 150 S751510 130 375-1210 416-5712 " ī

Feb-03-99 10:35A Geotech Services Inc 14404391544

### STANDARD SPECIFICATIONS for **HIGHWAY BRIDGES**

FIFTEENTH EDITION 1992



As Amended by the Interim Specifications—Bridges—1993 interim Specifications—Bridges—1994

Adopted and Published by the American Association of State Highway and Transportation Officials, Inc.

444 North Capital Street, N.W., Suite 245 Westington, D.C. 20001

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P.04/08

Feb-03-99 10:36A Geotech Services, Inc

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107 MANAGEM I-DESIGN 5.6.3 e Simple span (so soil arching) sures and specialize leadings, and theil greens from the (5.6.6-1)best of the well to a level one fact below the top of the M\_\_ = p.C% e Simple spen (soi webini) Where this drainings peach are used behind wells, saturated or moist still behind the peach may be subject (5.6.6-2) Man = p.(\*/)2 Continuous (no soil probing) to fracting and expansion. In such cases, implicing chall be provided on the sells to pieces: framing of the tail, or consideration should be given during well design to the preserves which may be distract on the well by frome (54.6-3) May = p.(\*/10 ै s Continuous (soil arching) (5.6.6-4)

Rafer to Section 6 of Division I-A-Solonic Design for guidance regarding the design of flexible castilevered walls subjected to dynamic and selemic loads. In general, the proude-static approach developed by

5.6.4 Salanie Prasture

Mosenche and Chale may be used to estimate the equivabout static forces. Porces menting from well increase effects may be ignored in orderating the solonia interal . The state of the BERTH PRESSURE. The beautiful at 17 27.

### S.S.S Structure Dimensions and External Stability

Firmitie continuent walls thall be dimensioned to cause stability against passive fellors of stabelded vertical elements ruch that 7% 2 1.5. Unfocured dead and live looks shall be used to praises the factor of takely against passive failure of embedded vertical elements.

Vertical elements can uncomme vertical complete.
Vertical elements shall be designed to respect the full
design earth, methorse and write framatic betteen the
elements. In descriptions the model of embeddings to
mobilize passive resistance committees thall be given
to places of weakness (e.g., elementation, bedding tract, the ficial test from secial sections the strength of the said or rock determined by field or inherency tous. Sunbournes in inspet rock, including messive to oppostale squest mak which thould not full Group's siciet a should be beaut on our allowable chour strongth of 9.10C, to 9.15C, of the inner reck.

### 5.6.6 Structure Desica

Speciare) design of individual will atmissibly may be referenced by service lead or look factor design methods a conferences with Article 3.72.

in confirmance with Article 1-22.

The maximum specing inspeces, writest papersing elements depend on the relative ellipse of the particle elements on the relative ellipse of the particle elements and facing, and the type and condition of sell to be enquered. Many in a monthly helps of well facing at may breakmay be determined by the following, or other secretalis design precedures:

taget and and

Equation 5.6.4.1 is applicable for simply supported freine hehind which the tot will not orth between ver'tcai sopposts (c.g., in 10th collective soils or for rigid concrote feeing placed tightly against the la-place soil). Renation 5.6.62 is applicable for simply supported facint behind which the soil will areb between vortical migports (s.g., in granulat or still cohesive soils with Cambis facing or rigid facing behind which there is sufficient space to permit the in-piece soil to ereb). Equations 5.6.63 and 5.6.64 are applicable for facing which is continuous over several vertical exposers (a.g., reiswood absorate ar capazale).

M\_ = p.6/12

Timber farings should be constructed of stones-grade lumber in conformance with Article 13.2.1. If timber is used where conditions are favorable for the prowth of decry-producing organisms, wond should be pressure tracted with a wood preservative unless the hourswood of a generally decemporationer apacies is evalishin and in appridered adequate with respect to the decay barard and reported service life of the structure.

### 5.6.7 Overall Stability

Rate to Article 5.2.2.3.

### 1.6.3 Corresion Protection

Refer to Article 5.7.8.

### 5.7 ANCHORED WALL DESIGN

### 5.7.1 Design Terminology

Befor to Figure 5.7.1A for terminology used for the design of analogue retaining walls.

### 5.7.2 Early Francis and Surcharge Landings

The development of layeral varie presentes for design thell counter the method and sequence of superviction, the righting of the well-tarefler system, the physical shar-americales and makelity of the proceed state to be rep-peried, allowable well defined on, the space between ore, residen presenters, and the potential for each

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Fab -03-99 10:37A Geotach Services, Inc

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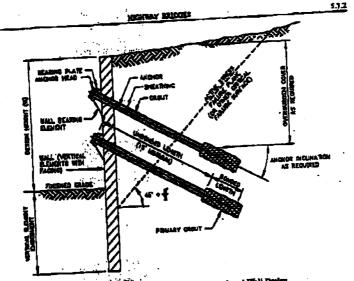


FIGURE S.7.1A Upical Toron Used in Familie Anchored Well Design

For stable ground masses, the final distributes and magnitude of internal patch pressure on a completed anored well with rose or more temp of the nated from the top down t Allente will as be more who Pers 1.728. M wall deflections estimated takes Figure 5.7.23 are sacoulte for a particular application, a most detailed satiyes using beam on clarke loundation, faits element or other methods of durings which consider the tollstructure interaction effects of anchored with Edit in

Anthered walls with one level of anthors may be destand mint a trimbiger enter bestene feinepation in religion with Artisis 5.6.2 or using exemples relicible anty historic marginalor compress signife advance well deflective. For the case where exception has adand down to the first market level but the feet now of suchors has not jut been installed, the well shall be trains in a perfectify extensionated well and the court because questionies located on the stall spell for exed as thengular in accordance with Article 5.6.2. Ornemating of the such on should be avoided to create the states bed relative to the capacity of the retained 5.7.2

14404391544 02/02/09 10:06Am; helen\_fecu; rege 10/1/

Feb -03-99 10:37A Geotech Services Inc Sent by: AMK CONSULTING ENGLINEEN INC STREETS !

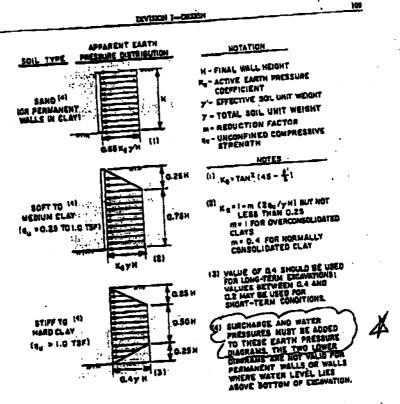


FIGURE 5.7.1A Guidelians for Emissering Farth Pressure on White with Two or More Levels of Anchors
Countracted from the Top Down
Maddined after Toronghi and Peck (1967)

pround mast to support the author hands one moult in undertaile deflections, or posites follow of the well han the mented self.

in the retained sell.

In developing the design insural pressure for wells be developing the design insural pressure for wells measured from the top down, the insural pressure due to traffic or other templacys leading, that he added to the intention carb pressure in secondars with Articles 3.21.3 and 5.5.2, using the outh pressure onefficient

व्यवस्थान कोने क्रेट स्थानिकार क्रान्तिकार व्यक्ती वृत्तीका

For the conditions where there is on or one anchorlevel, the magnitude and distribution of teers) resisting factor for embedded varietal alements in soil or root shall be desurated following precidence described in Article 5.5.7. When two or more levels of anchors have been installed, the magnitude of install resistance pro-

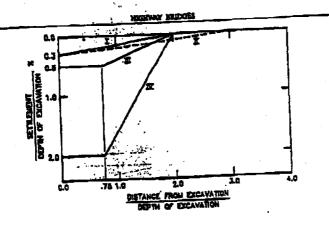


5.7.2



110





CURVE I = Send

CURVE II = Sulf to very hard day

CURVE II = Sent to medium sies, fector of substitute in Senty epoloxi based heave (- 1 + 4)

Equal to 2.0

CLRVE 12 = Self to medium days feeter of 5.1 \$\frac{5.1}{2.0}\$ Selfely against based heave (-\frac{5.1}{2.0} \frac{5.1}{2.0}\$) Equal to 1.2

FIGURE 2.7.23 Intimust Frails Behind Brand or Anthorod Wills Maddled After Congh and O'Rearis (1996)

20 - 2000

vised by embedded vertical elements will depend on the element millions and deflection under load.

The earth personner on authorist sells encouncied in El giuncions from the homen by his discuss by the method and supreme of construction. Therefore, the method and supreme of construction must be considered united and supreme of construction must be considered united and supreme of construction must be considered and supreme of considered.

- For walk with a single anchor lovel—A risagular distribution defined by Kay per unit larger of wait incide also companys tools.
- For each with makiple ansher levels—A recongular protoco distribution derived by increasing the soul figure from the stangular propage, distribution to the stangular propage distribution

described above by constitut and applying the force as a uniform pressure distribution.

## 5.7.3 Water Prostupe and Drainings

Rafer to Article 5.6.3.

## 1.7.4 Seinnic Pressure

Refer m Section 6 of Division I-A—Sciente Design for guidance regarding the design of anothered presiding walls subjected in dynamic and asimic heads. In general, the passedo-tante approach developed by Monanchu ted Chalm may be used in estimate the equivalent static

121

DIVISION !-DELICIN

5.7.4 forces provided the maximum lateral earth pressure be

computed thing a scientic coefficient by = 1.5A. Forces resolving from wall interio effects may be ignored in estimating the salemic lateral earth present.

## 5.7.5 Structure Dimendons and Externel Stability

The design of anthured walk includes desermination of the following:

o Size, speciog, and depth of embedment of vertical

nall alements and facing e Type, capacity, specing, depth, inclination and cor-

rotios protectica el sactors: · BEVERRAL STREET AND SUMMED of the well, well foundation, and surrounding soil mass for all intermagiste and [jan] strate of companion

The bearing expectly and makeness of vertical well channels under the vertical enquestent of the anchor forces and other vertical leads shall be determined in rdages with Articles 4.4, 4.5 or 4.6.

For wells supported in or through soft aloys with S. < 0.37'H, consistence vertical elements extracting well below the exposed here of the ball may be required to property heaves in front of the well. Otherwise, the wartheir plantates are controlled several fact as required for subility or end bearing. (Where eigenflowed and of the well is required to prevent bettern better, the lowest merites of well below the lemost trop of suchts stut be designed to resist the moment induced by the presom tegal persons the journe toth of evenus and the but of the expend will, end the face Pa = 0.7(ville, - 1.44 - pril.) active at the midhelight of the embatded depth of the vall.

The required embedment depth (D or D.) may be determined in semurfaces with Article 5.6-2.

Heler to Article 5.7.2 for poweral guidance regarding well deflections.

## 5.7.6 Structure Design

Depending on the characteristics of the wall, the wall warm shall be designed by service load or load factor methods in conformation with Article 3.22.

### 5.7.61 General

The precedure for anchored well design depends or the number of anchor rose and the emergesion responses. For a typical well with two or more rises of technic constructed from the usp down, the procedure

requires design for the final structure with scalable rows of suchers and checions the design for the various stages of well contraction.

The required heritoutal component of each archor form sure distributions in Figure S. 7.2A, or other applicable card present distributions, and any other horizontal water practure, surcharge or sciencic forces acting on the well. The total anchor force shall be descripted based on the anchor inclination. The instituted anchor specing and another capacity shall be selected to provide the required word anchor force.

The vertical well elements shall be designed to realer all horizontal earth pressure, such ungo, wever pressure, sacher and seismic loadings as well as the vertical comoment of the enchot loads and tay other vertical loads. ports may be assessed at each eacher logades and at the horsem of the well if the various element is extended the the posters of the well.

The stresses in and the design of the well facing shall he company in accordance with the regularization of Agicle 5.6.6.

All sumpenests of the enchand wall system shall be checked for the various earth posteres distributions and other leadings conditions which will exist during the COURSE OF DOSEDVERIOR.

## 47.62 Auchor Design

Aschor design shall include an evaluation of the feasibilley of using suchors, selection of an anchor system estimates of auchor capacity, determination of unbounded leagth, and determination of correction protection requirements. In determining the feasibility of bying eachers at a particular location, coupidarration shall be given to the evallability or ability to obtain underground extensions, proximity of buried facilities to ancher locations, and the suitability of subsurface soil and cock conditions within the anchor streaming wine.

The required eacher forms thail be determined in accordance with Article 5.7.6.1. The phinists anchor capacity per unit laugth may be proliminarily estimated using the guidelines presented in Tables 5.7.4.2A und \$7.6.28 for sell and rock, respectively. These guidelines are for preliminary design of straight shaft anchors installed in equal diameter beine using a low grout pressure. Other anchor types and installation progedures could provide other estimates phismate anchor capes and determination of the anchor opposity and required bond length that he the response horse well specialty contractor. The allowable sother capacity for small dissector anchors may be esti-

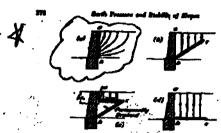


**Soil Mechanics** in Engineering Practice

Karl Terzaghi

Ralph B. Pock

Fab -03-99



- Fig. 46.5. Magico abundar parelatus for distings of health habital argifular - with (p) Verlind destroys toyou, (b) Endined habitats byte for estrationism habital, (c) Seriound data and not acceptant with indianal distings layer for whether health (d) Notice design to resultant examination of estimate habital.

During takestones water percetates through the backell toward the back of the well or shower in Fig. 66.6a. The compage presence (datinfor 23) exceted by the percetating water increase the earth presence arcreted by booksille with medium percentility, types 2 and 2 (Table 60.1), as long as perceivation anothers. This absold to prevented by mosess of inclinal dechange toyers, such so that shows in Fig. 46.3b. The drainage toyers were the death function of decides and protectales, spained, treat action. In addition, the surface of backfills of medium permeability decided be covered with a well-compacted layer of joss normachile only as above in Fig. 42.3c.

A day be skill is likely to pull army team the back of the wall to a dayth of about a. (Eq. 30.17). In order to prevent the accountability of which a clay in the open Sentence during a parameters, a draining forger about he inserted befores the wall and the backell to a depth of 1.1m, below the great, Sinte the supermost layer of a sky backell is likely to break my such betters thirty prevented on the result of alternate writing and drying, the vertical drainings layer should be sommeted in an inclined draining they by a garily sloping top title of the action of the supermost that provides thereof the top beyon of sky. The physical properties of the wedge-chaped body of sky house the termine that provides thereof the top sides and the instituted drainings layer out to expected to remain fairly consistent the straining that the property.

بالدالة مراملسنة 🔹 🌣 .

The questity of order that perceives through a well-conference bodies is or small that there is no steamer if the drains becoming shallouted by weaked-set only particle. Therefore, it is not necessary that the grain vice of the materials in the drainage layers abould satisfy the remaininguous for filter leaves (Article 18).

1.7 TO DAY

Bearing Parmarine Assessing Montrocoming Representation Water, Rigid wells in a fixed position, reads on the freed part of U-chaped heider abulancels or the side walls of does becausels, are acted on not by the action earth presents but by the earth presents at rest. The consists of the dark groups at real is produce that the active value. It desends ant only on the physical preparity of the bankets. but also, to a large critical, on the method of places the All. House, the intensity of the earth present against a first wall our to estimodel order an the basis of asperience. As yet, very little empirical information exists on this subject. The pressure secreted by a loose all maked a low theel well sprease to be qualler than that of the more backfill in a commission state (Through) 1996s). The possible of processor-sell exconuments as two V-shapet bridge abstracts in serthwestern Cormeny Indicated that the presence of the well-conpacted medium-send backfill was coughly equal to the Coulomb value at my death also a constant value of about 0.13 teather Collision HERE'S

### Foundations for Relaining Walks

Investment. Experience has shown that most relaining wall failwere one cannot by bredequery of the layed stiens. Since an adequate familiation count by desired without at least some trousledge of the true of soil increase beneath the have of the proposed well, the subsell much be investigated at least by primitive manne. The minisome regularment for exploring the soil beneath the base of any relatioone wall is to drill with a most hole distant or come other convenient fact to a depth below the best equal to the height of the wall. If a firm straines to ensurehend at a smaller depth, the baring can be discustiment after drilling about 2 A toto the stratum, provided local montienes ur readily available realogies evidence beaves no doubt that well eleate do not maint at meater doubt. On the other bend, if a suft stratum extends to a death greater then the beints of the well, the bosing should be sentimed until the bottom of the and strategy is precommend or well the stiffeness of the gold increases. persentibly. The designer chemic also know the death of frest practure then said the depth as which the sail is broken up by sessonal volume On the, emperhensive measurements of this hind in deep costs have been used only in course in Burlin, Minusch, and Mour Verte; in not to mediane immediate glocal stays in Chinage, and in and to motives incommittee marine clays in Osle. A few additional acts of chapteristics you profibility from side in a write variety of soils (Finate 1908).

Mart of the charrelines sensiti of the community of the back our ried by the strate in a given vertical cross section or in accord or on nations of a set. In case between the street determinations or explainteled by measurements of defaulture and self-court. Since tolicits divide manyunapale of the earth propagate against the photo have ready him made, the magnitude and distribution of the auth suppresentate the charting must be believed from the cheet tends. Leading to's wigh but presently apprecianties, the element preseday in to against the load in each about to the agent to the total ovelle promises registe on the destitut over a protecution arise extending probably half the distance to the seal vertical per all struly po althor alth and residently half the distance to the beingester after of strete immediately above and helpy. The earth promove to assumed in he uniformly distributed over the rectangular area. The regionsular gree tributers to the tensorment street to a cross median extends to the ground merice. For the purpose of the ashabitles, the bottom of the sad le servered to be a stool. If the shoet in the shoeting at the believe of the cut has agt been measured, the earth process per unit of even in becomed to have the same value as that tributary to the lowerment extend event. The pracedure is tifuntrated in Fig. 48.1.

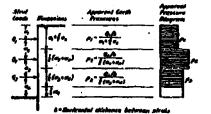


Fig. 48.9. Helical of extendating apparent presents disputes from exempted standards G in space and,

The real distribution of the earth greeners against the obselling many differ appreciably from that calculated in advertunce with the tempology procedure because of the sectionity of the shortless and because of the assumptions researching the procures mean the holters of the opt. Moneyer, he calculates materials the earth pressure asked the result of the pressure asked on the section of the pressure asked in this passent is designated the approach cartle pressure. However, if the superpoted earth pressure is known, the corresponding during leads one by required to thinking the however presentation.

Dury Over Heaterstin to them, three-link assessments were made desing the speciation of a solveny in Bollin, for which on again will varie measured to a depth of closes. I for fine, desses, follow with their measurements of a street of the fine desses, follow was breated to a sanddership depth below this ground-maker level was breated to a sanddership depth below this ground-maker level was breated above the cut was been desses to be a sanddership of the desses to provide the cut was breated above to the cut was been been as a cut of them glanns (Belliuw 1837). The apparent pressure of four safe of close to above to Fig. 6 fig. The apparent pressure of four for the other unto be within the resars of these observa.

Although the could of the site of this open set was inity uniform, the various discount representing the apparent earth presence very considerably frees the stabledcal average. The variations were probably counted to seem extent by local difference in the sell proportion and to a genetic order by difference in the sell proportion procedure at different instalant. Yet the distance u.W of the center of premier from the bottom of the out-would never atheirs conversely limits of getter and the self-out of the out-would never atheirs of term mon-recomments of agrees and of clouds in an excession for the Munich submy (Elember 1941), for which at agreed from the 1st of Africa mon-recomments of agrees and out-which as averaged from 0.45 to 0.44. Hence, the object of the self-out-will be self-out-will-o

According to Article 27, the total earth pressure for the deformation conditions emploited with the emercation and bracing of an open cutin eard should surveyand to that calculated on the assumption has the nurface of uliding in a togarithmic spinel. For a cut-of given depth If in a material of unit weight, the horizontal component of the total

(2)

0

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Services

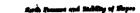
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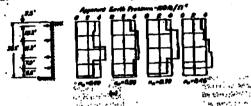
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a Boy that Subany, \$-55° a Brain Subany, \$-55° a Brain Subany, \$-65° a Brain Subany, \$-6

A-100 (105'- 96)

(A)

Fig. 68d. (c) Appears undispressed disprint for four sale of study in Bullin.
Substy open pet. (b) Comparison of respected and existings and loads in
swind sets of pints in neutron spin unit in send.

active pressure depends on the voluce of  $n_{\rm eq}$   $\phi_{\rm e}$  and the angle of small friction 5 hadron the horizontal and the direction of the meth pressure on the host of the clusting. Depending on the material of orbits the shoring compute and on the criteri is which the absence on cottle, 8 may mage between 0 and  $\phi$ . Values of the conficient of notive sorth pressure,

$$R_A = \frac{P_a}{k_B H^4} \tag{40.1}$$

calculated by the fugurithmic aginal method for \$ - \$/2, and for values of st. engine from 0.6 to 0.6, are given in Table 48.1. Also

- Egrand Segunda de Open Colo

initialisted and the values of  $X_{\rm d}=b_{\rm ml}^4$  (45°  $-\phi/3$ ) corresponding to

Rankint's theory, Rq. 20.1.

Thile 68.1 indicates that, for a given value of \$\phi\$ and for a range of \$\pi\$, from 0.4 in 6.6, the Rankine value does not differ from those advanted by the logarithmic opical method by more than 18%. Moreover, for \$\pi\$, \$\in 0.5\$, the difference is not over \$\pi\$. On the other hand, a varietien is the cuple of induced lection \$\phi\$ do ship \$\pi\$ produces a change to \$\pi\$, at oversety \$2\pi\$. Immeds as the values of \$\phi\$ for the camels of the other, of the span ents in Berlin, Munich, and New York were not detectable? by liefs, and one only be estimated from the discontinuous of the subside for an object the street, lead, measurements an antaly in department of the subside for a shoule for antalklishing this object; led

Trible dt.l.

Velter'd Displaint of Active Hoth Present &
for Open Guts in East (\* = 9/2)

			- · · -
٠ .	<b>~ 37</b> *	\$ - 26°	• - as-
0.4 0.0	0.\$\# 0.340 0.391 0.322	4,850,0 125,0 236,0 236,0	0,265 0,217 9,331 9,220

the tegerithmic spinal method over the simpler Rachine solution. Revertheless, a general evaluation of the applicability of either prenedure to the aphrelium of the teini earth pressure against the pideoff a qui can be used by comparing the sure of the hand in each
vertical set of strete where monacuments were reade with the total
earth pressure adjusted on the hade of Eq. 2.2.1 and caserable
earth pressure destributed on the hade of Eq. 2.2.1 and caserable
measured stret leads tudeds on effective to pressure treatferred to the sell beneath the bottom of the out, as shown in Fig. 6.6.1.
The computed stret leads are bested on a vedue of  $\phi = 60^\circ$  for the
fairly down come at the cuts in Berlin and Munich, and He for the
conseptal topes cands in New York. The conclient agreement infi'attent that was of Eq. 2.1.1 for columbing the total math pressure
against desire outs in small is passingle desire outs in small is passingle.

On the other head, the distribution of the apparent earth present at a given vertical section may remarkle any of the diagrams a Fig. 68.46. It shapes from plans to place, those each sired should be diagond for the maximum had to which it may be subjected, the de-

the of the strain about it brand on the expellent of all the appropria security discreme detarmined from the measured street leads. In Vic. Ale, the continue apparent earth prosper for each of the three projects has been plotted. The pressure was computed by taking the at taciridad siret head at each level and secretaing it lete oppermi earth pressys. The aspectate serth pressure was then expresent to term of the questity K.pH, where K. in the Runking and School ton (145 - 9/2). The simplest correspond has the bernagends to a uniform presents arrest to BAS Karel for the uniform death of the set.

...... Emm. for a finiter and in Arms bands; the street about the designal for lands determined from the oppositud passance (lagram (Fig. 42.65). This presentes should provide for the highest stret tends that sum sense. The west probable value of dier individual steat had is obout 20th lower than the confirment.

... The appearent pressure disgraces for dudge (Ma. 48.6b) has been middled on the basis of a saffer Replied number of only complex in depth form short 28 to 68 it. Monte, it should be need with saution for unte of existantially exector shorth. Moreover, it is emphasized

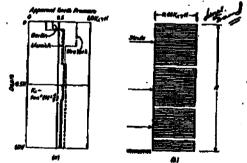


Fig. 48.2, (a) Mandopa of approved conflictement diagrams for watered street

Had the excused sometry discount for duting data and hear new secondance to the mal distribution of earth process option the chartley of the aldes of the mil; it is importe an artifica for commission value of the strat hade that will not be expended in any seel strat in a mailer own and In seneral, the bushing sensents in the shorting or coldies piles, and in write and inquire, will be substantially capille there there extrated from the apprecent earth pressure disgress engcouled for determining stret leads.

If the tester table is lowered by pumping free appr except in the sul. autale allevance stood be made for morate promute agricul The broad part of the hypotac Distance Course speak between the following broads to all sufficient by allminute seconds presents. The effect of this type of draining is duling to that of the vertical draining here belief the medicing wall shown to Fig. 48.4a.

Dust Core to Harmorem Street to Munitin Clare, in contrast to the reliablesty fees measurements of street leads in orth in eard, some our observations have bein excited out in outs in out to medius slays. Although most of the information was oblahed in Chicago and Orle, several arts of observations have also been made in Employed and James. At all after the undrained shearing strength of the chore has been investigated.

The opposed curti-procure discreme cubible a variety of shows. of which there is Fig. 42.60 are reconnectedire. The everage value of re. for 42 sets of clouds, representing all the localities where manestements were qualit, is 0.39. The values rather from 0.20 to 0.50: at one and the exceptionally high value of 0.58 was found. The mancommends been so dealt that winer and invellable varieties to quantiraction providers, such as differences in the fatorest of time beforein assertation of the clay and placement of the stort, me al necessaril importance in determining the load that will be parted by the street. This fact is illustrated by Fig. 48.00, to which each berinsated ber represente the average load in all tight simile at the same level and at the same expansion stage in one open out to Chicorn, as well at the mediante end minimum values of the steat leads at that level and stogs. The cut excluded I levels of stocks. Emeration was service out quelematically from noe level to the next, and after each place of exception the pickt say strain were excelled. installed and meritored to 10 tons such. Yet, in arise of the unusually wifers confruction pressions, jedinthest stret lands in each level varied so seeth so 4:00% from the overage, Similar variations are characteristic for all the cute in which enough street leads were exermercel to records administrative signatures of closes.

Sary ices 7886 TO 16142751354

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10:42A Geotech

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PLANNING DESIGN

Subject: Piezometers at SUM-82

Date: Wed, 10 Feb 1999 16:10:37 -0500 From: Jama! Nusairat <njamal@uakron.edu> Organization: Cinvil Engineering, Univ. of Akron

To: Rob Bobel@nps.gov, rliang@uakron.edu

Hi Rob;

Steve from Prime Eng. called me this afternoon saying that they finish installing the three piezometers. They drilled holes not deeper than 15 feet and installed the piezometrers in the sandy layer with depths ranging from 11 to 13 feet, without waiting for 24 hours to see if there is any water, and they did not drill deeper than 15'. They were supposed to drill dry holes with different depths to the shale elevation and wait one day to see if there is water. If they find water to install the piezometers.

This was not the procedure discussed with the contractor or their consultant. I did remind Scott Febus of National in the meeting on Tuesday about the dry holes and that they need to drill and monitor for a day to see if there is water.

The inclinometer holes were drilled with water, so it was difficult to judge if there is any water table. This is why we ask for dry holes.

Please, address this issue and let us know.

Sincerely

Jamal

OPTIONAL FORM 99 (7-90)		
FAX TRAN	SMITTAL	# of pages ▶ 2_
" GENE GEGGE	e From Lan	b Bobil
OBOI Central	This Phone 44	0-546-5972
Fax 614-275-13	54 Far 1440	0-546-5982
NSN 7540-01-317-7368	5099-101 GENER	AL SERVICES ADMINISTRATION

Subject: Demonstration Anchors

Date: Wed, 10 Feb 1999 15:32:33 -0500 From: Jamal Nusairat <njamal@uakron.edu> Organization: Cinvil Engineering, Univ. of Akron

To: Rob Bobel@nps.gov, rliang@uakron.edu

## Hi Rob:

We did review the submitted procedure by National for the Failure test setup. We have the following questions:

- 1) In the second page where the schematic of the setup is shown, the triangular bearing plate geometry is not clear. A front view section showing the details of these plates is required. The reason is that a complete bearing is required to transfer the load from the triangular plate to the vertical plate.
- 2) If the cylinder of the jack and the load cell are different in diameter, we need to have another bearing plate to have accurate reading from the load cell.
- 3) In the submittal there is no details about the setup of the measuring devices and the support system for those devices. The measuring devices are the dial gages and the pressure gage of the jack. Dial gages with range that is higher than the expected elongation is required to be used. There is some gages in the market with range up to 12 inches. The elastic elongation for a 7 strand tendon with free length of 55 ft. is more than 4 inches.
- 4) The dimensions of the bearing plates are not indicated.

Mainly, these are the things that need more declarations.

Thank you.

Sincerely;

Jamal Nusairat, Ph.D., P.E. Research Associate Civil Engineering Department The University of Akron Akron, OH 44325-3905 Tel. (330) 972-7364 Fax. (330) 972-6020 E-mail: njamal@uakron.edu

Bcc: From: Gene Geiger@MaterialsMgmt@EngPolicy Subject: **SUM-82 Failure Test** Date: Wednesday, February 10, 1999 10:33 AM

Attach:

Certify: Υ

Neal Miesle@Production@D-04

Neal.

To:

Cc:

give the size of the bearing plate for the lower tier test in shale and state they won't use the 3/4"x4' x 8' plate unless neccessary. Since it's there and already has a hole cut in for the upper tier test, why not go ahead and use it on the lower tier also to be safe. At the very least, I would require the contractor to show the size of the bearing plate in the detail.

I received a fax from Rob this morning. I have only one comment. They don't

Gene Geiger Geotechnical Engineering Coordinator **ODOT Office of Materials Management** (614) 275-1318/gegeiger@odot.dot.ohio.gov

# CVNRA- DEMONSTRATION ANCHORS

ONE DEMONSTRATION ANCHOR WILL BE INSTALLED & TESTED FOR EACH THE UPPER + LOWER WALIS. UPPER ANCHOR WILL BE INSTALLED BETWEEN PILE 26 + 27. LOWER ANCHOR WILL BE INSTALLED BETWEEN PILE 647 UNDER WET HOLE CONDITIONS. HOLE WILL BE FILLED WITH WATER FOR 48 HOURS PRIOD TO ANCHOR INSTALLATION. ROAD PLATE (34" THICK, 4'X8') USED ANCHOR WILL HAVE A 4" DIAMETER HOLF. OUT OF THE MIDDLE SO ANCHOR CAN BE TESTED AGAINST IT. FOR THE LOWER ANCHOR, THE SHALE FACE SHALL BE TRIMMED VERTICAL & JACKING WILL TAKE PLACE DIRECTLY AGAINST THIS ROCK FACE, SEE LANG TOUDON SHOP DRAWING FOR ANCHOR DETAILS.

AFTER GROUT HAS SET SUFFICIENTLY, ANCHORS WILL BE STRESSED (SEE TEST SHEET TABLES). THE ANCHORS WILL BE JACKED TO NO MORE THAN 80% OF G.U.T.S. WHICH IS 46.9 KIP /STRANT. FAILURE SHOWN BE ACHIEVED BEFORE 80% OF G.U.T.S. IS REACHED.

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL

1 of pages ▶ 9

To CRUE (TEIGEL From Rob Bobbel

Despitaging Control RC. Phone \$40-546-5872

Fax \$40-546-5982

NSN 7540-01-517-7388 S099-101 GENERAL SERVICES ADMINISTRATION

NATIONAL PARK SERVICE

APPROVAL OF THIS SUBMITTAL IS SUBJECT TO THE PROVISIONS OF THE CONTRACT DRAWINGS AND SPECIFICATIONS. THIS ACTION IS FOR GENERAL CONCURRENCE ONLY AND THE GOVERNMENT IS NOT RESPONSIBLE FOR ERRORS OR OMISSIONS.

APPROVED

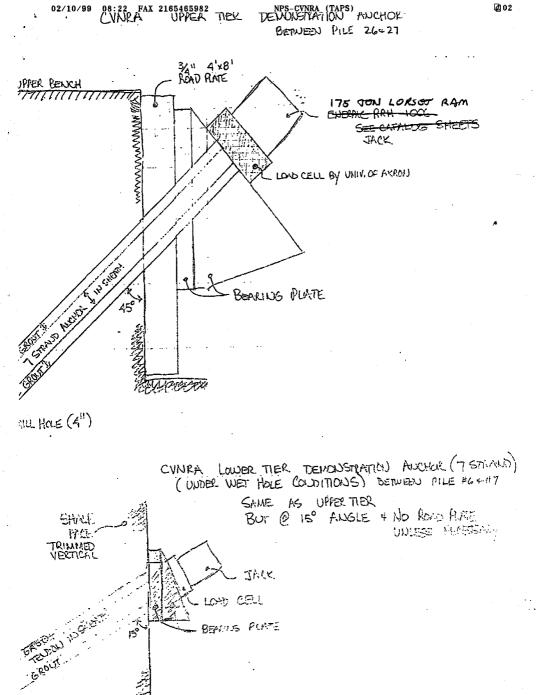
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BAPPROVED WITH MOTATIONS INDICATED RESUBMIT WITH CORRECTIONS.

Controding Officer or Authorized Rep. Date
Submitted Reviewed by Date



Lang Tendons, Inc. PH: 610-268-2221 1263 Newark Road FAX: 610-268-3053 Toughkenamon, Pennsylvania 13374 175 TON RAM

LOKSET STRESSING SYSTEM

DWG #:

Scale: NONE

Orawn by: RBR

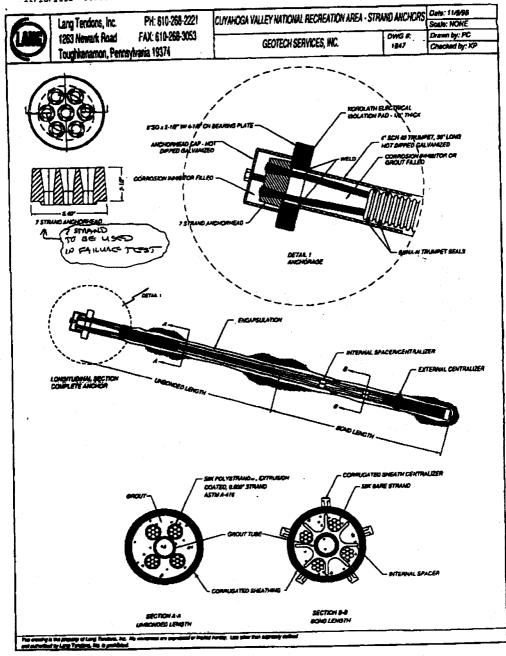
Chicked by: RBR

Date: 12/16/92

- REUSEABLE STRESSING WEDGE STRESSING HEAD TXTX 1 1/2" BRG. PL - PISTON 175 TON RAM 175 TON RAM ADAPTER PLATE JACK CHAIR ANCHOR HEAD BEARING PLATE

TENE		ANCHOR HEAD	JACK CHAIR	WEDGE STOP PL	STRESSING HEAD
		PART #8310	PART #9310	PART #9320	PART #9330
3 STF			PART #9310	PART #9420	PART #9430
4 STF	WND	PART #8410			PART 69730
7.577	RAND	PART #6710	PART #9710	PART #9720	FACILITIES.

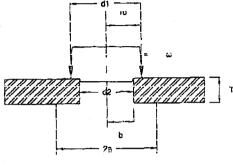
CAPACITY	175 TONS
STROKE	8 IN
CENTER HOLE	3 3/4 IN Ø
WEIGHT	175 LB
PISTON AREA	42.60 SQ IN



BEARING PLATE CALCULATIONS OVER A LARGE HOLE

Date: 01/07/99 Job No : 3773 Colos by: PC Page: 1 of 1

CUYAHOGA VALLEY NATIONAL RECREATION AREA



REFERENCE: FORMULAS FOR STRESS AND STRAIN, FIFTH EDITION, ROARK AND YOUNG, TABLE 24, CASE 1A.

N = NUMBER OF STHANDS = 4

d1 = ANCHORHEAD DIA = 4.70 in d2 = DIA OF HOLE IN BEARING PLATE = 3.4375 in

b = RAD. OF HOLE IN BEARING PLATE = 1.719 in 28 = SPAN OF PUPE SLEEVE SUPPORT = 7.00 in

m = LINE LOAD RADIUS

W = LINE LOAD

T . THICKNESS OF BEARING PLATE

a. - STRENGTH OF BEARING PLATE STEEL - 36 ksi

G. = ALLOWABLE STRENGTH OF STEEL - 27 kg

MID = MAXIMUM MOMENT

MIL @ INNER EDGE, 1 - b

0=86 F4 (CASE 1, / < 10)

Mr = 0, FOR r = b

₽7 = Ú

$$Mi0 = \frac{\omega a^2}{b} \frac{L9 F4}{C7} (1 F^2)$$

WHERE V=03

F4 = 1.0

L9 = (ro/a) [0.65 in(a/ro) + 0.18 (1-(ro/a)^2)]

LS = 0.240

C7 = 0.48 ((a/b) - (b/a))

C7 = 0.711

re = 
$$\frac{d3}{2}$$
 = 2.95 in  
 $\omega = \frac{4 \times 58.6 \times 100\%}{21100}$  = 15.88 kips/in

Mtb = 34.81 KIP IN

$$T = \left[ \frac{GHio}{\sigma_{\star}} \right]^{\frac{1}{2}} = 2.78 \text{ in}$$

USS T = 3,00 in

PLATE SIZE REQUIRED 8 in SQ x 3 in W/ 3-7/16 in CH A36 STEEL

## TIEBACK ANCHOR - FAILURE TEST RESULTS

## NATIONAL PARK SERVICE CONTRACT NO. 1443CX516098008 VALLEY RAILWAY SLOPE STABILIZATION

= Number of Strands feet = Anchor Stressing Length feet = Anchor Bond Length sq. in. = Area of Steel Per Strand tist = Strand Modulus of Elesticity			kips = A.L. = Alignment Load  77 kips = P = Anchor Design Load  deg. = CX = Anchor Inclination Angle						ries, Gago	No. :		
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Valley Rnäway Slape Stabilization Failure Test - Anchor No. \_\_\_\_

Date: \_\_\_\_\_\_\_\_\_NECC Project No. 9852

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Valley Rollway Stope Stabilization Feliure Test - Anchor No \_\_\_\_

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Valley Railway Slope Stabilization Failure Test - Anchor No. ; \_\_\_\_

Page 3 of 4

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Valley Rullway Slope Stabilization Folium Tast - Author No

## CUYAHOGA VALLEY NATIONAL RECREATION AREA

## MINUTES OF JOB SITE MEETING MEETING #4

PROJECT:

Valley Railway - Slope Stabilization Under SR 82 Bridge

Contract No. 1443CX616098008

DATE:

Tuesday, February 2, 1999

TIME:

10:00 A.M.

PLACE:

Job site trailer

ATTENDEES:

Rob Bobel

CUVA

Joyce Stumbo

CUVA

Scott Febus Rick Skube

National Engineering & Contracting National Engineering & Contracting

Ed Chrzanowski

National Engineering & Contracting

John McDonnell

Geotech

Paul Stubbs Jamal Nusairat

Geotech University of Akron

Bulent Bilgin

ODOT - D4

1. Job Site Meeting #4 was called to order at 10 AM; all attendees introduced themselves.

#### 2. Status of submittals:

Submittal No.	Re:	Status
003	Tie Back sub.	Approved
004	Haul Road	Disapproved
005	Piles	Approved
006	Tie Back proc. & mat.	Revised procedures under review
007	Lagging	Approved
800	Conc.	Approved
009	Catch basins	Approved

#### 3. Status of correspondence:

Item	Status
Condition Report 4 Condition Report 5 Plate thickness extra 14 day time extension 7 day time extension	verbal approval given-written pending verbal approval given-written pending pending pending pending

4. This week's schedule (week 19).

Day	Activity
Monday (2/1)	cleaning off lower bench; material moved to old house
_	site; install slope monitoring
Tuesday -	continue cleaning lower bench; install slope monitoring
Wednesday -	set mats & move crane into position; continue installing slope monitoring
Thursday -	second load of structural steel due; set mats for pile drilling rig; continue installing slope monitoring
Friday -	begin installing soldier piles; continue installing slope monitoring

#### 5. Upcoming schedule (week 20):

Day	Activity
Monday (2/8)	continue installing soldier piles; begin installation of tie back failure tests; continue installing slope
	monitoring
Tuesday -	continue installing soldier piles, failure tests and slope monitoring devises
Wednesday -	continue installing soldier piles, failure tests and slope monitoring devises
Thursday -	continue installing soldier piles, failure tests and slope monitoring devises
Friday -	continue installing soldier piles, failure tests and slope monitoring devises

#### 6. Old business:

- a. Work on the platforms has begun again and the Contractor expects once mats are in place that work should continue with fewer weather-related interruptions.
- b. Pile #22 will be shipped with the next load of steel.
- c. The Contractor has devised a method of attaching the strain gages and wires to the instrumented piles that is acceptable to the University.

#### 7. New business:

- a. A submittal outlining procedures for the tie back failure tests was requested of the Contractor. He expects this to be in by the end of the
- b. The Contractor has established a new ramp to the upper platform that should considerably improve access to the south end of the platform.
- c. Piling work will start south and proceed north.
- d. The University requested the use of load cells as part of the instrumentation procedures.
- e. A discussion about project schedule ensued. Two time extensions are pending. The Contractor will be submitting a revised progress schedule but expects to be complete on or about mid-April, depending on weather.

#### 8. Next job meeting: Tuesday, February 9, 10 AM at the job trailer.

Note: Those wishing to receive an e-mail copy of these minutes are requested to send their e-mail address to the undersigned at: Rob Bobel@hps.gov.

Submi

Bobel, P.E., COR

cc: Attendees (Sub-contractor copies sent via NECCo.) Joyce Stumbo, ACO (e-mail)

Billy Davis, CO (e-mail) Tom Bradley, CVNRA (e-mail)

Dave Humphrey, CVNRA (e-mail)

Pete Birgeles, CVSR

John Kenny, Gannett-Fleming (e-mail)

Dick Kerber, CMPS

Bulent Bilgin, ODOT D-4

Gene Geiger, ODOT Central Office

Richard Beckert, EDG (e-mail)

Robert Y. Liang, University of Akron (e-mail)

Chris Courtney, rep. City of Brecksville

## CUYAHOGA VALLEY NATIONAL RECREATION AREA

## MINUTES OF JOB SITE MEETING MEETING #3

PROJECT:

Valley Railway - Slope Stabilization Under SR 82 Bridge

Contract No. 1443CX616098008

DATE:

Tuesday, January 26, 1999

TIME:

10:00 A.M.

PLACE:

Job site trailer

### ATTENDEES:

Rob Bobel CUVA Scott Febus National Engineering & Contracting Rick Skube National Engineering & Contracting Wally Gratz National Engineering & Contracting Roy Cummins National Engineering & Contracting Ed Chrzanowski National Engineering & Contracting John McDonnell Geotech Paul Stubbs Geotech

Jamal Nusairat University of Akron

Bulent Bilgin ODOT - D4

1. Job Site Meeting #3 was called to order at 10 AM. Some parties came in after the meeting began and were introduced around.

2. Status of submittals:

Submittal No.	Re:	Status
003	Tie Back sub.	Approved
004	Haul Road	Disapproved
005	Piles	Approved
006	Tie Back proc. & mat.	Disapproved
007	Lagging	Approved
800	Conc.	Approved
009	Catch basins	Approved

з. Status of correspondence:

Item			Status
Condition			written response sent (12/22/98)
Condition	Report	2	written response sent (12/22/98)
Condition	Report	3	discussed at 1/22 meeting
Condition			verbal approval given-written pending
Condition			verbal approval given-written pending
			appearan green writer penaring

Questions or changes:

This week's schedule (week 18):

Day Monday (1/25)

first delivery of solider piles and mats

Tuesday too soft to drill Wednesday -

Thursday -

prep work for strain gages

Friday set up access for inclinometers

6. Upcoming schedule (week 19):

Day

Monday (2/1) begin installation of inclinometers/piezometers

Tuesday inclinometers Wednesday inclinometers Thursday inclinometers Friday inclinometers

- 7. Old business:
  - a. It was again mentioned that the inclinometer shown to be installed behind pile #29 will be moved to behind pile #31 to clear the bridge arch. The University representative agrees.
  - b. As a follow-up to Friday's meeting with Geotech, the Contractor will be submitting a revised proposal for wall construction procedures. That submittal is expected this week.
- New business:
  - a. The Contractor has suspended site work on the upper platform until the platform material firms up. He will be exploring other ways to keep the project moving in the meantime.
  - b. Pile #22 was not shipped with the first load and will be needed to begin the first run of piles.
  - c. A discussion ensued regarding methods to protect the strain gages and lead wires on the piles. R. Skube will obtain one of the gages and the Contractor will offer a proposed method.
  - d. The University has decided not to use pressure cells as part of the instrumentation procedures.
- 9. Next job meeting: Tuesday, February 2, 10 AM at the job trailer.

Note: Those wishing to receive an e-mail copy of these minutes are requested to send their e-mail address to the undersigned at: Rob\_Bobel@nps.gov.

Robert W. Bobel, P.E., COR

Submittee

CC: Attendees (Contractor subs sent via NECCo.)
Joyce Stumbo, ACO (e-mail)
Billy Davis, CO (e-mail)
Tom Bradley, CVNRA (e-mail)
Dave Humphrey, CVNRA (e-mail)
Pete Birgeles, CVSR
John Kenny, Gannett-Fleming
Dick Kerber, CMPS
Bulent Bilgin, ODOT D-4
Gene Geiger, ODOT Central Office
Richard Beckert, EDG
Robert Y. Liang, University of Akron (e-mail)
Chris Courtney, rep. City of Brecksville

ET. 82 SLOPE STABILIZATION MEETING V22/99

SIGN-UP LIST PARK HQ

NAME

OEG.

PHONE / FAK

1. Ros Bober NPS 440-546-5972 (V)

440-546-5982 (F)

2. John Kenny Gamett Fleming 614-794-9424

3. Anthony Pange ODOT 330-297-0801 4242

4. DAN KENT GANNETT FLORING 614-794-9424

5. MITCHELL LA. WERER GANNETT FLORING 614 794-9424

6. John Medennell GEOTECH 440-439-5801

7. ED CHRZAMOWSKI MECLO (440) 238-3331

8. BULENT BILGIN DOT D.44 (330)297-0801

10. NEAR MIESLE 00-T 0-4 PRODUCTION BRIDGES (\$30) 297-0801 x 347

11. Don Green AWK Consulting Engrs, (412) 823-8331

12 Rich Skuse Necco 440-343-1691

13 Scott FEBUS National Eng 440-238-3331

FRANK MARTIN

14 Robert Liana University of Akron (330) 972-7190
15 GENE GEIGER ODOT-MAT. MGT 614-275-1318

16 Faul Stubbs Geotech 440 439-5821
17 RAY TARTABINE "

0000 D-4 BRIDGES (330) 297-0801 EXT 34/

National Engineering and Contracting Company

## CUYAHOGA VALLEY NAȚIONAL RECREATION AREA NATIONAL PARK SERVICE CONTRACT No. 1443CX616098008 REVISED PROCEDURE FOR CONSTRUCTING TIE-BACK WALLS

## January 25, 1999

The following procedures are being submitted based on the actual conditions that have been identified at the jobsite, and, based on the discussions that occurred at the meeting at the National Park Headquarters on January 22, 1999 between the NPS, ODOT, Gannett-Fleming, National Engineering, Geotech and AWK Consulting Engineers, Inc.

### UPPER WALL

FAX TRANSMITTAL

OPTIONAL FORM 99 (7-90)

196/2

Drill hole and place steel pile section. Place Class C concrete and lean concrete to proposed-

Access bench is established at approx. elevation 684+/-. Drill tiebacks @ elevation 685.5 (middle row). In fill areas, Geotech will pre-drill hole and advance the 5-12" dia. steel pipe with internal threaded joints to bedrock. The pipe will be drilled approximately twelve (12) feet into the rock. The tiebacks will be installed and grouted. After the grout has cured for a minimum of three (3) days, the ties will be loaded, tested and locked as specified in Specification Section No. 02220.

Note that the 5-1/2" pipe casing will be used in lieu of the compression strut detail that is illustrated on Contract Drawing Sheet 3 of 9. If the pipe casing is exposed greater than 8 ft. in the fill area, the exposed section will be braced with additional supports and/ or pipe collars.

Care must be taken to ensure that casing pipe is drilled into bedrock that is beyond the excavation zone of the bridge piers.

- 3. Upon the completion of the testing of the ties at elevation 685.5, the piling will be excavated to approx. elevation 675.0. Temporary lagging will be installed as required, behind the back flange. The excavation will be performed so that minimal amounts of material will be removed to install the temporary lagging. The tieback anchors at elevation 677.17 will then be installed, loaded, tested and locked-off as per the Contract Documents.
- 4. Upon completion of the lower tieback anchors, the piling will be excavated to the bottom of lagging elevation 671.57. Temporary lagging will be installed as required. The permanent perforated drainage will be installed. The permanent lagging will be installed, working in varying lifts across the wall. As the lagging is being installed, the drainage fabric will be installed as well. The ends of the permanent lagging will be grouted in place. The lagging will be backfilled with pea-gravel as specified. It is estimated that approximately 7/8" of clear space will exist between the drainage fabric and the lagging. Because of this, the use of sand for backfilling this void is suggested. The only problem might be if the sand passed through the ¼" gap between the precast panels.
- 5. The lagging/ drainage/ backfill installation will proceed up to the elevation of the top row of tieback anchors, elevation 693.83. The tieback anchors will be installed using the 5-1/2" dia. steel pipe casing in the same manner as for the middle tiebacks. The pipe casing will be drilled twelve (12) feet +/- into the bedrock. The tieback anchors will be installed, grouted, loaded, tested and locked-off as per Specification 02220.
- The lagging, drainage and backfill will then be completed to the top of wall as per Contract Documents.

## National Engineering and Contracting Company

National Park Service
Cuyahoga Valley National Recreation Area
National Serial No. 9852-3011
Revised Procedure for Construction

01/28/99 Page No. 2

## LOWER WALL

- Drill hole and place steel pile section. Place Class C concrete and lean concrete to proposed elevation. The bench is currently graded @ elev. 647+/-.
- 2. Working from the bench, install tleback anchors on lower row, elevation 648.25. Load, test and lock-off anchors as per Specification 02220.

  [14 6] 6 444 1 65 NOF DJ
- Excavate to bottom of lagging, Install underdrains. Proceed with Installing permanent lagging, drainage fabric & backfill. Continue to the upper tieback anchors, elevation 660.75.
- 4. Install upper anchors. Anchor locations are to be pre-drilled and 5-1/2" casing pipe is to be spun to approximate embedment of twelve (12) ft. into rock. Install anchors & grout. After min. three day cure, load, test and lock-off anchors.
  - If more than eight (8) ft. of the 5-1/2" casing pipe is exposed in fill, the casing is to be braced.
- Once tieback anchors are complete, finish the installation of the remaining lagging, drainage and backfull.

NECCO WILL HAVE GASEN COMPARE LOADING COM DIFTENS FOR ASSET ASSET PROCEDURES TO SEE IF IT WILL INCREMENTED DESIGN LOADING

## National Engineering and Contracting Company

National Park Service
Cuyahoga Valley National Recreation Area
National Serial No. 9852-3011
Revised Procedure for Construction

01/28/99 Page No. 3

## NOTE:

This procedure is being submitted as an alternate to the procedure that is described in the Contract Drawings. This alternate procedure is based on the actual conditions. It is the opinion of National Engineering and our subcontractors that the actual conditions that have been identified do not match the conditions that are presented in the Contract Documents. As previously addressed, the existing slope varies from what is shown in the Contract Drawings. This results in compression struts being required in the middle row of the upper wall. Per information that is presented in the Contract Drawings, compression struts would have been required in the upper rows of both walls only. The net result is to increase the quantity of struts that will be needed over what could have been developed from the Contract Drawings. These are considered extra to the scope of work.

Based on field inspection of the in-situ material, Geotech's engineer has stated that the encased pipe for the compression strut will not be able to develop any frictional resistance unless the casing is drilled and grouted into the bed rock. In addition, because of the in-situ material, the compression strut, as detailed in the Contract Drawings, would not be stable laterally when the tieback is loaded.

It is the opinion of AWK Engineers, Geotech and National Engineering that given the differing conditions listed above, the most feasible method to install the tiebacks in the fill situations is to use the 5-1/2" steel pipe casing drilled into the bedrock as presented in this procedure. Since this modification is the result of differing site conditions, it is the opinion of National Engineering that the cost to furnish and install the 5-1/2" steel pipe casing into the bedrock, less the length that replaces the original plan compression strut, is extra to the Contract.

- 2. National Engineering is concerned about the effect of the test loads on the precast lagging. Per Contract Drawing No. 6 of 9, the lagging is to be designed for 770 psf. National Engineering requests that the Engineer confirm that the lagging will not be overloaded when the tieback anchors are subjected to the test loads that will be applied during the performance tests and the proof tests. The maximum test loads for the performance and the proof tests will be 1.33 x the design load of the tieback for either 300 minutes or for 60 minutes, respectively. According to the structural engineer for North American Precast, the same question was raised by him on the calculations that he submitted (Necco Submittal No. 7). The calculations were returned without comment from NPS' engineer. North American Precast's engineer designed the panels to withstand 770 psf as per the contract documents. If the loading of the tiebacks do result in a loading greater than 770 psf being applied to the precast, the precast will crack. North American Precast and National Engineering will not be responsible for the failure of the lagging if this does occur. North American Precast has advised National Engineering today that they are postponing production until they receive direction that the design is acceptable or directions as to modifying the design.
- 3. After inspecting the jobsite, the geotechnical engineer for Geotech has expressed concern about the potential for a slope plane failure of the retaining wall system. He strongly recommended that a slope failure analysis be performed for the wall system if it has not been performed yet. He also recommended that the lagging and the h-piling be analyzed for the construction loads, specifically the test loads. Regardless of the procedure used, the piling and the lagging will be subject to the test loads.

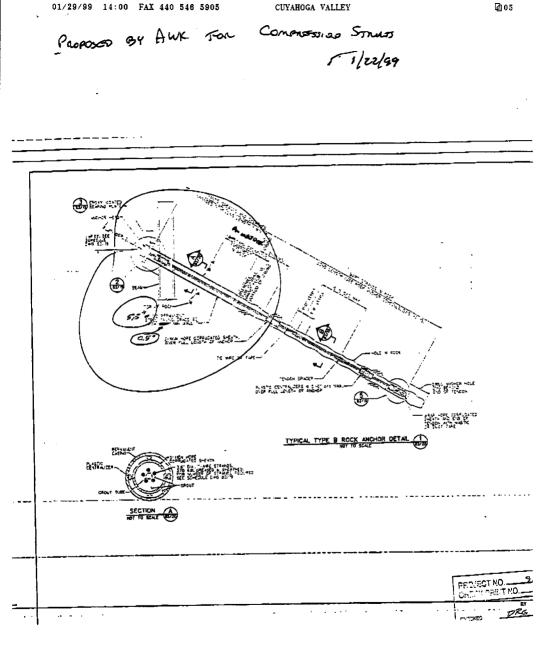
-MIRADIANI GEOTEXING DIANNAGE FABRIC (1/4"THICK) 800 LAGGING (HARDWOOD OR PLATES) (TEMPONAL) ( PERMANENT LAGGINGS ડું 14 % 148/8-つがしっかい 3'-0" 08 10:0

> TYPICAL PLAN EXCAVATED CONDITION

SCALC " /" : 1:0"

1/25/94

CNC





NATIONAL ENGINEERING & CONTRACTING COMPANY 12608 ALAMEDA DRIVE STRONGSVILLE, OHIO 44136 PH (440) 238-3331 / FAX (440) 238-3335



National Serial No. 9852-5010 Contract Number: 1443CX616098008

**DATE: January 20, 1999** 

TO: Mr. Robert Bobel

COMPANY: National Park Service

FAX#: 440-546-5982

FROM: Scott Febus

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL

# of pages > 4

CENE GUGER From Rob Bobel

0001 Fox 4/14 · 275-1354

\*440-546-5982

TOTAL # OF PAGES 4 (including cover)

## MESSAGE:

These are the bench elevations that we have established as of this date for your information.

Thank you,

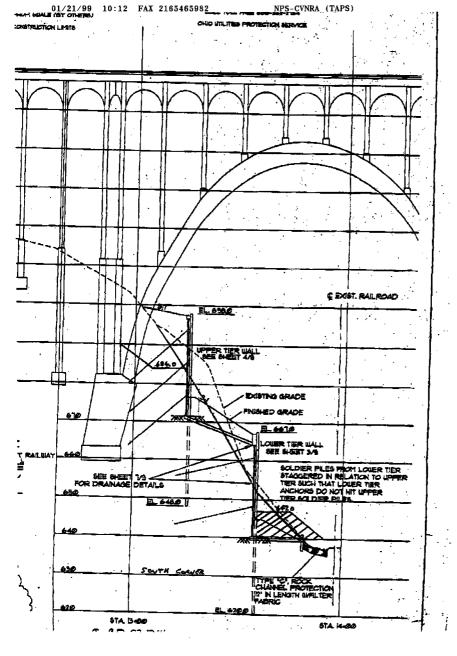
Scott Febus

If fax is not complete - please call Scott Febus at the above number.

cc:

Contract File 9852 E. Chrzanowski

\* INFORMATION FROM Contractor to be Discussed @ Frederic Mtg.



Ø 03

TOTAL P.04

From: Subject: Date:	Gene Geiger@MaterialsMgmt@EngPolicy re: fwd: SR82 Retaining Wall Wednesday, January 20, 1999 6:38 AM		
Attach: Certify:	Υ		
	oduction@D-04 Wrote:		
Comments By: Originally To: Miesle@Produ Originally Fron	Neal Miesle@Production@D-04 Frank Martin@Highway@D-04, Neal ction@D-04, Anthony Pamer@Construction@D-04 n: Bulent Bilgin@Construction@D-04 1/19/99 11:58 AM		
Gene,			
Here is some information from our Project Engineer, Bulent Bilgin. Apparently there is some concern with the width of the geocompostie drains. The meeting is still scheduled for Friday January 22nd at 11:00 am at the National Park Service's Headquarters which is located at the intersection of Vaughn Rd and Riverview Rd. in Cuyahoga County. I don't know if you have been to their facility so I will give you directions assuming you are coming from Columbus. I -71N to I- 271 E to I-77 N to Brecksville Rd (SR 21) exit 145. Go past Ohio Turnpike to Snowville Rd. Make a right here and follow it until the road dead ends into Riverview Rd. Make a left and the light yellow buildings will be on the right hand side. Turn right onto Vaughn Rd. There is a parking lot on the north side of Vaughn Rd. Their phone # is (440) 546-5972. I plan on being there but I do have a conflict with a 10:00 pre-construction meeting in the District.			
   Neal C. Miesle,   District Four PI   (330) 297-0801   	oduction		
Message]	[Original		
progress meeti   National Engind   associate) were	ne project site and attended weekly ng at 10:00 am today. Scott Febus of eering and Rob Bobel and Mr. Dale ( Rob's in attendance. Talked about upcoming roject. Nothing significant this week.		
today, surveyor	is working on dressing up upper wall bench 's are shooting elevations on the slope. meeting on Friday at NPS HQ at 11:00 am, I neeting.		
One of the questions is how to space 4' wide Geocomposite Drains, the plan spacing is given based on 2' wide drain, the manufacturer ( on the list in specs) makes 4' wide drains and can not be cut in half. I understand Neal is looking into this.			

Neal Miesle@Production@D-04

To:

Cc: Bcc:

l   I guess I'll see some of you gentlemen Frida 	ıy.
Regards,	
Bulent Bilgin, P.E.	

See you Friday.

Gene Geiger Geotechnical Engineering Coordinator ODOT Office of Materials Management (614) 275-1318/gegeiger@odot.dot.ohio.gov

## CUYAHOGA VALLEY NATIONAL RECREATION AREA

# MINUTES OF JOB SITE MEETING MEETING #2

PROJECT:

Valley Railway - Slope Stabilization Under SR 82 Bridge

Contract No. 1443CX616098008

DATE:

Tuesday, January 19, 1999

TIME:

10:00 A.M.

PLACE:

Job site trailer

### ATTENDEES:

Rob Bobel

CIIVA

Scott Febus Bulent Bilgin

National Engineering & Contracting

ODOT - D4

 Project Superintendent Rick Skube is in safety training today and tomorrow. Rest of crew will be in and out, as this is National's annual (mandatory) in-house safety training week. All staff must attend at least two days of training this week. Terry Austin will be acting Superintendent.

Status of submittals:

Submittal No.	Status
001	Approved
002	Approved
003	Disapproved
004	Disapproved
005	Approved
006	Disapproved
007	Approved
008	Disapproved
009	in process

3. Status of correspondence:

ItemStatusCondition Report 1written response sent (12/22/98)Condition Report 2written response sent (12/22/98)Condition Report 3pendingCondition Report 4verbal approval given-written pendingCondition Report 5verbal approval given-written pending

4. Questions or changes: At the request of the Contractor, a meeting has been set up this Friday (1/22/99) to discuss the questions relating to tiebacks. In attendance will be: National, their sub-contractor (Geotech Services), the sub-contractor's consultant (AWK Consulting Engineers), the park's title III consultant (Gannett-Fleming), representatives of ODOT (D-4) and Gene Geiger (ODOT central office).

5. This week's schedule (week 17):

Day Monday (1/18) continue establishing benches continue establishing benches continue establishing benches continue establishing benches continue establishing benches Friday - install failure tests

6. Upcoming schedule (week 18):

Day Monday (1/25)

first delivery of solider piles

Tuesday -

install failure tests

Wednesday -Thursday -

install inclinometers/piezometers

7.

install piles install piles

Friday -

Old business: The Contractor is still six weeks behind schedule.

New business: Because of warmer temperatures and melting snow, the Contractor will need to use mats on the access roads and work platforms. A field trip will be set up to visit the pre-cast panel manufacturer as soon as the Contractor informs us the panels are in fabrication.

9. Next job meeting: Tuesday, January 26, 10 AM at the job trailer.

Note: Those wishing to receive an e-mail copy of these minutes are requested to send their e-mail address to the undersigned at: Rob\_Bobel@nps.gov.

Submitted:

Robert W. Bobel, P.E., COR

Attendees

Joyce Stumbo, ACO Billy Davis, CO Tom Bradley, CVNRA Dave Humphrey, CVNRA Pete Birgeles, CVSR

John Kenny, Gannett-Fleming

Dick Kerber, CMPS

Bulent Bilgin, ODOT D-4

Gene Geiger, ODOT Central Office

Richard Beckert, EDG

Robert Y. Liang, University of Akron

Chris Courtney, rep. City of Brecksville

RECEIVED

JAN 29 1999

OFFICE OF MATERIALS MANAGEMENT

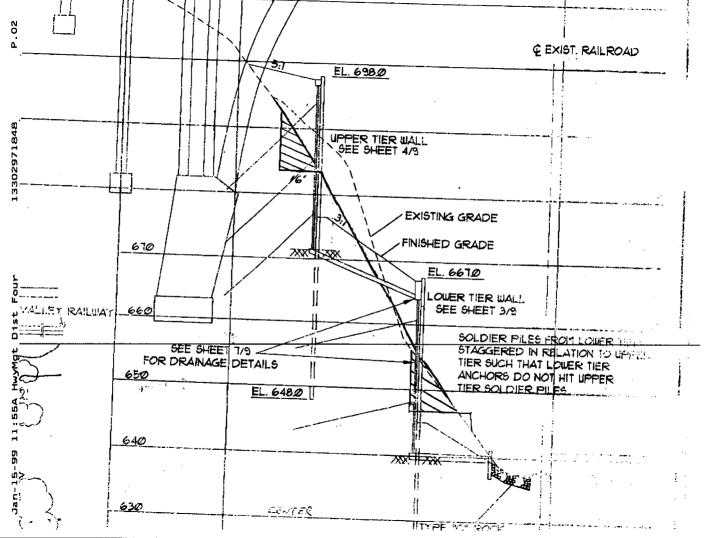
# facsimile TRANSMITTAL

data	, , , , , , ,
date:	1-15-99
•	
to: GEN	GEIGER
from: Fra	nk Martin, P.E., O.D.O.T. Bridge Engineer
7	IE - BACK WALLS
sub:	SUM - 82 - 0000
comme	
_ <u>Z</u> num	ber of pages (including this one)

## ohio department of transportation

705 Oakwood Street Pavenna, Ohio 44266 330-297-0801

fax # 330-297-1848



## Project 9852 National Park Service Contract No. 1443CX616098008 Valley Railway Slope Stabilization

Agenda for Meeting 01/22/99

- Review actual grades & conditions 1.)
- 2.) Compression Struts
  - a.) b.) Alignment
    - 12' min. depth of encasement
- Procedures for construction of walls 3.)
  - Plan
  - Revised? b.)
- Coordination of Inclinometers & Instrumentation 4.)
- Wall Drainage 5.)
- Schedule for work 6.)

## CUYAHOGA VALLEY NATIONAL RECREATION AREA

## MINUTES OF JOB SITE MEETING MEETING #1

PROJECT: Valley Railway - Slope Stabilization Under SR 82 Bridge

Contract No. 1443CX616098008

DATE: Wednesday, January 13, 1999

TIME: 10:00 A.M.

PLACE: Job site trailer

#### ATTENDEES:

Rob Bobel CUVA

Scott Febus National Engineering & Contracting Rick Skube National Engineering & Contracting

Frank Martin ODOT - D4
Brian Hines ODOT - D4

 Job Site Meetings will be held on a weekly basis on Tuesdays at 10:00 AM at the job trailer, unless otherwise noted. Those who do not normally attend, but wish to, should contact the undersigned to insure the meeting will be held as scheduled.

Status of submittals:

Submittal No.	Status
001	Approved
002	Approved
003	Disapproved
004	Disapproved
005	Approved
006	Disapproved
007	Approved
008	Disapproved

Status of correspondence:

1tem	Status
Condition Report 1	written response sent (12/22/98)
Condition Report 2	written response sent (12/22/99)
Condition Report 3	(see below)
Condition Report 4	verbal approval given-written pending
Condition Report 5	Verbal approval given-written pending

Condition Report 5 verbal approval given-written pending Questions or changes: The Contractor has submitted Condition Report 3, which states that the grades as surveyed in the field do not match those shown on the drawings. It was generally accepted this would be the case since some sloughing has occurred since the original survey work for the project over two years ago. The result of this is that more tiebacks will be in fill. The Contractor also has concerns about the stability of the wall system with so many tiebacks being stressed with only struts for support. The COR will set up a meeting with all concerned next week to discuss the problem.

5. This week's schedule (week 16):

Monday (1/11) Tuesday -

establishing upper bench establishing upper bench

Wednesday -Thursday -Friday - establishing lower bench continue establishing benches continue establishing benches

6. Upcoming schedule (week 17):

Day

Monday (1/18) install failure tests

Tuesday -Wednesday -

first delivery of solider piles

Thursday -Friday -

G/F site inspection

7. Old business: (none)

8. New business: The Contractor was informed he will be receiving a <u>Cure Notice</u> due to his being substantially behind as compared to the approved construction schedule.

Note: Those wishing to receive an e-mail copy of these minutes are requested to send their e-mail address to the undersigned at: Rob\_Bobel@nps.gov.

Next job meeting: Tuesday, January 19, 10 AM at the job trailer.

#### Submitted:

Robert W. Bobel, P.E., COR

CC: Attendees
Joyce Stumbo, ACO
Billy Davis, CO
Tom Bradley, CVNRA
Dave Humphrey, CVNRA
Pete Birgeles, CVSR
John Kenny, Gannett-Fleming
Dick Kerber, CMPS
Bulent Bilgin, ODOT D-4
Gene Geiger, ODOT Central Office
Richard Beckert, EDG
Robert Y. Liang, University of Akron
Chris Courtney, rep. City of Brecksville

Bcc:	
From:	Gene Geiger@MaterialsMgmt@EngPolicy
Subject:	SUM-82-0.00
Date:	Monday, January 04, 1999 2:08 PM
Attach:	
Certify:	Υ

Neal,

To: Cc:

I agree that the Amerdrain 200 looks OK. The fabric meets Type A and the core has adequate compressive strength and flow. I don't see any problem with using it.

By the way, what is the status of the construction?

Neal Miesle@Production@D-04

Gene Geiger **Geotechnical Engineering Coordinator ODOT Office of Materials Management** (614) 275-1318/gegeiger@odot.dot.ohio.gov

## FAX COVER SHEET

# OHIO DEPT. OF TRANSPORTATION

DISTRICT 4 705 OAKWOOD ST. RAVENNA, OHIO 44266 FAX: 330-297-7886

TO: Gene Geiger PE GEOTECH ENGRE FAX: (614) 275 - 1354

FROM: Neal Miesle PE ODOT 4

SUBJECT: CONTRACTOR'S SUBMITTAL FOR CHANGING
MATERIAL FOR PGD'S SUM-82-0.00
TIE BACK WALL

THIS TRANSMISSION HAS 2 PAGES INCLUDING THE COVER.

IF YOU HAVE ANY TROUBLE WITH THIS TRANSMISSION PLEASE CALL 330-297-0801 EXT. 347

REMARKS: I CHECKED THIS COMPANY'S WEBSITE THIS

PROTUCT IS ON THE LOW RANGE OF DEPTHS & FLOWS

BUT THIS MATERIAL SEEMS LIKE IT SHOULD BE OK

I HAVE CONTACTOCONTECH FOR SOME FINED ON THEIR PRODUCT

STRIP DRAIN 75. THEY WILL BE FAXING IT TO ME SOON.

ROBEL IS INCLINED TO MAKE CONTRACTOR OBTAIN MATERIAL FROM ONE OF FINE VENDORS IF THIS IS GROWN TO BE A HASSLE. LET ME KNOW WHAT YA THINK.

NEIL MIESLIE

## **AMERDRAIN® 200**

## Soil sheet drain and protection board

AMERDRAIN 200 sheet drain is designed for vertical and horizontal installations at shallower depths where moderate compressive strengths and flow capacity are adequate. AMERDRAIN 200 is a two-part prefabricated soil sheet drain and protection board consisting of a formed polystyrene core covered on one side with a non-woven, needle-punched polypropylene filter fabric. The fabric allows water to pass into the drain core while restricting the movement of soil particles which might clog the core. The core allows water flow to designed exits. Full-coverage protection is provided to waterproofing meterials.



Typical properties	US	SI	Test method
Fabric properties			
Material	Polypropylene	Polypropylene	
Weight	4.0 oz/yd²	136 gm/m <sup>2</sup>	ASTM D3776
Grab tensile strength	115 lbs	52.2 kg	ASTM D4632
Puncture strength	70 Ibs	31.7 kg	ASTM D3787
Trapezoidal tear	50 lbs	22.7 kg	ASTM D4533
Mullen burst strength	240 psi	17 kg/em²	ASTM D3786
Elongation	50%	50%	ASTM D4632
EOS (AOS)	80	80	ASTM D4751
Permeability	0.20 cm/sec	0.20 cm/sec	ASTM D4491
Flow rate	170 gpm/ft <sup>2</sup>	6,926 lpm/m <sup>2</sup>	ASTM D4491
Core properties			
Material	Polystyrene	Polystyrene	
Thickness	0.25 inch	6.35 mm	
Compressive strength	10,800 lbs/R <sup>2</sup>	527 kN /m²	ASTM D1621(Mod.)
Product properties			
Flow capacity per unit width	9 gpm/ft	1 12 lpm/m	ASTM D4716
Roll length	104 <del>ft</del>	31.7 m	
Roll width	4 ft	1.22 m	
Roll weight	60 lbs	27.2 kg	



301 Warehouse Drive Matthews, NC. 28105, USA Phones 800 242-WICK & 704 821-9300 Fax 704 821-6448

. 1

## UNITED STATES GOVERNMENT MEMORANDUM

DATE:

December 22, 1998

TO:

Scott Febus, National Engineering & Contracting Company

FROM:

Robert Bobel, Civil Engineer, CUVA

REF:

Valley Railway-Slope Stabilization Under SR 82 Bridge

Contract No. 1443CX616098008

I have set up a meeting at Park Headquarters to discuss installation methods and procedures for the tieback system for the project.

As we have discussed, your tieback sub-contractor and his Engineer-in-charge will be in attendance.

The time and place will:

Friday, January 22, 1999 11 AM at Park Headquarters conference room Vaughn and Riverview Roads Brecksville

We will visit the site after the meeting.

Please contact me at if you have any questions or need directions.

CC: Joyce Stumbo, Contracting Officer, CUVA
Pete Birgeles, CVSR
John Kenny, Gannett-Fleming
Dick Kerber, CMPS
Bulent Bilgin, ODOT D-4
Gene Geiger, ODOT Central Office
Richard Beckert, EDG
Robert Y. Liang, University of Akron
Chris Courtney, rep. City of Brecksville



Cc: Bcc:

> Neal Miesle@Production@D-04 re: SUM-82-0.00

From: Subject: Date:

Tuesday, November 24, 1998 4:11 PM

Gene Geiger@MaterialsMgmt@EngPolicy

Attach:

Ťo:

Certify:

## Gene.

pressures for the tailer wall. They calculated 751 psf, but apparently did not increase these loads with the appropriate FS factors. I calculated a pressure of 728 psf. but maybe my Ka factor was incorrect. I was considering a FS of 1.3, the lagging should be designed for 1000 psf. Does that sound appropriate? If you want, I can fax you EDG's three page calculations. I am not sure how the park will handle this information. I think they are leaning towards indicating that the pressure stated in the plans was the actual and the fabricator should design the lagging using the appropriate safety factors and or common practices for this type of material. The park is going to provide a copy of these calcs to the precastor.

Rob Bobel of the National Park Service recently sent me EDG's revised earth

The contractor, National Engineering has not begun much work yet, they have surveyed the haul roads for accessing the site. They are arguing with the NPS on the contract duration which is 180 days from the authorization to proceed. I'll keep you up to date.

Neal Miesle (330) 297-0801 ext 347

Gene Geiger@MaterialsMgmt@EngPolicy Wrote:

Neil.

It appears that 770 psf for earth pressure at the base of a 22-foot tier is reasonable, if you assume that the material behind the wall is either shale or granular | backfill (phi = 34 deg.). I would. That's apparently the pressure used to determine the required tieback loads. since they approximately balance the earth pressure.

The pressure of 770 psf is actual. The design of the lagging should have the appropriate FS or load factors applied.

See Chapter 4 of the manual recently sent for info on earth pressures.

Call if you have any questions.

Gene Geiger

**Geotechnical Engineering Coordinator** 

**ODOT Office of Materials Management** 

| (614) 275-1318/gegeiger@odot.dot.ohio.gov

Bcc: From: Gene Geiger@MaterialsMgmt@EngPolicy Subject: SUM-82-0.00

Date:

Friday, November 20, 1998 10:59 AM

Neal Miesle@Production@D-04

Attach:

Certify:

Υ

Neil,

To:

Cc:

It appears that 770 psf for earth pressure at the base of a 22-foot tier is

reasonable, if you assume that the material behind the wall is either shale or granular backfill (phi = 34 deg.). I would. That's apparently the pressure

used to determine the required tieback loads, since they approximately balance

the earth pressure. The pressure of 770 psf is actual. The design of the lagging should have the

appropriate FS or load factors applied.

See Chapter 4 of the manual recently sent for info on earth pressures.

Call if you have any questions. Gene Geiger

**Geotechnical Engineering Coordinator ODOT Office of Materials Management** (614) 275-1318/gegeiger@odot.dot.ohio.gov



## OHIO DEPARTMENT OF TRANSPORTATION

DISTRICT 4, 705 OAKWOOD ST., RAVENNA, OHIO 44266
(330) 297-0801

http://www.dot.state.oh.us

August 31, 1998

Mr. John P. Debo, Jr. Superintendent, National Park Service Cuyahoga Valley National Recreational Area 15610 Vaughn Road Brecksville, Ohio 44141

RE: SUM -82-0.00 SLIDE REPAIR / RETAINING WALL PID 16255

Dear Mr. Debo:

We have reviewed your letter dated August 19, 1998 regarding the above referenced project. The Ohio Department of Transportation District Four recommends that we approve an amount not to exceed \$1,500,000 to fund the above project. Any additional amount will need to be justified. We feel that some of these overruns could be attributed to selling a project that is highly weather sensitive fairly late in a construction season. We also note that ODOT provided approval of the revised detail plans on July 25, 1997. We anticipated this project would have been sold in the late fall or early winter of 1997. That would have provided the contractor with a full construction season to complete this complex project.

We also acknowledge that lump sum items are difficult to bid and estimate. The contractor might bid some of his risk in these items, especially if he feels additional work might be required to complete a particular item. We had previously recommended that the number of lump sum items be held to a minimum.

We strongly recommend that you provide Notice To Proceed by September 1, 1998 so this important project can commence as soon as possible. We need to take advantage of all decent weather that is available.

Respectfully

David R. Dreger, P.E. District 4 Deputy Director

DRD/JK/ncm

RECEIVED

SEP 0 4 1998

OFFICE OF MATERIALS MANAGEMENT

enclosures

c: D. Dreger, M. Kelsey, J. Thorne, J. Paradise, J. Kovach, E. Geiger, F. Martin, File

	Richard Engel@StructuralEng@EngPolicy	
	Jawdat Siddiqi@StructuralEng@EngPolicy	
Cc:		
Bcc:		
From:	Gene Geiger@MaterialsMgmt@EngPolicy	
Subject:	fwd: Manna 16255 Tie-back wall project schedule	
Date:	Monday, July 13, 1998 at 6:52:13 am EDT	
Attach:	• • • • • • • • • • • • • • • • • • • •	
Certify:	Y	
Forwarded By:	Gene Geiger@MaterialsMgmt@EngPolicy	
Comments By:	Gene Geiger@MaterialsMgmt@EngPolicy	
Originally To: [	David R Dreger@Administration@D-04, Joe Paradise@Production@D-04, Joseph	
Kovach@Plann	ning@D-04, John Avery@Highway@D-04, Frank Martin@Highway@D-04, Gene	
Geiger@Materi:	alsMgmt@EngPolicy	
- Selvidici ii	monight with the year	

Originally From: Neal Miesle@Production@D-04
Original Date: 7/10/1998 1:14 PM

smtp@wan@odot[rliang@uakron.edu]

FYI

Comments:

Gene Geiger Geotechnical Engineering Coordinator ODOT Office of Materials Management (614) 275-1318/geqeiger@odot.dot.ohio.gov

Gentlemen.

Rob Bobel of the National Park Service contacted me earlier today to inform ODOT that there will be a pre-bid meeting on Monday July 13 th at 10:00 am at the Park Headquarters which is located at the corner of Riverview and Vaughn Rds. Rob apologized for the late notice, he was out of the country on business and recently had a death in his family. The rest of the schedule for this project is tentatively:

 Bid opening
 7/29/98

 Award date
 8/17/98

 Pre-construction mtg
 8/24/98

 Notice to proceed
 8/24/98

--[Original Message]---

The completion date is currently 180 days after notice to proceed. Rob is considering adding an addendum which would allow for shut down during the winter and resuming in the spring to allow for the erosion repairs, seeding, landscaping etc.

If you have any questions please contact me (ext. 347) or Rob Bobel at (440) 546-5970.

Neal Mielse, P.E.



## Letter of Transmittal

Ohio Department of Transportation
District Four - 705 Oakwood Street Ravenna, Ohio 44266
Phone: (330) 297 - 0801 Extension: (34/2) Fax: (330) 297 - 7886

To: Office of Materials MANAGEMEN ROOM 2033	Date: <u>7//3/98</u> Proj.: <u>Sum-82-0,00</u>
Attn: <u>Eugené Géiger</u> PE	PID: <u>16255</u>
We are transmitting:	Mylars  A Pints  X Specs Other
15 NOT ENOUGH TIME TO BUIL	
Remarks: I CAN GET YOU AD	For review Revise & Resubmit Approved For Use Other  DITIONAL SETS IF NECESSARE ENGEL WOULD LIKE A SET?
Signed: Meal C Milslo	2 JULIANS BY

Alan Norris@Production@D-04 Joe Paradise@Production@D-04 Frank Martin@Highway@D-04 Gene Geiger@MaterialsMgmt@EngPolicy Bcc: From: Neal Miesle@Production@D-04

To:

Cc:

Subject: SUM-82-0.00, PID 16255 tieback slide repair project

Joseph Kovach@Planning@D-04

David R Dreger@Administration@D-04

Date: Friday, May 29, 1998 at 11:32:10 am EDT

Attach: Certify:

Ν

Joe.

I have researched our files on the above project. The original design call for a soldier pile spacing of approximately 16' c/c for the main wall and 12' c/c for the wingwalls. These piles were to be embedded a minimum of 5' into bedrock, although the exact location of the bedrock was variable. It was later found out that the consultant's calculations were based on 10' c/c spacing of the piles and no documentation or new calculations were provided by EDG on why the pile spacing was changed. This represented the original estimate of \$412,625. When this project was awarded, the only bid was approximately \$690,000. The contractor did little work on this project, claiming it was not constructible and unsafe for his men and equipment. This contract was terminated and the design was modified.

Eugene Geiger from ODOT's Pavement and Soils, took a second look at the design. He also received input from FHWA's Dick Chaney who is a national expert on tie back walls. The design was changed to a tighter pile spacing, 8' c/c on the upper wall and 10' c/c on the lower wall. The piles are to be embedded to a specified tip elevation which will be approximately 15' to 20' into bedrock. We also had some concerns about the soil anchors which were in some marginal soils with a high liquid index (LI). In sufficient borings were available in the bond zone so the anchors were changed to rock anchors. Several of the constructibility concerns were hopefully addressed with the revised design. The revised project is estimated at \$959,010 without contingencies.

Here is a brief look at some of the major quantities which were changed which might help explain the increase in estimated costs:

grazitary rescribitati	original quantity	revised quantity
Soldier Pile HP14 x 73	510 l.f.	1555 i.f.
Pre bored Holes above bedrock	360 l.f.	1186 l.f.
Pre bored Holes below bedrock	140 l.f.	252 l.f.
Tie back anchors	40 each	68 each
Testing of tiebacks	43 each	72 each
Temporary shoring	none/incidental	1 L.S.

Many of the other items were previously itemized but are now in a Lump Sum format thus these are difficult to compare such as: earthwork including excavation and haul roads, assisting University of Akron with instrumentation etc. Please note that we have tripled the amount of piling that is being installed but the time frame will be approximately the same as previous (120 days). This project must also be under construction when the adjacent railroad is in one of its busier seasons. I would not be surprised if this project comes in closer to \$ 1.1 million.

If you need any additional information, please notify me as soon as possible. Rob Bobel, from the NPS called today regarding the status of the Intragovernmental Agreement. They need the modified agreement before they proceed with their final processing of this project.

Neal Miesle

## OHIO DEPARTMENT OF TRANSPORTATION

District 4 705 Oakwood St Ravenna, Ohio 44266 (330)-297-0801



George Voinovich

DATE: Friday, July 25, 1997

Mr. Robert Bobel, P.E. National Park Service Cuyahoga Valley National Recreational Area 15610 Vaughn Road Brecksville, Ohio 44141

SUBJECT: SUM-82-0.00 SLIDE REPAIR / RETAINING WALL

Dear Mr. Bobel:

I have recently reviewed the plans and the "Project Manual" for the above referenced project that was received on July 2, 1997. Mr. Eugene Geiger, P.E., Soils Engineering Coordinator has also been asked to review these materials and I have incorporated his comments into this letter. A lot of his comments involve the instrumentation and items associated work Dr. Robert Liang's research. I assume Dr. Liang will be responding to you separately. I believe he has been on vacation this past week thus I have not been able to discuss these details with him.

My comments regarding the marked up plan sheets are:

Sheet No. 1 - Minor drafting change to location map.

Sheet No. 2 - Show piling extending to revised pile tip elevations, minor drafting cleanup.

Sheet No. 3 - Revise spacing of Prefabricated Geocomposite Drains so they are installed behind the lagging, currently the drawing shows some strips being centered around the piles. The spacing along the wings should also be specified. Provide notes or dimensions where the 6 inch underdrains terminate. Spacer should be revised to 10" x 10" x 1/4" to reflect deeper H-pile. Provide minor drafting changes to weld symbols and locations 'Piling and Strut Detail'

Sheet No. 4 - Revise spacing of Prefabricated Geocomposite Drains so they are installed behind the lagging, currently the drawing shows some strips being centered around the piles. The spacing along the wings should also be specified. Provide notes or dimensions where the 6 inch underdrains terminate. Spacer should be revised to 10" x 10" x 1/4" to reflect deeper H-pile. Provide acceptable location of welded splices in soldier piles similar to the way shown on Sheet No. 3.

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ROADWAY ENGINEERING

Mr. Robert Bobel, P.E. National Park Service

Cuyahoga Valley National Recreational Area

SUBJECT: SUM-82-0.00 SLIDE REPAIR / RETAINING WALL

- Sheet No. 5 The wall deflection sections need to be increased in depth to a 15 inch C channel in lieu of the original 12" C channel. This will accommodate the increase in soldier pile and lagging depths. Please have your consultant verify that the section modulus is greater than 100 in<sup>3</sup>. Revise your table to reflect the three design anchor loads shown on sheet no. 6. Minor drafting corrections and cross references.
- Sheet No. 6 In your 'Sequence of Construction' note, please clearly state that the TOP WALL SHALL BE CONSTRUCTED FIRST. Remind contractor that welded splices in piling shall be inspected by x-rays. Note # 4 indicates that tieback lockoff load is 90% of "P", this contradicts the requirements in the project manual. Revise "Project Manual" to be same as this note. Minor drafting corrections and dimensions.
- Sheet No. 7 Do we need any references to ODOT's standard drawings for the catch basins and headwall? Minor drafting corrections and cross referencing.
- Sheet No. 8 Label Cuyahoga River and show flow direction. Consider stating date of survey so contractor does not claim the slope is drastically different than what is shown.
- Sheet No. 9 Modify the grouted rock with the statement "to be repaired". Will the proposed landscaping grow under the bridge and will the root systems create any problems with the anchors?

The following comments apply to the "Project Manual":

- 1) Will this be governed by the 1997 CMS?
- Method of measurement for several items contradict the units described in the "Bid Schedule". Some of the items include Sections: 02220 and 02722 parts 4-1, 4-2 & 4-3. Section 03400 part 4-3 should be changed from "Concrete Slabs" (which does not exist as a pay item) to "Lagging". Section 02225 part 4-4, change "prebored holes, 21", above bedrock" to "prebored holes, 24" above bedrock".
- 3) Any references to 8"x 8" x 1/4" spacers should be changed to 10" x 10" x 1/4".
- Consider adding product reference in Section 02210 to cover filter fabric that will be placed under the rock channel protection.

page three

Mr. Robert Bobel, P.E. National Park Service

Cuyahoga Valley National Recreational Area

SUBJECT: SUM-82-0.00 SLIDE REPAIR / RETAINING WALL

Frank Martin, Gene Geiger and myself all feel that the completion date for this project should be carried into the late spring of 1998 to allow adequate time and weather to properly finish all the earthwork items. If you have any questions about this information or the enclosures, please contact me at (330) 297-0801 extension 347. The project plans and specifications are **approved** for the above project, pending the resolution of the above comments. Please provide written response to the deposition of these comments. Thank you for your cooperation in this matter.

Respectfully,

David R. Dreger, P.E. District Deputy Director

Neal C. Miesle

Neal C. Miesle, P.E.

District Production Bridge Design and Review

DRD/JKP/NCM/nm

enclosures

c. D. Dreger J. Paradise J. Kovach E. Geiger P. Oliva F. Martin Dr. R. Liang file

smtp@wan@odot[thomas.lefchik@fhwa.dot.gov] Bcc: From: Gene Geiger@Location-Design@Design Subject: fwd: SUM-82-0.00, PID 16255, Tieback Retaining Wall Date: Friday, July 11, 1997 10:29 AM Attach: Certify: Forwarded By: Gene Geiger@Location-Design@Design Comments By: Gene Geiger@Location-Design@Design Originally To: Neal Mieste@Production@D-04 Originally Cc: Joe Paradise@Production@D-04, Frank Martin@Highway@D-04, smtp@wan@odot[r1ryi@dax.cc.uakron.edu]. smtp@wan@odot[thomas.lefchik@fliwa.dot.gov] Originally From: Gene Geiger@Location-Design@Design Original Date: 7/11/97 10:21 AM Comments:

One additional comment. I agree that if this project is going to be done late in the year, adequate time be given in the spring to complete earthwork items.

Following are my comments on the preliminary plans and specifications transmitted with your 7-3-97 IOC.

----[Original Message]----

Neal Missis@Production@D-04

Joe Paradise@Production@D-04
Frank Martin@Highway@D-04
smtp@wan@odot[r1ryl@dax.cc.uakron.edu]

Cc:

1. Sheet 3/9: Because of the re-design, Note #2 needs to be revised to show the correct soldier piles to be instrumented.

2. Sheet 4/9: Because of the re-design, Note #2 in the Section View needs to

be revised to show the correct soldier piles to be instrumented.

 Sheet 4/9: Likewise, the notes on the Plan View need to be revised. Note #1should refer to Soldier Pile #30. Note #2 should refer to Soldier Piles #26 and #29.

4. Sheet 6/9: The Sequence of Construction Notes should be revised such that current #6 immediately follows #3. (i.e. Load testing and stressing of the tieback is performed prior to excavating and lagging down to the next row.)

5. Project Manual, Pages 11600-3 and 11600-4: Figures 3 and 4 detailing the Sociations of the instrumentation need to be revised to reflect the re-design.

Mease let me know if you have any questions.

## **Inter-Office Communication**

to: Eugene C. Geiger, P.E., Soils Engineering Coordinator	late: July 3	, 1997	
from: Neal C. Miesle, P.E., District Four Production Bridge Section	on		
subject: SUM-82-0.00, PID 16255 Resubmittal of tie-back retail	ining wall in	National I	Park
Please find enclosed a copy of the revised plans, specifications and project. The new estimate is approximately \$ 1.055 million. Pleas appropriate. The National Park Service (NPS) is requesting that w project can be bid this year. Frank Martin and I feel the NPS shou into next year to allow an adequate period of time to complete the concur or do you feel that this project can be built in late fall?	e review the we expedite ld extend the earthwork	ese as you our review le completi items. Do	feel is so the ion date you
I would like to send out the review comments to the NPS in three appreciate your assistance in this project. If you need any addition (330) 297-0801, extension 347.	weeks if that al informati	nt is possible on, please	le. I call me a
TEM) NCM/nm enclosures			
c. D. Dreger J. Paradise / P. Oliva F. Martin file	ROADWA	Y ENGINE	ERING
nie	JUL 0 9 1997		
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## United States Department of the Interior

#### NATIONAL PARK SERVICE

Cuyahoga Valley National Recreation Area 15610 Vaughn Road Brecksville, Ohio 44141

D52

July 2, 1997

Mr. David Dreger, Deputy Director

ODOT District 4 ATTN.: Neil Measlie 705 Oakwood Street Ravenna, Ohio 44266

Dear Mr. David R. Dreger:

Subject: Review of revised plans and specifications for Slope Stabilization Along the Valley Railway under S.R. 82 Bridge

Enclosed please find three sets of revised plans, specifications and cost estimates for the subject project as discussed with Civil Engineer Robert Bobel. We would appreciate if you would expedite the review of these plans so that we may proceed with bidding yet this year. A set of drawings and specifications will be sent directly to Dr. Robert Liang for his review and comment.

As you will see, the engineer's latest estimate for this project is \$1,054,911.00. Please contact David Humphrey at 216-546-5970 for changes to the original Intra Governmental Agreement,

If you have any questions regarding this matter, please contact Mr. Bobel at 216-546-5972.

Sincerely,

John P. Debo, Jr. Superintendent

Enclosures

**ROADWAY ENGINEERING** 

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□ ADM	☐ PAVTS	☐ B8
COORD	SOILS	□ QA
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## **PROJECT MANUAL**

## **FOR**

## **ROADWAY ENGINEERING**

	JUL 0 9 1997		
PROJECT	☐ ADM	☐ PAVTS	□ B8
	□ COORD	SOILS	□ 0 <i>i</i>
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VALLEY RATLWAY	☐ HYDR	□ VE	

SLOPE STABILIZATION UNDER SR 82 BRIDGE

TASK ORDER NO. 83

## **OWNER**

CUYAHOGA VALLEY NATIONAL RECREATION AREA BRECKSVILLE, OHIO

JUNE 1997



Engineers Landscape Architects Surveyors 450 Grant Street Akron, Ohio 44311-1183 (330) 375-1390

CONTRACTOR	CONTRACT SET NO.
BIDS OPENED19	PROPOSAL
CONTRACT DATED 19	SET NO.



450 GRANT STREET AKRON, OHIO 4431 I-1 183 PHONE (330) 375 - 1390 FAX (330) 375 - 1590

### VALLEY RAILWAY SLOPE STABILIZATION UNDER S.R. 82 BRIDGE TASK ORDER NO. 83 ENGINEER'S ESTIMATE JUNE, 1997

ITEM NO.	DESCRIPTION	EST. QUAN.	UNIT	UNIT PRICE	AMOUNT OF BID
. 1 01505	Mobilizaton & Demobilization	1	L.S.	\$25,000.00	\$25,000.00
2 01570 02110 02921	Site Preparation Work	1	L.S.	120,000.00	120,000.00
3 02210 02225	Earthwork	1	L.S.	85,000.00	85,000.00
4 02220	Tie Back Anchors	1	L.S.	160,000.00	160,000.00
5 02220	Failure Tests	3	E.A.	2,000.00	6,000.00
6 02220	Creep Tests	2	E.A.	1,000.00	2,000.00
7 02220	Performance Tests	· 7·	E.A.	900.00	6,300.00
8 02220	Proof Tests	59	E.A.	150.00	8,850.00
9 02221	Temporary Shoring	1	L.S.	20,000.00	20,000.00
10 02225	Prebored Holes, 24", Above Bedrock	1,186	L.F.	60.00	71,160.00
11 02225	Prebored Holes, 24" Below Bedrock	252	L.F.	200.00	50,400.00
12 02712	Prefabricated Geocomposite Drain	1,920	L.F.	15.00	28,800.00

### VALLEY RAILWAY SLOPE STABILIZATION UNDER S.R. 82 BRIDGE TASK ORDER No. 83 ENGINEER'S ESTIMATE JUNE, 1997

ITEM NO.	DESCRIPTION	EST. QUAN.	UNIT	UNIT PRICE	AMOUNT OF BID
13 02712	6" Pipe Underdrain, Type SP	224	L.F.	25.00	5,600.00
14 02722	12" Solid (Wall) Pipe	102	L.F.	40.00	4,080.00
15 02722	Catch Basin	2	E.A.	2,000.00	4,000.00
16 02722	Headwall	1. 1	L.S.	600.00	600.00
17 02725	Rock Protection	1	L.S.	22,400.00	22,400.00
18 02931 02950	Seeding, Fertilizing, Mulching, & Planting	1	L.S.	20,000.00	20,000.00
19 03400 05120	Lagging	1	L.S.	160,000,00	160,000.00
20 05120	Solder Pile, HP 14x73	1,555	L.F.	60.00	93,300.00
21 05120	Soldier Pile, Channel Section	194	L.F.	80.00	15,520.00
22 11600	Instrumentation Installation and Assistance	1	L.S.	50,000.00	50,000.00
	SUBTOTAL				959,010.00
	Contingency (10%)				95,901.00
	TOTAL				\$1,054,911.00

### VALLEY RAILWAY SLOPE STABILIZATION UNDER S.R. 82 BRIDGE TASK ORDER No. 83 BID SCHEDULE

SUBMIT BID FOR ALL ITEMS. IN CASE OF ERROR IN THE EXTENSION OF PRICES, UNIT PRICE GOVERNS. IN CASE OF ERROR IN SUMMATION, THE TOTAL OF THE CORRECTED BID AMOUNT GOVERNS.

ITEM NO.	DESCRIPTION	EST. QUAN.	UNIT	UNIT PRICE	AMOUNT OF BID
1 01505	Mobilizaton & Demobilization	i	LS.		
2 01570 02110 02921	Site Preparation Work	1	L.S.		
3 02210 02225	Earthwork	1	L.S.		
4 02220	Tie Back Anchors	1	L.S.		
5 02220	Failure Tests	3	E.A.		
6 02220	Creep Tests	2	E.A.		
7 02220	Performance Tests	7	E.A.		
8 02220	Proof Tests	59	E.A.		
9 02221	Temporary Shoring	1	L.S.		
10 02225	Prebored Holes, 24", Above Bedrock	1,186	L.F.		
11 02225	Prebored Holes, 24" Below Bedrock	252	L.F.		
12 02712	Prefabricated Geocomposite Drain	1,920	L.F.		
13 02712	6" Pipe Underdrain, Type SP	224	L.F.		
14 02722	12" Solid (Wall) Pipe	102	L.F.		

### VALLEY RAILWAY SLOPE STABILIZATION UNDER S.R. 82 BRIDGE TASK ORDER No. 83 BID SCHEDULE

ITEM NO.	DESCRIPTION	EST. QUAN.	UNIT	UNIT PRICE	AMOUNT OF BID
15 02722	Catch Basin	2	E.A.		
16 02722	Headwall	1	L.S.		
17 02725	Rock Protection	1	L.S.		
18 02931 02950	Seeding, Fertilizing, Mulching, & Planting	i	L.S.		
19 03400 05120	Lagging	1	L.S.		
20 05120	Solder Pile, HP 14x73	1,555	L.F.		
21 05120	Soldier Pile, Channel Section	194	L.F.		
22 11600	Instrumentation Installation and Assistance	1	L.S.		
	TOTAL				

QUANTITIES FOR UNIT PRICE BID ITEMS ARE ESTIMATED, BUT PAYMENT WILL BE MADE ONLY FOR ACTUAL QUANTITIES OF WORK COMPLETED.

AWARD WILL BE MADE TO ONE BIDDER IN ACCORDANCE WITH THE INSTRUCTIONS TO BIDDERS.

DETERMINATION OF THE LOW BIDDER WILL BE MADE BY TAKING EACH BIDDER'S BASE ESTIMATE.

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## TABLE OF CONTENTS

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SECTION NO.	PREFIX & NO. OF PAGES
Section 01010 - Summary of Work	01010-(2)
Section 01050 - Field Engineering	01050-(2)
Section 01090 - Reference Standards	01090-(2)
Section 01170 - Accident Prevention	01170-(3)
Section 01200 - Project Meetings	01200-(2)
Section 01300 - Submittals	01300-(3)
Section 01400 - Contractor Quality Control	01400-(3)
Section 01505 - Mobilization & Demobilization	01505-(1)
Section 01510 - Temporary Services	01510-(2)
Section 01530 - Barriers	01530-(1)
Section 01560 - Temporary Controls	01560-(2)
Section 01570 - Traffic Regulation & Haul Roads	01570-(1)
Section 01600 - Material and Equipment	01600-(1)
Section 01700 - Project Closeout	01700-(1)
Section 02110 - Clearing & Grubbing	02110-(1)
Section 02210 - Earthwork	02210-(4)
Section 02220 - Tieback Anchors	02220-(17)
Section 02221 - Utility Trenching and Backfill	02221-(3)
Section 02225 - Structure Excavation & Backfill	02225-(2)
Section 02229 - Utility Line Marking	02229-(2)
Section 02712 - Prefabricated Geocomposite Drains	02712-(2)
Section 02722 - Storm Drainage Systems	02722-(2)
Section 02725 - Rock Protection	02725-(2)
Section 02921 - Topsoil	02921-(2)

SECTION NO.	PREFIX & NO OF PAGES
Section 02931 - Seeding, Fertilizing and Mulching	02931-(3)
Section 02950 - Planting	02950-(4)
Section 03100 - Site Concrete Formwork	03100-(2)
Section 03200 - Site Concrete Reinforcement	03200-(2)
Section 03300 - Site Cast-in-Place Concrete	03300-(4)
Section 03400 - Precast Prestressed Concrete Slabs	03400-(6)
Section 05100 - Painted Structural Steel	05100-(4)
Section 05120 - Structural Steel	05120-(5)
Section 11600 - Instrumentation	11600-(8)

#### PART 1: GENERAL

#### 1-1 DESCRIPTION:

- A. The work of this contract consists of the general construction of tieback soldier pile retaining walls, grading, installation of rock protection, piping and underdrain systems and seeding restoration all as shown on the drawings.
- B. All work will be performed under a single contract.
- 1-2 LOCATION: Valley Railway, approximately 1000 feet north of Station Road Bridge Trailhead, indicated as MP 58.95 for the purpose of the contract.
- 1-3 CONTRACTOR'S USE OF PREMISES:
- A. Contractor shall at all times conduct his operations to ensure the least inconvenience to the public.
- B. Confine storage of materials to area designated by Contracting Officer.
- C. Preservation of Natural Features: Confine all operations to work limits of the project. Prevent damage to natural surroundings. Restore damaged areas, repairing or replacing damaged trees and plants, at no additional expense to the Government.
  - Install temporary construction fencing to protect existing trees and plants and root zones at
    the drip line of trees. Do not store material or equipment in these protected areas.
  - Do not remove, injure, or destroy trees or other plants without prior approval. Consult with Contracting Officer, remove agreed-on roots and branches that interfere with construction.
  - 3. Do not fasten ropes, cables, or guys to existing trees.
  - Carefully supervise excavating, grading, filling and other construction operations near trees to prevent damage.
- D. Existing Utilities: Notify Contracting Officer and utility companies of proposed locations and times for excavation.
  - Contractor shall be responsible for locating and preventing damage to known utilities. If damage occurs, repair utility at no additional expense to the Government.
- E. Hauling Restrictions: Comply with all legal load restrictions in the hauling of materials. Load restrictions on park roads are identical to the state load restrictions with such additional regulations as may be imposed by the Park Superintendent. Information regarding rules and regulations for vehicular traffic on park roads may be obtained from the Office of the Park Superintendent. A special permit will not relieve Contractor of liability for damage which may result from moving of equipment.
- F. All work must be done without disrupting normal excursion train runs and the track must be returned for revenue service at the end of each day. Other than times listed below, track occupancy requests shall be submitted for approval by 10:00 a.m. Friday for work to be performed the following week. Permission must be obtained prior to any work being done at night. This Contractor recognizes that other Contractors

may be working on the right-of-way and working schedules may have to be adjusted accordingly.

The Contractor may be granted 24-hour track occupancy from 9:00 p.m. Sunday to 7:00 a.m. Wednesday after June 1 and before October 1. During the month of October, all work must be done around a seven day a week operating schedule. From November 1 to May 31 the Contractor will work around the track's current schedule.

In addition, the Contractor shall submit his plans for hauling material to the job site for review and approval. Temporary and existing haul roads are designated on the plans.

- 1-4 FIELD VERIFICATION: Field verify all new and existing dimensions affecting the work of this contract before ordering products.
- 1-5 CONTRACTOR-FURNISHED ITEMS: All materials, including borrow and aggregates, shall be Contractor-furnished from outside the park.
- 1-6 REFERENCES: All work referenced to ODOT will conform to relevant sections of Ohio's Construction and Material Specifications, 1997 edition indicated herein as ODOT.
- PART 2: PRODUCTS Not used.
- PART 3: EXECUTION Not used.
- PART 4: MEASUREMENT AND PAYMENT
- 4-1 SUMMARY OF WORK: Payment will be included in the bid item to which this work relates.

**END OF SECTION 01010** 

#### PART 1: GENERAL

1-1 SUMMARY: <u>General</u>. This section specifies administrative and procedural requirements for survey work required for layout and execution of the project and survey measurement of quantities for payment as reviewed and approved by the Contracting Officer, all as indicated in the Contract Documents.

#### 1-2 QUALITY ASSURANCE:

<u>Surveyor.</u> Engage a Registered Land Surveyor registered in the State of Ohio, to perform surveying services required.

Geotechnical Engineer. Engage a Registered Geotechnical Engineer registered in the State of Ohio to perform required geotechnical work, i.e., piezometer and inclinometer installation.

### PART 2: PRODUCTS

N/A

### PART 3: EXECUTION

## 3-1 CONSTRUCTION STAKING, LINES AND GRADES:

- A. <u>The Government</u> has provided initial controls (horizontal and vertical) as shown on the drawings. The Contractor shall use these to establish construction controls for the project.
- B. The Contractor shall transfer the line and grade from the controls shown on the plans as is necessary to do the work. He shall also be responsible for the preservation of all stakes and marks, as previously established by the Government. Any and all alterations of previously established survey shall be replaced as before.
- C. As it is the Contractor's responsibility to perform the work from the basic control, the Contractor shall, before performing the work, satisfy himself that he has adequate control to lay out the work for line and grade, and that he fully understands the control as set, in order to ensure the completion of the project as per the plans. If there are any questions or discrepancies pertaining to the survey work, the Contractor shall immediately notify the Contracting Officer for clarification, or for additional control, prior to doing the construction work. For the Contractor to do the work implies that he has complied with this requirement.
- D. <u>The instruments</u> and other equipment used in surveying by the Contractor, as provided in this section, shall be suitable and maintained in proper condition and adjustment for such use. Such surveying shall be performed by personnel qualified and experienced in such work and under the direct supervision of a qualified surveyor.

E. <u>Tolerances in Setting Survey Stakes.</u> Tolerances in setting survey stakes shall not exceed those stated below:

SURVEY STAKE OR MARK TOLERANCE OF ERROR IN ALIGNMENT:

	Distance Ratio	Feet/	Tolerance <u>Feet</u>	
Marks or control hubs and monuments on centerlines and offset centerlines	1:5,000	<u>0.02</u> 100	<u>+</u> 0.01	
Intermediate stakes or marks on centerline and offset centerlines	1:2,500	<u>0.04</u> 100	<u>+</u> 0.02	
Excavation and embankment for the project and other work not otherwise provided	1:500	<u>0.20</u> 100	<u>+</u> 0.10	
Trimming of excavation for pipe bedding ditches and swales	1:1,000	<u>0.10</u> 100	<u>+</u> 0.05	
GRADE STAKES OR ELEVATIONS FOR:		Elevation of (f	Elevation of (ft.)	
Excavation and embankment for the pand other work not otherwise provide for	project d	<u>+</u> 0.10		
Trimming of excavation and embanks unless otherwise provided	nent	<u>±</u> 0.05		
Trimming and preparation for pipe be ditches and swales	dding	<u>+</u> 0.02		

F. The Contracting Officer shall not be responsible for transferring grade from controls to locate the elevation of the work.

## PART 4: MEASUREMENT AND PAYMENT

4-1 FIELD ENGINEERING: Payment will be included in the bid item to which this work relates.

END OF SECTION 01050

#### PART 1: GENERAL

1-1 REFERENCE STANDARDS: The following abbreviations, which may be used in the construction specifications, refer to the organizations and specifications of the organizations listed below:

ACI - American Concrete Institute

Box 5754 Redford Station

Detroit, Michigan 48219-0150

AISC - American Institute of Steel Construction, Inc.

400 N. Michigan Avenue 8th Floor, Wrigley Building

AISI - Chicago, Illinois 60611-4185

American Iron and Steel Institute

1000 16th Street, N.W.

Washington, D.C. 20036-5761

ASTM - American Society for Testing and Materials

1916 Race Street

Philadelphia, Pennsylvania 19103 AWS - American Welding Society, Inc.

550 N.W. Leleune Road

P.O. Box 35140

Miami, Florida 33135

CRSI - Concrete Reinforcing Steel Institute

933 N. Plum Grove Road Schaumburg, Illinois 60195

CRSI - Concrete Reinforcing Steel Institute

38 S. Dearborn Street Chicago, Illinois 60603

NCMA - National Concrete Masonry Association

P.O. Box 781

Herndon, Virginia 22070

NFPA - National Fire Protection Association

Batterymarch Park

Quincy, Massachusetts 02269 National Paint and Coatings Association

1500 Rhode Island Avenue, N.W.

Washington, D.C. 20005
ODOT - Ohio Department of Tran

NPCA -

T - Ohio Department of Transportation

Bureau of Contract Sales

P.O. Box 899

Columbus, Ohio 43215-0899

PCA - Portland Cement Association 5420 Old Orchard Road

Skokie, IL 60077-4321

PCI - Prestressed Concrete Institute

175 W. Jackson Boulevard Chicago, Illinois 60604 PART 2: PRODUCTS Not used.

PART 3: EXECUTION Not used.

PART 4: MEASUREMENT AND PAYMENT Not used.

END OF SECTION 01090

#### PART 1: GENERAL

1-1 DESCRIPTION: The work of this section consists of establishing an effective accident prevention program and providing a safe environment for all personnel and visitors.

#### 1-2 SUBMITTALS:

- A. Accident Prevention Program: Before on-site work begins, submit for approval an accident prevention program. The Contracting Officer will review the proposed program for compliance with OSHA and project requirements. If the program requires any revisions or corrections, the Contractor shall resubmit the program within 10 calendar days after Notice to Proceed. No progress payments will be processed until the program is approved. The program shall include:
- 1. Name of responsible supervisor to carry out the program.

- 2. Weekly and monthly safety meetings.
- 3. First aid procedures.
- 4. Outline of each phase of the work, the hazards associated with each major phase, and the methods proposed to ensure property protection and safety of the public, National Park Service personnel, and Contractor's employees. Identify the work included under each phase by reference to specification section or division numbers.
- 5. Training, both initial and continuing.
- 6. Planning for possible emergency situations, such as floods, fires, cave-ins, slides, explosions, power outages, and wind storms. Such planning shall take into consideration the nature of construction, site conditions, and degree of exposure of persons and property.
- 7. Housekeeping: Section 01560.
- 8. Fire Protection: Section 01510.
- B. Certificates: Provide certificates from a mechanic that all mechanical equipment has been inspected and meets OSHA requirements.
- C. Submit a copy of test reports, as required by OSHA, for personnel working with hazardous materials.
- D. Submit a report of safety meetings and of inspections.
- E. Upon request, submit proof of employees' qualifications to perform assigned duties in a safe manner.

## 1-3 QUALITY ASSURANCE:

- A. Clauses entitled "Accident Prevention" and "Permits and Responsibilities" of the General Provisions. In case of conflicts between Federal, state, and local safety and health requirements, the most stringent shall apply. Equipment or tools not meeting OSHA requirements will not be allowed on the project sites. Failure to comply with the requirements of this section and related sections may result in suspension of work.
- B. Qualifications of Employees:
- 1. Ensure that employees are physically qualified to perform their assigned duties in a safe manner.
- 2. Do not allow employees to work whose ability or alertness is impaired because of drugs, fatigue, illness, intoxication, or other conditions that may expose themselves or others to injury.
- 3. Operators of vehicles, mobile equipment, hoisting equipment, and hazardous plant equipment shall be able to understand signs, signals, and operating instructions, and be capable of operating such equipment. Provide operating instructions for all equipment. Newly hired operators shall be individually tested by an experienced operator or supervisor to determine if they are capable of safely operating equipment.

## 1-4 ACCIDENT REPORTING:

- A. Reportable Accidents: A reportable accident is defined as death, occupational disease, traumatic injury to employees or the public, property damage by accident in excess of \$100, and fires. Within 7 days of a reportable accident, fill out and forward to the Contracting Officer a DI-134 form, which may be obtained from Contracting Officer.
- B. All Other Accidents: The Contractor shall report all other accidents to the Contracting Officer as soon as possible and assist the Contracting Officer and other officials as required in the investigation of the accident.

## PART 2: PRODUCTS

- 2-1 FIRST AID FACILITIES: Provide adequate facilities for the number of employees and the type of construction at the site.
- 2-2 PERSONNEL PROTECTIVE EQUIPMENT: Meet requirements of NIOSH and MSHA, where applicable, as well as ANSI.
- 2-3 BARRIERS: Section 01530.

## PART 3: EXECUTION

- 3-1 EMERGENCY INSTRUCTIONS: Post telephone numbers and reporting instructions for ambulance, physician, hospital, fire department, and police in conspicuous locations at the work site.
- 3-2 PROTECTIVE EOUIPMENT:
- A. Inspect personal protective equipment daily and maintain in a serviceable condition. Clean, sanitize, and repair, as appropriate, personal items before issuing them to another individual.
- B. Inspect and maintain other protective equipment and devices before use and on a periodic basis to ensure safe operation.

#### 3-3 SAFETY MEETINGS:

A. As a minimum, conduct weekly 15-minute "toolbox" safety meetings. These meetings shall be conducted by a foreman and attended by all construction personnel at the worksite.

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B. Conduct monthly safety meetings for all levels of supervision. Notify the Contracting Officer so that he may attend. These meetings shall be used to review the effectiveness of the Contractor's safety effort, to resolve current health and safety problems, to provide a forum for planning safe construction activities, and for updating the accident prevention program. The Contracting Officer will enter the results of the meetings into his daily log.

# 3-4 HARD HATS AND PROTECTIVE EQUIPMENT AREAS:

- A. A hard hat area will be designated by the Contracting Officer. The hard hat area shall be posted by the Contractor in a manner satisfactory to the Contracting Officer.
- B. It is the Contractor's responsibility to require all those working on or visiting the site to wear hard hats and other necessary protective equipment at all times. As a minimum, provide six hard hats for use by visitors. Change liners before reissuing hats.

#### 3-5 TRAINING:

- A. First Aid: Provide adequate training to ensure prompt and efficient first aid.
- B. Hazardous Material: Train and instruct each employee exposed to hazardous material in safe and approved methods of handling and storage. Hazardous materials are defined as explosive, flammable, poisonous, corrosive, oxidizing, irritating, or otherwise harmful substances that could cause death or injury.

# PART 4: MEASUREMENT AND PAYMENT

4-1 ACCIDENT PREVENTION: Payment will be included in the bid item to which this work relates.

1-1 PRECONSTRUCTION CONFERENCE: Before start of construction, Contracting Officer will arrange a meeting with Contractor. The meeting agenda will include the following:

## A. Minimum Agenda:

Correspondence procedures Designation of responsible personnel Labor standards provisions Payroll reports Changes Payments to Contractor Subcontractors National Park Service regulations Accident prevention program (including name of responsible supervisor) Accident reporting Documents required under the contract Park rules and regulations Saturday, Sunday, holiday and night work Safety program (compliance with the "Accident Prevention" clause of the General Provisions) Tentative construction schedule Submittal of shop drawings, project data, and samples Relationship of Division 1 to other divisions

1-2 PROGRESS MEETINGS: The Contracting Officer will schedule periodic meetings with the Contractor and subcontractors. Subcontractors will not be allowed to work until they have attended a meeting. Additional meetings will be held as needed or for new subcontractors.

## A. Minimum Agenda:

Approval of minutes of previous meetings
Review of work progress
Field observations, problems, and decisions
Identification of problems which impede planned progress
Review of submittals schedule and status of submittals
Review of off-site fabrication and delivery schedules
Maintenance of progress schedule
Corrective measures to regain projected schedules
Planned progress during succeeding work period
Coordination of projected progress
Maintenance of quality and work standards
Effect of proposed changes on progress schedule and
coordination
Other business relating to work

PART 2: PRODUCTS Not used.

PART 3: EXECUTION Not used.

# PART 4: MEASUREMENT AND PAYMENT

4-1 PROJECT MEETINGS: Payment will be included in the bid item to which this work relates.

- 1-1 DESCRIPTION: The work of this section consists of submittal requirements before and during construction.
- 1-2 RELATED REQUIREMENTS: Closeout submittals Section 01700.
- 1-3 SCHEDULES: As soon as possible after Notice of Award and before beginning any work, submit Progress Schedule and Schedule of Values as a package. Contracting Officer will review the Progress Schedule and the Schedule of Values for format and content.
- A. Progress Schedule: Submit four copies of Progress Schedule (normally in bar chart form) showing estimated starting and completion dates for each part of the work. The first progress payment will not be issued until an acceptable progress schedule is submitted.
- B. Schedule of Values: Submit a schedule of dollar values based on the Contract Bid Schedule including all bid items. Break down into component parts each bid item involving a series of operations for which progress payments may be requested. The total costs for the component parts shall equal the bid amount for that item, and the total cost of all items shall equal the contract sum. The Contracting Officer may request data to verify accuracy of dollar values. The Schedule of Values will form the basis for progress payments as provided for in the General Provisions.
- 1-4 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:

#### A. General Procedures:

- 1. As specified in the individual sections, forward submittals to Contracting Officer at least 30 days before need for approval. Unless a different number is specified, submit five copies of each shop drawing, three specimens of each sample, and five copies of all other submittals requested, all of which will be retained by Contracting Officer. Submit one additional copy that shall be returned.
- 2. Coordinate all submittals and review them for legibility, accuracy, completeness, and compliance with contract requirements. Forward submittals that are related to or affect one another as a package to facilitate coordinated review.
- List submittals on National Park Service form DSC-1(CS). Contracting Officer will provide an approval stamp. Imprint the front sheet of each item with approval stamp and write the contract number on the lower right corner of every page.
- 4. Submittals will not be accepted for review if identification or approval stamps are missing or are placed on the back of the submittal, an incorrect amount of submittals are submitted, the transmittal form is incorrectly filled out, submittals are not coordinated, or submittals do not show evidence of Contractor's approval.
- Contracting Officer reserves the right to require submittals in addition to those called for in individual sections.

- B. Specific Procedures:
- 1. Shop Drawings: Identify each copy of shop drawings with contract drawing number in lower right hand corner.
- 2. Samples: Samples shall be large enough to illustrate clearly the functional characteristics and full range of color, texture, or pattern.
- 3. Manufacturers' Literature: Submit only pertinent pages; mark each copy of standard printed data to identify products referenced in specification section.
- C. Contracting Officer's Approval:
- 1. Contracting Officer will indicate approval or disapproval of each submittal and the reasons for disapproval.
- 2. After Contracting Officer's review, revise and resubmit as required. Identify changes made since previous submittal.
- 3. When Contracting Officer has approved submittals, Contractor's copies will be returned. Any work done before approval shall be at Contractor's own risk.
- 1-5 APPROVED EQUALS:
- A. For each item proposed as an "approved equal," submit a separate request. With each request submit supporting data, including:
- 1. Drawings and samples as appropriate.
- 2. Comparison of the qualities of the proposed item with that specified.
- 3. Changes required in other elements of the work because of the substitution.
- 4. Name, address, and telephone number of vendor.
- Manufacturer's literature regarding installation, operation, and maintenance, including schematics for electrical and hydraulic systems, lubrication requirements, and parts lists. Describe availability of maintenance service, and state source of replacement materials.
- B. A request for approval constitutes a representation that Contractor:
- 1. Has investigated the proposed item and determined that it is equal or superior in all respects to that specified.
- 2. Will provide the same warranties for the proposed item as for the item specified.
- 3. Has determined that the proposed item is compatible with interfacing items.
- 4. Will coordinate the installation of an approved item and make all changes required in other elements of the work because of the substitution.
- 5. Waives all claims for additional expenses that may be incurred as a result of the substitution.

1-6 MANUFACTURER'S INSTALLATION INSTRUCTIONS: When contract documents require compliance with manufacturer's printed instructions, provide one complete set of instructions for Contracting Officer and keep another complete set of instructions at the project site until substantial completion.

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1-7 PLAN FOR HAUL ROAD ACCESS: Submit plans for haul road access to each site for approval prior to construction.

PART 2: PRODUCTS Not used.

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PART 3: EXECUTION Not used.

# PART 4: MEASUREMENT AND PAYMENT

4-1 SUBMITTALS: Payment will be included in the bid item to which this work relates.

## 1-1 DESCRIPTION:

A. The work of this section consists of preparing and executing a quality control program.

# 1-2 SUBMITTALS:

A Quality Control Plan: At the time of the preconstruction conference, submit for approval a written Contractor Quality Control (CQC) plan. If the plan requires any revisions or corrections, the Contractor shall resubmit the plan within 10 days. The Government reserves the right to require changes in the plan during the contract period as necessary to obtain the quality specified. No change in the approved plan may be made without written concurrence by the Contracting Officer. The plan shall include:

- A list of personnel responsible for quality control and assigned duties. Include each person's qualifications.
- A copy of a letter of direction to the Contractor's quality control supervisor outlining assigned duties.
- Names and descriptions of laboratories to perform sampling and testing, and samples of proposed report forms.
- Methods of monitoring and controlling environmental pollution and contamination as required by regulations and laws.
- 5. Methods of performing, documenting, and enforcing quality control of all work.
- B. Daily Submittals: Submit Daily Quality Control Report showing all inspections and tests on the first workday following the date covered by the report.
- C. Tests: Submit triplicate copies of complete test results not later than three calendar days after the test was performed. Submit failing test results and proposed remedial actions within four hours of noted deficiency. Person performing test shall complete Test Report Information Sheet and include this with the Daily Quality Control Report for that day.
- D. Off Site Inspection Reports: Submit prior to shipment.
- E. Progress Payments: If the CQC plan and Daily Quality Control Reports are not submitted in a timely manner, the Contracting Officer may retain an appropriate amount of the applicable progress payment.

# 1-3 QUALITY ASSURANCE:

A. General: Except for tests or other items of work specified to be performed by the Government, the quality of all work shall be the responsibility of the Contractor. Inspect and test all work often enough to ensure that the quality of materials, workmanship, construction, finish, and functional performance is in compliance with applicable specifications and drawings.

## B. Quality Control Staff:

- The Contractor's designated Quality Control Supervisor shall be employed full time at the project site whenever contract work is in progress.
- The Engineer-in-charge required in section 02220, Tie Back Anchors, may be the contractor's designated Quality Control Supervisor, or one of the members of the Quality Control Staff.

- The Contractor's job supervisory staff may be used to assist the Quality Control Supervisor, supplemented as necessary by additional technicians.
- C. 1. Testing Laboratory and Equipment: Employ certified independent laboratory to perform sampling and testing.
  - All measuring devices, laboratory equipment, and instruments shall be calibrated at
    established intervals against certified standards in accordance with NBS requirements.
    Upon request, measuring and testing devices shall be made available for use by the
    Government for verification tests.
  - The testing laboratory organization shall be experienced in the type of testing work to be done.

## PART 2: PRODUCTS

Not used.

## PART 3: EXECUTION

#### 3-1 OFF-SITE CONTROL:

A. Items that are fabricated or assembled off-site shall be inspected for quality control at the place of fabrication.

## 3-2 ON-SITE CONTROL:

- A. Notify the Contracting Officer at least 24 hours in advance of the initial and follow-up phases.
- B. Preparatory: Perform before beginning each feature of work.
  - Review control submittal requirements with personnel directly responsible for the quality control work.
  - 2. Ensure that provisions have been made for field control testing.
  - 3. Examine the work area to ensure that all preliminary work has been completed.
  - 4. Verify all field dimensions and advise the Contracting Officer of discrepancies.
  - Ensure that necessary equipment and materials are at the project site and that they comply
    with approved shop drawings and submittals.
- C. Initial: As soon as work begins, inspect and test a representative portion of a particular feature of work for quality of workmanship. Review control testing procedures to ensure compliance with contract requirements.
- D. Follow-Up: Inspect and test as work progresses to ensure compliance with contract requirements until completion of work.

## 3-3 DOCUMENTATION:

A. Maintain Daily Quality Control Reports (sample can be attained from Contacting Officer, and will be presented at the Pre-construction Conference) of quality control activities and tests. Daily Quality Control Reports may not be substituted for other written reports required under the General Provisions, such as Disputes, Differing Site Conditions, or Changes.

#### 3-4 ENFORCEMENT:

A. The Contractor shall stop work on any item or feature pending satisfactory correction of any deficiency noted by the quality control staff or the Contracting Officer. Construction shall not proceed on any feature of work containing uncorrected work.

# PART 4: MEASUREMENT AND PAYMENT

- 4-1 CONTRACTOR QUALITY CONTROL:
  - A. Payment will be included in the bid item to which this work relates.

## 1-1 WORK REQUIRED:

A. The work to be included in this section consists of the preparatory work and operations for the assembling and setting up necessary for the project, such as shops, storage areas, sanitary facilities, moving in of personnel and equipment, incidentals to the project site, and any other temporary facilities, as required by the specifications and special requirements of the Contract, as well as by local or state law and regulation. It shall also include attendance at meetings and administration of the Contract.

#### 1-2 FEES:

A. Contractor shall pay all fees associated with this item.

## PART 2: PRODUCTS

#### 2-1 MATERIALS:

A. The Contractor shall furnish all materials and furnishings required for this item. These materials and furnishings will not be considered as a part of the various items of the completed Contract.

## PART 3: EXECUTION

#### 3-1 MOBILIZATION:

A. Prior to commencing work, Contractor shall submit his plans for mobilization of equipment and facilities and location of sanitary facilities, shop, storage areas, etc. for approval.

# 3-2 DEMOBILIZATION AND CLEAN-UP:

A. Upon completion of work, Contractor shall remove all equipment and facilities and clean up all areas associated with this item.

#### 3-3 ADMINISTRATION:

A. Contractor shall administer the Contract as mentioned in the General Conditions.

#### PART 4: PAYMENT

## 4-1 MOBILIZATION/DEMOBILIZATION:

A. Payment for mobilization/demobilization which shall include mobilization, demobilization, attendance at meetings, administration of the Contract and clean-up associated with demobilization shall be made at the Contract lump sum price of:

"Project Start-up". This item will be paid in three equal payments, one in each of the first two payment applications and in the final payment application.

1-1 DESCRIPTION: The work of this section consists of providing temporary services required for Contractor's performance of the work of this Contract.

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## PART 2: PRODUCTS

- 2-1 GENERAL: Temporary materials may be new or used, but must be adequate in capacity for the required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.
- 2-2 SANITARY FACILITIES: Sufficiently lighted and ventilated toilet facilities in weatherproof, sightproof, sturdy enclosures.
- 2-3 FIRE PROTECTION EQUIPMENT: UL Class 2A, 2-1/2-gallon water type, stored-pressure extinguisher and UL Class 10, Type I, 15-pound B:C carbon dioxide extinguisher.

#### PART 3: EXECUTION

- 3-1 WATER:
- A. Non-potable water is available from the River at the site.
- B. Furnish cool, potable water for construction personnel in locations convenient to work stations.
- 3-2 SANITARY FACILITIES:
- A. Place in approved locations secluded from public observation and convenient to work stations. Relocate as work progress requires.
- B. Completely remove sanitary facilities on completion of work.
- 3-3 FIRE PREVENTION AND PROTECTION:
- A. A capable and qualified person shall be placed in charge of fire protection. The responsibilities shall include locating and maintaining fire protective equipment and establishing and maintaining safe torch cutting and welding procedures.
- B. Hazard Control: Take all necessary precautions to prevent fire during construction. Do not store flammable or combustible liquids in historical structures or existing buildings. Provide adequate ventilation during use of volatile or noxious substances.
- C. Locate internal combustion equipment so that exhausts discharge well away from combustible materials.
- D. Welding: Cutting by torch or welding shall be performed only when adequate fire protection is provided.
- 3-4 PROTECTION EQUIPMENT REQUIRED:
- A. Vehicles and Equipment: Provide one extinguisher on each vehicle or piece of equipment.

# PART 4: MEASUREMENT AND PAYMENT

4-1 TEMPORARY SERVICES: Payment will be included in the bid item to which this work relates.

CONTROL CONTRO

1-1 DESCRIPTION: The work of this section consists of furnishing, installing, and maintaining barriers to protect existing facilities and the public from construction operations.

## PART 2: PRODUCTS

- 2-1 GENERAL: Material may be new or used, but shall be suitable for intended purpose. Fences and barriers shall be structurally adequate and neat in appearance.
- 2-2 FENCING: Construction fencing, high density, polyethylene; 4 ft. high; color-orange as manufactured by Tensar Corp. (Rep.: P.S. Construction Fabrics 216/335-3635 or approved equal.
- 2-3 BARRICADES AND SIGNS: ANSI D6.1-78, "Manual on Uniform Traffic Control Devices" (MUTCD), Part VI.
- 2-4 LUMBER: Free of nails, large knot holes and splinters.
- 2-5 BARRIER TAPE: Banner Guard, imprinted with "CAUTION: CONSTRUCTION AREA", manufactured by Reef Industries, Inc., Houston, Texas, or approved equal.

# PART 3: EXECUTION

- 3-1 PROTECTION OF TRAIN TRACKS:
- A. Protection of the train tracks must be maintained at all times. In no instance shall the Contractor engage in an activity that will damage or submit the possibility of damage to the train tracks. The track area must remain free of any interference to the normal operation of the train.
- B. The Contracting Officer retains the right to implement a system of barricades if it is felt the Contractor's construction procedures might interfere with the train operations, its track stability or any aspect which might interfere with the train operation or safety. This will be implemented at no additional expense to the Government.
- 3-2 BARRIER TAPE: Install where directed by Contracting Officer. Keep a minimum of two rolls on site at all times.
- 3-3 REMOVAL: Completely remove barriers no longer needed and when approved by Contracting Officer. Return padlock and key to Contracting Officer.

## PART 4: MEASUREMENT AND PAYMENT

4-1 BARRIERS: Payment will be included in the bid item to which this work relates.

1-1 DESCRIPTION: The work of this section consists of providing temporary controls.

#### PART 2: PRODUCTS

2-1 TEMPORARY SILT FENCE: Material shall be Econofence as manufactured by Webtec, Inc., Charlotte, N.C. or approved equal.

#### PART 3: EXECUTION

- 3-1 HOUSEKEEPING:
- A. Keep project neat, orderly, and in a safe condition at all times.
- B. Provide enough refuse containers for collecting construction debris.
- C. Wet down dry materials and rubbish to prevent blowing dust.
- D. Keep volatile wastes in covered containers.
- E. Utilize excavated material as soon as possible.
- 3-2 DISPOSAL:
- A. Dispose of debris and excess excavated material (including rocks and boulders) that cannot be used in construction outside the park, at an approved landfill or other location.
- B. Unless otherwise specified, all removed material becomes the property of the Contractor and shall be disposed of outside the park.
- 3-3 AIR AND WATER POLLUTION CONTROL:
- A. Take all necessary reasonable measures to reduce air and water pollution by any material or equipment used during construction.
- B. Do not dispose of volatile wastes or oils in storm or sanitary drains.
- 3-4 SOIL EROSION & SEDIMENTATION CONTROL:
- A. Natural vegetation shall be preserved temporarily wherever possible until grading is necessary. Vegetative cover will be established as quickly as possible by topsoiling, fertilizing and mulching disturbed areas.
- B. Stabilization. All slopes, channels, ditches or any disturbed areas shall be stabilized as soon as possible after the final grade or final earthmoving has been completed.
- C. Clean up. Upon final stabilization of the site remove all temporary control facilities, restore finished grades and provide permanent cover as specified.

## 3-5 SILT FENCE:

A. Install temporary silt fence where shown and as detailed on the drawings.

## PART 4: PAYMENT

4-1 TEMPORARY CONTROLS: Payment for temporary controls will be included in the bid item to which this work relates.

## 4-2 SILT FENCE:

A. <u>Payment</u>: Payment for this work which shall include installation, maintenance and ultimate removal of silt fences shall be included in the Contract lump sum price of "Site Preparation Work".

1-1 WORK REQUIRED: The work to be performed under this section consists of furnishing all labor, materials and equipment necessary to maintain traffic on adjacent railroad tracks and haul roads during the construction period, and other related items as specified herein and as indicated on the contract drawings.

#### 1-2 PROTECTION:

Section 02210, Par. 1-5 shall apply to this section.

#### 1-3 RELATED WORK SPECIFIED ELSEWHERE:

Section 02110: Clearing & Grubbing

Section 02210: Earthwork

Section 02931: Seeding, Fertilizing & Mulching

1-4 REFERENCE SPECIFICATIONS: Ohio Department of Transportation Construction and Material Specifications Section 614, Maintaining Traffic, shall be used as the standard for this section.

## PART 2: PRODUCTS Not Applicable

## PART 3: EXECUTION

- 3-1 MAINTAINING TRAFFIC:
- A. Traffic shall be maintained on railroad tracks adjacent to the project throughout construction.
- B. All stockpiles of materials and equipment storage shall be located so as not to interfere with traffic.
- 3-2 HAUL ROUTES: Contractor shall submit plans for delivery of materials to the site for approval by the Contracting Officer.
- 3-3 HAUL ROADS: Maintain haul roads throughout construction. Restore areas to preconstruction conditions upon completion as specified in Section 02931. Contractor shall minimize disturbance in use of haul roads.
- 3-4 REPAIRS: Contractor shall repair any damage to roadways caused by construction. Match existing cross-section of roadways and repair as directed.

#### PART 4: PAYMENT

4-1 Payment for haul roads and railroad track maintenance will be included in the Contract lump sum price for "Site Preparation Work". Payment shall include all labor, materials and other items pertaining to the maintenance and restoration of the haul roads and maintaining rail traffic.

- 1-1 DESCRIPTION: The work of this section consists of the general procedures for handling, storing, and protecting material and equipment.
- 1-2 TRANSPORTATION AND HANDLING: Arrange deliveries of materials in accordance with construction schedules; coordinate to avoid conflict with work and conditions at the site. Deliver materials in undamaged condition, in manufacturer's original containers or packaging and identifying labels intact and legible.
- 1-3 STORAGE AND PROTECTION: Store materials in accordance with manufacturer's instructions, with seals and labels accessible for inspection.
- A. Interior Storage: Maintain temperature and humidity within the ranges required by manufacturer's instructions.
- B. Exterior Storage:
  - Store products subject to damage by the elements in weathertight enclosures.
  - Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
- C. Protection After Installation: Provide adequate coverings as necessary to protect installed materials from damage resulting from natural elements, traffic and subsequent construction. Remove when no longer needed.
- PART 2: PRODUCTS Not used.
- PART 3: EXECUTION Not used.

## PART 4: MEASUREMENT AND PAYMENT

4-1 MATERIAL AND EQUIPMENT: Payment will be included in the bid item to which this work relates.

1-1 DESCRIPTION: The work of this section consists of final cleanup, closeout submittals, and final inspection procedures.

## PART 2: PRODUCTS Not used.

# PART 3: EXECUTION

- 3-1 CLEANING: Remove all tools, equipment, surplus materials, and rubbish. At time of final inspection, project shall be thoroughly clean and ready for use.
- 3-2 PROJECT RECORD DRAWINGS:
- A. Using colored ink, make changes on a set of clean prints of original tracings. Show all changes and revisions to the original design that affect the permanent structures and will exist in the completed work. Reference underground utilities to semipermanent or permanent physical objects. Reference water, sewer, telephone, and electric lines.
- B. Keep record drawings current. Inspection will be made monthly. Certification of accuracy and completeness will be required on monthly payment requisitions. Project record drawings are the property of the Government and shall be delivered to the Contracting Officer before closeout.
- 3-3 CLOSEOUT SUBMITTALS: Submit before final inspection request.
- A. Project Record Drawings: As specified above.
- B. Guarantees and Bonds: As specified in individual sections.
- 3.4 SUBSTANTIAL COMPLETION AND FINAL INSPECTION: Submit written certification that project, or designated portion of project, is substantially complete, and request in writing a final inspection. Contracting Officer will make an inspection within 10 calendar days of receipt of request.
- A. When Contracting Officer determines that the work is substantially complete, he will prepare a list of deficiencies to be corrected before final acceptance and issue a Letter of Substantial Completion.
- B. If Contracting Officer determines that the work is not substantially complete, he will immediately notify Contractor in writing, stating reasons. After completing work, Contractor shall resubmit certification and request a new final inspection.
- 3-5 ACCEPTANCE OF THE WORK: After all deficiencies have been corrected, a Letter of Acceptance will be issued.
- 3-6 POST-CONSTRUCTION INSPECTION: Before expiration of warranty period, Contracting Officer will inspect project and notify Contractor in writing of all deficiencies.

# PART 4: MEASUREMENT AND PAYMENT

4-1 CONTRACT CLOSEOUT: Payment will be included in the bid item to which this work relates.

1-1 DESCRIPTION: The work of this section consists of clearing, grubbing, and removing and disposing of trees, vegetation, and debris.

## PART 2: PRODUCTS

## PART 3: EXECUTION

- 3-1 PROTECTION OF TREES AND PLANTS TO REMAIN: Section 01010.
- 3-2 CLEARING: Remove all trees, brush, and vegetation from areas designated to be cleared. Trim, as directed, low hanging, unsound, or unsightly branches on trees and shrubs designated to remain. Make cuts flush with trunk or branch.
- 3-3 GRUBBING: Remove all stumps, roots, and debris a minimum of 12 inches below original ground. Fill stump and root holes with suitable material in accordance with placement and compaction requirements of Section 02210.
- 3.4 DISPOSAL: Dispose of debris and excess material as specified in Section 01560 and as per construction drawings.

## PART 4: MEASUREMENT AND PAYMENT

4-1 CLEARING AND GRUBBING: Payment will be made at the contract lump-sum price for "Earthwork". Payment to include labor, materials, equipment and all items pertaining to the clearing and grubbing requirements.

- 1-1 DESCRIPTION: The work of this section consists of general site excavation, embankment construction, slope finishing, removal and disposal of excess and unsuitable material and furnishing and placing imported borrow
- 1-2 CLASSIFICATION: All excavation under this section shall be considered unclassified regardless of the nature of material encountered.
- 1-3 PROJECT CONDITIONS: Maintain fills, slopes, channels and ditches within the limits of the new construction until final acceptance. Repair areas damaged as a result of floods, storms or construction. Take necessary precautions to prevent the entrance of soils and other materials into the River or waterways. Refer to Section 01560 for project requirements.

#### 1-4 PROTECTION:

- A. The Contractor shall at all times, protect adjacent properties from damage due to trenching and backfilling. Damage to adjacent properties due to operations by the Contractor shall be repaired at the Contractor's expense to the satisfaction of the Contracting Officer.
- B. The Contractor shall use all precautions necessary to prevent damage or interruptions of service of any utility and shall be responsible for any and all damage to existing structures, utilities, etc., from operations under the Contract. The Contractor shall notify all utilities existing in the area as required by Section 153.64, ORC.

## 1-5 DISPOSITION OF UTILITIES:

A. Rules and regulations governing the respective utilities shall be observed in executing all work under this section. Notify all utilities existing in the area of this operation to verify locations, prior to beginning as required by Section 153.64 ORC.

All known utilities are shown on the drawings. Contact Ohio Utilities Protection Service (1-800-362-2764) 48 hours in advance of any excavations.

- B. Active utilities shown on the drawing shall be adequately protected from damage and removed or relocated only as indicated or specified.
- C. Inactive and abandoned utilities encountered in excavating and grading operations shall be removed, plugged or capped as directed. Report in writing the location of such abandoned utilities.
- 1-6 SUBSURFACE INVESTIGATION: The Contractor shall perform his own independent evaluations should questions arise concerning the nature of existing conditions. A soils report has been performed and is available for inspection from the Contracting Officer and can be seen by contacting the office of the Park Superintendent.

## PART 2: PRODUCTS

#### 2-1 GENERAL:

A. All embankment and backfill material will be subject to approval by the Contracting Officer.

- B. Before importing borrow, use all suitable material obtained from excavation for embankment construction. Obtain approval from the Contracting Officer before importing borrow.
- C. Material for embankment construction shall be free from detrimental quantities of organic materials, and free of all debris, muck, and other unsuitable materials. Frozen material will not be permitted in embankment construction.
- 2-2 IMPORTED BORROW: Clean, readily compatible soil, with all particles passing a 1 ½-inch square opening and with no more than 50 percent by weight of the material passing a No. 200 sieve, as determined by AASHTO T88-81. The portion of material passing the No. 40 sieve shall have a plasticity index of not more than 10, as determined by AASHTO T90-81. Material shall contain no organic material, expansive clays or rocks larger than 1 ½" in diameter. Distribution of material shall be such that no lens or pockets differing substantially from surrounding materials shall exist.
- 2-3 SUITABLE BACKFILL (BF): Soils that contain no rock larger than 6 inches at greatest dimension. If expansive clays are present, such content shall not exceed one-third of the material by volume, and shall be well mixed with noncohesive soils. Material shall be capable of being compacted to the specified densities.

#### PART 3: EXECUTION

- 3-1 STRIPPING AND STOCKPILING TOPSOIL: Prior to general excavation, the Contractor shall strip sod, organics and topsoil to its entire depth from the areas which are to be graded or surfaced. Vegetation and topsoil shall not be stripped when the soil is excessively dry, wet, or in a frozen state. Contractor shall take necessary and practical precautions to prevent mixture of topsoil with subsoil, clay lumps, brush, objectional weed growth, litter, stone and other foreign material that would interfere with planting and seeding operations. Stripped topsoil shall be protected and stockpiled in convenient areas as approved by the Contracting Officer.
- 3-2 GROUND SURFACE PREPARATION: Before excavating or placing embankment, complete all clearing and grubbing, strip all topsoil, and scarify ground surface to provide ample bond between old and new material.
- 3-3 DEWATERING: Except for rock embankment below waterline, unless otherwise specifically authorized in writing, all operations in this section shall be performed in dry surroundings. Any water encountered, either surface or subsurface, shall be removed by pumping, well pointing, subsurface drains, or any other such suitable and approved means. Care shall be taken to avoid damage to adjacent properties as a result of dewatering.

## 3-4 EXCAVATION:

- A. Excavation shall be performed so as to permit segregation and selection of materials of different character in accordance with their suitability. Existing slabs, abandoned utilities, etc., discovered during excavations shall be removed within 2' of finished grades.
- B. All excavations shall be maintained in good condition during construction so as not to impair the attainment of the final slopes and grades called for on the Contract Drawings, and all necessary precautions shall be taken to prevent movement of cut slopes in all excavation areas.
- C. Insofar as feasible, the excavated material shall be placed in its final position but shall not be done in a manner to interfere with satisfactory progress of the work. If transportation of excavated materials directly from their place of excavation to the point of final use would, in the opinion of the Contracting Officer,

interfere with the satisfactory progress of the work, they shall be deposited in storage piles or drying areas located at convenient points approved by the Contracting Officer. All materials so placed shall be entirely removed before completion of the work, unless otherwise directed or permitted by the Contracting Officer.

D. Keep excavations free from impounded water.

## 3-5 EMBANKMENT CONSTRUCTION:

- A. Prior to the placement of fill material, the prepared ground surface shall be proof-rolled to determine location of unsuitable subgrade. Unsuitable subgrade that cannot be stabilized in-place shall be removed and replaced with imported borrow material and compacted according to paragraph 3-7 of this section.
- B. Place embankment material in layers not exceeding 8 inches loose measurement. Compact each layer before placing the next layer. As the compaction of each layer progresses, continually level and manipulate to ensure uniform moisture and density.
- C. Materials having a water content in excess of the allowed tolerance shall be dried or mixed with drier materials prior to being placed in an embankment or fill. Materials having a lower water content than the allowed tolerance shall have water added by traditional mechanical means before being used for fill. If the fill material in place has dried sufficiently to cause cracks in the surface, it shall be disced to a depth of approximately 4 inches and dampened before the fresh material is deposited thereon.

## 3-6 MAINTENANCE OF EMBANKMENT:

- A. The embankment shall be maintained at all times in a manner satisfactory to the Contracting Officer until final completion and acceptance of the work.
- B. Any embankment material eroded or loosened after being placed shall be replaced or recompacted. The replacing or recompaction of materials shall be done in accordance with these specifications at the Contractor's expense.
- 3-7 DENSITY REQUIREMENT: The entire embankment shall be compacted to 95 percent of maximum density as determined by AASHTO T99-81 or T180-74, Method D, at plus or minus 2 percent of the optimum moisture content. Density of compacted material will be made in accordance with AASHTO T191-61, T205-64, or other standard accepted field density testing methods, such as non-destructive nuclear density testing.

Random compaction testing shall be conducted at 100 foot approximate intervals along each lift of material, within the fill area. Testing laboratory shall be chosen by the Contractor. Submit qualifications to the Contracting Officer for approval. Laboratory must meet approval of Contracting Officer prior to utilization of services.

- 3-8 SUBGRADE TOLERANCE: The finish subgrade elevation shall not vary above or below the theoretical grade more than 0.1 foot.
- 3-9 PLACING TOPSOIL: Section 02921.
- 3-10 DISPOSAL: Dispose of all unsuitable material as specified in Section 01560.

# PART 4: MEASUREMENT AND PAYMENT

- 4-1 EXCAVATION: Payment shall be included in the Contract lump sum price of "Earthwork". Payment shall include all labor, materials and other items pertaining to excavation.
- 4-2 DITCH RESTORATION: Payment shall be included in the Contract lump sum price of "Earthwork". Payment shall include all labor, materials and other items pertaining to ditch restoration.

## 1-1 DESCRIPTION:

- A. This work shall consist of a permanent tieback retaining system constructed in accordance with this specification and in reasonable close conformity with the lines, grades, design, and dimensions shown on the drawings or established by the Contracting Officer. The tieback work to be performed shall comply with the contents of the latest edition of "Recommendations for Prestressed Rock and Soil Anchors," published by the Post Tensioning Institute (PTI) located at 301 West Osborn, Suite 3500, Phoenix, Arizona 85013 (telephone 602-265-9158) except as modified herein.
- B. The required tieback elevations and the design loads are shown on the drawings.

## 1-2 QUALIFICATION OF CONTRACTOR:

- A. The Contractor proposing to perform the tieback work for this project shall be prequalified with the Ohio Department of Transportation (ODOT) per the Ohio Revised Code 5525.02 through 5525.09.
- B. Prior to the commencement of tieback work, the Contractor shall submit to the Contracting Officer a report which identifies the Contractor's personnel who will be performing and supervising the tieback work. The report shall include the names of an Engineer-in-charge, on-site supervisors, and drill operators. The report shall also contain a list of employer's names and telephone numbers, location and dates of previous permanent tieback projects, and the extent of work performed. This information must be verifiable. Tieback work shall be defined as all activities related to the tiebacks, including furnishing, fabricating, drilling, installing, and testing the tiebacks.
- C. Further, in order to meet the requirements of ODOT Specification 108.05, the personnel performing tieback work shall have acquired work experience which is not less that the level of experience as defined below:

#### 1-3 ENGINEER-IN-CHARGE:

A. The Engineer-in-charge shall be a registered <u>Professional Engineer</u> and shall be responsible for overseeing the tieback work and verifying the results of the tieback testing. The Engineer-in-charge shall have three (3) years of construction experience in the installation of permanent tiebacks and shall have overseen the successful installation of 100 permanent tiebacks. The work experience time period is computed by the addition of all documented durations of tieback work time on construction projects.

#### 1-4 ON-SITE SUPERVISORS:

A. An on-site supervisor shall be present at the job site at all times during the performance of tieback work. The on-site supervisor shall have one (1) year of construction experience in the installation of permanent tiebacks and shall have supervised the successful installation of 100 permanent tiebacks. The work experience time period is computed by the addition of all documented durations of tieback work time on construction projects.

#### 1-5 DRILL OPERATORS:

A. Drill operators shall have successfully installed 50 permanent tiebacks.

- B. The Contracting Officer will approve or reject the Contractor's personnel within thirty (30) calendar days following the submission of the report of names and verifiable resume information. Tieback work shall not commence until a written letter of approval has been provided by the Contracting Officer. In the event the Contractor elects to substitute personnel, verifiable resume information shall be submitted to the Contracting Officer prior to that individual's performance of tieback work. The Contracting Officer will approve or reject the Contractor's proposed substitute within fifteen (15) calendar days.
- C. The Contracting Officer will take action afforded to him pursuant to ODOT Specifications, including but not limited to Specification 108.05, in order to be assured that all personnel have the sufficient and requisite skill and experience to perform properly the work assigned to them.
- 1-6 DEFINITIONS:
- 1-6-1 Tieback:
- A. A structural system which uses an anchor to secure a tendon which applies a force to a structure.
- 1-6-2 Tendon:
- A. The individual prestressing steel bar or strand with a grease filled sheathing.
- 1-6-3 Anchor (Bond) Length:
- A. The length of the prestressing steel where the tensile force in the prestressing steel is transferred to the ground.
- 1-6-4 Unbonded Length:
- A. The length of the prestressing steel which is free to elongate and is located between the anchorage and the anchor length.
- 1-6-5 Anchor Head:
- A. The nuts or wedging device used to transfer the tension from the prestressing steel to the bearing plate.
- 1-6-6 Bearing Plate Insulation:
- A. The bearing plate insulation material placed between the bearing plate and the concrete bearing surface electrically insulates the tendon from the structure so as to prevent galvanic action.
- 1-6-7 Bracket:
- A. A triangular shaped structural element that may be required to transfer the load from the base plate to the structure when the tendon is not perpendicular to the structure.
- 1-6-8 Anchorage Cover:
- A. The anchorage cover is used to retain corrosion protection grease around the anchor head.

## 1-6-9 Anchorage:

A. The anchor head, bearing plate insulation, bearing plate, bracket, anchorage cover, and other items which transfer the tensile force in the prestressing steel to the structure.

#### 1-6-10 Sheathing:

A. Enclosure around the unbonded length of the prestressing steel to prevent the prestressing steel from bonding to the surrounding grout and to provide corrosion protection.

#### 1-6-11 Coating (Grease):

A. Material used to protect against corrosion and/or lubricate the prestressing steel in the unbonded length. Also used to protect anchor head from corrosion.

#### 1-6-12 Bituminous Seal:

A. The bituminous seal is used to seal the surfaces between the concrete, bearing plate insulation, bearing plate, and the anchor head so as to prevent moisture from reaching and corroding the prestressing steel.

#### 1-6-13 Trumpet:

A. The trumpet consists of one or more pipes. The trumpet protects the upper end of the tendon and prevents grout from entering the porous drainage system.

## 1-6-14 Anchor Grout (Primary Grout):

A. Material that is injected into the tieback hole to cover the anchor length of the tendons and provide the medium for transmitting the tieback load to the bedrock within the anchor length.

## 1-6-15 Secondary Grout:

A. Material that is injected into the tieback hole to cover the unbonded length of the tendons to provide corrosion protection.

#### 1-6-16 Jacking Length:

A. The length of the prestressing steel which is located on the jacking side of the final anchor head position and is tensioned during the stressing of the tieback.

## 1-6-17 Unbonded Testing Length (Stressing Length):

A. The sum of the unbonded length and the jacking length which is equal to the length of the prestressing steel that is free to elongate elastically during stressing.

#### 1-6-18 Tieback Design Load:

A. The load for which the tieback is designed. The tieback design load is the actual tension force on the tieback that will provide equilibrium to the wall system at the maximum loading condition.

#### 1-6-19 Maximum Permissible Load:

A. The maximum permissible load is the maximum load that may be applied to the tieback during any stage of the work. This load is 1.33 times the tieback design load unless a lower load is noted on the drawings.

## 1-6-20 Preliminary Loads:

A. Preliminary loads are loads, less than the lock-off load, that may be required due to staged construction. Where required, preliminary loads are noted on the drawings.

## 1-6-21 Proof Load:

- A. The largest load applied to the tieback when stressing the tendons during a load test. This load is a defined percentage increase in the tieback design load.
- 1-6-22 Lock-Off Load (Transfer Load):
- A. The load carried by the tieback after completion of testing and/or stressing.
- 1-6-23 Alignment Load:
- A. The nominal load maintained on a tieback during testing to assure that the testing equipment remains in proper position.
- 1-6-24 Proof Test:
- A. A tieback load test that requires the application of defined incremental loads to the prestressing steel. The movement of the prestressing steel is recorded at each load increment.

#### 1-6-25 Performance Test:

A. This load test requires the application of defined incremental loading and unloading of the prestressing steel. The movement of the prestressing steel is recorded at each loading and unloaded increment. The maximum load applied during this test is maintained constant for a defined time period while movements are recorded.

#### 1-6-26 Creep Test:

A. The loading and unloading increments for this test are the same as used for a performance test. The movement of the prestressing steel is recorded at each loading and unloading increment and the movement of the prestressing steel is also recorded for a defined extended time period while maintaining certain load increments.

#### 1-6-27 Creep Movement:

- A. The time-dependent movements of the prestressing steel at a constant load.
- 1-6-28 Creep Curve:
- A. A semilogarithmic plot of the creep movement versus time, the units of time plotted on logarithmic axis.

## 1-6-29 Creep Rate:

- A. The slope of the creep curve per log cycle of time over the final decade of the observation period.
- 1-17 Related Work:
- A. Section 11600 Instrumentation.
- B. Section 02225 Structure Excavation and Backfill.
- C. Section 05120 Structural Steel.

## PART 2: PRODUCTS

The Contractor shall make arrangements to acquire the tieback system and all necessary incidentals for construction of the proposed tiebacks.

## 2-1 BEARING PLATE INSULATION:

A. The bearing plate insulation shall be 1/8 inch thick UHMW PE "Korolath" by Koro Corp. or equal and shall have the same length and width as the bearing plate. It shall not creep when subjected to the design load.

### 2-2 BITUMINOUS SEAL:

A. The bituminous seal shall conform to the requirements of ODOT Specification 702.05, 702.06, or 702.11.

#### 2-3 WATERSTOP:

A. The waterstop shall conform to ODOT Item 512, "Water-Stop RX" by American Colloid Company or approved equal.

# 2-4 BAR TYPE PRESTRESSING STEEL:

A. Steel bars shall conform to ASTM A722, "Uncoated High-Strength Steel Bars for Prestressed Concrete."

# 2-5 STRAND TYPE PRESTRESSING STEEL:

- A. The strand shall conform to the requirements of ASTM A416, "Uncoated Seven-Wire Stress-Relieved Steel Strand for Prestressed Concrete;" or
- B. The strand shall conform to compacted strand requirements as per ASTM 799 "Uncoated Seven-Wire Compacted Stress-Relieved Steel Strand for Prestressed Concrete."

## 2-6 SHEATHING:

A. The sheath (bond breaker) shall be either a polyvinyl chloride (PVC), polyethylene, or propylene pipe or tube. The sheath may surround an individual prestressing bar or strand or the set of prestressing bars or strands. The material shall be capable of withstanding damage during shipping, handling, and installation.

The sheath shall have a minimum wall thickness of 0.04 inch. The material is subject to the approval of the Contracting Officer.

The materials shall conform to the following:

PVC

ASTM D 1785

Polyethylene

ASTM D1248

Propylene AST

**ASTM D4101** 

B. The installed sheathing shall permit at least 95 percent of the tendon force to be transmitted to the anchor length. The sheathing shall have a tensile strength exceeding 3,000 pounds per square inch (psi) as determined by ASTM D638 and an izod impact strength exceeding 4 foot-pounds per inch as determined by ASTM D256A.

## 2-7 COATING:

A. The coating shall provide both corrosion inhibited properties and lubricating properties conforming to the following criteria:

Test		Test Method	Acceptance Criteria
а.	Dropping point, °F (°C.)	ASTM D566 or ASTM D2265	Minimum 300 (148.9)
Ъ.	Oil separation @ 160°F (71.1°C.), % by weight	FTMS 791B Method 321.2	Maximum 0.5%
c.	Water, % maximum	ASTM D95	0.1%
d.	Flash point, °F. (°C.) (Refers to oil component)	ATMD92	Minimum 300 (148.9)
e.	Corrosion Test, 5% salt fog @ 100°F.(37.8°C.), 5 mils, min. Hours (Q Panel, Type S)	ASTM B117	For normal environments: Rust grade 7 or better after 720 hours of exposure according to ASTM D610. For corrosive environments: Rust Grade 7 or better after 1,000 hours of exposure according to ASTM D610.
f.	Water soluble ions: 1) Chlorides, ppm max. 2) Nitrates, ppm max. 3) Sulfides, ppm max.	ASTM D512 ASTM D922 APHA 427D (15th ed.)	10 ppm 10 ppm 10 ppm

g.	Soak test, 5% salt fog @ 100°F. (37.8°C.), 5 mils coating, A panels, Type S (modifies). Immerse panels 50% in a 5% salt solution and expose to salt fog.	ASTM D992	No emulsification of the coating after 720 hours of exposure.
h.	Compatibility with sheeting:		
	1) Hardness and volume change of polymer after exposure to grease, 40 days @ 150°F.	ASTM D4289	Permissible change in hardness 15% Permissible change in volume 10%
	2) Tensile strength change of polymer after exposure to grease, 40 days @ 150°F.	ASTM D638	Permissible change in tensile strength 30%

#### 2-8 BEARING PLATE:

A. The bearing plate shall conform to requirements of ODOT Specification 711.

## 2-9 ANCHOR HEAD:

A. The anchor head shall be the standard product of the tendon manufacturer and conform to the requirements of ODOT Specification 711. It shall be capable of transferring 100 percent of the guaranteed ultimate tensile strength (GUTS) from the tendon to the bearing plate.

## 2-10 CENTRALIZERS:

A. Centralizers shall be fabricated from a steel or plastic material that is nondetrimental to the prestressing steel. They shall position the tendons so as to provide the minimum required cover of 1 inch.

#### 2-11 SPACERS:

A. Spacers shall be fabricated from a steel or plastic material that is nondetrimental to the prestressing steel. They shall separate the tendons so as to assure bond between the tendons and the grout in the anchor length.

# 2-12 Grout (Anchor, Secondary, and Incidental):

A. The cement for the grout shall be Type I, Type II, or Type II conforming to ASTM C 150. The grout shall conform to all applicable requirements of ODOT Specification 499. Grout additives should be avoided. Chemical additives which can control, bleed, and/or retard set may be used in the anchor grout as directed by the Contracting Officer.

#### 2-13 TRUMPET:

A. The trumpet shall be made of Schedule 40 galvanized steel pipe conforming to the requirements of ODOT Specification 707.10. The minimum trumpet length shall be as shown on the plans. The length and diameter shall be sufficient for the splay of the tendons. The trumpet shall provide a watertight protection for the tendon. The part of the trumpet not filled with grout shall be filled with grease.

# 2-14 ANCHORAGE COVER:

A. The anchorage cover shall be galvanized steel. The cover can be a standard product of the tendon manufacturer of fabricated in accordance with ODOT Item 711.

#### 2-15 CAPSULE:

- A. The encapsulation material shall be a corrugated plastic tube in the anchor length and smooth plastic tube in the unbonded length. Corrugated plastic tube shall conform to the same requirements as in 2-6. The capsule shall be:
  - 1. Resistant to chemical attack from aggressive environments, grout, or grease.
  - 2. Fabricated from materials nondetrimental to the tendon.
  - 3. Capable of withstanding abrasion, impact, and bending during handling and installation.
  - 4. Free of flaws which would permit water to enter into the tieback system.
  - Capable of transferring stresses from the grout inside the capsule to the grout outside the
    capsule.

#### 2-16 SEAL:

A. The seals shall be resilient neoprene rubber "O" rings or approved equal.

## 2-17 DESIGN REQUIREMENTS:

The Contractor shall be responsible for determining the bond length necessary to develop adequate load capacity to satisfy anchor testing acceptance criteria for the design load specified for each anchor. The Contractor shall use his expertise to determine the drilling method, grout pressures, multiple grouting techniques, bond lengths, and testing setup, as per the requirements and limitations defined in these Special Provisions or on the drawings.

## 2-17-1 Free Length:

A. Each tieback shall have a free length that is not less than that shown on the plans.

#### 2-17-2 Bond Length:

A. The Contractor shall determine the total length necessary to satisfy anchor testing acceptance criteria. The bond length of the anchor shall not be less than 15 feet.

#### 2-17-3 Design Load (P):

A. The design load (P) for each tieback is shown on the drawings. The Contractor shall stress each anchor in accordance with the procedures specified to provide the required design load resistance at each tieback.

#### 2-17-4 Tendon:

A. The tendon size shall be as shown on the plans. The Contractor shall not impose any additional surcharge load on the tendons that can increase the tendon tension beyond 80 percent of the Guaranteed Ultimate Tensile Strength (GUTS).

## 2-17-5 Anchorage:

A. The physical dimensions of the anchorage components shall be as shown on the drawings. The anchorage system shall be suitable for transferring the tension force in the tendon to the structure. The ultimate capacity of the anchorage shall not be less than 95 percent of the Guaranteed Ultimate Tensile Strength (GUTS) of the tendon.

## 2-17-6 Grout Mix Design:

- A. The Contractor shall provide the Contracting Officer with the proposed grout mix design and shall include documentation which indicates that the proposed mix will develop a 7-day compressive strength which is greater than 3500 p.s.i. (AASHTO T 106).
- B. Generally, strength testing of the grout will not be required during construction of the tiebacks because proof-testing of the anchors will verify the performance of the grout as part of the tieback system. The Contracting Officer may request that the Contractor perform compression tests on grout samples obtained from the initial installation of the anchors. Compression strength tests will be required if additional admixtures are used or irregularities occur in grout consistency and/or tieback testing.

#### 2-17-7 Tendon Fabrication:

- A. Tendons shall be shop fabricated. The bond length shall be clean, bare, prestressing steel which will be centralized and covered with grout in the capsule (double corrosion protection). The free length of the tendon shall have the coating and sheath installed at the shop. The corrosion inhibiting coating shall fill all void space within the sheathing and between wires. Strand-type tendons are to be extrusion coated.
- B. Tendons shall be stored and handled in such a manner as to avoid damage or corrosion.
- C. Prestressing steel shall be protected from dirt, rust, or deleterious substances. (A light coating of rust on the steel will not affect the function of the tendon.) Corrosion or pitting is cause for tendon rejection. If the Contracting Officer is uncertain about the extent of the corrosion, the steel shall be tested to determine if the tendon still meets the appropriate ASTM requirements as given in these Special Provisions.

## 2-17-8 Coupler:

A. Coupler type and location shall be as approved by the Contracting Officer. The ultimate capacity of the coupler shall not be less than the GUTS of the prestressing steel.

#### 2-17-9 Electrical Installation:

- A. The prestressing steel and anchorage shall be electrically insulated from the trumpet and the soldier pile. This insulation shall include:
  - bearing plate insulation under the anchorage plate;
  - the sheathing;

- 3. the coating; and
- 4. other features required to prevent galvanic action.

#### 2-17-10 Bearing Plate:

A. In compliance with the design standards, the bearing plate shall be capable of transferring 100 percent of GUTS from the anchor head to the structure. Only bearing area outside of outer diameter of the trumpet shall be considered to carry load. The bearing plate shall have sufficient thickness so as to be capable of spanning from the anchor head to the bearing surface beyond the trumpet.

## 2-17-11 Trumpet:

A. The trumpet shall be designed to protect the upper end of the prestressing steel from mechanical damage, retain the corrosion preventing grease within the trumpet, accommodate movement, and prevent grout from being pumped into the existing and proposed drainage systems.

#### 2-17-12 Seal:

A. Two seals shall be provided to act with the trumpet so as to prevent moisture from entering the end of the trumpet and to prevent loss of grease. The seals shall accommodate the specified movement. During this movement, the displacement of the incompressible grease may cause large displacements of the seal due to hydraulic action. This movement shall not impair the function of the seals.

#### PART 3: EXECUTION

#### 3-1 DRILLING:

A. Auger drilling, rotary drilling. Or percussion driven casing may be used to install the tieback system. The specialty Contractor shall determine the appropriate installation methods. The centerline of the hole for the tendon shall be located within 3 inches of the plan location. No water may be used in drilling.

## 3-2 TENDON:

- A. The tendon shall be centralized and secured inside the corrugated capsule. A leakproof transition shall be provided between the bonded length capsule and the free length capsule. A heat shrinkable sleeve, or another suitable splice, subject to the approval of the Contracting Officer, shall be used.
- B. Centralizers shall position the tendon in the drill hole such that a minimum of 0.5 inches of grout cover outside the capsule and an average of no less than 0.2 inches of grout between the capsule and the tendon is provided for the full bond length of the tendon. The spacing of the centralizers shall not exceed 10 feet. Spacers shall be used to separate elements of multi-elements tendons. A combination centralizer-spacer may be used.

#### 3-3 GROUTING:

A. The grout shall be installed by a positive displacement grout pump. The pump shall be equipped with a pressure gauge which can monitor the grout pressure. (Note the length of hose used to install grout will affect the grout pressure in the tieback system.)

- B. Provisions shall be taken to prevent grout from being pumped into the existing or proposed drainage systems.
- C. The grouting equipment shall be sized to enable the tieback to be grouted in one continuous operation. Neat cement grouts should be screened to remove lump. The maximum size o the screen openings shall be 0.250 inch. Mixing and storage times should not cause excessive temperature build-up in the grout. The mixer should be capable of continuously agitating the grout.
- D. The anchor grout shall be injected from the lowest point of the tieback and cover a minimum of 2 feet of the lower end of the sheathing. The anchor trout shall be placed in one operation. The grout may be placed using grout tubes, casing, or drill rods.
- E. The remainder of the drilled hole shall be filled with secondary grout. This grout shall extend into the trumpet to within 6 inches of the bearing plate and as shown on the drawings.
- F. The grout can be placed before or after insertion of the tendons. The quantity of the grout and the grout pressures shall be recorded. The grout pressures and grout takes shall be controlled to prevent excessive ground heave.
- G. The tieback shall remain undisturbed until grout has cured as specified in 2-17-6.
- 3-4 WELDING:
- A. Suitable precautions shall be taken during all welding operations to prevent damage to the prestressing steel and shall be at the direction of the Contracting Officer.
- 3-5 TRUMPET:
- A. A trumpet shall extend from the bearing plate to the protection over the tendon behind the soldier pile. It shall extend 6 inches beyond existing or proposed drainage system. Two tight fitting seals shall be provided that will prevent loss of the grease from the trumpet and entrance of water into the trumpet, but permit the required movement.
- 3-6 ANCHORAGE PROTECTION:
- 3-6-1 General:
- A. The anchorages shall be protected from rust, mechanical damage, and vandalism.
- 3-6-2 Bituminous Seal:
- A. Apply bituminous seal to the bottom of the bearing plate insulation, bottom of the bearing plate, and the bottom of the anchor head so as to seal the surface between the steel and bearing plate insulation, the surface between the bearing plate insulation and the bearing plate, and the surface between the bearing plate and the anchor head. After final lockoff, coat exposed anchorage with a 20 mil dry film thickness of bituminous seal.
- 3-6-3 Anchorage Cover:
- A. A grease filled anchorage cover shall be installed over all anchor heads and attached so as not to be dislodged.

## 3-6-4 Anchorage Encasement:

A. The anchorage shall be encased in concrete that is securely attached to the soldier pile and provides a minimum of 4 inches of concrete cover over the anchorage.

#### 3-7 COUPLING:

A. If a coupling is used within the unbonded length, it shall be enclosed in a grease filled larger diameter sheath that extends beyond the coupling and is sealed and taped to the sheathing with waterproof tape.

## 3-8 TIEBACK ANGLE:

A. The tiebacks shall be installed at the location and angle shown on the drawings except as directed otherwise by the Contracting Officer. The tieback tolerances are ±3 inches for the vertical and horizontal directions and ±3 degrees for the angle. If the Contractor desires a change in the plan angle, the design load shall be adjusted so that the horizontal force component remains the same as the plan value. The plan tieback angle can only be changed upon approval of the Contracting Officer. Generally, tieback angles are between 15 and 30 degrees.

#### 3-9 SUBMITTALS:

- A. The contractor shall submit his proposed tieback system to the Contracting Officer for review, with a copy to the Ohio Department of Transportation, District 4. The tieback system submission shall consist of details required to completely describe the tieback system and shall include the following:
  - Shop drawings shall be furnished as per all applicable requirements of ODOT Specification 501.05.
  - Manufacturer's literature for all materials to be used.
  - 3. All required material properties shall be furnished.
  - All dimensions and any additional details not shown on the drawings shall be shown.
  - Description of the sequence of construction.
  - The proposed grout mix design.
  - Drawings indicating specifics such as tendon type, tendon capacity, anchorage details
    including concrete encasement, corrosion protection details, the proposed installation
    method, and shop and field welding details. Give coupler type, location, and sheathing
    details.
  - 8. Design calculations of all elements of the tieback system.
  - 9. Repair criteria for damaged sheathing material if field repair is to be attempted.
- B. The Contractor is not authorized to order any of the tieback system components prior to receiving approval from the Contracting Officer of his design for the tieback system. The Contractor can expect the review time period by the Contracting Officer to take no more than 50 calendar days. The Contractor shall not begin the installation of the tieback system until after he has received written approval from the Contracting Officer.

#### 3-10 TESTING:

- A. A calibrated hydraulic jack and pump shall be used to load the tendons. The jack and pump shall be calibrated as a unit. The Contractor shall submit the calibration curve to the Contracting Officer for approval prior to performing any tests. The load cell shall be used in tandem with the jack on all tiebacks. Each load increment shall be totally applied in less than 30 seconds after the jack pump is started. All observation time periods begin when the jack pump is started. The total and creep movements of the anchor shall be measured to the nearest 0.001 inch with a dial gauge. The gauge shall be supported on a reference independent of the structure.
- B. All jacks, pumps, load cells, dial gauges, and other instruments used to measure load and deflection of the tieback system shall be accompanied by documented verification of the calibration of the gauges and devices. The calibration shall have been obtained within the past year and shall have been verified by a reliable testing agency equipped to do the required calibrating. The Contracting Officer shall be furnished with all appropriate documentation.
- C. In no case may a load be applied to the tieback that exceeds the maximum permissible load.
- D. Each tieback system shall be tested as stated herein and as directed by the Contracting Officer. Creep tests shall be conducted on the first two tiebacks installed. A performance test shall be conducted on the third and fourth tiebacks that are installed and on at least 7 percent of the remaining tiebacks. All tiebacks which are not creep tested or performance tested shall be proof tested. Testing shall not be performed on any tieback until after the anchor grout has cured for 7 days, unless otherwise approved by the Contracting Officer. Tiebacks which are tested and do not satisfy the testing acceptance criteria shall be subject to 3-11 and shall not be permitted to be regrouted or retested once the initial testing has been performed.

#### 3-10-1 Failure Test:

A. The Contractor shall install three tiebacks which are not one of the drawing production tiebacks, creep test the tiebacks and then test the tieback system to failure. There shall be two located in the upper tier area see Section No. 11600 for additional details and one in the lower tier area and shall be performed prior to the tier that the tieback(s) are to represent. The Contractor shall design this additional tieback system such that the anchor length is similar to and installed the same as the production tiebacks. The Contractor shall install this additional tieback at a location that is satisfactory to the Contracting Officer. The location of this additional anchor shall be such that damage is not inflicted upon the proposed retaining wall of the existing adjacent properties. This additional tieback shall include the appropriate corrosion protections and shall provide an adequate tendon capacity such that anchor failure can be attained prior to the tendon reaching 80 percent of GUTS.

# 3-10-2 Creep Tests:

- A. Creep tests shall be conducted by incrementally loading, holding the load, measuring movement, and unloading the tieback and recording the movements with the following load sequence:
- P = Tieback design load for production anchor.
- AL = Alignment load which is normally between 2 and 10 percent of the design load.
- 1. AL
- 2. 0.25P
- 3. AL
- 4. 0.25P
- 5. 0.50P

- 6. AL
- 7. 0.25P
- 8. 0.50P
- 9. 0.75P
- 10. AI.
- 11. 0.25P
- 12. 0.50P
- 13. 0.75P
- 14. 1.00P
- 15. AL
- 16. 0.25P
- 17. 0.50P
- 18. 0.75P
- 19. 1.00P
- 20. 1.20P
- 21. AL
- 21. AL
- 22. 0.25P
- 23. 0.50P
- 24. 0.75P
- 25. 1.00P
- 26. 1.20P
- 27. 1.33P
- 28. 1.20P 29. 1.00P
- 30. Lock-off at 0.9P to 1.0P.
- B. Loadings 2, 5, 9, 14, 20, and 27 shall be maintained constant for the following holding periods respectively: 10, 20, 30, 45, 60, and 300 minutes. All other loads shall be held until movement stabilizes (approximately 1 minute). During the holding periods, the movements shall be recorded at each of the following elapsed times: 0, 1, 2, 3, 4, 5, 6, 10, 15, 20, 25, 30, 45, 60, 75, 100, 120, 150, 180, 210, 240, 270, and 300 minutes.
- C. Care must be taken to assure that the applied loads are maintained constant during the holding periods. A load cell shall be used to monitor the applied loads during the holding periods. The total movement and residual anchor movement shall be plotted as a function of a load. A creep curve showing the creep movement for each load increment shall be plotted as a function of the logarithm of time.
- D. The creep tested tieback is acceptable if: the measured elastic movements exceed 80 percent of the theoretical elongation of the unbonded length plus the jacking length at the maximum test load; and the creep curve plotted from the movement data indicates a creep rate of less than 0.08 inch per log cycle of time (i.e. between 30 and 300 minutes), regardless of the tendon length or load.

# 3-10-3 Performance Test:

- A. Performance tests shall be conducted by incrementally loading the unloading the tieback and recording the movements with the following loading sequence:
- 1. AL
- 2. 0.25P
- 3. AL
- 4. 0.25P
- 5. 0.50P

- 6. AL
- 7. 0.25P
- 8. 0.50P
- 9. 0.75P
- 10. AL
- 0.25P 11.
- 0.50P 12.
- 13. 0.75P
- 14. 1.00P
- 15. ΑL
- 16. 0.25P
- 17. 0.50P
- 18. 0.75P
- 19. 1.00P
- 20. 1.20P
- 21. AL
- 22.
- 0.25P
- 23. 0.50P
- 24. 0.75P
- 25. 1.00P
- 26. 1.20P
- 27. 1.33P 28.
- 1.20P 29. 1.00P
- 30. Lock-off at 0.9P to 1.0P.
- Loading Nos. 2, 5, 9, 14, and 20 shall be maintained constant for 10 minutes. If the total movement observed in 10 minutes exceeds 0.04 inch, the test load shall be held for an additional 50 minutes. Loading No. 27 shall be maintained constant for 60 minutes (holding period). All other loads shall be held until movement has stabilized (approximately 1 minute). During the holding period, the movements shall be recorded at each of the following elapsed times: 0, 1, 2, 3, 4, 5, 6, 10, 15, 20, 25, 30, 45, and 60 minutes. Care must be taken to assure that the applied load is maintained constant during the holding period. A load cell shall be used to monitor the applied load during the holding period. A creep curve showing the creep movement between 1 minute and 60 minutes shall be plotted as a function of the logarithm of time.
- C. A performance tested tieback is acceptable if:
  - 1. The measured elastic movements exceed 80 percent of the theoretical elongation of the unbonded length plus the jacking length at the maximum test load; and
  - 2. The total movement measured at the anchor head is less than the theoretical elastic elongation of the tendon length measured from the head of the jack to the center of the installed bond length; and
  - 3. The creep movement between 1 and 10 minutes is less than 0.04 inch.
- Performance tested tiebacks which fail to meet acceptance criteria (1) above will be acceptable if the maximum load is held for 60 minutes and the creep curve plotted from the movement data indicates a creep rate of less than 0.08 inch per of cycle of time.

#### 3-10-4 Proof Test:

- A. All tiebacks which are not subject to creep tests or performance tests shall be proof tested. Proof tests shall be conducted by incrementally loading and recording the movements as per the following loading sequence:
- 1. AL
- 2. 0.25P
- 3. 0.50P
- 4. 0.75P
- 5. 1.00P
- 6. 1.20P
- 7. 1.33P
- 8. 1.00P
- 9. Lock-off
- B. Loading No. 7 shall be maintained constant for 10 minutes (holding period). All other loads shall be held until movement has stabilized, but not less than 1 minute. During the holding period, the movement shall be recorded at each of the following elapsed times: 0, 1, 2, 3, 4, 5, 6, and 10 minutes. The total movement shall be plotted as a function of load for each proof tested tieback. A proof tested anchor is acceptable if:
  - The total movement measured at ¼ the design load and at the test load exceeds 80 percent of the theoretical elastic elongation of the free stressing length for this load range; and
  - 2. The pattern of movements is similar to adjacent acceptable performance tests; and
  - Proof tested anchors which fail to meet the above acceptance criteria will be acceptable if the load is maintained until a creep rate is determined and the creep rate is less than 0.080 inch per log cycle of time.

#### 3-11 REDESIGN:

- A. If the Contractor desires to use a tieback that has failed to satisfy testing acceptance criteria, he must obtain approval from the Contracting Officer. The total movement measured at the anchor head must have been greater than 80 percent of the theoretical elastic elongation of the free length. The Contracting Officer will determine the magnitude of load resistance that can be assigned to the failed tieback. An additional tieback shall then be installed at a location approved by the Contracting Officer, and in accordance with these Special Provisions. This additional tieback shall be tested to determine if the total capacity of the failed tieback plus the additional tieback exceeds the 1.33P load.
- B. The additional tests described in this section and all replacement and/or additional tiebacks which are necessary as a result of the Contractor's procedures shall be furnished at no additional cost.

# 3-12 CUTTING OF PRESTRESSING STEEL PROTRUSIONS:

A. After a tieback has been accepted by the Contracting Officer, the portion of the anchored prestressing steel protruding over the anchorage may be cut, if not otherwise required for use in retesting. Cutting shall be done to the prestressing steel manufacturer's recommendations and as approved by the Contracting Officer. Care shall be taken not to damage the anchorage. Cutting shall be done prior coating the anchorage.

# 3-13 FINAL REPORT OF TIEBACK INSTALLATIONS:

- A. During each week of the time period when tieback work is in progress, the Contractor shall furnish to the Contracting Officer three copies of a tieback report. This report shall be submitted at the end of each week and shall contain the following information:
  - 1. A tabulation of data from all tieback testing;

- 2. Plots of all graphical test data:
- B. The Contractor shall also furnish three copies of a final report to the Contracting Officer and 4 copies to O.D.O.T. District 4, in a bound 8-1/2 inch by 11 inch format, which is to include the above items, plus the following:
  - 1. Type of instrumentation used for conduction testing;
  - Testing procedures;
  - Construction procedures;
  - Grouting records;
  - 5. Construction difficulties and/or special techniques;
  - 6. Final tieback locations, bond length, free length, and angles; and
  - 7. A discussion describing the failure test procedures and results.
- C. The reporting of this information is considered incidental to the installation of the tiebacks.

# PART 4: METHOD OF MEASUREMENT AND PAYMENT

- A. Tieback Anchors: Payment will be included in the Contract each of "Tieback Anchors". Payment shall include all materials, labor, equipment and other items pertaining to the installation of the tieback anchors.
- B. Failure Tests: Payment will be included in the Contract each of "Failure Tests". Payment shall include all materials, including the non-production tiebacks, labor, equipment and other items pertaining to the failure tests.
- C. Creep Tests: Payment will be included in the Contract each of "Creep Tests". Payment shall include all materials, labor, equipment and other items pertaining to the creep tests.
- D. Performance Tests: Payment will be included in the Contract each of "Performance Tests". Payment shall include all materials, labor, equipment and other items pertaining to the performance tests.
- E. Proof Tests: Failure Tests: Payment will be included in the Contract each of "Proof Tests". Payment shall include all materials, labor, equipment and other items pertaining to the proof tests.

1-1 DESCRIPTION: The work of this section consists of trenching and backfilling for the construction and installation of pipelines, conduits, and cables. All trenching will be open cut.

# 1-2 QUALITY ASSURANCE:

- A. All references to percent of maximum density will be as determined by ASTM D698 latest edition, Method C, at a moisture content determined to be suitable for such density. Moisture-density curves will be prepared in a certified soils testing laboratory.
- 1-3 SUBMITTALS: As specified in Section 01300.

- A. Written procedure for trench dewatering and disposal of fluidized materials removed.
- B. Written description of barricading, shoring, cribbing, bracing, and sloping precautions.
- 1-4 RELATED WORK SPECIFIED ELSEWHERE:
- A. Utility Line Marking: Section 02229
- 1-5 PROJECT CONDITIONS:
- A. Arrange construction sequences to provide the shortest practical time that the trenches will be open to avoid hazard to the public and to minimize the possibility of trench collapse.
- 1-6 EXCAVATION CLASSIFICATION: Regardless of the nature of material excavated, all excavation will be considered unclassified.

#### PART 2: PRODUCTS

- 2-1 GENERAL: All backfill material shall be approved before use and be free of cinders, ashes, ice, frozen soil, large hard clods, organic debris, or other deleterious items.
- 2-2 BACKFILL MATERIALS: Materials used in backfill, is defined as follows:
- A. Bedding (BD): Material shall be as specified in ODOT Section 603.04 for Class B, except that slag is not permitted.
- B. Suitable backfill (BF): See Section 02210.

# PART 3: EXECUTION

# 3-1 TRENCH EXCAVATION:

A. Trenching Guidelines: Excavate the trench to the approximate level of the top of the utility line to be installed, using adequate trench width and side slopes to safely accommodate worker access. Continue excavating for the utility line, to a width not greater than is shown on the appropriate trench detail.

- Rocky Trench Bottom: Where ledge rock, hard pan, boulders, or sharp-edged materials are
  encountered, over-excavate a minimum depth of 6 inches below the bottom of the utility
  exterior wall to permit adequate bedding preparation. The installed utility shall have at least
  6 inches of any clearance from any rock protrusion.
- 2. Unstable Trench Bottom: Secure approval of depth of over-excavation and stabilization method. For wet trench construction, use approved method of dewatering through diversion, damming and pumping, well points, or underdrain systems. Dispose of removed fluidized materials as approved. Use bedding material to build a suitable foundation to within 6 inches of finished utility grade, prior to bedding with the specified material. Compact layers to 95 percent of maximum density in not greater than 6-inch layers. Do not proceed with utility installation until wet trench and unstable conditions are under control.
- Hand Excavation: Perform hand excavation of trenches dug within the drip line of selected trees as shown. Carefully excavate around all roots 2 inches in diameter and larger to ensure against damage.

# 3-2 SHORING AND SHEETING:

- A. Construct and maintain all shoring, sheeting, and slope lay-back necessary to protect the excavation, as needed for the safety of the employees and as required by applicable State and Federal laws.
- B. For trenches over 5 feet deep, provide suitable barricades for worker protection. When work area is left open and unattended by Contractor, provide suitable barricades for public safety, regardless of trench depth.
- C. For trenches over 4 feet deep, provide suitable exit means in accordance with applicable provisions of OSHA.
- D. Do not remove timber or sheeting if it is in a compacted zone. Instead, trim it off at a safe level above that zone.
- E. As directed, remove all other sheeting and shoring when safe to do so.

# 3-3 BACKFILLING:

- A. Compaction: Use vibratory compactors for sands and gravels (noncohesive soils). Use mechanical tampers for sand and gravel containing a significant portion of fine-grained material, such as silt and clay (cohesive soils). Hand tamp around pipe or cable to protect the lines until adequate cushion is attained. Puddling or water flooding for consolidation of backfill or compaction by wheel rolling with construction equipment will not be permitted.
- B. Utility Installation: Shape the trench bottom to ensure uniform contact with the full length of the installed line and remove any sharp-edged materials that might damage the line. Compaction shall be maintained beneath the line.
- C. Suitable Backfill: Place backfill above the utility in not more than 6-inch layers. Compact each layer to 95 percent of maximum density.

# 3-4 SURFACE FINISH WORK:

A. Open and Seeded Areas: Grade all disturbed areas to a finish ordinarily obtained from a blade grader, with no abrupt changes in grade or irregularities that will hold water.

- B. Drainage Ditches: Restore drainage ditches to appropriate line and grade, using approved surface erosion prevention techniques.
- C. Clean-Up: Prior to final inspection and acceptance, remove all rubbish and excess material for disposal as approved, and leave area in a neat, satisfactory condition.

# PART 4: MEASUREMENT AND PAYMENT

- 4-1 UTILITY TRENCHING AND BACKFILLING: Payment will be included in the bid item to which this work relates, and shall include the costs for density testing.
- 4-2 TEMPORARY SHORING: Payment shall be included in the Contract Lump Sum Price of "Temporary Shoring". Payment shall include all labor, materials and other items pertaining to Temporary Shoring.

1-1 DESCRIPTION: The work of this section consists of structure excavation and backfill for the tieback wall and headwall structure.

- 1-2 QUALITY ASSURANCE: Testing required to determine compliance for the work of this section will be the responsibility of the Contractor under the cash allowance specified in the item to which it pertains. The Contractor shall cooperate by rerouting equipment or by temporarily closing the immediate work area being tested. Areas where test results indicate noncompliance shall be corrected before placing additional embankment. Contractor shall employ the laboratory and testing firm approved by the Contracting Officer to perform testing:
- A. AASHTO T99-81, Method D, will be used to determine maximum density, and AASHTO T191-61, or a standard nuclear method, will be used to determine in-place density. In-place densities specified are minimums and may be exceeded.
- 1-3 CLASSIFICATION: All excavation under this section will be considered unclassified regardless of the material encountered.
- 1-4 SUBMITTALS: The Contractor shall prepare and submit for approval by the Contracting Officer, a plan detailing the method of water control including construction, maintenance and subsequent removal of all cofferdams, cribs, sheeting, shoring, bracing or other materials necessary to safely support the sides of excavations, embankments or adjacent structures and all pumping necessary to complete the required construction.

# PART 2: PRODUCTS

- 2-1 GENERAL: All backfill material shall be approved before use and be free of cinders, ashes, ice, frozen soil, large hard clods, organic debris, or other deleterious items.
- 2-2 BACKFILL MATERIALS: Materials used in backfill, is defined as follows:
- A. Bedding (BD): Material shall be as specified in ODOT Section 603.04, except that slag is not permitted and the material shall meet the gradation requirements of No. 57 Aggregate.
- B. Select Backfill (SB): Materials shall meet the gradation requirements of No. 57 Aggregate, Grading A, except that slag is not permitted.
- C. Suitable backfill (BF): Soils that contain no rock larger than 6 inches at greatest dimension. If expansive clays are present, such content shall not exceed one-third of the material by volume, and shall be well mixed and noncohesive coils. Material shall be capable of being compacted to the specified densities.
- 2-3 FILTER FABRIC: Material shall be woven or non-woven meeting the requirements of ODOT Section 712.09, Type A.

# PART 3: EXECUTION

- 3-1 GENERAL:
- A. Provide required bracing, shoring, sheeting for installation of specified structures.
- B. If the Contracting Officer approves excavation below the design elevation because of unsuitable foundation material, an equitable adjustment will be made. If unauthorized overexcavation occurs, repair the area by backfilling with lean concrete (2000 psi min.) at no additional expense to the Government.
- C. Upon completion of excavation and before placing forms or structure(s), notify the Contracting Officer who will inspect the excavation and may take tests to determine soil bearing values.
- 3-2 EXCAVATION MATERIALS: Use suitable material removed from excavation as backfill before importing backfill.
- 3-3 DISPOSAL: Dispose of surplus and unsuitable material as specified in Section 01560.

# PART 4: MEASUREMENT AND PAYMENT

- 4-1 STRUCTURE EXCAVATION AND BACKFILL: Payment will be included in the price for "Earthwork".
- 4-2 COFFERDAMS, CRIBS AND SHEETING: Measurement will be lump sum. Payment will be made at the contract lump sum price for "Earthwork".
- 4-4 PREBORED HOLES, 24" ABOVE BEDROCK: Measurement will be based on the linear foot of holes bored in the field. Payment will be at the contract unit price per linear foot which shall include excavation, encasement (concrete, ODOT Class "C" and lean concrete above the Class "C" where required), backfill and dewatering. Payment shall be based on holes bored above bedrock and paid at the Contract unit price for "prebored holes, 21", above bedrock.
- 4-5 PREBORED HOLES, 24" BELOW BEDROCK: Measurement will be based on the linear foot of holes bored in the field. Payment will be at the contract unit price per linear foot which shall include excavation, encasement (concrete, ODOT Class "C"), backfill and dewatering. Payment shall be based on holes bored below bedrock and paid at the Contract unit price for "prebored holes, 24", below bedrock.

- 1-1 DESCRIPTION: The work of this section consists of furnishing and installing utility line marking.
- 1-2 SUBMITTALS: As specified in Section 01300.
- A. Samples: 24-inch strips of tape.
- B. Certification that the materials used in the tape fabrication meet the requirements of this section.

# PART 2: PRODUCTS

- 2-1 MARKING TAPE: Capable of bing inductively detected electronically.
- A. Construction: Metallic foil laminated between two layers of impervious plastic film not less than 2 inches wide. The adhesive shall be compatible with the foil and film. Total thickness of tape shall not be less than 0.005 inch (5 mil).
- B. Film: Inert plastic. Each film layer shall be not less than 0.0005 inch thick (0.5 mil).
- C. Foil: Not less than 0.0005 inch thick (0.5 mil).
- D. Imprint: 3/4-inch or larger bold black letters.
- E. Legend: The buried utility line tape shall be identified with imprint such as "Caution: Sewer Line Below" and the identification repeated on approximately 24-inch intervals.
- F. Background Color: American Public Works Association color code and as specified below:

# Color

#### Utility

Safety Red

High Visibility Safety Yellow

Safety Alert Orange

Safety Precaution Blue Safety Green

Safety Brown

Electric

Gas, Oil, Steam, Dangerous Materials

Telephone, Communications, Cable Television

Water System, Irrigation

Sanitary Sewer, Storm Sewer

Force Mains, Reclaimed Water, Effluent Lines

G. Detectable marking and warning tape shall be as manufactured by Lineguard, Inc., Wheaton, Illinois, Reef Industries, Inc., Houston, Texas, Thor Enterprises, Inc., Waterloo, Wisconsin, or approved equal.

# PART 3: EXECUTION

#### 3-1 MARKING TAPE:

- A. Install tape in backfill directly over each buried utility. Place tape during the final backfilling operation at 18" below the surface.
- B. Where utilities are buried in a common trench, identify each line by a separate warning tape. Bury tapes side by side directly over the applicable line.

# PART 4: MEASUREMENT AND PAYMENT

4-1 UTILITY LINE MARKING: Payment will be included in the contract lump sum price for which it applies.

1-1 DESCRIPTION: This item consists of furnishing and installing prefabricated geocomposite drains (PGD) behind the retaining walls. The PGD shall be installed in accordance with these requirements, and to the details and dimensions called for on the drawings.

1-2 RELATED WORK: Section 02722 - Storm Drainage Systems.

# PART 2: PRODUCTS

- 2-1 GEOTEXTILE FABRIC: ODOT Specification 712.09 Type A or the geotextile supplied with the PGD.
- 2-2 BACKFILL: Sharp angular stones shall not be permitted adjacent to the PGD.
- 2-3 PGD SYSTEMS: The Contractor shall use one of the following:

A. Miradrain 2000 Nicolon/Mirafi, Inc. 3500 Parkway Lane, Suite 500 1-800/234-0484

B. Battle Drain 1 Linq Industrial Fabrics Co. 2550 West Fifth North Street Summerville, SC 29483-9699 1-800/543-9966

C. Hyrdaway 100 Monsanto Company 800 N. Lindberg St. Louis, MO 63167

St. Louis, MO 6316 1-800/325-4330

D. Stripdrain 75 Contech
Construction Products, Inc.
1001 Grove Street
Middletown, OH 45044

1-614/457-7450

E. Tensar DCF 100 The Tensar Corp. 5775B Glenridge Drive

Atlanta, GA 30328 1-800/836-7271

# PART 3: EXECUTION

#### 3-1 INSTALLATION:

A. The excavation when needed for installation including removal of the materials encountered, shall be of such dimensions, with sheeting and bracing when necessary, to provide the minimal disturbance to the soil for attachment to the PGD.

- B. Place PGD against the side of the wall which will retain backfill with the geotextile fabric side out. Attach PGD with construction adhesive or with 2" concrete nails with 1" dia. Washers at a minimum of 4' on centers. Care shall be exercised in not ripping the fabric. All rips shall be repaired with a 4" minimum overlap of geotextile fabric. The limits of the PGD shall be as shown on the drawings.
- C. All exposed edges shall be sealed with geotextile fabric, with a 4" minimum overlap, to prevent intrusion of the backfill. All edges shall be attached to the wall.
- D. Overlap all PGD cores and fabric 4" at splices or seams. Fabric overlap shall be shingled to prevent backfill intrusion. Attach the PGD to the wall at all splices and seams.
- E. Where a plastic drainage collection pipe is specified, a 24" wide strip of geotextile fabric shall be first attached to the wall above the crown of the pipe. The bottom 6" of the PGD fabric shall be peeled back from the PGD core, and the PGD shall be attached to the wall. Lay the perforated plastic drainage pipe with the perforations down. Envelope the plastic drainage pipe with the 24" wide stip of geotextile fabric. Overlap the pipe and the enveloping 24" geotextile strip with the 6" PGD face fabric.
- F. Backfill as soon as practical. The backfill shall be compacted without disturbance to the prefabricated drain. Compaction within 3 foot of the drains shall be achieved by requiring at least 3 passes of a light mechanical tamper but no tamping is permitted within 4 inches of the drain. Avoid damaging the drain with compactor exhaust or tamper foot. Backfilling with a backhoe or using other than a light mechanical tamper requires the use of a 4 foot x 4 foot (or larger) sheet of plywood that shall be placed against the panel. The plywood "shield" shall be moved across the drain as backfilling progresses.

# PART 4: MEASUREMENT AND PAYMENT

4-1 BASIS OF PAYMENT: Payment for the Prefabricated Geocomposite Drain will be included in the Contract lump sum price for "Prefabricated Geocomposite Drain". Payment shall include costs for all labor, materials, and equipment necessary to install the prefabricated geocomposite drains.

- 1-1 DESCRIPTION: The work of this section consists of furnishing and installing storm pipe, underdrains, and catch basins as required and shown on the drawings.
- 1-2 SUBMITTALS: As specified in Section 01300. Submit two copies of manufacturer's certification that pipe meets the requirements of the appropriate referenced standard.
- 1-3 RELATED WORK SPECIFIED ELSEWHERE:
- A. Prefabricated Geocomposite Drains: Section 02712
- B. Rock Protection: Section 02725
- C. Utility Line Marking: Section 02229

# PART 2: PRODUCTS

- 2-1 POLYETHYLENE PIPE AND FITTINGS:
- A. Pipe for underdrains shall be high density, corrugated polyethylene pipe with a smooth interior liner conforming to AASHTO M252 (4"-10" Dia.), AASHTO M294 (12"-36" Dia.), and ODOT supplemental specification 944. Provide Type SP (perforated) pipe for underdrains at the locations shown on the drawings.
- B. Fittings for underdrain pipe shall be manufactured to the same specifications as the pipe. Fabricated fittings shall be solid (no perforations) in all cases.
- C. Fittings for solid wall pipe shall be manufactured to the same specifications as the pipe.
- 2-2 BEDDING AND BACKFILL MATERIALS: Section 02221.
- 2-3 CATCH BASINS:
- A. Precast concrete units, frames and grates shall conform to ODOT 604.02.
- 2-4 HEADWALLS:
- A. Concrete and reinforcing steel for headwalls shall conform to ODOT Construction and Material Specifications Section 602.02.

#### PART 3: EXECUTION

- 3-1 SOLID PIPE:
- A. Excavation: Section 02221.
- B. Installation: Before construction begins, submit to the Contracting Officer a detailed sequence of construction for approval of the storm sewer system. Sequence of construction to include the connection of the vertical pipes connecting into the horizontal pipes located at the bottom inside face of the retaining walls.
- C. Bedding: Provide bedding from 6" below pipe invert to 12" above the pipe. Bedding shall be per Section 02221, Type BD. Install bedding by hand in 6" lifts.

- D. Backfill: Section 02210, Type BF. Do not place backfill until structure has been approved by the Contracting Officer.
- E. Compaction: Section 02221.
- F. Pipe shall be stored out of direct sunlight. Pipe heated by sunlight shall be allowed to cool before backfilling.
- 3-2 UNDERDRAIN:
- A. Excavation: Section 02221.
- B. Install underdrain in locations shown on the drawings. Begin at the downstream end. Install per requirements of ODOT Specification 605.03.
- C. Pipe shall be stored out of direct sunlight. Pipe heated by sunlight shall be allowed to cool before backfilling.
- D. Overlap fabric seams. Minimum overlap of all seams to be 12".
- 3-3 CATCH BASINS:
- A. Install per requirements of ODOT Section 604.06, and as shown on the drawings.
- 3-4 HEADWALLS:
- A. Install per requirements of ODOT Section 602.03, and as shown on the drawings.

# PART 4: MEASUREMENT AND PAYMENT

### 4-1 6" PIPE UNDERDRAIN, TYPE SP:

Measurement and Payment will be included in the Contract lump sum price for "6" Pipe Underdrain, Type SP". Payment shall include costs for excavation, furnishing and installation of pipe, aggregate, fittings and connections, bedding, compacting and dewatering.

# 4-2 12" SOLID (WALL) PIPE:

Measurement and Payment will be included in the Contract lump sum price for "12" Solid (Wall) Pipe". Payment shall include labor, equipment, excavation, catch basin, frame, grate, pipe connections, bedding, backfill, dewatering and compacting.

# 4-3 CATCH BASINS:

Measurement and Payment will be included in the Contract lump sum price for "Catch Basins". Payment shall include labor, equipment, excavation, catch basin, frame, grate, pipe connections, bedding, backfill, dewatering and compacting.

#### 4-4 HEADWALLS:

Measurement and Payment will be included in the Contract lump sum price for "Headwalls". Payment shall include labor, equipment, excavation, formwork, backfill, compaction, dewatering, concrete and reinforcing steel.

- 1-1 WORK REQUIRED: The work to be performed under this section consists of furnishing all labor, materials, utilities and equipment necessary to install rock slope protection and other related items as specified herein and as indicated on the contract drawings.
- 1-2 RELATED WORK SPECIFIED ELSEWHERE:
- A. Section 02210: Earthwork
- 1-3 REFERENCE SPECIFICATIONS: The publications of the Ohio Department of Transportation Construction and Material Specifications, latest edition, shall apply to this section when indicated.
- 1-4 REQUIREMENTS OF REGULATORY AGENCIES: Work shall conform to regulations, codes, safety requirements, ordinances and laws of federal, state and local governing bodies having jurisdiction.
- 1.5 DRAWINGS: The right is reserved by the Contracting Officer to make any reasonable changes in the layout of these features prior to installation. If need be, equitable cost adjustments will be made prior to the change as negotiated.
- 1-6 SUBMITTALS: Submit certification of rock material's conformance to specifications from source of material. List soundness testing and size certification.

# PART 2 - PRODUCTS

- 2-1 ROCK BACKFILL: ODOT Section 601.04 and 601.08 as follows:
- A. Rock backfill shall be sound and durable rock, placed as shown on the contract drawings, with gradations conforming to the type(s) noted on the drawings.

# PART 3 - EXECUTION

- 3-1 ROCK WORK:
- A. Perform rough grading as required to create subgrade for installation as called for in Section 02210.
- B. Install rock as detailed. The rock material shall be placed with the larger pieces at the outer face and the smaller pieces and spalls near the inner surface of the protected area. The material shall be placed so as to ensure a reasonably smooth and continuous surface conforming to the slope line shown on the drawings. The completed rock material shall be sufficiently uniform to avoid concentration of fines and small pieces at any location. The Contractor shall make an effort to fill voids among the larger material with smaller pieces or spalls.
- 3-2 REPAIR OF GROUTED ROCK:

All existing grouted rock which is damaged or removed during construction shall be replaced as follows: Grouted rock shall be thoroughly wet immediately before placing grout. Grout shall be thoroughly worked into the joints by an appropriate method, ODOT Section 601.03 and those pertaining to it shall apply. ODOT Type A rock shall be applied.

# PART 4 - PAYMENT AND MEASUREMENT

- 4-1 ROCK CHANNEL PROTECTION, W/FILTER: Measurement and Payment will be included in the Contract lump sum price for "Rock Protection". Payment shall include the labor, materials, excavation and all items pertaining to the rock channel placement.
- 4-2 REPAIR OF GROUTED ROCK: Measurement and Payment will be included in the Contract lump sum price for "Rock Protection". Payment shall include the labor, materials, excavation and all items pertaining to the grouted rock placement.

- 1-1 DESCRIPTION: The work of this section consists of furnishing and placing topsoil for seeded areas to be fertilized, seeded and mulched.
- 1-2 RELATED WORK: Section 02931 Seeding, Fertilizing and Mulching.
- 1-3 SUBMITTALS: In accordance with Section 01300, submit soil analysis certificate covering grain size and additive recommendations from the State University Agricultural Extension Service or other certified testing laboratory.
- 1-4 PRODUCT HANDLING: Do not deliver topsoil in frozen or muddy condition.
- 1-5 PROJECT CONDITIONS: Do not perform tilling operations when ground is frozen or excessively wet.

# PART 2: MATERIALS

2-1 TOPSOIL: Natural, friable, loamy soil, typical of local topsoil which produces heavy vegetative growth; free from subsoil, weeds, sods, stiff clay, stones larger than 1 inch, toxic substances, litter, or other foreign material harmful to plant growth; having a PH between 6.0 and 7.0. Organic content shall be no less than 1% nor greater than 12% by weight as determined by loss through ignition.

### MECHANICAL ANALYSIS

U.S. Standard	
Sieve Size	Minimum Percent Passing
3/4-inch	100
No. 4	90-100
No. 10	80-90
No. 200	0-10

2-2 Topsoil shall contain, sand, silt, and clay as required by AASHTO M146.

Minimum Percent	Maximum Percent
Sand 20	75
Silt 10	60
Clay 5	30

2-3 ADDITIVES: As prescribed by solid analysis.

### PART 3: EXECUTION

3-1 Use equipment and methods to prevent damage to existing structures, utilities, lawns, and plantings.

- 3-2 Prior to placing topsoil, shape the subgrade to grades, lines, and cross sections to provide for 6" of compacted topsoil. Clear the subgrade of rock and debris larger than 1-inch. Excavate to a depth of 12"inches all areas that have become saturated with oil, gasoline, or bituminous products; backfill with approved material.
- 3-3 After alignment of subgrade, loosen and till to a depth of 6-inches by discing, harrowing, rototilling, or other approved methods.
- 3.4 After approval, place and spread the topsoil to secure required depth after compaction; rake and remove materials larger than 1-inch. Compact with approved roller equipment. Finish smooth, even, and true to line and grades shown.
- 3-5 Should insufficient quantities of on-site topsoil be available to place the required cross-section uniformly, reduce the cross-section to accommodate the quantity available.
- 3-6 All staging areas shall be regraded, if necessary, and topsoil placed to insure proper growth of plant life. This shall include seeding, fertilizing and mulching to the satisfaction of the Contracting Officer, at no additional expense to the Government.

# PART 4: MEASUREMENT AND PAYMENT

4-1 TOPSOIL IN SEEDED AREAS: Measurement and Payment shall be included in the Contract lump sum of "Earthwork". Payment shall include the installation, excavation, materials and all items pertaining to topsoil in seeded areas.

- 1-1 DESCRIPTION: The work of this section consists of furnishing all labor, equipment, and materials for fertilizing, preparing seedbed, seeding, and mulching the areas shown on the drawings and all disturbed or regraded non-paved areas disturbed by construction.
- 1-2 RELATED WORK: Section 02921 Topsoil.
- 1-3 QUALITY ASSURANCE: Standards, Federal Specifications (FS) and manufacturers' printed recommendations.
- 1-4 SUBMITTALS: In accordance with Section 01300, submit sample of mulch prior to use.

#### 1-5 PRODUCT HANDLING

- A. SEED: Deliver in acceptable condition in original, unopened containers.
- B. FERTILIZER: Deliver in original, unopened containers with analysis, type, and trade name attached.
- 1-6 REQUIREMENTS OF REGULATORY AGENCIES
- A. Comply with federal and state seed laws and other applicable laws and regulations. Brands must be registered with the State of Ohio, Department of Agriculture, Division of Plant Industry and packed and labeled in accordance with 907.02, ORC.

# 1-7 REFERENCE STANDARDS

- A. Scientific and common names for seeds are generally in conformity with approved names published by the American Joint Committee of Horticulture Nomenclature.
- B. Ohio Department of Transportation, Construction and Materials Specifications, latest edition.

#### PART 2: MATERIALS

# 2-1 SEEDING

# A. Seed Mixture - Native Grasses

Seed Type	Proportion By Weight	Minimum Purity	Minimum Germination
Panicum virgatum Blackwell Switchgrass	40%	98%	85%
Sorghastrum nutans Cheyenne Indiangrass	10%	98%	85%
Lollium multiflorum Annual Ryegrass	50%	98%	85%

Supplier:

Oliger Seed Co., Akron, OH (330) 724-1266 or other approved equal.

Rate: 50 pounds PLS per acre

B. Seeding rates will be on the basis of Pure Live Seed (PLS) at the time of seeding.

Determination of seeding rate:

Percent purity x percent germination = Pure Live Seed

Example: Seed has purity of 98% and germination of 75% (as indicated on tag). The seeding rate is 40 pounds per acre of PLS.

Y = Amount of above-quality seed needed.

40 = Seeding rate of PLS

 $0.98 \times 0.75 = 0.7350$ 

0.7350 = 54.4 Y

Seeding rate for above example is 54.4 pounds per acre.

- C. The Contracting Officer reserves the right to test, reject, or approve all seed after delivery on the project.
- FERTILIZER: FS O-F-241, granular, or pelleted; complete commercial type 12-12-12; spread at the rate determined by soil test results.
- 2-3 GROUND AGRICULTURAL LIME: ODOT Section 659.02 except material to be derived from dolomitic limestone. Spread at the rate determined by soil test results.
- 2-4 MULCH: Clean straw, free from noxious weed seed, and other harmful elements as specified in ODOT Section 659.06. Commercial products may be used with the approval of the Contracting Officer.

#### PART 3: EXECUTION

- BED PREPARATION: After grading operations are complete, loosen soil to depth of 4 inches and remove large rocks, debris, and clods. Spread fertilizer and lime evenly and incorporate into soil.
- SEEDING: Sow seed, lime and fertilizer uniformly at prescribed rates. Use hydroseeding methods along railway. Sow conventionally in other areas of the project. Seed during planting season, May 1 to November 15. No seedings shall be done on frozen ground or when temperature is 35 F or lower. Also seed and mulch according to ODOT Section 659.09. Seed all disturbed areas not otherwise surfaced.
- MULCHING: Immediately after seeding, apply mulch uniformly at a rate of two tons per acre.

Mulch within 48 hours of seeding. Seeded areas to be mulched include the limits of work for underdrain and solid (wall) pipe installation.

# 3-5 MAINTENANCE OF SEEDED AREAS

- A. Maintain all seeded areas by watering, repair of excelsior matting and replanting as necessary to establish a uniformly dense stand of specified grass and until accepted. Type A seeded areas shall be maintained until a uniformly dense stand is established.
- B. Scattered bare spots, smaller than one square foot will be allowed up to five (5%) percent of the seeded areas.
- C. Any areas failing to establish a stand shall be reseeded, refertilized and remulched as directed by the Contracting Officer at no addition cost. Reseeding shall conform in all respects to these specifications.
- D. The Contractor shall repair any damage to the work areas resulting from erosion and/or equipment. No additional payment shall be allowed for erosion and/or equipment maintenance. The Contractor shall repair damage, including regrading, reseeding, etc. as necessary, before significant damage occurs.
- 3-6 LIMITS OF SEEDING: Seeding limits shall be as follows:
  - 1. Adjacent to Valley Railway: Maximum limits shall be as shown on the Contract drawings.
  - 2. Adjacent to Trenches: Maximum limits shall be 10' on each side of the trench centerline.

Areas disturbed beyond these limits shall be seeded, fertilized and mulched by the Contractor at his expense. Seeding, fertilizing and mulching for haul roads shall be included in traffic regulation and haul roads.

### PART 4: MEASUREMENT AND PAYMENT

4-1 SEEDING, FERTILIZING AND MULCHING: Payment will be included in the Contract lump sum price for "Seeding, Fertilizing, Mulching & Planting". Payment shall include furnishing all labor, equipment and materials necessary.

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#### PART 1: GENERAL

- 1-1 DESCRIPTION: The work of this section consists of furnishing all labor, materials and equipment necessary to plant trees, shrubs and vines and placing fertilizer and mulch, as show on construction drawings.
- 1-2 QUALITY ASSURANCE:
- A. Plant names shall comply with nomenclature of Hortus Third, 1976. Sizing and grading shall be in accordance with ANSI Z60.1-86.
- B. Notify Contracting Officer in writing ten (10) calendar days before planting. Locations shall be approved prior to construction and be undisturbed after installation.
- 1-3 SUBMITTALS: As specified in Section 01300.
- A. Planting schedule.
- 1-4 PRODUCT HANDLING:
- A. Plant Material:
  - 1. "B & B" (Balled & Burlapped) plants shall be dug in approved manner with roots contained in a solid ball of earth securely held with burlap and twine. Earth balls shall be of adequate size for the particular species and size of plant. Balls which are deemed too small or which are loose or damaged will be cause for rejection of the plant or plants. "B & B" plants shall be protected in transit and continuously at the site in an approved manner. "B & B" plants that cannot be planted at once on receipt at the site shall be heeled-in by setting in the ground and covering the ball with soil and then watering. Protect roots, trunks, branches and foliage at all times from drying winds, sun and bruise injuries. Do not drop plants from vehicles. Legibly label plant with correct botanical name and common name.
  - Container grown stock shall be delivered in their containers and protected from drying or exposure. Plants that cannot be planted upon receipt, shall be kept well watered and adequately protected.
- B. On-Site Temporary Storage
  - 1. Place plants temporarily in shaded areas and protected from wind, drying and freezing. Cover roots with moist sawdust, wood chips, shredded bark, peat moss, or other approved moisture-retaining medium. Keep all plants moist, throughout the time in temporary storage. Set-up temporary watering system that meets the approval of the Contracting Officer. Water shall not exceed 15°C. Temporary storage of more than two weeks must be approved by the Contracting Officer and may require additional storage measures at no additional cost to the Government.
- 1-5 PROJECT CONDITIONS: Plant during normal season determined by climatic conditions and accepted practices in region of construction.
- 1-6 GUARANTEE: For 12 months from date work is certified as complete, remove deficient plants and cuttings and replace with same size and quality as originally specified at no additional expense to the Government. Plant replacement plants on dates approved by the Contracting Officer.

#### PART 2: PRODUCTS

CONTRACTOR SERVICE AND SERVICE

#### 2-1 PLANTS:

A. Plants shall be high quality nursery-grown materials from hardiness zones 4 and 5, as established by the Arnold Arboretum, except as approved by the Contracting Officer, sound and free of disease or insect infestation. Plants shall be freshly dug and shall conform with requirements as established in the ANSI Z60.1, American Standard for Nursery Stock.

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- B. Deliver with federal and state certificates of inspection attached.
- C. Measurement for height of shrubs shall be taken from ground level to the average height of the top of the shrub and not to the longest branch. Side branches shall be generous and well-twigged. Shrubs shall be well bushed to the ground.
- D. Vines shall have full and well developed root masses and crown, sized as required.
- All plant material shall be subject to the approval of the Contracting Officer prior to planting.
- 2-2 SHRUB BACKFILL:
- A. For backfilling shrub pits the material taken from the pit excavation should be used for backfill to within 6" of the surface for shrubs and vines, provided it is acceptable to the Contracting Officer.
- B. Topsoil shall be clean and reasonably free from clay lumps, stones and similar substances which may be a hindrance to the planting operation and substantially the same as native topsoils in the area.
- C. The pH value of the backfill shall be 6.0 to 7.0 for deciduous plants. Adjust pH by addition of ground agricultural limestone or aluminum sulfate.
- D. For spring planting, mix shall include 5 pounds per cubic yard of the specified fertilizer.
- 2-3 SOIL MIX: Shall be 70% loam or silt loam, 10% peat moss, and 20% sand. It shall be free of foreign matter and injurious weed seed.
- A. Topsoil: Section 02921.
- B. Peat Moss: FS Q-P-166e. Natural rad sedge peat, reed peat, or sphagnum moss peat, obtained from fresh water sites, consisting of organic matter of incompletely decomposed plant residues containing a negligible amounts of woody matter. Peat shall be shredded to pass the ½ inch mesh screen and be conditioned for minimum 6 months after excavation.
- 2-4 FERTILIZER: Shall include any approved all-purpose commercial fertilizer of 10-10-10 or 12-12-12 formula, including self-release capsules or stakes.
- 2-5 MULCH: Shall consist of approved wood shavings or shredded bark. Chips and shredded bark shall not exceed 8 inches in length nor 1-1/4 inches in thickness. At least 85% by weight shall pass a 1-inch sieve. The chips shall be aged approximately 6 months.
- 2-6 WATER: Clean, fresh and free from harmful substances.

2-7 ANTIDESSICANT: Wilt-Pruf, by Wilt-Pruf Products, Inc., Greenwich, Connecticut, or approved equal.

2-8 COARSE SAND: Material shall be well graded natural or manufactured sand of the following approximate ranges:

Sieve Size	% Passing
#8	100%
#16	50-70%
#30	10-20%
#50	0%

### PART 3: EXECUTION

# 3-1 PREPARATION FOR PLANTING:

- A. Stake areas to be planted. Notify Contracting Officer if rocks or obstructions necessitate relocation and to review staked location.
- B. Ascertain locations of utilities and subsurface drainage so that proper precautions may be taken not to disturb or damage any subsurface improvements. The Contractor will be held responsible for making at his own expense, all repairs to subsurface improvements damage by the work of this section. Contact all utilities prior to digging as required by Section 153.64 ORC. All known utilities are listed on the drawings.
- C. Apply specified fertilizer for spring planting only.

# 3-2 PLANTING SEASON:

A. The planting shall be done only during periods which are suitable, as judged from the standpoint of weather conditions and approved by the Contracting Officer. In general, shrubs and vines shall be planted between March 15 and May 15, and October 15 and December 1.

# 3-3 PLANTING:

A. Final grades shall be inspected and approved by the Contracting Officer prior to installing plant material. All materials shall be inspected and approved by the Contracting Officer prior to installation. All construction shall be approved prior to backfilling.

#### B. Setting Plants:

- 1. All plants shall normally be placed so as to be at the same depth in the soil after settlement as they were before digging.
- C. Watering: Immediately after planting, thoroughly saturate soil, applying water by open end hose at low pressure. Avoid causing air pockets and injury to roots. If necessary, reset plants to proper grade and position.
- 3-4 MULCHING: Immediately after planting, cover surface with a 3-inch layer of mulch.
- 3-5 MAINTENANCE: Water, prune, spray, mulch, week and otherwise maintain and protect plants until work is certified as complete.

### 3-6 PLANT GUARANTEE AND REPLACEMENT:

- A. Plant material shall be guaranteed for one (1) growing season and dormant period including death and unsatisfactory growth. The Contractor further guarantees that all plants will be in a healthy, growing condition at the time of final inspection.
- B. At the end of the guarantee period, inspection will be made by the Contracting Officer upon written notice requesting such inspection submitted by the Contractor at least two (2) days before the anticipated date. Any plant required under this contract that is dead or not in satisfactory growth, as determined by the Contracting Officer, shall be removed and replaced during the planting season.
- C. All replacements shall be plants of the same kind and size as specified in the plant list. They shall be furnished and planted as specified under Planting; and cost shall be borne by the Contractor except for possible replacement, resulting from removal, loss or damage due to occupancy of the project in any part by the Government.
- D. Final acceptance of this contract shall take place after replacement operation is satisfactorily completed and all shrubs and vines are in a healthy growing condition.

# PART 4: MEASUREMENT & PAYMENT

- 4-1 PLANTING: Payment will be made in the contract lump sum price for "Seeding, Fertilizing, Mulching & Planting".
- 4-2 TOPSOIL MIX: Payment will be made in the contract lump sum price for "Seeding, Fertilizing, Mulching & Planting".

1-1 DESCRIPTION: The work to be performed under this section consists of furnishing all labor, materials, equipment and utilities necessary for supplying, delivering and placing forms and accessories required for completion of concrete work as indicated on the contract drawings.

# 1-2 RELATED WORK SPECIFIED ELSEWHERE:

A. Earthwork:

Section 02210

B. Site Concrete Reinforcement:

Section 03200

C. Site Cast-in-Place Concrete:

Section 03300

- 1-3 DESIGN: It is the Contractor's responsibility to determine size, shape, adequacy and rigidity of the formwork. Forms, in general, shall be properly and adequately braced to provide necessary rigidity and to maintain the desired shape and position during and after placement of concrete. At joints and splices, the forms shall be sufficiently tight and adequately braced to prevent excessive leakage of concrete and to provide a neat, uniform surface.
- 1-4 SCHEDULING: Contractor shall schedule formwork to coincide with the progress of the work and shall give full cooperation with all other trades to maintain progress of the work.

#### PART 2: MATERIALS

# 2-1 TYPE:

A. Forms shall be mortar tight and be of metal, wood, plastic, or plywood as required. The type of formwork selected by the Contractor and approved by the Contracting Officer shall be straight, free of warp and of sufficient rigidity capable of withstanding concrete pressure without buckling, bowing or springing. The subject forms shall have a depth at least equal to the depth of concrete and shall not deviate from a true plane more than 1/8-inch in 10 feet. Use of forms that are bent, worn or otherwise damaged is not permitted.

### 2-2 ACCESSORIES:

- A. Form Ties: Shall be removable "she-bolt" type or "snap-ties" with minimum 1-inch breakback with plastic cones. Forming systems using catheads and tensile rods are unacceptable.
- B. Clips: Form clips used with prefabricated forms shall be compatible with the forms and shall be of the type approved and supplied with the forms by the manufacturer or supplier.
- C. Braces: Wooden stakes, steel pins or reinforcing bars used as braces for form supports shall be of sufficient length to provide required rigidity to the formwork.
- 2-3 COATING: The non-staining product shall be commercial formulation of satisfactory and proven performance that will not bond with or otherwise adversely affect concrete surfaces that are to be cured.
- 2.4 SETTING OF MANUFACTURED ITEMS: Set all anchor bolts, posts, trays, etc. required by the manufacturers for the various items to be installed. Secure templates as required.

# PART 3: EXECUTION

- 3-1 ERECTION OF FORMS:
- A. Erect forms for footings, walks, walls and conform to shape form, grade and line as required.
- B. Make all joints leakproof and securely brace to prevent offsets in alignment. Check dimensions before installing reinforcing to insure correct size. Make forms removable without hammering or prying against concrete.

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- C. The form liner shall be secured to the forming system in accordance with the manufacturer's recommendations without detracting from the desired texture.
- D. Set top of forms to finished elevations.
- E. Place no concrete until forms have been inspected by the Contracting Officer and approved.
- 3-2 OILING OF FORMS: Treat with oil before pouring and before placing reinforcing. Wipe off excess oil with rags; leave surface just oily to the touch.
- 3-3 REMOVAL OF FORMS: Forms shall not be removed from freshly poured concrete until it has set for at least 24 hours for slabs on grade, and for 48 hours for other structures. Contractor shall exercise proper care and judgment in checking hardness of concrete before removal of forms. Forms shall be carefully removed so as to avoid any damage to the concrete.

### PART 4: MEASUREMENT & PAYMENT

4-1 SITE CONCRETE FORMWORK: Payment will be included in the bid item to which this section pertains.

- 1-1 DESCRIPTION: The work to be performed under this section consists of furnishing all labor, materials, equipment and utilities necessary for supplying, delivering and placing conventional reinforcing as indicated on the contract documents.
- 1-2 RELATED WORK SPECIFIED ELSEWHERE:
- A. Catch Basins: Section 02722
- B. Culverts and Storm Drains: Section 02722
- C. Site Concrete Formwork: Section 03100
- D. Site Cast-in-Place Concrete: Section 03300
- 1-3 REFERENCE SPECIFICATIONS:
- ACI: American Concrete Institute P.O. Box 5754 Redford Station Detroit, Michigan 48219
- ASTM: American Society for Testing and Materials 1916 Race Street Philadelphia, Pennsylvania 19103
- CRSI: Concrete Reinforcing Steel Institute 38 S. Dearborn Street Chicago, Illinois 60603
- 1-4 SHOP DRAWINGS: Indicate bending diagram, assembly, splicing and taps: shapes, dimensions and details of reinforcing and accessories. Prepare drawings in accordance with "Manual of Standard Practice for Detailing Reinforced Concrete Structures" ACI 315. Submit for approval.

#### PART 2: MATERIALS

- 2-1 BARS: Reinforcing bars shall be deformed bars, except as otherwise noted, and conform to ASTM A-615 intermediate or hard grade new billet steel with deformations conforming to ASTM A-305 and shall be free from grease, dirt, scale, oil or other coating that may reduce bond and concrete. Reinforcing bars shall be furnished and placed in accordance with ACI 318. (ACI Building Code) and ACI 315 (Manual for Standard Practice for Detailing Reinforced Concrete Structures.)
- 2-2 WIRE FABRIC: Welded wire fabric reinforcement shall be of the size shown on the drawings and shall meet the requirements of ASTM Specification A-185.
- 2-3 ACCESSORIES: Conform to CRSI, "Manual of Standard Practice for Reinforced Concrete Construction", latest edition. Include all devices necessary for proper placing, spacing, supporting and fastening steel reinforcement in place.

# PART 3: EXECUTION

3-1 CONTRACT DRAWINGS: Sizes, types and locations are according to the drawings.

- 3-2 FABRICATION: Clean, bend and splice reinforcement in accordance with ACI publication No. 315, latest edition. Welding, if used, shall be performed by welders certified by American Welding Society.
- 3-3 WORKMANSHIP: Following any substantial delay in work, inspect and clean previously placed reinforcement left for future bonding. Do not bend or straighten reinforcement in manner injurious to material. Do not place splices at points of maximum stress. Stagger splices in adjacent bars. Lap bars 12" minimum. Lap mesh for slabs at least 1 mesh but not less than 6 inches. Fasten securely in place to prevent displacement before ad during pouring of concrete.
- 3-4 CLEAR COVER FOR REINFORCING STEEL:
- A. Refer to A.C. I. Specifications.
- B. The same requirements for cover of bars shall apply to metal accessories. The Contracting Officer shall be given complete access to all reinforcement before concrete is poured to assure the above requirements are fulfilled.
- 3-5 APPROVALS: All reinforcing must be approved by the Contracting Officer prior to placing concrete.

# PART 4: MEASUREMENT & PAYMENT

4-1 SITE CONCRETE REINFORCEMENT: Payment will be included in the bid item to which this section pertains.

- 1-1 DESCRIPTION: The work to be performed under this section consists of furnishing all labor, materials, equipment and utilities necessary to supply, transport, place, finish and cure cast-in-place concrete where indicated on the contract drawings for footings, abutments and wingwalls as specified herein.
- 1-2 RELATED WORK SPECIFIED ELSEWHERE:
- A. Earthwork: Section 02210
- B. Formwork: Section 03100
- C. Site Concrete Reinforcement: Section 03200
- D. Structural Steel: Section 05120
- 1-3 REFERENCE SPECIFICATIONS: The publications of the American Society for Testing Materials (ASTM), the Ohio Department of Transportation (ODOT), Construction and Material Specifications latest revisions, the American Concrete Institute (ACI), & the Portland Cement Association referring to the cast-in-place concrete are included herein and made an integral part of this specification.
- 1-4 QUALITY ASSURANCE: Testing required to determine compliance for the work of this section will be the responsibility of the Contractor under the cash allowance specified in Section 01019. The Contractor shall cooperate by rerouting equipment or by temporarily closing the immediate work area being tested. Areas where test results indicate noncompliance shall be corrected before placing additional embankment. Contractor shall employ the laboratory and testing firm approved by the Contracting Officer to perform testing.
- A. Responsibility: All tests shall be performed when requested by the Contracting Officer. The responsibility of performing tests as specified below shall rest with the Contractor. The test results shall be submitted to the Contracting Officer. In general, only the compressive strength, slump and air indicator tests will be required; but if the tests fail to meet the requirements set forth, other tests shall be performed as designated by the Contracting Officer.
- B. Slump Tests: The test shall comply with the requirements of ASTM C 142. The sample shall be taken at the mixer during discharge for preparing the molds. The measured slump height in inches, shall be confined to maximums and minimums as indicated below. Failure to meet these requirements within two consecutive tests will be cause for rejection.
  - Maximum 5 inches Minimum 2 inch.
- C. AIR INDICATOR TESTS: Air content shall be performed according to ASTM C231. The percent of entrained air shall be 5-8% of the volume. Tests shall be performed for each truck of concrete or field batch mix.
- D. COMPRESSIVE STRENGTH TESTS: Four cylinder samples shall be collected for each truck load and two tested at 7-day intervals and two at 28-day intervals for strength according to ASTM C31.
- 1-5 PROTECTION: Contractor shall take necessary precautions to prevent any damage to freshly poured concrete from adverse weather conditions, pedestrian and vehicular traffic.

#### 1-6 SUBMITTALS:

- A. Contractor shall provide delivery tickets from concrete supplier listing the following:
  - 1. Concrete supplier's name and address
  - 2. Batch number
  - 3. Mix by number or sack content with maximum size aggregate
  - 4. Admixtures
  - 5. Air content
  - 6. Slump
  - 7. Time of loading
- B. Test results of slump, air indicator and compressive strength.

### PART 2: MATERIALS

- 2-1 PORTLAND CEMENT: Portland Cement ASTM C 150, Type 1 for exterior concrete exposed to weather shall be as specified in ODOT Section 701.04.
- 2-2 COARSE AGGREGATE: Coarse aggregate for concrete shall conform to AASHTO M43, ODOT Section 703.02 and shall be well graded from fine to coarse within the prescribed limits. For all concrete, the gradation shall be #57 aggregate. The aggregate shall be washed crushed limestone.
- 2-3 FINE AGGREGATE: Fine aggregate shall be natural sand or manufactured sand and shall conform to AASHTO M43 and ODOT Section 703.02.
- 2-4 CLASS OF CONCRETE: Material shall be Class C concrete as specified in ODOT Section 499. Compressive strength shall be 4000 psi.

# 2-5 READY-MIX CONCRETE:

- A. Ready-mix concrete shall meet the requirements of ASTM Specification C 94 and Section 499 ODOT Specifications.
- B. Concrete batching and mixing equipment shall meet the requirements of ODOT Section 499.04.
- C. Air entraining admixtures shall be thoroughly incorporated in the mix, prior to placing at the recommended rates.
- D. The concrete shall be tinted to match the color of the adjoining concrete as approved by the Contracting Officer.
- 2-6 WATER: Water used for mixing or curing concrete shall be fresh and free from injurious amounts of oil, acid, salt, alkali, organic material or other deleterious materials. It shall be considered potable.

#### 2-7 ADMIXTURES:

- A. Air entraining admixtures shall meet requirements of AASHTO M154 and ASTM C 260 and entrain air consistently at five (5%) percent to eight (8%) percent.
- B. Except for curing compound and air entraining compound, no admixtures shall be permitted unless approved by the Contracting Officer.

- 2-8 CURING AND PROTECTING CONCRETE: Covers and insulation that may be necessary shall meet the requirements of ODOT Sections 705.05 and 705.06. Liquid membrane-forming curing compound shall be according to ODOT Section 705.07, except that compound shall be clear.
- A. Curing compound shall be a transparent liquid formulated from chlorinated rubber, plasticized and stabilized or a styrene, co-polymer, plastic base material capable of forming a continuous film. IT SHALL CONTAIN NOT LESS THAN 18% solids and shall meet the following specifications:

Federal Specification TT-C-0800 AASHTO M-148 ASTM C-309 ODOT 705.07

- 2-9 PENETRATING WATER REPELLANT: Shall conform to AREA Chapter 8, Section 2.1.1.
- 2-10 PREFORMED JOINT FILLER: Shall conform to the requirements of ODOT Section 705.03.
- 2-11 TYPE B WATERPROOFING: Shall conform to the requirements of ODOT Section 512.06.

# PART 3: EXECUTION

- 3-1 CONVEYING CONCRETE: Concrete shall be conveyed from mixer to the forms as rapidly as possible by methods that will prevent segregation or loss of ingredients.
- 3-2 PREPARATION FOR PLACING CONCRETE:
- Dewater excavation before depositing concrete.
- B. Concrete footings shall be poured as soon as weather conditions permit after excavation is completed and inspected. In case bottoms of footings become wet, frozen, or soft, all soft or frozen material shall be removed and the footings poured the required extra depth.
- C. Existing concrete surfaces should be clean of all grease, oil, curing compound, loose material, dust or disintegrated concrete. The surface should be pre-wetted and all standing water removed.
- D. Preformed joint fillers shall be in place as shown on the plans.
- 3-3 WORKMANSHIP:
- A. The placing or depositing of all concrete shall be done in accordance with the requirements as set forth in the American Concrete Institute Standards ACI 318, latest edition. Concrete shall be worked into the corners and angles of the forms and around all reinforcement, and proper care shall be taken to prevent segregation of ingredients.

#### B. WEATHER CONDITIONS:

- 1. The methods and recommended practice described in ACI Standard 306 shall be followed for winter concreting.
- The concrete shall not be poured in rainy or freezing weather in general, and in particular, when the surrounding temperatures are 50 degrees F and falling with relative humidity being not less than

30 percent or not more than 75 percent unless otherwise approved in writing by the Contracting Officer.

- C. CONCRETE TEMPERATURE: Concrete, when deposited, shall have a temperature not below 50 degrees F and not above 85 degrees F. The maximum temperature of concrete produced with heated aggregates and/or water shall not exceed 90 degrees F at any time during its production and transportation.
- D. TIME INTERVAL: Concrete mixed in stationary mixers and transported to the job site by non-agitating equipment shall be placed within thirty (30) minutes after it has been mixed. Time lapse shall be not more than one and one-half (1 1/2) hours after introduction of cement to the aggregates when transported in agitated equipment.
- E. COMPACTION: The concrete shall be thoroughly compacted with internal vibrators supplemented by hand spading as necessary.
- F. CURING: Concrete shall be cured by one of the following methods:

Method (a) Water Curing. All surfaces not covered by forms shall be protected with two thicknesses of wet burlap, wet jute felt cotton mats or wet cotton mats, as soon after placing the concrete as it can be done without marring the surface and kept wet by the continuous application of water for a period of not less than 7 days. Formed surfaces shall after the removal of forms be cured in like manner for the remainder of the curing period with the entire surface of the concrete being thoroughly drenched with water and covered immediately after forms are removed. Portions of the covered material may be removed temporarily and continuous sprinkling stopped when and as necessitated by any required finishing operation.

In lieu of continuous sprinkling, wet burlap covered with white polyethylene sheeting or plastic coated burlap blankets ODOT 705.06 may be used. They shall be placed wet with the burlap side against the concrete. Adjoining plastic coated blankets or polyethylene sheets used to cover wet burlap shall be lapped sufficiently and held securely in place at laps and edges so that positive moisture seal is provided. White polyethylene sheeting or plastic coated blankets containing holes or tears shall be covered with additional covering of sheeting or blankets as directed.

Method (b) Membrane Curing. Immediately after the free water has disappeared on surfaces not protected by forms and immediately after the removal of forms, if such are removed before the end of the 7-day curing period, the concrete shall be sealed by spraying as a fine mist a uniform application of curing material ODOT 705.07, in such manner as to provide continuous, uniform, water impermeable film without marring the surface of the concrete.

The membrane curing shall be applied in one or more separate coats at the rate of at least 1 gallon (1 liter) per 200 square feet of surface.

- G. PENETRATING WATER REPELLANT: All exposed concrete surfaces shall receive penetrating water repellant coating.
- H. RECORDS: Shall be kept by the Contractor to show the date of placement, mix used and air temperatures at time of concreting. Records shall be available to the Contracting Officer.

### PART 4: MEASUREMENT & PAYMENT

4-1 Payment will be included in the bid item to which this section pertains.

#### 1-1 DESCRIPTION OF THE WORK:

A. The work of this section includes providing and installing precast prestressed concrete slabs as indicated on drawings.

#### 1-2 RELATED DOCUMENTS:

A. Not used.

# 1-3 QUALITY ASSURANCE:

- A. Codes and Standards. Comply with provisions of the following codes, specifications and standards, except as otherwise indicated.
  - American Concrete Institute (ACI) 301 "Specifications for Structural Concrete for Buildings."
  - 2. ACI 318 "Building Code Requirements for Reinforced Concrete."
  - Prestressed Concrete Institute MNL 116 "Manual for Quality Control for Plants and Production of Precast Concrete Products."
- B. Fabricator Qualifications. Firms with at least 5 years of successful experience in fabrication of precast concrete units similar to units required for this project will be acceptable.
  - Fabricator must be producer member of the Prestressed Concrete Institute (PCI) and participate in its Plant Certification Program.
  - Fabricator.
    - a. Flexicore Systems, Spancrete Northeast, Inc. or approved equal.
- C. Fabrication Qualifications. Produce precast concrete units at fabrication plant engaged primarily in manufacturing of similar units, unless plant fabrication or delivery to project site is impractical.
  - 1. Comply with PCI MNL 116 for production of precast concrete units.

### 1-4 SUBMITTALS:

# A. General. Submit the following:

- Product data and instructions for manufactured materials and products. Include manufacturer's certifications and laboratory test reports as required.
- Shop drawings showing complete information for fabrication and installation of precast concrete units. Indicate member dimensions and cross section as well as location, size, and type of reinforcement, including special reinforcement and lifting devices necessary for handling and erection.

Provide layout, dimensions and identification of each precast unit corresponding to sequence
and procedure of installation. Indicate welded connections by American Welding Society
(AWS) standard symbols. Detail inserts, connections and joints, including accessories and
construction at openings in precast units.

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- Indicate location and details of anchorage devices that are to be embedded in other construction.
- 5. Provide load tables for each type of plank identified on the shop drawings.

#### 1-5 JOB CONDITIONS:

- A. Design modifications may be made as necessary to meet field conditions, to ensure proper fitting of work, and as acceptable to Contracting Officer. Changes to general design concept as shown must be acceptable to Contracting Officer.
- B. Provide setting diagrams and directions as required for installation of anchorage items that are to be embedded in other construction before start of such work.
- 1-6 DELIVERY, STORAGE, AND HANDLING:
- A. Deliver precast concrete units to project site in such quantities and at such time to assure continuity of installation. Store units as project site to prevent cracking, distortion, staining, or other physical damage and so that markings are visible. Lift and support units at designated lift points.
- 1-7 SPECIAL WARRANTY:

Not Used.

#### PART 2: PRODUCTS

- 2-1 PRESTRESSING TENDONS:
- A. Material. Uncoated, seven wire stress relieved stand complying with America Society for Testing and Materials (ASTM) A 416. Use Grade 250 unless Grade 270 indicated.
- 2-2 CONCRETE MATERIALS:
- A. Portland Cement. ASTM C 150, Type I or Type III.
  - Use only one brand and type of cement throughout project unless otherwise acceptable to Contracting Officer.
- B. Aggregates ASTM C 33.
  - Local aggregates not complying with ASTM C 33, but that have been shown by special test
    or actual service to produce concrete of adequate strength and durability, may be used when
    acceptable to Contracting Officer.
- C. Water. Potable and free from foreign materials in amounts harmful to concrete and embedded steel.
- D. Air Entraining Admixture. ASTM C 260.

- E. Water Reducing Admixture. ASTM C 494, Type A.
- 2-3 CONNECTION MATERIALS:
- A. Weld Plates. Structural quality, hot rolled carbon steel, ASTM A, Grade C.
- B. Steel Shapes. ASTM A 36.
- C. Finish of Steel Units Exposed units galvanized per ASTM A 153; others pointed with rust inhibitive primer.

- D. Cement Grout. Portland Cement, ASTM C 150, Type 1, and clean natural sand, ASTM C 404. Mix at ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum water required for placement and Hydration.
- 2-4 PROPORTIONING AND DESIGN AND MIXES:
- A. General. Prepare design mixes for each type of concrete required.
- B. Design mixes may be prepared by an independent testing facility or by qualified precast manufacturing plant personnel, at precast manufacturers's option.
  - Produce standard weight concrete consisting of specified portland cement, aggregates, admixtures, and water to produce the following properties:
    - a. Compressive strength 5,000 pounds per square inch (psi) minimum at 28 days.
    - b. Release strength for prestressed units. 3,500 psi.
  - 2. Cure compression test cylinders by the same methods used for precast concrete work.
- C. Admixtures. Use water reducing admixtures in strict compliance with manufacturer's directions. Admixtures to increase cement dispersion or provide increased workability for low slump concrete may be used if acceptable to Contracting Officer.
- D. Amounts. Use amounts as recommended by admixture manufacturer for climatic conditions prevailing at time of placing. Adjust quantities of admixtures as required to maintain quality control.
- 2-5 FABRICATION:
- A. General. Fabricate precast concrete units complying with manufacturing and testing procedures, quality control recommendations, and dimensional tolerances of PCI MNL-116.
- B. Forms. Accurately construct forms of sufficient strength to withstand pressures due to concrete placing operations, temperature changes, and pretensioning and detensioning operations. Maintain formwork to provide completed precast concrete units of shapes, lines, and dimensions indicated, within specified fabrication tolerances.
- C. Quality. Furnish units that are free of voids or honeycomb, with straight true edges and surfaces.
- D. Standard Finish. Norman plant run finish produced in forms that impart a smooth finish to concrete. Small surface holes caused by air bubbles, normal form joint marks, and minor chips and spalls will be tolerate,

but major or unsightly imperfections, honeycomb or structural defects will not be permitted.

- E. Adequately reinforce slab units to resist transporting and handling stresses.
- F. Include cast-in weld plates where required for anchorage or lateral bracing to structural steel members.
- G. Cooperate with other trades for installation of items to be cast-in hollow slab units. Notify Contractor of items not received in ample time so as not to delay work.
- H. Provide headers of cast-in place concrete or structural steel shapes for openings larger than one slab width in accordance with hollow slab unit manufacturer's recommendations.
- Dimensional Tolerances. Fabricate slab units to comply with PCI MNL 116 fabricated dimensional tolerances.

#### 2-6 PRESTRESSED CONCRETE MEMBER CORROSION INHIBITOR:

The Contractor shall use a corrosion inhibition admixture in the concrete.

This admixture shall be one of the following three products and shall be added at the rate, per product, as listed below:

DCI as manufactured by Grace Construction Products 20 liters per cubic meter (4.0 gallons per cubic yard) of concrete.

or

RHEOCRETE 222+ as manufactured by Master Builders Technologies 5 liters per cubic meter (1.0 gallon per cubic yard) of concrete.

or

ARMATEC 2000 as manufactured by SIKA Corporation 2.5 liters per cubic meter (0.5 gallon per cubic yard) of concrete.

Reinforcing bars which project from the prestressed/post-tensioned concrete members into cast-in-place concrete slabs, sidewalks, curbs, parapets or tee-sections over piers which do not contain a corrosion inhibitor admixture shall be epoxy coated in compliance with ODOT 709.00 of the Construction and Materials Specifications.

Fabricators of prestressed/post-tensioned concrete members should recognize that the above admixtures may have an effect on strength, entrained air content, workability, etc. of their concrete mixes. The fabricator's choice of one of these corrosion inhibitors does not alleviate meeting all requirements of ODOT 515 of the Construction and Materials Specifications.

### PART 3: EXECUTION

#### 3-1 INSTALLATION:

A. General. Lift, place, and secure hollow slab units in accordance with manufacturer's printed instructions and final shop drawings, keeping units tight and perpendicular to bearing supports. Do not install slab units unit supporting members are in place and secured.

- B. Follow erection procedures and sequence of erection as recommended by slab unit manufacturer and as acceptable to Contracting Officer.
  - Installation Tolerances. Install precast units without exceeding PCI MNL 116 tolerance limits.
  - 2. Level slabs accurately or set to uniform slope as indicated.
  - Align and level by methods, procedures, and equipment as recommended by slab unit manufacturer.
  - 4. Do not cut holes or install sleeves.
  - Do not cut reinforcing or prestressing strands without approval of manufacturer.
  - At continuous electrical raceway joints, carefully align cells and tape butt joints in accordance with manufacturer's recommendations and to comply with applicable code requirements.
  - Grout joints and repair damaged exposed surfaces, as directed. Completely fill void with grout to finish smooth and level with adjacent surfaces. Promptly remove grout material from exposed surfaces before it hardens.

## 3-2 PLANT QUALITY CONTROL EVALUATIONS:

- A. General. The Contracting Officer may employ, if deemed necessary, a separate testing laboratory to evaluate precast manufacturer's quality control and testing methods, at no additional expense to the Government.
- B. Testing. The precast manufacturer shall allow Contracting Officer testing facility access to materials storage areas, concrete production equipment, and concrete placement and curing facilities. Cooperate with Contracting Officer testing laboratory and provide samples of materials and concrete mixes as may be requested for additional testing and evaluation, at no additional expense to the Government.
- C. Dimensional Tolerances. Units having dimensions smaller or greater than required, and outside specified tolerance limits, may be subject to additional testing as herein specified.
- D. Dimensions. Precast units having dimensions greater than required will be rejected if appearance or function of the structure is adversely affected or if larger dimensions interfere with other construction. Repair or remove and replace rejected units as required to meet construction conditions.
- E. Strength of Units. Strength of precast concrete units will be considered potentially deficient if manufacturing processes fail to comply with requirements that may affect strength of precast units, including the following conditions.
  - 1. Failure to meet compressive strength test requirements.
  - Reinforcement and pretensioning and detensioning of tendons of prestressed concrete, not
    conforming to specified fabrication requirements.
  - Concrete curing and protection of precast units against extremes in temperature, not as specified.

- 4. Precast units damaged during handling and erection.
- F. Testing Precast Units. Where there is evidence that strength of precast concrete units does not meet specification requirements, the concrete testing service shall take cores drilled from hardened concrete for compressive strength determination, complying with ASTM C 42 and as follows:
  - Take at least three representative cores from precast units of suspect strength from location directed by Contracting Officer.
  - Test cores in any air dry condition per ACI 318 if concrete will be dry during use of completed structure.
  - Strength of concrete for each cores will be considered satisfactory if their average compressive strength is at least 85 percent of 28 day design compressive strength.
  - 4. Test results will be made in writing with copies to Contracting Officer, contractor, and precast manufacturer. Include in test report the project identification name and number, date, name of precast concrete manufacturer, name of concrete testing service, identification letter, number and type of member or members represented by core tested, design compression strength, compressive breaking strength and type of break (corrected for length diameter ratio), direction of applied load to core with respect to horizontal plant of concrete as placed, and moisture condition of core at time of testing.
- G. Patching. Where core test results are satisfactory and precast units are acceptable for use in work, fill core holes solid with patching mortar and finish to match adjacent concrete surfaces.
- H. Defective Work. Precast concrete units that do not conform to specified requirements, including strength, tolerances, and finishes, shall be replaced with precast concrete units that meet requirements of this section. Contractor shall also be responsible for cost of corrections to other work affected by or resulting from correction to precast concrete work.

## PART 4: MEASUREMENT & PAYMENT

- 4-1 12" X 20" PRECAST PRESTRESSED CONCRETE SLABS, 7'-3": Payment will be included in the Contract lump sum price of "Lagging". Payment shall include furnishing all labor, materials, equipment and all items pertaining to placing the precast, prestressed concrete slabs.
- 4-2 12" X 20" PRECAST PRESTRESSED CONCRETE SLABS, 9'- 3": Payment will be included in the Contract lump sum price of "Lagging". Payment shall include furnishing all labor, materials, equipment and all items pertaining to placing the precast, prestressed concrete slabs.
- 4-3 12" x 20" PRECAST PRESTRESSED CONCRETE SLABS, 3'-3": Payment will be included in the Contract lump sum price of "Concrete Slabs". Payment shall include furnishing all labor, materials, equipment and all items pertaining to placing the precast, prestressed concrete slabs.

**END OF SECTION 03400** 

#### PART 1: GENERAL

#### 1-1 DESCRIPTION:

This item consists of shop applying an inorganic zinc prime coat, an epoxy intermediate coat and a urethane finish coat to new structural steel.

#### PART 2: PRODUCTS

#### 2-1 INORGANIC ZINC PRIME COAT:

This coating shall conform to ODOT Specification 708.17, Inorganic Zinc Silicate Primer paint. Prime coat shall be applied in accordance with ODOT Specification 513.222 and ODOT Specification 514.01 through ODOT Specification 514.04. Thickness of the prime coat and measurement of the thickness shall conform to Dry Film Thickness requirements in this specification.

#### 2-2 EPOXY INTERMEDIATE COAT AND URETHANE TOP COAT:

These coatings shall be selected from the list of coatings approved for use under ODOT Supplemental Specifications 910. Materials for each coat of the intermediate and finish coatings shall be supplied from the same manufacturer.

#### PART 3: EXECUTION

#### 3-1 SURFACE PREPARATION:

A. All steel shall be washed then solvent cleaned as per the manufacturer's recommendations.

#### 3-2 TEMPERATURE:

A. Paint shall not be applied when the temperature of the air, steel, or paint is below 50 degrees F. Paint shall not be applied when the steel surface temperature is expected to drop below 50 degrees F. before the paint has cured for the minimum times specified below:

	50F	60F	70F
Intermediate	6 hrs	5 hrs	4 hrs
Finish	8 hrs	6 hrs	4 hrs

#### 3-3 MOISTURE:

A. Paint shall not be applied when the steel surface temperature is less than 5 degrees F. above the dew point. Paint shall not be applied to wet or damp surfaces. Paint shall not be applied when the relative humidity is greater than 85%.

## 3-4 INTERMEDIATE AND FINISH COAT APPLICATION:

A. Each coat of paint shall be in a proper state of cure or dryness before the application of succeeding coats. Paint shall be considered ready for overcoating when an additional coat can be applied without the development of any detrimental film irregularities, such as lifting, wrinkling or loss of adhesion of the undercoat. The time interval between coating applications shall be in compliance with the manufacturer's

written instructions and no more than thirteen (13) days between the intermediate and finish coats. Any coat which has cured more than the above allotted time without overcoating, shall be removed and the steel reblasted to Sa 1 ½.

#### 3-5 PAINT THICKNESS:

Prime thickness, cumulative prime and intermediate thickness, and cumulative prime, intermediate and finish thickness shall be determined by use of Type 2 magnetic gage in accordance with the following:

Five (5) separate spot measurements shall be spaced evenly over each 100 square feet of area to be measured. These measurements shall be taken on flanges, webs, cross bracing, stiffeners, etc. Three (3) gage readings shall be made for each spot measurement of either the substrate or the paint. The probe shall be moved a distance of one to three inches for each new gage reading. Any unusually high or low gage reading that cannot be repeated consistently shall be discarded. The average (mean) of these three gage readings shall be used as the spot measurement. The average of five spot measurements for each such 100 square foot area shall not be less than the specified thickness. No single spot measurement in any 100 square foot area shall be less than 80% of the specified minimum thickness nor greater than 150% of the maximum specified thickness.

Any one of three readings which are averaged to produce each spot measurement, may under-run by a greater amount. The five spot measurements shall be made for each 100 square feet of area as follows:

- 1. For structures not exceeding 300 square feet in area, each 100 square foot area shall be measured.
- 2. For structures not exceeding 1,000 square feet in area, three 100 square foot areas shall be randomly selected and measured.
- 3. For structures exceeding 1,000 square feet in area, the first 1,000 square feet shall be measured as stated in section 2 and for each additional 1,000 square feet, or increment thereof, one 100 square foot area shall be randomly selected and measured.
- 4. If the dry film thickness for any 100 square foot area (sections 283) is not in compliance with the requirements of paragraph 1 of this section, then each 100 square foot area shall be measured.
- 5. Other size areas or number of spot measurements may be specified in the contract plans or as appropriate for the size and shape of the structure shall be measured.
- A. Each coat of paint shall have the following mil thickness measured above the peaks:

	Min. Spec. Thickness	Max. Spec. Thickness	Minimum Spot	Maximum Spot
Prime	3.0	5.0	2.4	7.5
Intermediate	5.0	7.0	4.0	10.5
Sub Total	8.0	12.0	6.4	18.0
Finish	2.0	4.0	1.6	6.0
Total	10.0	16.0	8.0	24.0

Film thickness greater than the maximum specified thicknesses that do not exhibit defects (such as runs, sags, bubbles, mudcracking, etc.) and for which the Contractor has received a written statement from the coating manufacturer stating that this excessive thickness is not detrimental, may remain in place at the discretion of the Contracting Officer.

## 3-6 PAINT DAMAGE:

A. Any painted surface damaged during transportation, placement, welding or other situation occurring up to the time the project has been completed and accepted shall be repaired at the Contractor's expense.

#### 3-7 LIMITS OF PAINTING:

- A. All the steel's surface area in this project shall be painted except for the following:
  - 1. Beam spacers, 8"x8"x1/4" steel plates, do not require painting.
  - 2. The part of the pile sections encased in the Class "C" concrete except for the section 1 foot from the top of concrete.

#### 3-8 COLOR:

The finish coat shall be flat black. A sample shall be provided to and approved by the Contracting Officer.

#### 3-9 REPAIR PROCEDURES:

Damaged areas of paint shall have the paint removed and all defects corrected. If the primer is damaged, the steel should then be retextured to a near white condition to produce a profile of between 1 to 3 ½ mils. This profile should be measured immediately prior to the application of the prime coat to insure that the profile is not destroyed during the feathering procedure.

The existing paint should be feathered to expose a minimum of 1/2 inch of each coat.

During the reapplication of the paint, care shall be used to insure that each coat of paint is applied only within the following areas. The prime coat shall only be applied to the surface of the bare steel and the existing prime coat which has been exposed by feathering. The prime coat shall not be applied to the adjacent intermediate coat. The intermediate coat shall only be applied to the new prime coat and the existing feathered intermediate coat. The intermediate coat shall not be applied to the adjacent finish coat. The finish coat shall only be applied to the new intermediate coat and the existing finish coat which has been feathered or lightly sanded. The finish coat should not extend beyond the areas which have been feathered or slightly sanded.

At the perimeter of the repair area, the first two coats shall be applied by brush. The finish coat shall be applied by either brush or spray.

It may be necessary to make several applications in order to achieve the proper thickness for each coat.

During the application of the prime coat, the paint shall be continuously mixed. The prime coat shall be a prequalified organic zinc as per ODOT SS 910.

All surface preparation and painting shall be done in accordance with the specifications. Surface preparation shall be by power tools steel grit or low dusting abrasive.

All repairs shall be made in a manner to blend the patched area with the adjacent coating. The finished surface of the patched area shall leave a smooth, even profile with the adjacent surface.

The Contractor shall submit his method of correcting runs in writing to the Contracting Officer for approval.

#### 3-10 CONTINUITY:

Each coat of paint shall be applied as a continuous film of uniform thickness free of all defects such as holes, runs, sags, etc. All thin spots of areas missed shall be repainted and permitted to dry before the next coat of paint is applied.

## PART 4: MEASUREMENT & PAYMENT

4-1 PAYMENT: Will be included in the bid item to which this work relates.

**END OF SECTION 05100** 

#### PART 1: GENERAL

#### 1-1 DESCRIPTION:

- A. The work of this section includes general provisions of the contract, general conditions and supplementary conditions that apply to all work specified in this section.
- B. Structural steel framing members, structural steel support members, complete with required bracing, welds, washers, nuts, shims, anchor bolts, and pipe columns.
- C. Steel anchor plates.
- D. Field location of steel supports.
- E. Erection and connecting structural steel frame.
- 1-2 RELATED WORK:
- A. Section 02220 Tieback Anchors.
- B. Section 05100 Painted Structural Steel.
- 1-3 QUALITY ASSURANCE:
- A. Codes and Standards: Comply with the provisions of the following except as otherwise indicated:
  - 1. AISC "Code of Standard Practice for Steel Buildings and Bridges.
  - AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings" and including the "Commentary" and Supplements thereto as issued.
  - AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
  - 4. AWS D1.1 "Structural Welding Code."
  - ASTM A6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."
  - ODOT Standard Specifications.
- B. Qualification for Welding Work:
  - Qualify welding processes and welding operators in accordance with the AWS "Standard Qualification Procedure."
  - Provide certification that welders to be employed in the work have satisfactorily passed AWS
    qualification tests within the previous 12 months. Also, provide proof that the welder has performed
    satisfactory work under the code for which qualified within the preceding three months.

- a. Any welder found to be producing unsatisfactory work even though he has passed qualification tests shall be immediately recertified or replaced with a qualified welder.
- If re-certification of welders is required, retesting will be the Contractor's responsibility.

#### C. Source Quality Control:

- Materials and fabrication procedures are subject to inspection and tests in the mill, shop and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve the Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.
  - Promptly remove and replace materials or fabricated components which do not apply.

### D. Design of Members and Connections:

1. All details shown on typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at the site whenever possible without causing delay in the work.

#### 1-4 SUBMITTALS:

- A. Manufacturer's Data: Include laboratory test reports and other data as required to show compliance with these specifications (including specified standards).
  - Certified copies of all mill reports covering the chemical and physical properties (each type).
- B. Shop Drawings: See Section 01300 requirements and below. Furnish complete fabrication and erection drawings as follows:
  - All drawings shall have a revision block which shall be used when drawings have been revised
    and all items or drawings that were revised shall be circled. When shop drawings are prepared in
    small segments and erection drawings are issued again, the new erection marks added to the erection
    drawings must be circled. If the new marks are not circled, the drawings will be rejected and
    unchecked.
  - 2. When detailing beams, girders, columns, angles, etc., the entire plan of any given landing shall be detailed completely before submitting for review. All detailing must be complete in any one area, if not, this shall be cause for rejection.
  - 3. Detailing of beams, columns, angles, etc. shall be done on a 24 x 36 sheet, minimum, and the drawing shall be filled completely to minimize number of shop drawings.
  - Drawings containing only one item will be rejected.
  - Each drawing that has beams, pipe columns, size and type of welds, etc., detailed thereon shall state type of welding electrode, size and type of bolts, grade of steel being used for all materials on that sheet.

- 6. No changes or substitutions shall be made on the shop drawings until a letter and sketch explaining the change and how it affects other components of the structure has been submitted and accepted by the Contracting Officer.
- The Contracting Officer reserves the right to reject and order redrawn any shop drawing that does not comply with the above-mentioned procedures, at no additional expense to the Government.
- 8. Contracting Officer review of shop drawings will be for general considerations only. Compliance with requirements for materials fabrication and erection of structural steel is the Contractor's responsibility. The Contracting Officer reserves the right to have any piece of steel which does not comply to contract documents redone at no additional expense to the Government, even though it was detailed wrong on the shop drawings, and reviewed by the Contracting Officer.
  - a. Include details of cuts, connections, holes, and pertinent data. Indicate welds by standard AWS symbols, and show size, length, and type of each weld.
- 1-5 DELIVERY, STORAGE AND HANDLING:
- A. Deliver materials to the site at such intervals to insure uninterrupted progress of the work.
- B. Store materials to permit easy access for inspection and identification.
  - 1. Keep steel members off the ground, using pallets, platforms, or other supports.
  - Protect steel members and packaged materials from corrosion and deterioration.
  - 3. Handle and pile materials in a manner such as to prevent damage.
  - 4. Do not store materials on the structure in a manner that might cause distortion or damage to the members or the supporting structures. Repair or replace damaged materials or structures ad directed at no additional expense to the Government.

#### PART 2: PRODUCTS

#### 2-1 MATERIALS:

- A. Rolled Steel Plates, Shapes and Bars: ASTM A36, such as columns, angles, etc., except where other type steel is shown.
- B. Metal Surfaces, for Architecturally Exposed Structural Steel: For the fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemished including pitting, seam marks, roller marks, rolled trade names and roughness. Remove such blemished by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.
- C. Arc Welding Electrodes: Shall conform to the Specifications for Mild Steel Covered Arc Welding Electrodes, AWS A-5.1, latest edition. The size and classification of electrodes used shall be suitable for all positions and other conditions of intended use. E-70XX electrodes shall be used for all welding of structural materials.

#### D. Connections:

1. All connections, bolts, rivets, bearing plates, anchorages, anchor bolts, etc., necessary for

complete erection of all materials shall be furnished whether or not specifically shown on drawings.

#### 2-2 FABRICATION:

### A. Shop Fabrication and Assembly:

- Fabricate and assemble structural assemblies in the shop to the greatest extent possible.
   Fabricate items of structural steel in accordance with AISC specifications and as indicated on the final shop drawings.
- Properly make and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
- 3. Where finishing is required, complete the assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in the final structure free of markings, burrs and other defects.
- B. Shop Connections: Shop connections shall be welded as required in Standards article above, or high tensile bolted (3/4" minimum) as required in Standards article above.

#### C. Holes:

- 1. Shop drill or punch holes in members as required.
- 2. Show such holes on shop drawings wherever possible.
- 3. Hole requirements received before fabrication will be at no extra expense to the Owner.

#### D. Connections:

- 1. Weld, bolt or rivet shop connections, as indicated.
  - Connections not detailed on the drawings shall conform to the requirements of the cited AISC Specifications.
  - b. Where the reaction values of beams, bracing, etc., are not shown on drawings, the connections shall be designed to support the maximum allowable uniform load as indicated I the tables of AISC Manual of Steel Construction for given member size and span. No connection for any beam shall be less than the smallest connection shown in AISC Manual Table I for that particular beam section.
- Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.
  - Assemble and weld built-up sections by methods which will produce a true alignment of axes without warp.
  - b. Select weld sizes, sequence, and equipment to limit distortions to allowable tolerances. Surface "bleed" on back side welding on exposed surfaces will not be acceptable.
  - c. For high-strength low-alloy steels, follow welding procedures as recommended by the

steel producer for exposed and concealed connections.

- d. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp. Grind smooth exposed fillet welds that are 1/2" and larger; grind butt welds flush; dress all exposed.
- e. H-Pile Splices: Splicing may be necessary to provide length to bearing. See detail in plans for allowable locations and method of making the required welded butt splice. Welding shall be performed by a prequalified welder. Mill test reports are required for steel H-piles and should be reviwed by the Contracting Officer for conformance to 711.01.

#### PART 3: EXECUTION

#### 3-1 INSPECTION:

- A. Erector must examine the area and conditions under which structural steel work is to be installed, and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until satisfactory conditions have been corrected in a manner acceptable to the Erector.
- B. Touch-up: After erection is complete, touch-up all shop finishes damaged during transportation and erection. Repair zinc-coating and paint as specified for shop painting.
- C. All groove-welds for H-pile splices shall be xrayed for quality control.

## PART 4: MEASUREMENT & PAYMENT

- 4-1 6x4x 1/2ANGLE: Payment shall be included at the Contract unit lump sum of "Lagging". Payment shall include all labor, materials, welding, equipment and all items pertaining to the placement of the 6x4x 1/2 Angle.
- 4-2 Soldier Pile, HP 14 x 73: Measurement shall be the number of linear feet as shown on the drawings and measured in the field. Payment shall be made at the contract unit price per linear foot "Soldier Pile, HP 14 x 73".
- 4-3 Soldier Pile, Channel Section (18.5°, 22°, 34°, 45°): Measurement shall be the number of linear feet as shown on the drawings and measured in the field. Payment shall be made at the contract unit price per linear foot "Soldier Pile, Channel Section (18.5°, 22°, 34°, 45°)".
- 4.4 10"x10"x 1/4" Steel Spacers: Payment shall be included in the Contract unit lump sum of "Lagging". Payment shall include all labor, materials, equipment and all items pertaining to the placement of the 10"x10"x 1/4" steel spacers.

**END OF SECTION 05120** 

#### PART 1: GENERAL

- 1-1 DESCRIPTION: The proposed work shall consist of assisting in the installation or installation of the following items:
- A. Failure tests of fully instrumented non-production tie backs. The tests in this section shall count towards the testing requirements of the tieback anchors.
- Instrumentation of tieback walls and anchors.
- Installation of piezometers and inclinometers.
- 1-2 RELATED WORK:
- A. Section 02220 Tie Back Anchors.
- B. Section 05120 Structural Steel.

#### PART 2: PRODUCTS

## 2-1 CONCRETE BOX FOR DATA COLLECTION SYSTEM:

A. The concrete box shall be a modified ODOT 2-2-B catch basin with a closed top, open side with a lockable steel cover painted green, all of which to the appropriate dimensions as indicated in Figure 7 in this section.

#### 2-2 INSTRUMENTATION:

A. All instrumentation and accessories not including piezometers and inclinometers which will be provided by the Contractors Geotechnical Engineer, shall be provided by the University of Akron.

#### PART 3: EXECUTION

## 3-1 FAILURE TESTS OF FULLY INSTRUMENTED NON-PRODUCTION TIEBACKS:

A. Two failure tests of non production anchors under wet and dry conditions, respectively, are planned. The wet conditions will be produced by allowing the bore hole to fill with water and remain full for 48 hours. After the 48 hour period, the water will be pumped out and grouting will commence. The dry condition will consist of a bore hole in a dry situation. This work shall be performed by the Contractor.

## 3-2 INSTRUMENTATION OF THE WALLS AND TIEBACK ANCHORS:

A. Instrumentation of the anchors will include vibrating wire strain gauges, vibrating wire load cells applied to anchor head, and dial gauges to measure the displacement at the anchor head (See Figure 3 thru 6, inclusive). As shown in Figure 3, a total of (4) four soldier piles will be instrumented. Each instrumented pile will have an earth pressure cell embedded at the base of the soldier pile. Work will consist of placement of the above gauges and general assistance in running wires underground to the instruments. The University of Akron will hook up the instrumentation.

B. Strain gauges, provided by the University of Akron, will require welding which will be provided by the contractor. Exact locations will be provided by the Contracting Officer.

### 3-3 INSTALLATION OF PIEZOMETERS AND INCLINOMETERS:

In addition to the three inclinometers shown on the drawings, one inclinometer will be imbedded by each instrumented pile from a point at least 15 feet below the bottom of the drilled shaft to the top elevation of the soldier pile. Three vibrating wire piezometers (Geocon Model 4500 AL) will be installed in the ground behind the upper tier wall. A licensed Geotechnical Engineer, provided by the Contractor at no additional expense to the Government, will be required to install and furnish the piezometers and inclinometers and all materials required to install the piezometers and inclinometers as directed by the Contracting Officer.

#### 3-4 CONCRETE BOX:

The Contractor will provide 2 (two) concrete boxes that will house the instruments. Each location will be determined by the Contracting Officer.

#### 3-5 RESEARCH ASSISTANCE:

Research assistance will consist of running wires underground, running wires from testing gauges to the concrete box, placement of materials (i.e. concrete box, welding strain gauges) and general assistance. It is understood that research assistance is limited to placing testing equipment which cannot be reasonably performed by the University of Akron Graduate Students.

#### PART 4: MEASUREMENT AND PAYMENT

- 4-1 RESEARCH ASSISTANCE: Measurement and Payment will be included in the Contract lump sum for "Instrumentation Installation and Assistance". Payment shall include all materials, labor and equipment necessary to complete the research assistance
- 4-2 STRAIN GAUGE PLACEMENT: Measurement and Payment will be included in the Contract lump sum for "Instrumentation Installation and Assistance". Payment shall include all materials, labor and equipment necessary to complete the strain gauge placement.
- 4-3 PIEZOMETERS: Measurement and Payment will be included in the Contract lump sum for "Instrumentation Installation and Assistance". Payment shall include all materials, labor, equipment necessary to complete the piezometers placement.
- 4.4 INCLINOMETERS: Measurement and Payment will be included in the Contract lump sum for "Instrumentation Installation and Assistance". Payment shall include all materials, labor, equipment necessary to complete the inclinometers placement.
- 4-5 CONCRETE BOX: Measurement and Payment will be included in the Contract lump sum for "Instrumentation Installation and Assistance". Payment shall include all materials, labor, equipment necessary to complete the inclinometers placement.
- 4-6 LICENSED GEOTECHNICAL ENGINEER: Measurement and payment will be included in the Contract lump sum for "Instrumentation Installation and Assistance". Payment shall include all materials, labor and equipment necessary to perform and complete the required work.

FIGURES 3-7, INCLUSIVE, FOLLOW THIS PAGE.

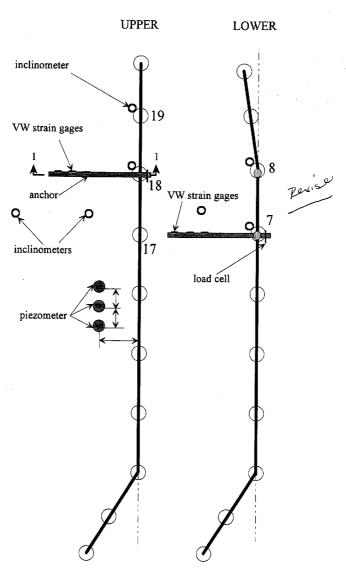


Fig.3 Plan view

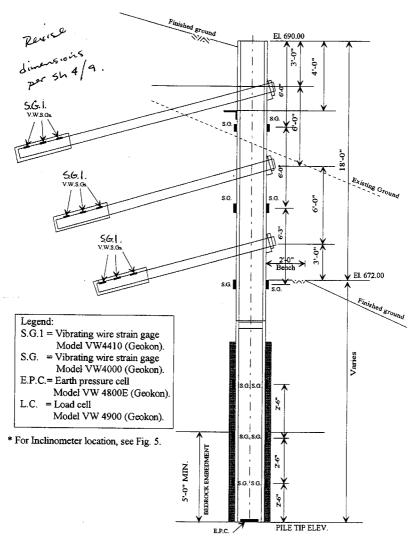
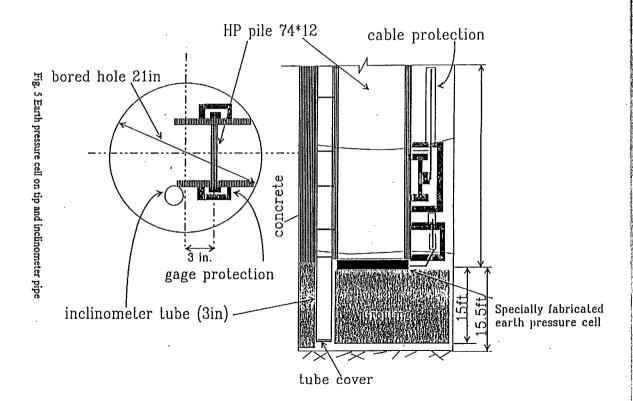


Fig.4 Cross section 1-1



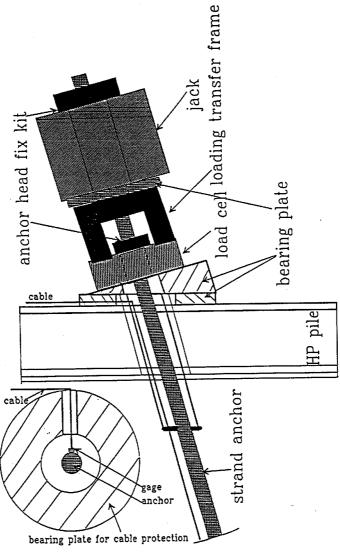


Fig. 6 Anchor head set up

Detailing of the design of the concrete box for the data collection system

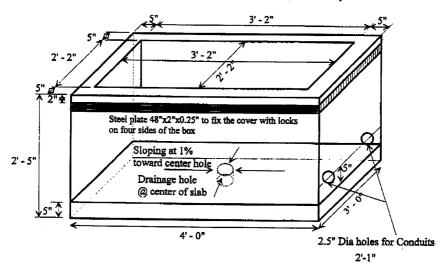


Fig. 7 Details of the design of the concrete box for the data collection system

## details of the steel cover for the concrete box

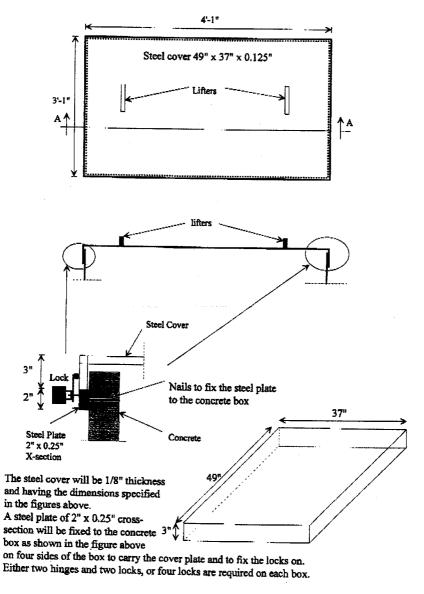


Fig. 7 (continued) Details of the steel cover for the concrete box 11600-8
END OF SECTION 11600

## **Inter-Office Communication**

to: Eugene C. Geiger, P.E., Soils Engineering Coordinator date: May 13, 1997

from: Neal C. Miesle, P.E., District Four Production Bridge Section

subject: SUM-82-0.00, PID 16255 Revisions to tie-back retaining wall in the National Park

We recently met with EDG and the National Park Service (NPS) to discuss some of your detail design comments that you provided on the marked up set of prints sent on April 4, 1997. This meeting was held on April 23, 1997 at EDG's facility in Akron. EDG has indicated that they feel these are some substantial changes and will need approximately \$10,250 to modify the existing plans and specifications. Originally, the NPS did not know if their contract with EDG could be extended, but after checking with their Contracting Office in Omaha, they were given permission to amend or modify EDG's contract.

EDG had several design questions that they felt needed to be clarified before proceeding:

- Do we need to provide rock embedment of approximately 20 feet? EDG felt that would dramatically increase the construction cost.
- 2) What was the reason why the height of wall increased? This will probably present a handling problem with the longer h-piles.
- Can pile spacing be increased by placing additional anchors, especially in the lower wall?
- 4) The original wall design had a combination of soil and rock anchors, why are we changing the design to all rock anchors?
- 5) Will these changes affect Dr. Liang's proposed research?

The NPS had Gannett Flemming look at this proposed wall and conducted a constructability review. They had several possible construction methods for building this wall:

- 6) Does the work have to begin at the upper level and work down? They felt that if excavation was to be minimized as discussed in the notes on sheet 6, they felt that they would have to construct a temporary tie-back wall to work from.
- 7) Use shotcrete and soil nailing to stabilize the slope was another possible method.
- 8) Use a possible "insert wall" to stabilize the slope.
- 9) Can the piling be spliced by welding? If so, what procedure or details should be provided in the contract plans and specifications?

Frank Martin and myself talked to you about some of the above concerns and you provided the following responses:

....

- The design procedure was based on FHWA formulas. The controlling factor for embedment into rock is based on vertical loads, not the horizontal forces in the system.
   The piles need to be embedded in rock approximately twenty (20) feet.
- 2) The height of the wall was raised to provide for an elevation where the clay is more stable
- 3) No, spacing can not be increased nor can the number of anchors per pile be increased due to concerns about creep in the anchors.
- 4) The soil has a liquid index (LI) greater than that recommended for using soil anchors. We do not have adequate borings in the bond zone. The clay layer is relatively unstable and might continue to slip.
- 5) These changes should be coordinated with Dr. Liang of U of A. He might want to put his instrumentation on other piles or anchors. Any and all changes should be part of the contract documents.
- 6) The work must definitely proceed from the top of the upper wall to the bottom of the lower. Gene never considered adding a third (permanent) tier because it was not tall enough to warrant the significant additional expense of a third level.
- Soil nailing with gunnite and rock bolts were utilized to stabilize the slope on the Steubenville US 22 project.
- 8) No comment on this since the concept was difficult to explain to Mr. Geiger
- 9) The piles probably can be field welded. I have enclosed Figure 4.2.2.2 from the Manual of Procedures for Structures. This detail is used for splicing H-piles with the use of welded butt splices. I have discussed this detail with Lloyd Welker of O.S.E. and he felt that this detail probably would be acceptable, but we might want to specify that the welds are not located in the areas of maximum moments or a certain distance from the anchors. These welds should probably be X-rayed for quality control, but they will not be receiving dynamic loadings like a beam would.

Rob Boble of the NPS was also contacted and the following information was resolved:

- A) The piling shall be embedded into the rock as indicated in Gene Geiger's comments.
- B) The note on sheet six shall be modified to indicate that the wall shall definitely be constructed from the top down and the top wall shall be constructed first.
- C) A bench approximately 15 feet wide may be constructed with minimal excavation not below where the existing ground meets the projection of the proposed wall.
- D) A lump sum item for temporary cribs and sheeting shall be provided for the contractor to shore or stabilize the slope so the walls can be constructed. No specific method should be provided but the contractor should submit this procedure to NPS for review.

If these comments do not accurately reflect the conversations that we had together, please modify and I will document our files accordingly. I appreciate your assistance in this project. If you need any additional information, please call me at (330) 297-0801, extension 347.



D. Dreger

J. Paradise

F. Martin

R. Bobel

file

Splicing may be necessary to provide length to bearing. See Figure 4.2.2.2 for method of making the required welded butt splice. Welding shall be performed by a prequalified welder. Numerous splices using small lengths in the same pile should be avoided, particularly in an area exposed to view.

Mill test reports are required for steel H-piles and should be reviewed by the Engineer for conformance to 711.01.

4.2.2.3 Cast-in-place Piles. A cast-in-place reinforced concrete pile consists of a metal shell or casting which is filled with concrete. The gage of metal shell elected generally is heavy enough that additional reinforcement is not necessary. See Appendix 2 for a graph showing the gages necessary to provide the reinforcement for various depths.

The shells may be tapered or of uniform section. The tapered piles generally used are monotubes, and shells of uniform section are called pipe piles. Tapered monotube point sections come equipped with a bullet-nosed tip. Pipe piles usually have a plate welded on the point which shall not extend more than 1/4 inch beyond the surface of the pile at any point. The metal of the shells is not specified and mill test reports are not required.

The shells shall be inspected and necessary measurements made. Before filling, water and debris shall be removed. Concrete required for filling the shell is Class C containing a superplastizing admixture. This should be deposited in a steady small stream so complete filling and consolidation is obtained. Upon filling to the tip, the concrete should be vibrated or jarred further to consolidate that which dropped only a short distance. No driving shall be performed within 15 feet of filled piles until the concrete has cured at least seven days.

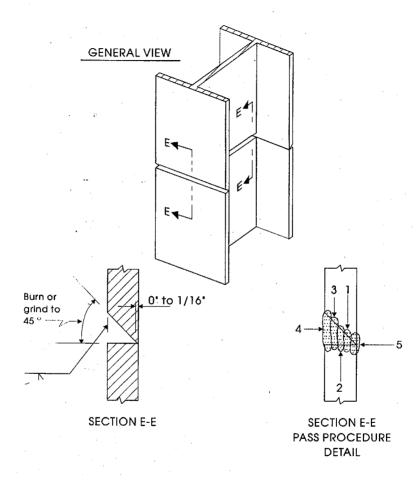
#### 4.2.2.4 Driving Operation.

- 4.2.2.4.1 Alignment in Leads. For the full effect of the energy of the hammer to be transmitted to penetration of the pile, the axis of the hammer must be in line with the axis of the pile.
- 4.2.2.4.2 Operation of the Hammer. After significant bearing is obtained, double-acting hammers must operate at one of the speeds or a greater speed for which an energy is assigned. If that speed is not obtained, something is wrong with the set-up or condition of the hammer, and driving should not continue until correction is made. If the hammer is operated at too fast a speed it will jump off the pile and the ram will strike before it has settled back down. Maximum energy is obtained at that throttle setting just under this point.

Single-acting diesel hammers can be expected to be operating at the assigned energy when the ram is observed to rebound out of the housing approximately 3 feet when about 40 tons resistance is encountered.

- 4.2.2.4.3 Use of An Energy Gage. Some double-acting diesel hammers may be equipped with a gage connected to the bounce chamber by a hose. The gage has a pressure scale and indicator which shows the pressure developed for each stroke of the ram. On an accompanying graph, the energy of the hammer for that pressure can be read. A graph which shows B/F for various bearings and pressures is included in Appendix 3 and 4.
- 4.2.3 Defective Piles. A pile is considered defective if damaged to the extent that the strength of its section is reduced over 20 percent. This can occur as a collapse of the shell where less than 80 percent of the cross-sectional area remains open or where the shell is ruptured to the extent that the pile will have over 20 percent less strength. A pile is considered to be defective if the location of the pile at the ground surface differs from the specified location by more than the top diameter for piles which will be entirely underground or by more than one-fourth the top diameter for piles which project above the ground. No attempt should be made to draw these piles to the specified location. All other piles which project above the ground will be considered defective if they cannot be drawn and secured to the specified plan location.

# JOINT PREPARATION FOR GROOVE-WELDED H PILE



NOTES: In case a different number of passes is required than shown, a similar sequence must be followed with the finishing pass on reverse side.

Back gouge root pass prior to making the finishing pass.

From: R

Richard Cheney

To:

FH05RG FH05RG POSBORN

Date: Subject:

2/12/97 11:25am Ohio Slope Stabilization

Peter...Per your request for technical assistance, I reviewed the tieback design for the subject project. Basically the design as shown in the plan documents is flawed seriously. The lack of subsurface information at the wall specific comments are attached. If you need further assistance let me know.

CC:

PTHOMPSON, CCHAMBERS, WPODOLNY, JDIMAGGIO

Fax to:

Gene Geiger

3 pages

To: < Gene = Geiger%Location-Design%Design@ODOT.OHIO.GOV>
Cc:
Bcc:
From: "Lefchik, Thomas" < Thomas.Lefchik@fhwa.dot.gov>
CUY-82
Date: Friday, February 14, 1997 9:24 AM
Attach:
Certify: Y

(B-Av-Rea d on f or Dick Cheney's coments. He has a lot of corperns. Gill matter you read this. Dick will be in today and then out for 4 weeks.

From: Richard Cheney

To: FH05RG.FH05RG.POSBORN

Date: 2/12/97 11:25am

Subject: Ohio Slope Stabilization

Peter...Per your request for technical assistance, I reviewed the tieback design for the subject project. Basically the design as shown in the plan documents is flawed seriously. The lack of subsurface information at the wall location is a major problem as is the constructibility of the design. Phy specific comments are attached. If you need further assistance let me know. Dick

CC: PTHOMPSON, CCHAMBERS, WPODOLNY, JDIMAGGIO

Ohio; Cuyahoga Valley Recreation Area Slope Stabilization under Bridge SR82 Comments on Tieback Design

The following information was used in the review of the tieback design:

Half scale plans of the proposed upper and lower tieback walls dated 3-14-96 and prepared by Environmental Design Group Inc.
 Soils information provided on full size plan sheets prepared by Ohio DOT and dated 8-26-93.

#### Comments

- 1. The FHWA guidelines for borings for tieback walls recommend borings spaced at 100' center at the wall location with additional borings atken behind the wall in the bond zone. No borings appear to exist at the location of either the upper or lower walls, ie. Stations 13+25 and 13+60.. Borings do exist in the vicinity of station 12+75 which could be used to estimate the soils at the bond zone location if horizontal stratification of the soil layers was verified. However the profile view indicates a rock outcrop exists at a level much higher than where rock was encountered in the borings. If rock is dipping steeply into the slope, the wall pressures on the upper wall may be higher than anticipated; particularly if a hydrostatic pressure situation exists in the soil behind the rock face. In addition, the overall slope stability after removal of the rock face should be verified. Consideration should be given to obtaining borings at the wall location in accord with FHWA guidelines.
- 2. The bond zone of the upper wall tiebacks appears to be located in soils described as silts or clays. FHWA guidelines indicates that the bond zone of anchors should not be founded in cohesive soils unless the liquid limit exceeds 50 and the liquidity index less than 0.2. The laboratory test data indicates the liquidity index of samples near the bond zone elevation is higher than 0.2. The ultimate capacity and creep characteristics of anchors founded in such materials should be determined prior to design by a field test program. This information is particularly critical at this location as any anchors which do not pass the construction field tests cannot be extended to greater lengths due to the presence of the existing footing for the main pier of the spandrel arch. The possibility exists for the use of steeper inclinations of the anchors if the soil and rock profile were better defined and the potential for conflict with the anchors of the lower wall was checked. These design issues which could affect the success or failure of this construction should be resolved before the construction of these walls.

 The upper anchor row for the lower steback wall appear to penetrate the soldier piles for the upper wall. The position of these anchors and their effect on the upper wall should be reviewed; particularly as no borings exist at this location and deeper required embedment of the piles may impact the lower anchor row as well.

4. The use H-pile sections for soldier beams of tieback walls requires trumpets to be fabricated into the soldier beam at predetermined location along the beam. If variations occur in the proposed embedment depth of the soldier beam, these trumpets will be located at the wrong elevations for anchor installations. Previous projects where this soldier pile type has been used successfully, have involved predetermined tip elevations in medium to compact soils. This soldier beam type has not proved successful in areas where rock support is needed a varying elevations. Construction corrections for this type of soldier beam are difficult and expensive. Consideration should be given to other soldier beam types.

Also we note that the minimum diameter of the encapsulated bar or strand tendons to carry the design load is larger than 75 mm trumpet outside diameter specified on section M-M. The size of the trumpet opening needed to accommodate an encapsulated tendon of the specified design load should be reviewed.

5. The proposed length for the soldier beams for the upper wall appears to be close to or greater than the vertical clearance to the face of the arch. This may require difficult splicing of soldier beam sections to accomplish beam installation unless holes can be drilled thru the deck and the arch. The placement of the soldier beam in construction should be reviewed.

Also the drilling of the soldier beam holes may require special support facilities as the ground slope is very severe; particularly at the lower wall. Special mention of this condition should be made in the contract documents.

- 6. The upper wall contains a fill section which will prevent stressing of the upper anchor until the fill is in place. The acceptance testing and stressing sequence of these upper row anchors should be clearly specified to prevent damage to the wall or soldier beam.
- 7. The table of soldier pile and anchorage data contains two items which should be reviewed. The zero inclination for the anchors at soldier piles 15 and 17 cannot be achieved in the field unless special grout packers are used. The need for this angle should be reviewed. Also the free length for the anchors is based on the height of the individual walls rather the suggested combined height of the tiered walls. Although this project has some unusual features, such as the lower wall appears to be entirely in rock, the combined tiered wall height should be considered for use in the free length computation if the lower wall is resisting the total earth pressures.

Ohio; Cuyahoga Valley Recreation Area Slope Stabilization under Bridge SR82 Comments on Tieback Design

The following information was used in the review of the tieback design:

- a. Half scale plans of the proposed upper and lower tieback walls dated 3-14-96 and prepared by Environmental Design Group Inc.
- Soils information provided on full size plan sheets prepared by Ohio DOT and dated 8-26-93.

## Comments

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# UNITED STATES GOVERNMENT MEMORANDUM

DATE: January 14, 1997

REPLY TO

ATTN OF: Rob Bobel, Civil Engineer

SUBJECT: Valley Railway-Slope Stabilization Under SR 82 Bridge

Re-biding project

TO: Meeting attendees (see attached list)

As you may be aware, the contract that was awarded to Choice Construction Co. for the Valley Railway-Slope Stabilization Under SR 82 Bridge is being canceled. You are invited to attend a meeting to discuss any revisions that should be made to package prior to resolicitation.

The meeting will be held at 10:00 A.M., Friday, January 24, 1997, at Hines Hill Conference Center, 1403 Hines Hill Road, Peninsula Ohio. Directions are attached.

If you have any questions about the arrangements, call me at 216-546-5972.

ROADWAY ENGINEERING

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## Agency/Name

ODOT District 4 Mr. Neil Miele Mr. Frank Martin

## ODOT Central office

EDG

Mr. Richard Beckert

Cuyahoga Valley Scenic Railroad Mr. Peter Birgeles

University of Akron
Dr. Robert Y. Liang, Dept. of Civil Engineering

National Park Service Ms. Joyce Stumbo; Messrs. Tom Bradley, Dave Humphrey, Tim Atkinson, Dan Cloud

## SEQUENCE OF CONSTRUCTION TIEBACK SOLDIER PILE AND LAGGING

## VALLEY RAILWAY - SLOPE STABILIZATION UNDER S.R. 82 BRIDGE TASK ORDER NO. 83

## CUYAHOGA VALLEY NATIONAL RECREATION AREA

- Prebore hole from the existing grade elevation and place steel pile section. Pour Class C concrete to proposed elevation, fill remaining hole with lean concrete.
- 2.\* Begin placing lagging to the first tieback from the top down. Lagging shall be placed by chipping the minimal amount of lean concrete from around the piles to insert an individual precast concrete member between the piles (hand methods may be required). Excavation of the wall face shall be performed incrementally with the lower limit of each individual excavation to be roughly the proposed elevation of the bottom of the individual lagging to be placed (hand method may be required). Over excavation shall be avoided as much as possible. If a void space behind the lagging occurs, the void shall be filled with pea gravel to the satisfaction of the Engineer and at no expense to the Owner.

It is the intent for the back of the proposed tieback wall lagging to be placed against undisturbed soil, which would jeopardize this placement of wall panels against undisturbed by Phone soil.

6 J. waldron 19/29/96

- Install tieback and apply a nominal load.
- Continue installing lagging to next tieback and support the previously installed tiebacks and repeat steps 2 and 3 until all tiebacks are placed.
- 5. Finish lagging, insure bottom lagging is fully supported on structural angle and ground.
- Perform required load tests and stress tieback to full design load (see Project manual for required tests).
- \* Fill Situation

  The work in this sequence is to be executed from the existing ground line upward to the top of the wall. Whenever a tieback is placed in fill, the Contractor will utilize a compression strut in order to stress the tieback to its full load capacity and perform required load tests prior to placing backfill above it.

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t associated with detonating cord tion blast hole spacings varied aged 7 feet center to center. poured into dry holes and was loaded into wet holes. A nachine controlled the blast timitiating systems were also used construction, but they were of the cheaper electric systems. blems were encountered during The stress relief joints which e at 10 to 20 degrees from ere sub-parallel to the ooth, vertical pre-splits an imt. Saw toothed finished faces e exception. In extremely satisfactory results were prosplit holes on 2- foot centers er hole. We believe the open

el through the stress relief

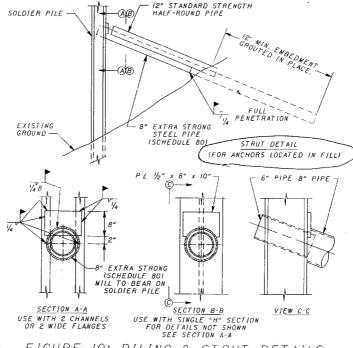
all 5 also presented a chalntrolled blasting. Any overequired additional wall conned wall face at the plan line. petween tiers is 5.5 or 12.5 evel at the base of any tier is pelow the top of the tier below oper tier was over excavated rock dowel installation for complicated, because rock nly front at their plan locaminimum imbed length. a tier therefore required hen the excavation reached er, a flat bench remained. e lower tier was then offset ariably, the top lip of the break. Pre-split spacings as revent this unwanted overduce blast damage to the vels were grouted into the grees prior to blasting. ebar and were spaced at 4 e finished product was de-

break problem, there were erns. In one instance, a e and 200 feet long experiing pre-split blasting. This feet and parallel to the preding on an underclay some illing, pile installation, and placement of lean concrete in the pre-bored holes became an extremely difficult and time consuming operation. In the Buffalo sandstone unit, smaller blocks would separate at stress relief joints and bedding planes and move slightly outward into the excavation limits. These blocks required either total removal or trimming with hoe ram equipment.

#### 6.4 Tieback Problems and Solutions

A total of 2139 tiebacks were installed during the construction of Retaining Wall #5. Only strand anchors were permitted, ranging from 2 to 7 strands and having free lengths ranging from 25 to 115 feet. The presence of joint systems in the rock not only created problems during the excavation, but also

complicated tieback installation. The anchor subcontractor experienced severe grout loss through the joints. When an anchor bore hole contained no voids, tieback installation would proceed normally. A consolidation grouting program, which utilized bulk flyash, portland cement, and water at a lower cost than the hand mixed Type II Portland grout required for tieback installation was used if a void was encountered during the drilling operation. In this case, the drill would move horizontally to the next tieback location and continue drilling. Typically, adjacent drill holes were interconnected by joints, and a series of holes were drilled prior to consolidation grouting. The consolidation grout was pumped into the holes until they were filled. These holes were then re-drilled the following day.



# facsimile TRANSMITTAL

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ohio department of transportation
705 Cakwood Street
Ravenna, Ohio 44266
330-297-0801

fax # 330 297-1848

P. 1

FAX NO. 2165460459

Choice Construction Co., Inc. 30675 Solon Road Solon, Ohio 44139

(216) 498-5333

FAX (216) 498-5340

October 17, 1996

Re: Slope Stabilization Under S.R. 82 Bridge Contract No. 1443CX603096011

Subject: Mobilization Plan, Sequence of Operations and Construction Methods

#### Mobilization Plan:

It is our intent to utilize all Staging Areas as layed out in the commen drawings for the purposes as noted on the attached sheets. We further request an additional area, for a Job Site Trailer, which is located northwest of what we have identified as Area #1.

#### Sequence of Operations and Construction Methods:

- 1. Construct a bank road from Station Rd. along the railroad tracks to the project location. This haul road will be constructed by placing an 8" to 10" convugated pipe in the existing ditch line, backfilling with on site materials and placing approximately 8" of base material for the road.
- 2. Construct a working beach first he Lower Tier Well from piling location 2 to 9 at El 647.00: from 1 to 2 & 9 to 10 at El 650.00. This beach will necessiste an average vertical cut of 6 fbot which will be protected, if needed, with shotcrete. This will give a working beach of 14', which is needed for the drilling equipment.
- Drill 21" holes for Lower Wall piling. Set piling in place and place Class C concrete to El 641.00 and Lean concrete from El 641.00 to El 647.00 and/or El 650.00
- 4. Excavate between pling and set lagging to the first row of the backs. Install the backs. Install the backs. Install the backs and complete lagging operations.
- Construct a working bench for the Upper Tier Wall from piling location 11 to 20 at El 675.00. This
  bench will necessiate an average vertical cut of 7 foot which will be protected with shotcrets.
- Drill 21" holes for Upper Wall piling. Set piling and place Class C conscrete to El 667.00 and Lean concrete to El 675.00.
- 7. Excavate between piling, set lagging and install tie backs in sequence as described for Lower Wall.
- 8. Drainage behind the wall will be installed as the wall is constructed. Catch Basins and lateral drain pipe will be installed after wall completion.

ROADWAY ENGINEERING GENC GEIGER

**DCT 1 6 1996** 

DISTRICT 4

BRIDGE DEPT.

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Cuyahoga Valley National Recreation Area CCORD	SCILS	□ OA
Minutes of Meeting No.4 GEOM		
Valley Railway-Slope Stabilization under S.R.	<b>⊠</b> VE <b>8</b> 2	

Project:

Bridge

Contract No.: 1443CX603096011 Date: October 7, 1996

Location:

Project site

Attendees:

Rob Bobel NPS/CUVA Robert Liang University of Akron Amir Tavakoli Choice Construction Art Lindrose Choice Construction

Chris Namestnik Choice Construction Kelvin Kingery McKinney Drilling Co. Frank Martin ODOT/D-4 Ken Cooper

Phil Crish

ODOT/D-4 ODOT/D-4

Review of work progress: No work has been done since the last on site meeting.

Percentage complete:

1%

Field observations/problems: No field work being done.

Resolution of field problems:

Review of submittals, off-site fabrication & delivery schedules: The Contractor's list of sub-contractors and his on-site personnel has been reviewed and approved. His Plan of Operation was rejected as it did not follow the sequence of construction as outlined on the drawings.

Planned progress during next work period: No work is scheduled until the Contractor has submitted and had approved a work plan.

Proposed changes: A discussion was had regarding why the Contractor's proposed work plan was unacceptable to both the Government and to ODOT. ODOT, owner of the bridge, is very concerned that the bridge could be damaged if wall construction disturbed the bridge's foundations. The Contractor was asked if they were allowed to excavate to the bottom of the lagging, what method would be used to temporarily support the slope above until the wall was constructed and backfilled. He stated he had not determined that yet.

Corrective measures to regain projected schedules: After lengthy discussions, the following was resolved. The Contractor will

again look at the possibility of constructing the upper wall first. This may require going outside the limits of work as shown on the drawings, but R. Bobel said this should not be a problem. In addition, the contractor will have his surveyor draw a set of cross-sections showing the existing profiles at each pile line and on either end of the wall limits.

Other business: Regarding the Contractor requested clarification on the structural steel painting, he was informed although painting was not shown as a line item on the bid schedule, it was to be included in the per foot cost of structural steel and was so referenced by the specifications.

After the meeting, R. Bobel and ODOT officials will travel to Steubenville Ohio to see the wall there build under similar circumstances and which used a top-down construction method.

Next meeting: The next meeting will be Friday, October 11, 9:30 AM at the project site.

Action Items:			By:
have additional to R. Bobel	survey done a	and get copies	A. Tavakoli

Please notify the undersigned of any additions/corrections to the above. If no comments are received within three days of sending out these minutes, they will be assumed correct.

Submitted by:

Robert W Bobel, P.E.

Contracting Officer's Representative

cc: Joyce Stumbo-Contracting Officer

Choice Construction Co.
Dan Cloud-Project Inspector
Dave Humphrey-Chief/TAPS

Pete Birgeles-CVSR Neal Miesle-ODOT Robert Liang-U/A Dick Kerber-CMPS

Chris Courtney-City of Brecksville

#### **Ohio Department of Transportation**

## **Inter-Office Communication**

Office of Roadway Engineering

Date:

April 24, 1996

To:

Neal C. Miesle, P.E., District Four Bridge Section

From:

Eugene C. Geiger, P.E., Soils Engineering Coordinator

Subject:

SUM-82-0.00, PID 16255, Tieback Retaining Wall

Reference is made to your April 15, 1996 IOC transmitting a copy of the plans and project specifications for the subject wall to be constructed by the National Park Service. I've given these a quick review. It appears that prior comments have been addressed. I agree that the use of lump sum items could make bidding and contract administration more difficult. The NPS apparently has the means to administer contracts this way.

The specifications regarding the instrumentation appear to be satisfactory, although the lump sum item for Research Assistance raises some concern if something unforeseen should occur. I noticed that the steel plate cover for the instrumentation box was quite heavy. After discussing this with Dr. Liang, he will be sending you a revision of Figure 7 in the specifications.

I suggest that you ask the consultant why the material specifications for the sheathing in Section 02220/2-6-A have been changed from the prototype note. It is not clear to me.

The specifications require the tieback contractor to be prequalified with ODOT. I suggest that you check with the Office of Contracts to see if it would be appropriate to send some form of notification to those prequalified contractors, perhaps a letter that refers them to the NPS.

Please feel free to contact me should you have any questions.

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c. Mr. Dreger, Mr. Werner, Mr. Paradise, Mr. Riaz, Reading File, File

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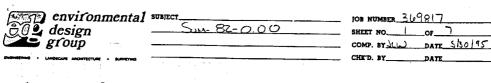
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		LETTER O	F TRANSMITTAL
700	OAKWOOD UKUNA, OH	DOE	DATE: 7/6/95 JOB #: 369817 ATTN: FRED WIFTLIER LOCATION & DOS. RE: 7/36/K CROBER 83 STATE ROSE BY SLOPE FAILURE
PARTIAL P COPY OF	AY REQUEST	[] CHAN- REPORT []	ED [] SHOP DRAWINGS [] PRINTS NGE ORDER [] SPECIFICATIONS ORIGINAL DRAWINGS, THE FOLLOWING
COPIES	DATE	NO.	DESCRIPTION
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	7		
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Landscape Architecture •

Surveying

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<i>302</i>	environmental design group	Sum - 82-0.00	SHEET NO. 2	
	group		COMP. BY JLW	DATE 5/30/95
			CHK'D. BY	DATE

ENGINEERING - LANDSCAFE ARCHITECTURE - SURVEYING	CHK'D. BYD	ATE
AUCHOL CAPACITIES		
- Lower		
3		
$Q_{ULT} = 10^{E FT} \times 40^{FT} = 400^{E}$ $Q_{NLDW} = \frac{400}{3.0} = 133^{E}$	entra de la companya de la companya de la companya de la companya de la companya de la companya de la companya	
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	Agent Salara and Agent Control	
- Upper		
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Qnuon = 64 cos 15 = 62 K	and which	
EALTH PRESSURE COEFFICIENTS	A comment of the second	
Cos o	Cos 234	
$K_{\alpha} = \begin{bmatrix} c_{\alpha} \dot{s} & \phi \\ 1 + \sqrt{\frac{S_{10} \phi S_{10} (\phi - \omega)}{C_{\alpha} s_{\alpha} \omega}} \end{bmatrix}^{2} = \begin{bmatrix} 1 + \sqrt{\frac{S_{10} \phi S_{10} (\phi - \omega)}{C_{\alpha} s_{\alpha} \omega}} \end{bmatrix}^{2}$	Siv 34 Siv (34-266)	
	Co5 26.6	= .42
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$K_{P} = \begin{bmatrix} S_{in} \phi S_{in} (\phi + \omega) \\ C_{O} \omega \end{bmatrix}^{2}$	C - 21 1	= 10.00
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SUM - 82-0.00 SHEET NO. 3 OF 7

COMP. BY JUM DATE \$/30/95

Luchon Coufic	
Lowez	
IL SPACING	
M = (LIS)(IC)(9) <sup>2</sup> /B = 100 K-FT Seg = (100 K-FT) 12" x 1/20 KSI = LO in <sup>3</sup>	
12' SPRIJG	
M = (.U.S)(12')(9')2 '18 = 76 K-FT Seg = 75 K-FT (12") 1/20 K-51 = 45 113	
Upper 10' Spacius	
M= .615 (10')(9') 1/8 = 63 EFT  Sig = 63 (12") (/20") = 38:03	
B' SPACING	
M= .615 (8') (9) $^{2}$ $^{1}/8 = 50^{2}$ $^{2}$	
U:5×9=   q'	
5535 <sup>9</sup> /FT   18'	
	time to the second seco

environn Egg design group	nental
group	1 744

SUM - 82 - 0 0 SHEET NO 4 OF 7

COMP. BY JUD DATE \$130/95

	LAMOSCAPE	MONTECTURE		BLAVE	7940	_	 	_	_	 	 	
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AUCHOE LOADINGS			
Lawer Tier	PHOLIZ = 5535 ( Pr = 886 7  PHOLIZ = 5.535 (12	osis = 91.7K	(IL' SPACING)
	PT = 664 CO	515 = 68.7k	(IE SINCIPO)
U Free Tier	PHOLIZ = 5.535 (1	515 = 57.4K	(10, Sprene)
	PHONE = 5534 ( )	the state of the comment of the state of the	(8 SPACIOG)
Soldier Pile Encedies	T:		
Lower		Ka XHu= .42 (	.lzs)(18)(18)=1.42 <sup>4</sup> /
A <sub>1</sub>	H	X = Ke X	140 - 1.42 840 - 1.25(12-42)15
P. (te-en)8		L-25 (5535)	= 7.60 ) + 1/2 (2.60)(1.42) = 1/2(36
(1/3 Kp-Ka) Y		19.1	4 = 1824 <sup>2</sup> 103 = 4
(/3(l0)42).12	sH	D€61.H =	103 + 2.6 = 129'



SHEET NO. S. OF COMP. BY LL DATE \$130/95

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WEIGHT S.	• • • • • • • • • • •		Lower	الم الم
der comment of the contract of	(40)	: :		
Cookers	10 X	18, × 1 × 120	= 43.2	27.0
woon_		18 x.6 x.073	= 10.5	6.6
STEEL	= 100=14	(35)	= 3.5	3.5
			57.2×	37.1K
VERTICAL ANCHOR REAC	خامات			
91.7 Siv	15 (2) = 47.5		57.4 5	15(2) = 29.7
	TOTAL LOAD	1047 <sup>K</sup>		66.8
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HOMEERING . LANDSCAPE AND	PATECTURE - SURVEYORS			(	HKD. BY	DAYE				
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<u> </u>	11 - 60 /	- 21	1	."						
1 1 1	N'g = 54 ( B = 125 D	Fig 4.6)								
		i								
· <del>  -   -   -  </del>	d - 10									
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DISTANCE (Ft.)

Job # 369817

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### Department of Civil Engineering

Akron, Ohio 44325-3905

FAX: (330) 972-6020 TEL: (330) 972-7286

TO: Gene Geiger DDOT (614) 152-47/8

FROM: Robert Y. Liang

Subject: Design/ Calculation Note

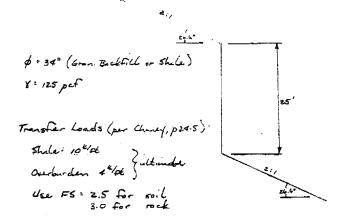
Hi: I found your calculation sheets

for the SUM. Bz project. Hopefully.

It is not too late.

No. of Pages: \_\_\_\_ (+ cover sheet)

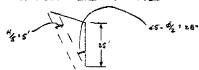
#### DESIGN FOR FOLLOWING CASE



#### FIND REQUIRED FREE LENGTH :

A) Circular or Translational - N/A

3) Rankine Plane and 45 offset



#### FIND ANCHOR CAPACITIES:

#### FIND EARTH PLESSURE COEFFICIENTS:

Assume vartical wall with no well friction:

$$K_{a} = \frac{\cos^{2} \phi}{\left[1 + \sqrt{\frac{\sin \phi \sin (\phi - \omega)}{\cos \omega}}\right]^{2}}$$

$$= \frac{\cos^{2} \phi}{\cos^{2} \cos^{2$$

$$\frac{\cos^{2} \phi}{\left[1 - \sqrt{\frac{\sin \phi \sin (\phi + \omega)}{\cos \omega}}\right]^{2}} = \frac{\cos^{2} 3\phi}{\left[1 - \sqrt{\frac{\sin \phi \sin (\phi + \omega)}{\cos 2\phi \cos \omega}}\right]^{2}}$$

#### = 1.3¢

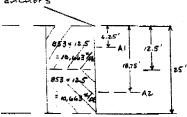
#### DETERMINE FINAL PRESSURE DIAGRAM.



#### FIND ANCHOR CONFIGURATION

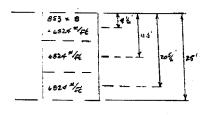
#### LOWER TIER :

#### 10-FT SPACING



1853 = 10

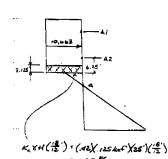
#### UPPER TIER



#### ANCHOR LOADINGS :

#### ... SOLDIER PILE EMBEDMENT :

#### .. LOWER TIER :



. 1/81

Active force \* Passive force
(3.125' X10.663" (2) + 2(2.92' X1.97" (4) = 2(675" (4) ) + 2

Y = 10.36'

1.2 Y = 12.4'

EQ'D TOTAL EMB. FOR LATERAL STABILIT

20.9

Dead wt Consider (10 /25 / 11) (150 pol) = 37.5 kg

Vend (10) (25) (1/2) (13 pol) = 18.3

Start (100 \*/42) (45") : 4.5

40.3 kg TOTAL DEAD WT.

Vertical Anchor Zeaction: (110.4 x)(sin 15°)(z) =

TOTAL YELTICAL LOAD = 117.4

Vertical Copacity:

QTOT = QSKIN = QPT = Ks (CF) PD sin & CD D + Ap x PD N'

> Kg = Earth pressure factor = 1.0 (augured pile) CF : Correction Factor = 0.95

Po: Ave. eff. overborden press. = 2 (125 kcf)

8 : Eff friction angle = 0.9 (34°) = 30.6°

Co : Pile per inter : or (1.5') = 4.71'
D: Pile embedment

Ap = Pi (6 enee = 4 (15) = 1.77 AZ

x = Reduction factor = 1.0 (augured pile)

Pd = Eff press.@pile pt = (125 kcf) D

No Bearing cap. Factor = 35

Prot = (10)(95)( 2)(125kef)(51,30.6° (411) D + (17758°)(10)(125kef) D (35)
= 2(117.4°)

: --- \* ~ - .

90 d

SUMMARY OF WALL DESIGN

234.8 - 0.1426 D2 + 7.744 D D" + 54.40 - 1647 = 0 D = 21.6

" VERT CAMELTY CONTROLS

.. UPPER TIER

a = 2,92 Active force . Passive Fire (2.083')(6820 4) + 1/2.92)(1.97") = 1/2(1.075 46) 42 Y = 7.12'

124 - 8.5'

REG'D TOTAL EMB FOR LATERAL STABILITY

\* 8.5' + 2.4' \* //. 4'

Dead wt : (0.8)(60,3")

Vartical Anchor Rection: (50.1 × )(sin 20)(3)

TOTAL VERTICAL LOAD - 107.8

124.0 = 0.1893 D2 + 13.74D 21576 : 0.1424 D2 + 7.744 D

D2 + 54.4 D - 1515 = 0

D = 20.3'

" VERT CAPACITY CONTROLS

D: 25 ,

24

201

79





















