WEST VIRGINIA DEPARTMENT OF TRANSPORTATION

Division of Highways

1900 Kanawha Boulevard East • Building Five • Room 110
Charleston, West Virginia 25305-0430 • (304) 558-3505

Earl Ray Tomblin
Governor

Paul A. Mattox, Jr., P. E.
Secretary of Transportation/
Commissioner of Highways

April 2, 2012

MEMORANDUM

TO: CC

THRU: CH

FROM: HD

SUBJECT: Value Engineering Proposal
Federal Project ACBI-0025(091)
State Project S320-P25-0.05 00
Dick Henderson Bridge
Kanawha County

The Contractor (Kokosing Construction) of the subject project has submitted an initial Value Engineering Proposal (VEP) to the District Construction Engineer.

As per the State Highway Engineer, we are to follow the memorandum issued on December 29, 2011 (Pilot Program for Contractor Value Engineering Proposals).

The purpose of this memo is to request that the committee make arrangements for the presentation and review of the final VEP by the Contractor. The final date in which to approve or deny the VEP is May 1, 2012. Please inform the Contractor (contact information below) of the date and time of the presentation, once it is scheduled.

Kyle Stalder
Ahern – A Division of Kokosing Construction Company, Inc.
5725 Kanawha Turnpike, Southwest
South Charleston, West Virginia 25309
(304) 766-8062
kns@kokosing.biz

Your prompt attention to this matter is greatly appreciated. Should you have any questions, please contact my office at (304) 558-6266.

DWA:Rh

cc: CH, HD, DC, D-1(Construction)

March 29th, 2012

WV Department of Transportation
Division of Highways, District 1
1334 Smith Street
Charleston, WV 25301

Ahern A DIVISION OF Kokosing CONSTRUCTION COMPANY INC.
5725 Kanawha Turnpike SW
South Charleston, WV 25309
Phone 304-766-8062 • Fax 304-766-7396

Letter No.: 15279 - 028

Attn: Gary Mullins
Construction Engineer

Re: Dick Henderson Bridge
State No. S320-P25-0.05 00
Federal Project No.: ACBR-0025 (091) TC
Kanawha County, West Virginia
Value Engineering Proposal – MSE Walls

Dear Mr. Mullins:

Kokosing Construction would like to formally present a Value Engineering Proposal (VEP) for the Dick Henderson Bridge Project. We propose to provide ground improvements under the MSE Wall approaches which would allow the construction of a traditional MSE Wall with granular backfill. This would replace the Expanded Polystyrene Fill (EPS) without reducing design capacity and will provide a quality final product while reducing long term risk and maintenance. Additional significant benefits to the project are outlined below.

We have teamed with the Reinforced Earth Company (RECO) and their affiliate Menard Ground Improvement Specialists to prepare this proposal. RECO is a worldwide leader in designing and supplying earth retention products. Menard is a geotechnical contractor that specializes in ground improvements for sites with poor soil.

Per your letter dated March 12, 2012, we are providing the information required in Section 104.12 of the Standard Specifications.

i. *A statement that this proposal is submitted as a VEP*

   Kokosing is pleased to submit this proposal as a Value Engineering Proposal (VEP).

ii. *A description of the difference between the existing contract requirements and the proposed change*

   The contract plans have been designed using EPS fill within the MSE Wall reinforced zone as a method of decreasing potential settlement and downdrag of adjacent structures. This requires that the approach roadways be excavated deeper than required by traditional design methods because enough in-situ material must be removed to offset the weight of the EPS fill. This also requires the use of specialized connections between the MSE Wall facing panels and the reinforcing elements to allow for settlement and compression of the foam. Additionally, unistrut connections are provided to attach the sleeper slabs and abutments to the MSE Wall facing panels to allow for future settlement and compression. All of these details are very unconventional and unproven for long term performance. The proposed VEP presents an alternate solution to the soils issues on this project and provides a conventional MSE Wall.

Kokosing proposes to improve the soils under the MSE Wall approaches by installing Controlled Modulus Columns (CMC). CMCs are semi-rigid columns that are installed using a displacement auger. This method displaces the soil laterally, with virtually no spoil or vibration. As the auger is extracted, a column is developed by pressure-grouting to achieve a predetermined stiffness ratio with the surrounding soil. The result is a composite soil/cement ground improvement system. The CMCs reinforce the soil rather than function as distinct structural elements or piles.

Once the underlying soil is reinforced using the CMCs, a conventional MSE wall will be constructed using standard Select Granular Backfill. The EPS fill, specialized connections, and unitstruts will be eliminated. The use of ground improvements will allow for a shallower excavated area along the approach roadway. The moment slab as detailed on contract plan sheets 155 thru 158 will be raised to just below pavement level and constructed as a conventional pavement section.

Attached for reference are the following:
- Contract plan sheets 153 thru 159 detailing the 'as-bid' MSE Wall plans
- Revised MSE Wall typical section showing conventional wall on top of CMCs
- Sample CMC layout from Menard (final design and layout will occur after VEP approval)
- Revised MSE Wall layout from the Reinforced Earth Company
- Information packet from Menard Ground Improvement Specialists

iii. *A statement concerning the basis for the VEP and benefits to the Division together with an itemization of the contract items and requirements affected by the VEP.*

This proposal provides a better quality final product using known MSE Wall construction techniques rather than the unconventional and unproven EPS/MSE Wall combination. This proposal also reduces the potential for project delays due to uncovering archeological artifacts.

Some of the benefits of this proposal include:
- Reduced Excavation of Existing Soils:
    - The EPS fill requires that the in-situ soils be removed to a depth of up to 10 feet in some areas.
    - Using CMCs, the excavation can be decreased to approximately 3 feet.
    - This reduces the amount of disturbed soil and potential impacts to archeologically and environmentally sensitive areas, thereby reducing the potential for project delays.
    - The CMCs produce no spoils and simply displace the soils around them rather than mix or dig them up.

- This proposal will provide a better quality final product and reduce long term risk to the DOH by eliminating the EPS fill and Specialized Connections:
    - The EPS fill is predicted to compress up to 5 inches over the life of the structure. This will require more roadway maintenance and has the potential to cause problems with the connections to the MSE Walls.

- CMCs will stabilize the underlying soils minimizing settlement. A conventional MSE Wall can then be constructed using granular backfill, thereby eliminating the compression concerns.
- The EPS fill is susceptible to hazardous spills (fuels, oils, etc...) and may melt or be otherwise compromised in the event of an accident on the approach roadways.
- The EPS fill is not sufficient to support the MSE Wall reinforcing elements. To construct the walls with EPS fill, parallel walls will need to be connected to each other. Additionally, a series of back up panels is required parallel to and behind the abutment to hold the front face of the MSE Wall. All of this results in more material than would be required to construct a conventional MSE Wall.

CMCs have several distinct advantages over other forms of ground improvements and EPS fill:

- Other forms of ground improvement run the risk of damaging nearby structures due to excessive vibrations. CMCs provide virtually no vibrations and are safe to drill beside nearby structures, such as the existing Nissan Dealership and high school structures adjacent to the project site.
- Since CMCs are installed using a displacement auger, no spoils are generated.
- CMC installation techniques allow us to adapt our drilling methods to accommodate variable soil conditions across the project site. Each CMC is installed to a torque requirement, rather than a specified depth, ensuring that each element is properly installed and achieves the required capacity and resistance to settlement.
- Displacement ground elements provide immediate support and require no surcharging to settle our organic soils and soft clay zones.
- CMC elements are self casing and do not run the risk of hole collapse.

Contract Items Affected by the VEP:

- Item 105 307001-000 Aggregate Base Course, Class 1
  - quantity decrease – eliminate thickened layer between load distribution slab and pavement section
- Item 565 212001-000 Cofferdam
  - elimination of planned temporary sheet piling along school property due to decrease in excavation depth
- Item 575 601002-001 Class B Concrete
  - quantity decrease – eliminate moment slab wall by raising moment slab
- Item 650 602001-001 Reinforcing Steel Bar
  - quantity decrease – due to elimination of moment slab wall
- Item 780 626002-002 MSE Retaining Wall, Reinforced Earth
  - scope change from EPS fill to standard Select Granular Backfill
  - quantity decrease – due to raising the leveling pad elevations

Contract Requirements Affected by the VEP:
Special Provision 626 – Retaining Wall Systems Expanded Polystyrene (EPS) Geofoam for Use as Lightweight Fill Material will be eliminated and replaced with Standard Specification 626 – Retaining Wall Systems for construction of the standard MSE wall with Select Granular Backfill. The use of bottom ash or fly ash material will not be restricted as select granular backfill material.

iv. *Separate detailed cost estimates for both the existing contract requirements and the proposed change*

The following existing contract items will be non-performed:

Item		Description	Qty	Units	Unit Price	Bid Amount
105	307001-000	Aggregate Base Course, Class 1	(2,000)	cy	$ 40.00	$ (80,000.00)
565	212004-000	Cofferdam (partial elimination)	(1)	ls	$ 40,000.00	$ (40,000.00)
575	601002-001	Class B Concrete (moment slab wall)	(209)	cy	$ 800.00	$ (167,200.00)
650	602001-001	Reinforcing Steel Bar	(29,500)	lb	$ 1.20	$ (35,400.00)
780	626002-002	MSE Retaining Wall, Reinforced Earth (EPS Backfill)	(25,850)	sf	$ 105.00	$ (2,714,250.00)
						$ (3,036,850.00)

The following item will be added to the contract:

Item		Description	Qty	Units	Unit Price	Bid Amount
780	626002-002	MSE Retaining Wall, Reinforced Earth (Conventional – Including Ground Improvements)	23,242	sf	$ 110.00	$ 2,556,620.00
						$ 2,556,620.00

Total Savings to Project = $3,036,850 – $2,556,620 = $480,230

WV Department of Highways 50% Share = $240,115
Kokosing Construction 50 % Share = $240,115

v. *An itemization of the plan details, design standards or specifications to be changed if the VEP is adopted*

The following plan details would be changed:

a. Unistrut connections from abutments to concrete apron as shown on sheets 84 & 89/281 would not be constructed
b. All references to EPS Backfill would be disregarded
c. MSE typical section as shown on sheet 155/281 would be modified to reflect standard construction with Select Granular Backfill
    i. 8" granular leveling pad would be replaced with a granular load transfer platform as designed by Menard Ground Improvement Specialists
    ii. Select Granular Backfill would replace the EPS Backfill in the reinforced zone with retained fill outside of the reinforced zones
    iii. A conventional MSE panel to reinforcement strip connection would be used
    iv. 6" load distribution reinforced slab would be eliminated
    v. Thickened Aggregate Base Course material on top of load distribution slab would be eliminated

vi. Moment slabs would be raised to just below the pavement structure and the moment slab walls would be eliminated
    1. Detailing of the revised moment slabs to be performed by Reinforced Earth as part of their wall design and shop drawing submittal

vii. Unistrut connections from moment slabs to MSE walls would be eliminated

vi. An estimate of the effect on collateral costs to the Division. Collateral costs are defined to be reduced costs of operation, maintenance or repair and extended useful service life

This proposal provides a reduction in Department risk of time delays during construction as well as a reduction in the liabilities of using EPS foam for a long term solution.

- By reducing the amount of disturbed in-situ soils from a 10'max cut to 3', the amount of disturbed soil and potential impacts to archeologically and environmentally sensitive areas is greatly reduced, thereby decreasing the potential for project delays on this high-profile project with large incentive/disincentive clauses. The CMCs produce no spoils and simply displace the soils around them rather than mix or dig them up.
- The details for construction of an MSE Wall with EPS backfill are unconventional and potentially present a long term durability issue. This proposal constructs a conventional MSE Wall which is a proven and tested solution.
- The EPS fill is susceptible to hazardous spills (fuels, oils, etc...) and may melt or be otherwise compromised in the event of an accident on the approach roadways. Elimination of the EPS fill will guarantee this doesn't occur.
- CMCs will stabilize the underlying soils minimizing settlement and allowing the construction of a conventional MSE wall system. This eliminates any concerns with non-traditional connections, compression of the EPS Backfill, or long term settlement.
- The EPS fill is predicted to compress up to 5 inches over the life of the structure. This will require more roadway maintenance and has the potential to cause problems with the connections to the MSE Walls. This VEP eliminates compression concerns.

vii. A statement of the time by which approval must be issued to obtain the total cost reduction during remainder of Contract, noting any effect on contract completion time or delivery schedule

We request that this proposal be accepted by May 1, 2012 to obtain the full benefit of current pricing.

In summary,
This proposal provides a better solution to the underlying soils issues on this project by using proven construction methods while decreasing the long term risks associated with the EPS fill. We appreciate your consideration of this proposal and look forward to discussing it further.

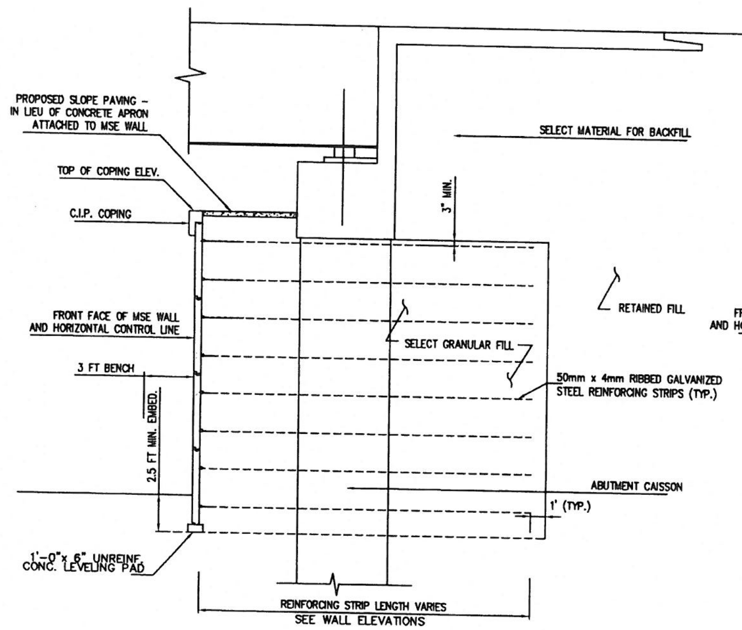
If you have any questions or need additional information regarding this matter, please call me at (304) 766-8062.

Sincerely,

Kyle Stalder

Kyle Stalder
Project Engineer
AHERN A Division of Kokosing Construction Company, Inc.

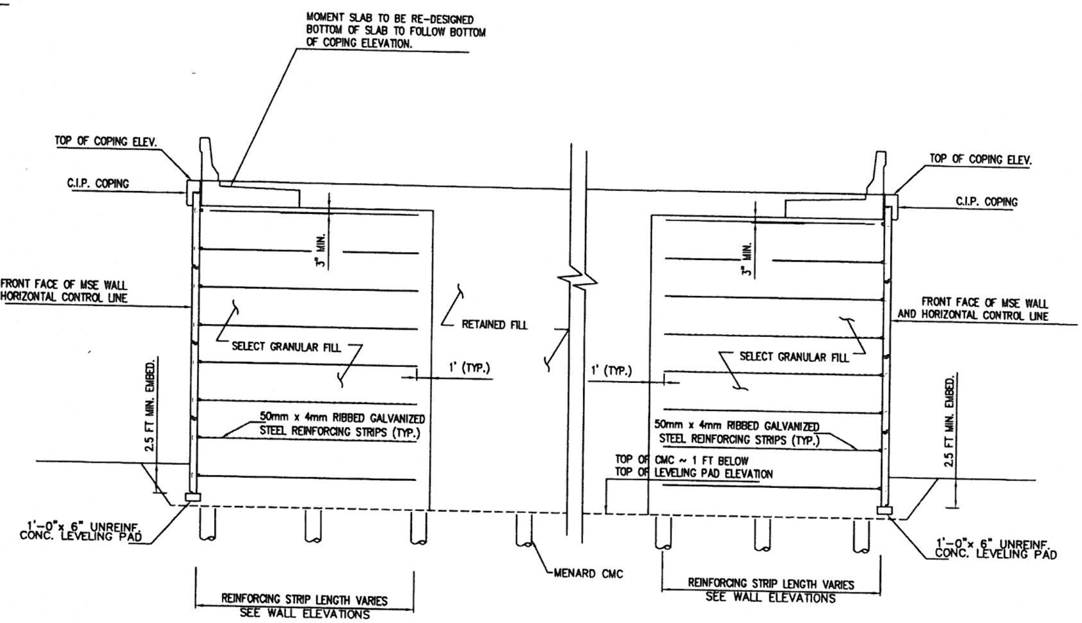
PUBLIC ROAD DIV.	STATE DIST. No.	STATE PROJECT No.	FEDERAL PROJECT No.	FISCAL YEAR	COUNTY
W.V.	1	S320-P-25-0.05 00	ACBR-0025 (091)TC	2011	KANAWHA



ANY UNSUITABLE MATERIALS BELOW THE MSE WALL FOOTPRINT / UNDERCUT AREA SHALL BE REMOVED AND REPLACED WITH COMPACTED SELECT GRANULAR BACKFILL, OR OTHERWISE STABILIZED AS DIRECTED BY THE ENGINEER

TYPICAL SECTION AT ABUTMENTS

SCALE : 1/4" = 10'



ANY UNSUITABLE MATERIALS BELOW THE MSE WALL / CMC FOOTPRINT SHALL BE REMOVED AND REPLACED WITH COMPACTED SELECT GRANULAR BACKFILL, OR OTHERWISE STABILIZED AS DIRECTED BY THE ENGINEER

TYPICAL SECTION - APPROACH WALLS

SCALE : 1/4" = 10'

CERTIFIED WITH RESPECT TO THE INTERNAL STABILITY OF REINFORCED EARTH STRUCTURES ONLY

PRELIMINARY - NOT FOR CONSTRUCTION

PRELIMINARY - NOT FOR CONSTRUCTION

The design contained on these drawings is based on information provided by the owner. On the basis of this information, The Reinforced Earth Company has designed, and is responsible for the internal stability of the structure only. External stability, including foundation (bearing capacity and settlement) and slope (global) stability, is the responsibility of the owner.

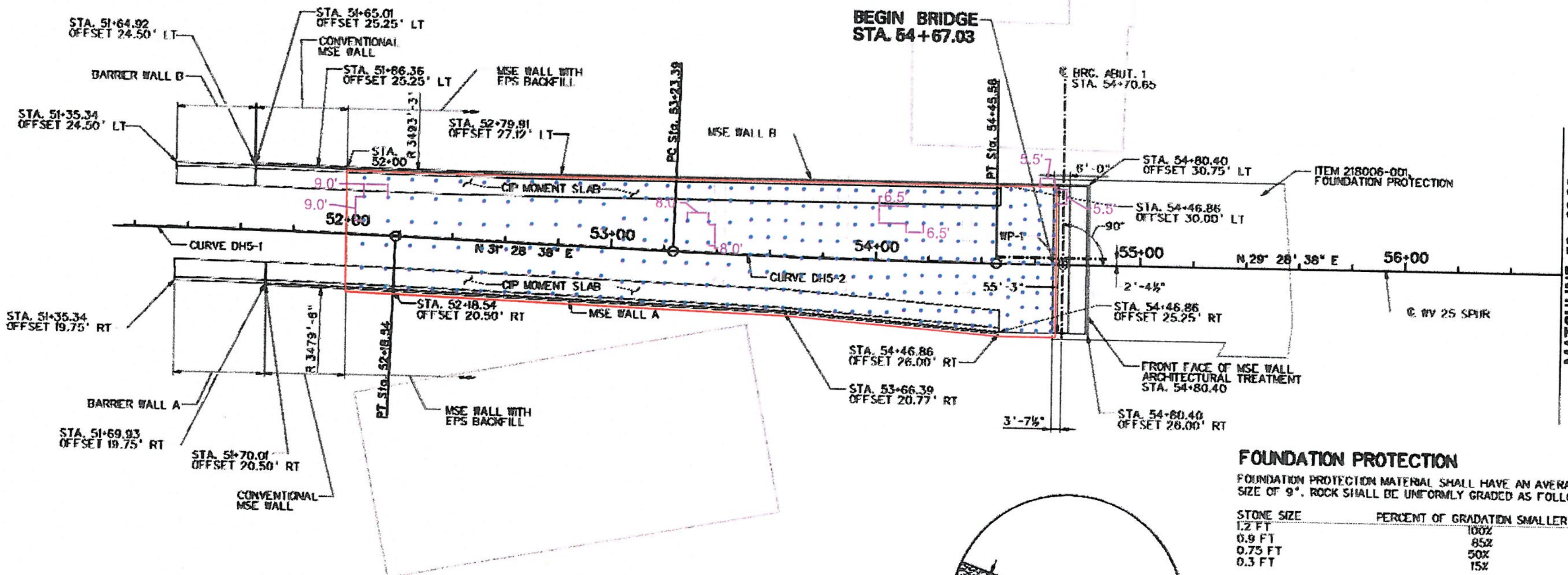
REINFORCED EARTH
8614 Westwood Center Drive, Vienna, VA 22182 (703) 821-1175

"REINFORCED EARTH" is the registered trademark of The Reinforced Earth Company.

DESIGNED BY: XX	PROJECT NAME	DICK HENDERSON BRIDGE OVER KANAWHA RIVER	DATE 1-10-2012
PROJECT ENGR: KPB	LOCATION	ST. ALBANS AND NITRO WEST VIRGINIA	CONTRACT NO. 15530
CHECKED BY: XX	OWNER	WVDOT - DOH	DRAWING NO. 6 OF 9
REV. / DATE / DESCRIPTION	DRAWING COVERS	TYPICAL SECTIONS	SCALE AS SHOWN

C:\XXX

State Project No.	Federal Project No.	State Dist. No.	Fiscal Year	County	Sheet No.	Total Sheets
S320-P25-0.05 00	ACBR-0025(081) ITC	1	2011	KANAWHA	01	201

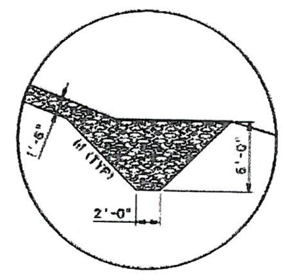


FOUNDATION PROTECTION

FOUNDATION PROTECTION MATERIAL SHALL HAVE AN AVERAGE STONE SIZE OF 9". ROCK SHALL BE UNIFORMLY GRADED AS FOLLOWS:

STONE SIZE	PERCENT OF GRADATION SMALLER THAN
1.2 FT	100%
0.9 FT	85%
0.75 FT	50%
0.3 FT	15%

FOR ADDITIONAL LOCATIONS OF FOUNDATION PROTECTION, SEE SHEETS 8 AND 9



KEY DETAIL

NTS

COORDINATES (FT)

LOCATION	NORTHING	EASTING
WP-1	507,446.7970	1,729,823.0869
WP-2	507,670.5286	1,729,949.5509
WP-3	508,082.2767	1,730,170.9859
WP-4	508,325.1832	1,730,319.5934

CURVE DH5-1

PI = 51+62.15
Δ = 1° 50' 47" (RT)
D = 1° 38' 13"
R = 3,500.00
L = 112.79
T = 56.40
SE = NC

CURVE DH5-2

PI = 53+84.48
Δ = 2° 00' 00" (LT)
D = 1° 38' 13"
R = 3,500.00
L = 122.17
T = 61.09
SE = NC

NO.	REVISION	DATE:	BY:

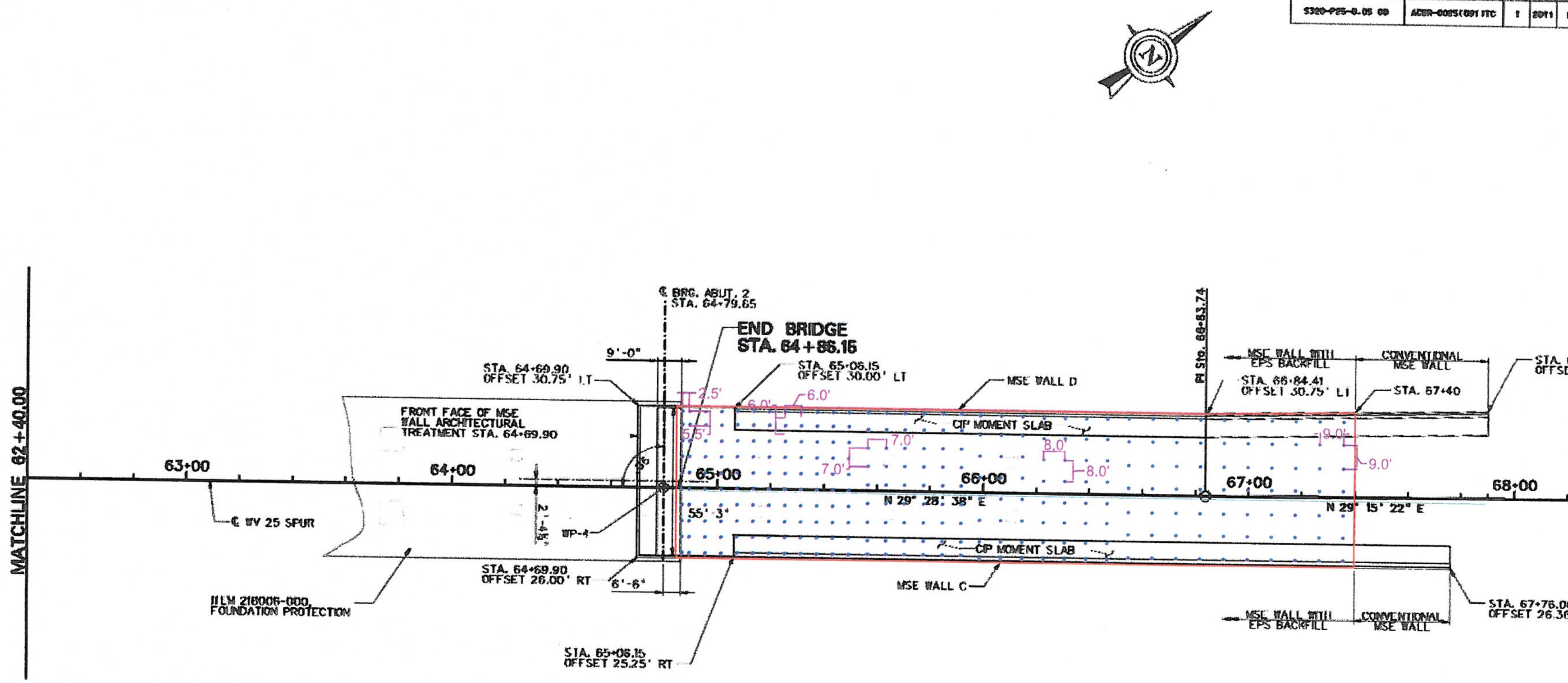
W. VA. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DICK HENDERSON BRIDGE
OVER KANAWHA RIVER
SUBSTRUCTURE AND FOUNDATION LAYOUT
SHEET 1 OF 3

Baker
Michael Baker Jr., Inc. Charleston, WV

SHEET 7 of 190
BRIDGE NO. 11020

State Project No.	Federal Project No.	State Dist. No.	Fiscal Year	County	Sheet No.	Total Sheets
S320-P25-0.05 00	ACBR-0025(091)TC	1	2011	KANAWHA	03	201



NOTES:

FOR ADDITIONAL DETAILS, SEE SHEET 7

NO.	REVISION	DATE:	BY:

W. VA. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

**DICK HENDERSON BRIDGE
OVER KANAWHA RIVER
SUBSTRUCTURE AND FOUNDATION LAYOUT
SHEET 3 OF 3**

Baker
Michael Baker Jr., Inc. Charleston, WV

SHEET 9 of 120
BRIDGE NO. 11020

PUBLIC ROAD DIV.	STATE DIST. No.	STATE PROJECT No.	FEDERAL PROJECT No.	FISCAL YEAR	COUNTY
W.V.	1	S320-P-25-0.05 00	ACBR-0025 (091)TC	2011	KANAWHA

REINFORCED EARTH®

8614 Westwood Center Drive, Vienna, VA 22182 (703) 821-1175

GENERAL NOTES

DESIGN CRITERIA

1. DESIGN IS BASED ON THE ASSUMPTION THAT THE MATERIAL WITHIN THE REINFORCED EARTH VOLUME, METHODS OF CONSTRUCTION AND QUALITY OF PREFABRICATED MATERIALS SHALL CONFORM TO THE WEST VIRGINIA DOT TECHNICAL SPECIFICATIONS FOR REINFORCED EARTH WALLS.
2. SOILS CHARACTERISTICS ASSUMED FOR DESIGN:

   SELECT GRANULAR BACKFILL
   ϕ = 34 degrees, c = 0 p.s.f., γ= 125 p.c.f.

   RANDOM BACKFILL
   ϕ = 30 degrees, c = 0 p.s.f., γ= 125 p.c.f.

   FOUNDATION MATERIAL
   ϕ = 30 degrees, c = 0 p.s.f.
3. THE MAXIMUM APPLIED BEARING PRESSURE AT THE FOUNDATION LEVEL IS AS SHOWN ON THE WALL ELEVATIONS FOR EACH DESIGN CASE. IT IS THE RESPONSIBILITY OF THE OWNER TO DETERMINE THAT THIS APPLIED BEARING PRESSURE IS ALLOWABLE FOR THAT LOCATION.
4. THE FOUNDATION SOILS SHALL BE PROOF ROLLED AND ANY UNSUITABLE FOUNDATION MATERIAL BELOW THE REINFORCED EARTH VOLUME, AS DETERMINED BY THE ENGINEER, SHALL BE EXCAVATED AND REPLACED WITH SUITABLE MATERIAL OR OTHERWISE STABILIZED AS DIRECTED BY THE ENGINEER.
5. REINFORCING STRIPS SHALL BE RIBBED 50mm WIDE AND 4mm THICK, AND SHALL CONFORM TO THE PHYSICAL AND MECHANICAL PROPERTIES OF ASTM A-572 GRADE 65. GALVANIZATION SHALL BE APPLIED IN ACCORDANCE WITH ASTM A-123 OR AASHTO M111 (2oz/ft^2).

WALL CONSTRUCTION

6. STATIONS SHOWN ARE ALONG CENTERLINE WV 25 SPUR.
7. REINFORCED EARTH WALLS IN CURVES WILL FORM A SERIES OF SHORT CHORDS OF 9.84' EACH TO MATCH DESIRED WALL ALIGNMENT.
8. FOR LOCATION AND ALIGNMENT OF REINFORCED EARTH WALLS. SEE CONTRACT DRAWINGS.
9. IF MANHOLES AND DROP INLETS ARE PRESENT, THEY SHALL BE LOCATED AS SHOWN ON WALL ELEVATIONS.
10. IF PILES ARE LOCATED WITHIN THE REINFORCED EARTH VOLUME, THEY SHALL BE DRIVEN PRIOR TO CONSTRUCTION OF THE REINFORCED EARTH WALL UNLESS A METHOD TO PROTECT THE STRUCTURE, WHICH IS ACCEPTABLE TO THE ENGINEER AND THE REINFORCED EARTH COMPANY, AND IS PROPOSED AND APPROVED IN WRITING.
11. BACKFILL MATERIAL SHALL BE COMPACTED IN ACCORDANCE WITH THE SPECIFICATIONS FOR REINFORCED EARTH WALLS TO A LEVEL OF 2" (±) ABOVE THE TIE STRIPS EMBEDDED IN THE PANELS. INSTALLATION OF REINFORCING STRIPS SHALL BE PERMITTED ONLY AFTER PLACEMENT AND COMPACTION OF THE BACKFILL MATERIAL HAS REACHED THE REQUIRED LEVEL.
12. COMPACTION AND OPERATION EQUIPMENT SHALL BE KEPT A MINIMUM DISTANCE OF 3'-0" FROM THE BACK FACE OF THE REINFORCED EARTH PANELS. COMPACTION WITHIN 3'-0" OF THE REINFORCED EARTH PANELS SHALL BE ACHIEVED WITH AT LEAST THREE (3) PASSES OF A LIGHTWEIGHT MECHANICAL TAMPER, ROLLER OR VIBRATORY SYSTEM. NO COMPACTION DENSITY TESTS SHALL BE TAKEN WITHIN THE 3 FT. ZONE.

WALL CONSTRUCTION (CONT.)

13. IF STRUCTURES IN EXCESS OF 20' IN HEIGHT OCCUR, THE FINISHED GRADE IN FRONT OF THE WALL SHALL BE PLACED AND COMPACTED BEFORE WALL CONSTRUCTION EXCEEDS A HEIGHT OF 20'. FINISHED GRADE BACKFILL SHALL BE COMPACTED TO 95% OF ASTM D-698, METHODS 'C' OR 'D', UNLESS OTHERWISE DIRECTED BY THE ENGINEER.
14. IT IS THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE THE LOCATION OF ANY GUARDRAIL POSTS BEHIND THE REINFORCED EARTH PANELS. PRIOR TO PLACEMENT OF THE TOP LAYER OF REINFORCING STRIPS, INDIVIDUAL STRIPS MAY BE SKEWED TO AVOID THE POST LOCATIONS IF AUTHORIZED BY THE REINFORCED EARTH COMPANY. ANY DAMAGE DONE TO THE REINFORCING STRIPS DUE TO THE INSTALLATION OF THE GUARDRAIL SHALL BE REPAIRED BY THE CONTRACTOR AT THE CONTRACTOR'S EXPENSE.
15. IF EXISTING OR FUTURE STRUCTURES, PIPES, FOUNDATIONS OR GUARDRAIL POSTS WHICH ARE WITHIN THE REINFORCED EARTH VOLUME INTERFERE WITH THE NORMAL PLACEMENT OF REINFORCING STRIPS AND SPECIFIC DIRECTION HAS NOT BEEN PROVIDED ON THE PLANS, THE CONTRACTOR SHALL NOTIFY THE REINFORCED EARTH COMPANY TO DETERMINE WHAT COURSE OF ACTION SHOULD BE TAKEN.
16. ALL DETAILING AND CHECKING OF REINFORCING STEEL FOR ANY C.I.P. CONCRETE WORK IS THE RESPONSIBILITY OF THE CONTRACTOR.
17. TOP PANELS BENEATH CAST-IN-PLACE COPING SHALL HAVE #4 DOWELS PROTRUDING FROM THEIR TOP EDGE.
18. FOR OTHER INFORMATION PERTAINING TO WALL CONSTRUCTION PLEASE REFER TO THE REINFORCED EARTH CONSTRUCTION MANUAL.
19. THE CONTRACTOR IS RESPONSIBLE FOR GRADUALLY DEFLECTING UPPER REINFORCING STRIPS DOWNWARD TO AVOID CONFLICTS WITH PAVING AND SUBGRADE PREPARATION. THE CONTRACTOR'S ATTENTION IS DIRECTED ESPECIALLY TO SITUATIONS WHERE ROADWAY SUPERELEVATION AND/OR SOIL MIXING ARE ANTICIPATED.
20. THE CONTRACTOR IS RESPONSIBLE FOR CONTROLLING STORM WATER DRAINAGE IN THE VICINITY OF THE WALL DURING CONSTRUCTION. STORM WATER RUNOFF IS TO BE COLLECTED AND DISCHARGED AWAY FROM THE WALL AND REINFORCED BACKFILL.

MATERIALS NOTES

21. NOMINAL STRIP LENGTHS

    THE REINFORCING STRIP LENGTHS SHOWN ON THE PLANS, MEASURED FROM BACK FACE OF PANEL, ARE THE NOMINAL LENGTHS REQUIRED BY CALCULATION. THE ACTUAL FABRICATED STRIP LENGTHS ARE OFTEN LONGER (UP TO 6") DUE TO MANUFACTURING TOLERANCES. THE REQUIRED HORIZONTAL LIMIT OF GRANULAR BACKFILL IS EQUAL TO THE NOMINAL STRIP LENGTH. ADDITIONAL GRANULAR BACKFILL BEYOND THE NOMINAL STRIP LENGTH IS NOT REQUIRED BY CALCULATION.
22. SELECT BACKFILL QUANTITY

    THE SELECT BACKFILL QUANTITY, IF INDICATED BY THE REINFORCED EARTH COMPANY, IS CALCULATED BY MULTIPLYING THE NOMINAL STRIP LENGTHS SHOWN ON THE PLANS (PLUS 0 FT.) BY THEIR TRIBUTARY WALL SURFACE AREA AND CONVERTING THE RESULT TO A NEATLINE CUBIC YARD QUANTITY. THIS INFORMATION IS FURNISHED FOR THE CONTRACTOR'S INFORMATION ONLY AND IS NOT INTENDED TO REPRESENT THE ACTUAL QUANTITIES REQUIRED TO COMPLETE THE WORK. THE CONTRACTOR MUST CALCULATE HIS OWN EXCAVATION AND BACKFILL QUANTITIES BASED UPON THE SPECIFIC CONDITIONS OF THE PROJECT.

MATERIALS NOTES (CONT.)

23. PANEL FINISH

    THE PRECAST PANELS FOR THIS PROJECT SHALL HAVE AN ASHLAR STONE FORM LINER FINISH. CORNER ELEMENTS SHALL HAVE A PLAIN SMOOTH FINISH.
24. NOTE TO CONTRACTORS

    ONLY THE FOLLOWING MATERIALS ARE SUPPLIED BY THE REINFORCED EARTH COMPANY:

    - PRECAST CONCRETE FACING PANELS
    - REINFORCING STRIPS
    - BOLT SETS (FOR ATTACHING PANELS TO THE REINFORCING STRIPS)
    - BEARING BLOCKS
    - RUBBER SHIMS
    - FILTER CLOTH AND ADHESIVE (FOR PANEL JOINTS ONLY)

    ANY OTHER MATERIALS CALLED FOR IN THE CONTRACT PLANS OR SPECIFICATIONS ARE TO BE SUPPLIED BY THE CONTRACTOR. ANY JOINT MATERIALS SHOWN AT THE INTERFACE OF PRECAST PANELS AND CAST-IN-PLACE CONCRETE STRUCTURES ARE TO BE SUPPLIED BY THE ERECTION CONTRACTOR. ALL SANDBLASTING, PAINTING, SEALERS OR OTHER SPECIAL APPLIED COATINGS ARE ALSO SUPPLIED/INSTALLED BY THE CONTRACTOR IN THE FIELD FOLLOWING PANEL ERECTION.
25. THE REINFORCED EARTH COMPANY SUPPLIES PRECAST CONCRETE FACING PANELS AND ACCESSORIES TO BE USED IN CONJUNCTION WITH OTHER MATERIALS IN THE CONSTRUCTION OF THE REINFORCED EARTH® RETAINING WALLS DETAILED HEREIN. THE CONSTRUCTION AND QUALITY CONTROL PROCEDURES MANUAL FURNISHED BY THE REINFORCED EARTH COMPANY IS INTENDED TO PROVIDE A GENERAL EXPLANATION OF THE SYSTEM. IT IS THE CONTRACTOR'S OBLIGATION TO DEVISE AND EXECUTE A PROJECT SPECIFIC ERECTION SEQUENCE, PANEL UNLOADING, HANDLING AND BRACING SYSTEM, AND FALL PROTECTION SYSTEM. THE BRACING SYSTEM SHOWN IN THE CONSTRUCTION AND QUALITY CONTROL PROCEDURES MANUAL IS GENERAL IN NATURE AND DOES NOT ACCOUNT FOR PROJECT SPECIFIC CRITERIA. COMPLIANCE WITH THE GUIDELINES IN THIS MANUAL DOES NOT RELIEVE THE CONTRACTOR OF ITS RESPONSIBILITY TO ADHERE TO THE PROJECT PLANS, SPECIFICATIONS AND CONTRACT DOCUMENTS OR COMPLIANCE WITH ALL FALL PROTECTION, SAFETY, LAWS, STANDARDS AND PROCEDURES AT THE JOBSITE. CONTRACTORS SHOULD TAKE SPECIAL PRECAUTIONS TO PREVENT THE PANELS FROM SHIFTING OR FALLING DURING THE ERECTION PROCESS.

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5	ELEVATION – MSE WALL – ABUTMENT 2
6	TYPICAL SECTIONS
7	DETAILS
8	COPING DETAILS
9	STANDARD PANEL DETAILS

CERTIFIED WITH RESPECT TO THE INTERNAL STABILITY OF REINFORCED EARTH STRUCTURES ONLY

PRELIMINARY – NOT FOR CONSTRUCTION

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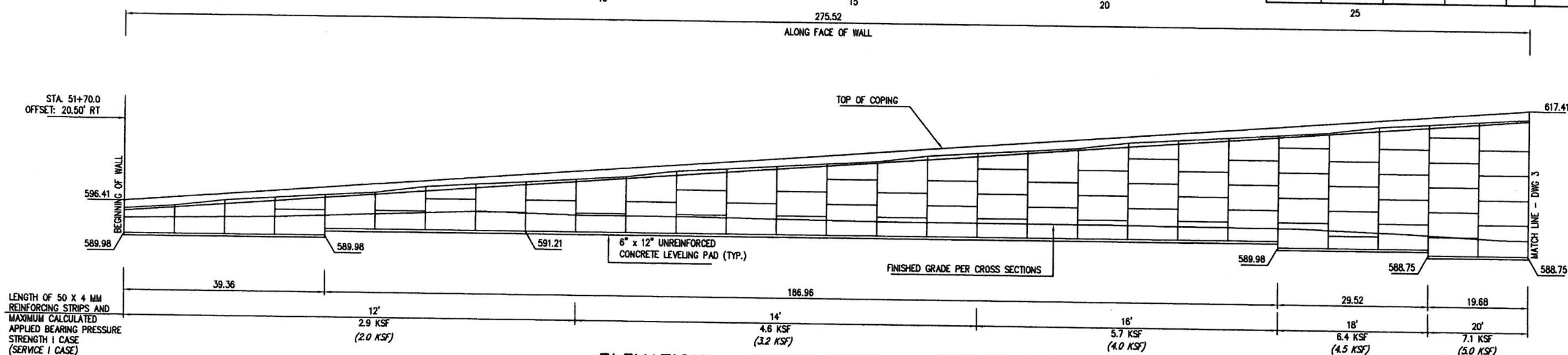
REINFORCED EARTH® 8614 Westwood Center Drive, Vienna, VA 22182 (703) 821-1175

DESIGNED BY: XX			
PROJECT ENGR: KPB			
CHECKED BY: XX			
	REV.	DATE	DESCRIPTION

PROJECT NAME	DICK HENDERSON BRIDGE OVER KANAWHA RIVER	DATE 1-10-2012
LOCATION	ST. ALBANS AND NITRO WEST VIRGINIA	CONTRACT NO. 15530
OWNER	WVDOT – DOH	DRAWING NO. 1 OF 9
DRAWING COVERS	MSE WALL NOTES	SCALE AS SHOWN

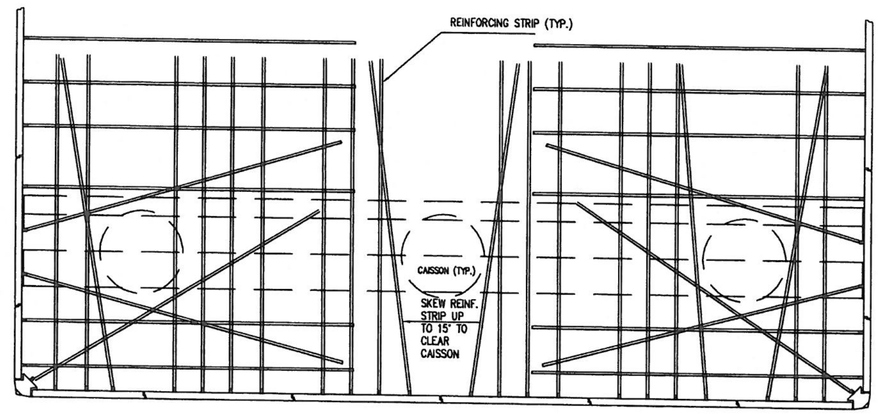
C:\XXX

PUBLIC ROAD DIV.	STATE DIST. No.	STATE PROJECT No.	FEDERAL PROJECT No.	FISCAL YEAR	COUNTY
W.V.	1	S320-P-25-0.05 00	ACBR-0025 (091)TC	2011	KANAWHA



ELEVATION – FRONT FACE – ABUTMENT 1

SCALE : 1" = 10'



PARTIAL PLAN ABUTMENT AND WINGWALLS

SCALE : 1/4" = 1'-0"

NOTES:

1. LENGTH OF LEVELING PAD IS BASED ON INDIVIDUAL PANEL WIDTHS. ℄ OF PANEL JOINT TO ℄ OF PANEL JOINT. USE STEP DETAIL ON SHEET 7 TO DETERMINE THE ACTUAL LEVELING PAD STEP LOCATION.
2. FOR TYPICAL SECTIONS, REFER TO SHEET 6.
3. FOR COPING DETAILS, REFER TO SHEET 8.

* MOMENT SLAB DETAILS TO BE DEVELOPED

PRELIMINARY – NOT FOR CONSTRUCTION

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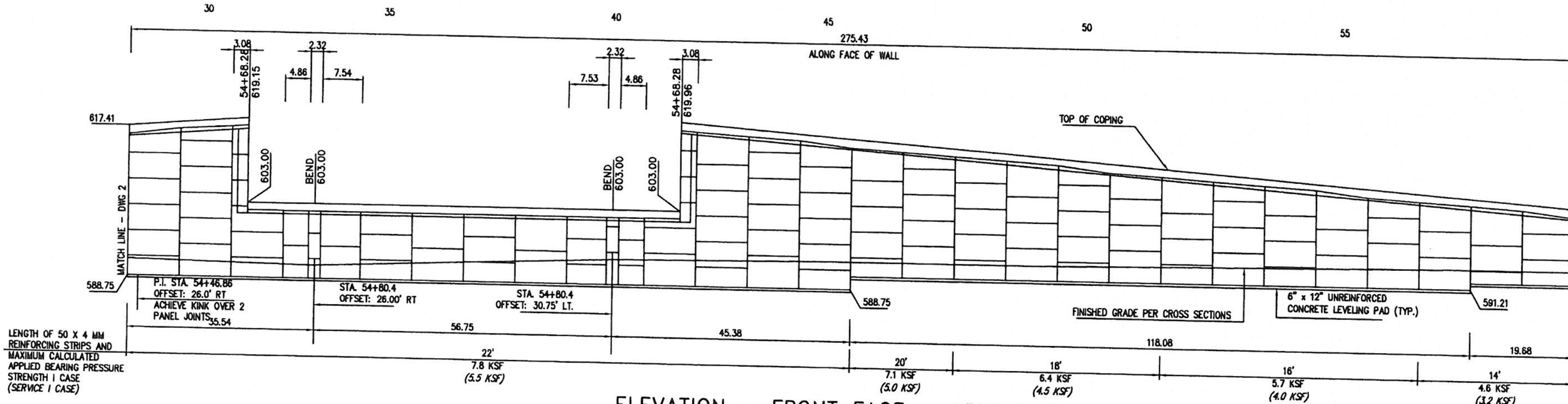
DESIGNED BY:	XX
PROJECT ENGR:	KPB
CHECKED BY:	XX

REV.	DATE	DESCRIPTION

PROJECT NAME	DICK HENDERSON BRIDGE OVER KANAWHA RIVER	DATE 1-10-2012
LOCATION	ST. ALBANS AND NITRO WEST VIRGINIA	CONTRACT NO. 15530
OWNER	WVDOT – DOH	DRAWING NO. 2 OF 9
DRAWING COVERS	MSE WALL AT ABUT. 1	SCALE AS SHOWN

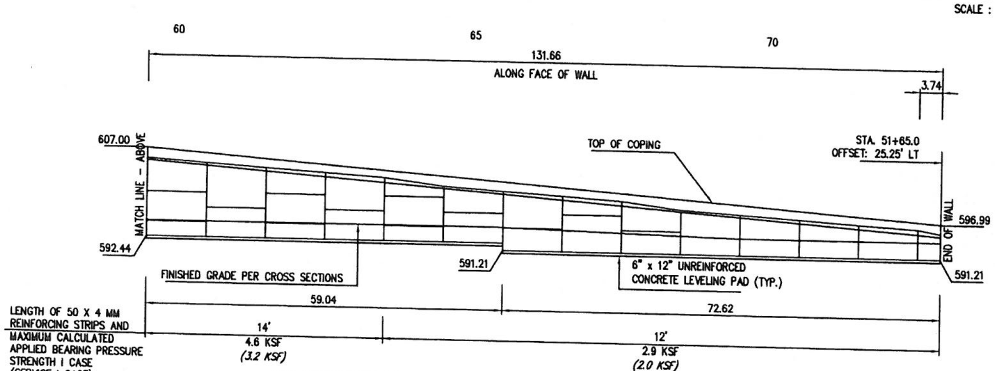
C:\xxx

PUBLIC ROAD DIV.	STATE DIST. No.	STATE PROJECT No.	FEDERAL PROJECT No.	FISCAL YEAR	COUNTY
W.V.	1	S320-P-25-0.05 00	ACBR-0025 (091)TC	2011	KANAWHA



ELEVATION – FRONT FACE – ABUTMENT 1

SCALE : 1" = 10'



ELEVATION – FRONT FACE – ABUTMENT 1

SCALE : 1" = 10'

NOTES:

1. LENGTH OF LEVELING PAD IS BASED ON INDIVIDUAL PANEL WIDTHS. ℄ OF PANEL JOINT TO ℄ OF PANEL JOINT. USE STEP DETAIL ON SHEET 7 TO DETERMINE THE ACTUAL LEVELING PAD STEP LOCATION.
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* MOMENT SLAB DETAILS TO BE DEVELOPED

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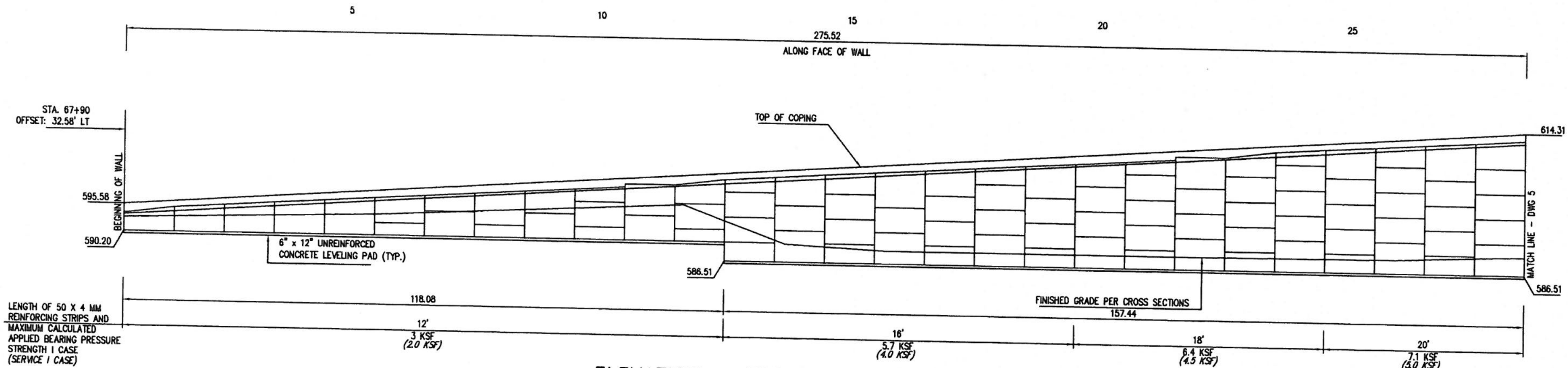
DESIGNED BY: XX			
PROJECT ENGR: KPB			
CHECKED BY: XX			
	REV.	DATE	DESCRIPTION

PROJECT NAME	DICK HENDERSON BRIDGE OVER KANAWHA RIVER	DATE 1-10-2012
LOCATION	ST. ALBANS AND NITRO WEST VIRGINIA	CONTRACT NO. 15530
OWNER	WVDOT – DOH	DRAWING NO. 3 OF 9
DRAWING COVERS	MSE WALL AT ABUT. 1	SCALE AS SHOWN

C:\XXX

PUBLIC ROAD DIV.	STATE DIST. No.	STATE PROJECT No.	FEDERAL PROJECT No.	FISCAL YEAR	COUNTY
W.V.	1	S320-P-25-0.05 00	ACBR-0025 (091)TC	2011	KANAWHA



ELEVATION - FRONT FACE - ABUTMENT 2

SCALE : 1" = 10'

NOTES:

1. LENGTH OF LEVELING PAD IS BASED ON INDIVIDUAL PANEL WIDTHS. ℄ OF PANEL JOINT TO ℄ OF PANEL JOINT. USE STEP DETAIL ON SHEET 7 TO DETERMINE THE ACTUAL LEVELING PAD STEP LOCATION.
2. FOR TYPICAL SECTIONS, REFER TO SHEET 6.
3. FOR COPING DETAILS, REFER TO SHEET 8.

* MOMENT SLAB DETAILS TO BE DEVELOPED

PRELIMINARY - NOT FOR CONSTRUCTION

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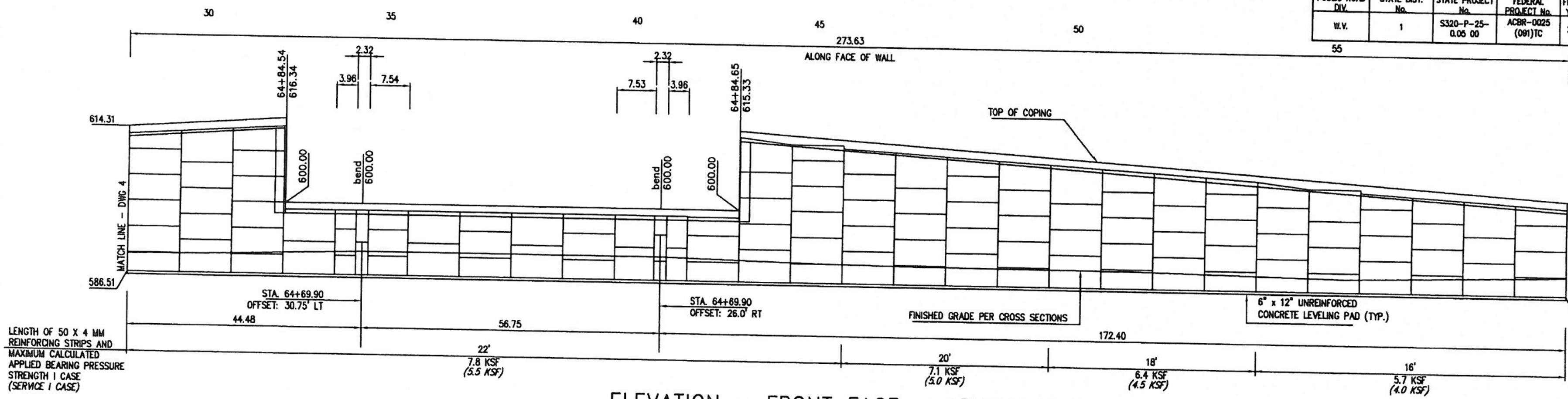
DESIGNED BY: XX				
PROJECT ENGR: KPB				
CHECKED BY: XX				
	REV.	DATE	DESCRIPTION	

PROJECT NAME	DICK HENDERSON BRIDGE OVER KANAWHA RIVER	DATE 1-10-2012
LOCATION	ST. ALBANS AND NITRO WEST VIRGINIA	CONTRACT NO. 15530
OWNER	WVDOT - DOH	DRAWING NO. 4 OF 9
DRAWING COVERS	MSE WALL AT ABUT. 2	SCALE AS SHOWN

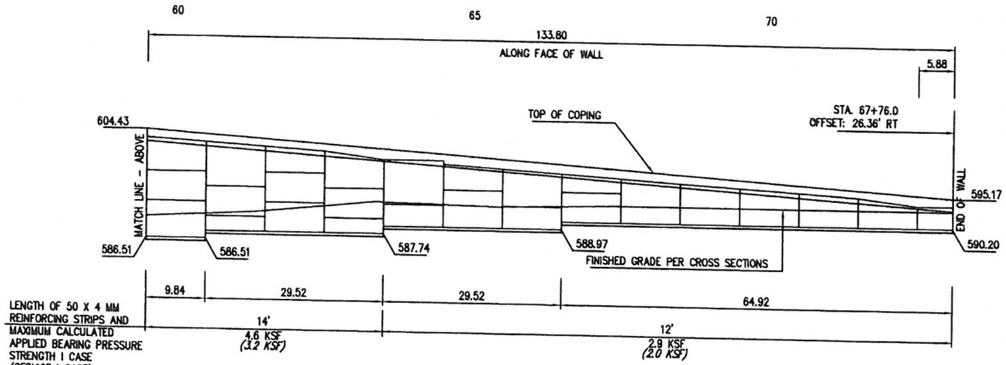
C:\XXX

PUBLIC ROAD DIV.	STATE DIST. No.	STATE PROJECT No.	FEDERAL PROJECT No.	FISCAL YEAR	COUNTY
W.V.	1	S320-P-25-0.05 00	ACBR-0025 (091)TC	2011	KANAWHA



ELEVATION – FRONT FACE – ABUTMENT 2

SCALE : 1" = 10'



ELEVATION – FRONT FACE – ABUTMENT 2

SCALE : 1" = 10'

NOTES:

1. LENGTH OF LEVELING PAD IS BASED ON INDIVIDUAL PANEL WIDTHS. ℄ OF PANEL JOINT TO ℄ OF PANEL JOINT. USE STEP DETAIL ON SHEET 7 TO DETERMINE THE ACTUAL LEVELING PAD STEP LOCATION.
2. FOR TYPICAL SECTIONS, REFER TO SHEET 6.
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* MOMENT SLAB DETAILS TO BE DEVELOPED

PRELIMINARY – NOT FOR CONSTRUCTION

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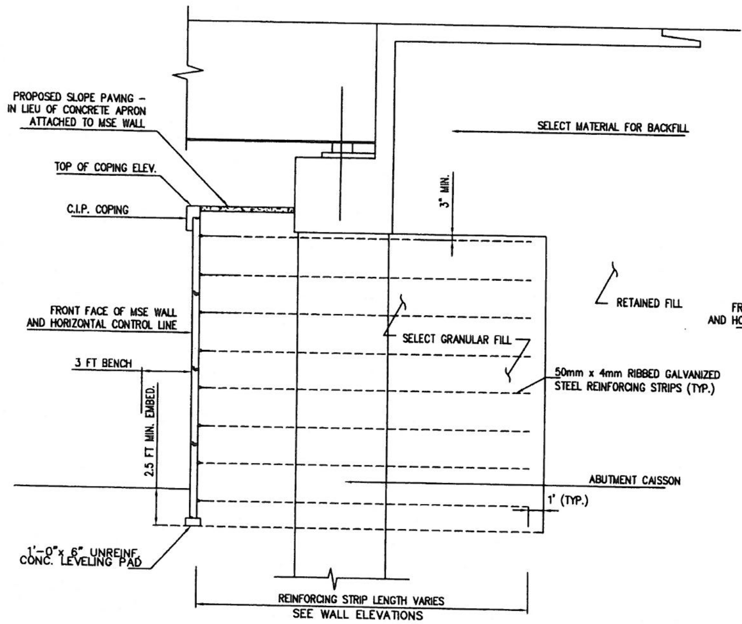
DESIGNED BY:			
XX			
PROJECT ENGR:			
KPB			
CHECKED BY:			
XX			
	REV.	DATE	DESCRIPTION

PROJECT NAME	DICK HENDERSON BRIDGE OVER KANAWHA RIVER	DATE 1-10-2012
LOCATION	ST. ALBANS AND NITRO WEST VIRGINIA	CONTRACT NO. 15530
OWNER	WVDOT – DOH	DRAWING NO. 5 OF 9
DRAWING COVERS	MSE WALL AT ABUT 2	SCALE AS SHOWN

C:\XXX

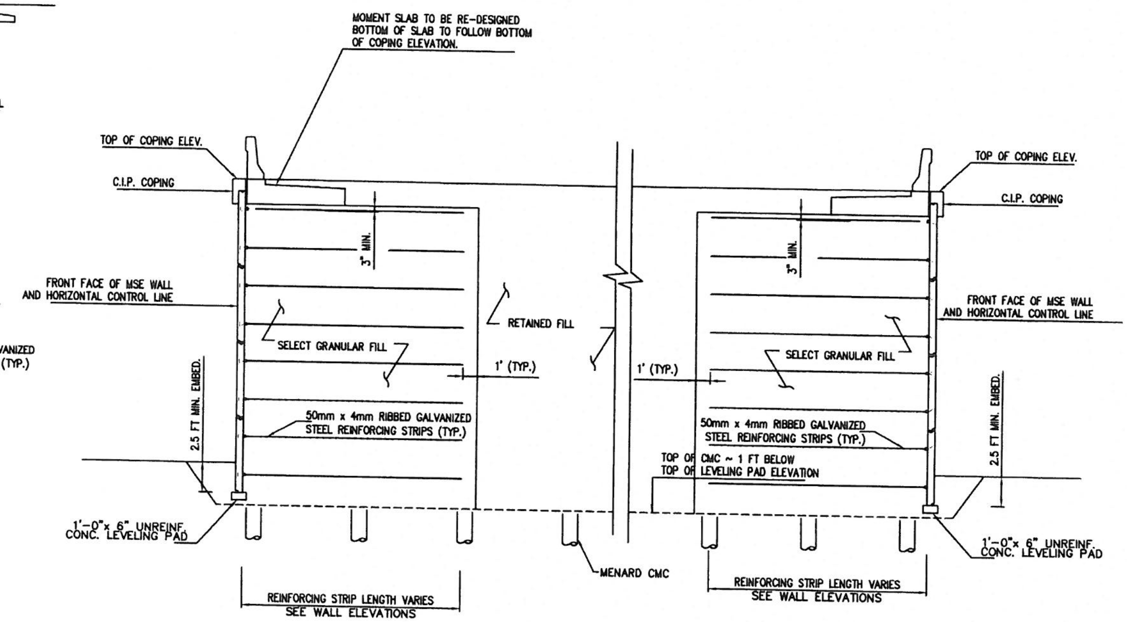
PUBLIC ROAD DIV.	STATE DIST. No.	STATE PROJECT No.	FEDERAL PROJECT No.	FISCAL YEAR	COUNTY
W.V.	1	S320-P-25-0.05 00	ACBR-0025 (091)TC	2011	KANAWHA



ANY UNSUITABLE MATERIALS BELOW THE MSE WALL FOOTPRINT / UNDERCUT AREA SHALL BE REMOVED AND REPLACED WITH COMPACTED SELECT GRANULAR BACKFILL, OR OTHERWISE STABILIZED AS DIRECTED BY THE ENGINEER

TYPICAL SECTION AT ABUTMENTS

SCALE : 1/4" = 10'



ANY UNSUITABLE MATERIALS BELOW THE MSE WALL / CMC FOOTPRINT SHALL BE REMOVED AND REPLACED WITH COMPACTED SELECT GRANULAR BACKFILL, OR OTHERWISE STABILIZED AS DIRECTED BY THE ENGINEER

TYPICAL SECTION – APPROACH WALLS

SCALE : 1/4" = 10'

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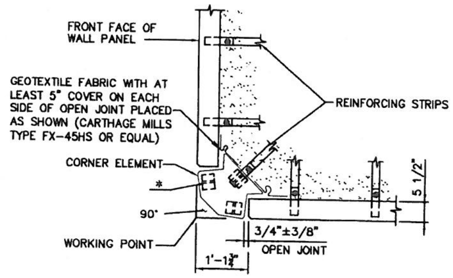
DESIGNED BY: XX				PROJECT NAME	DICK HENDERSON BRIDGE OVER KANAWHA RIVER	DATE 1-10-2012
PROJECT ENGR: KPB				LOCATION	ST. ALBANS AND NITRO WEST VIRGINIA	CONTRACT NO. 15530
CHECKED BY: XX				OWNER	WVDOT – DOH	DRAWING NO. 6 OF 9
	REV.	DATE	DESCRIPTION	DRAWING COVERS	TYPICAL SECTIONS	SCALE AS SHOWN

C:\XXX

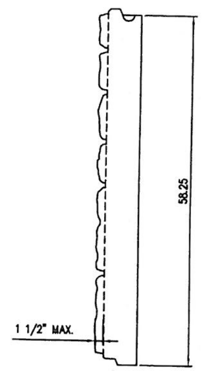
PUBLIC ROAD DIV.	STATE DIST. No.	STATE PROJECT No.	FEDERAL PROJECT No.	FISCAL YEAR	COUNTY
W.V.	1	S320-P-25-0.05 00	ACBR-0025 (091)TC	2011	KANAWHA



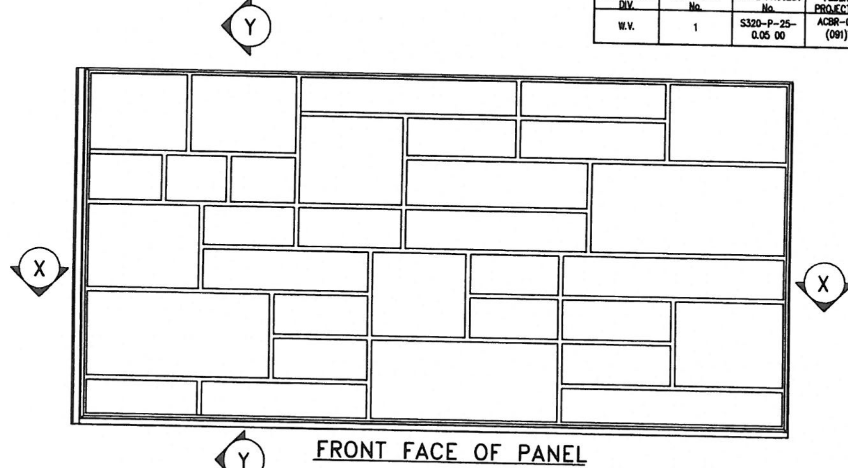
90° CORNER ELEMENT DETAIL

SCALE: 3/4" = 1'- 0"

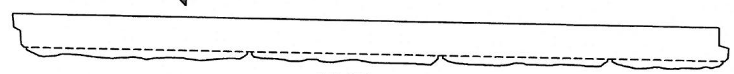
* THREE BEARING PADS PER UNIT BEARING PAD SHALL FIT FLAT ON TOP OF CORNER ELEMENT. FRONT PADS SHALL BE PLACED ON INSIDE EDGE OF LIP.



SECTION Y-Y

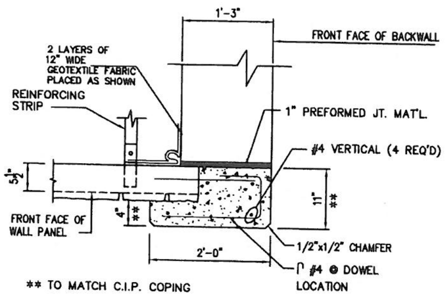


FRONT FACE OF PANEL



SECTION X-X

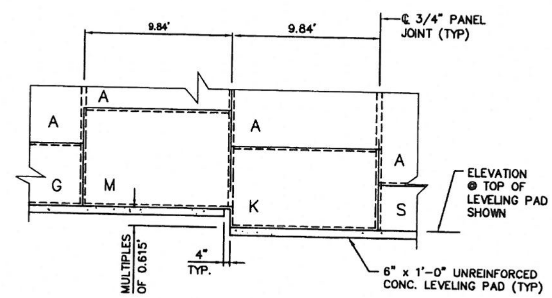
TYPICAL PANEL WITH ASHLAR STONE FORM LINER



** TO MATCH C.I.P. COPING

C.I.P. CONC. VERTICAL COPING DETAIL

SCALE: 1"=1'



TYPICAL LEVELING PAD STEP DETAIL

N.T.S.

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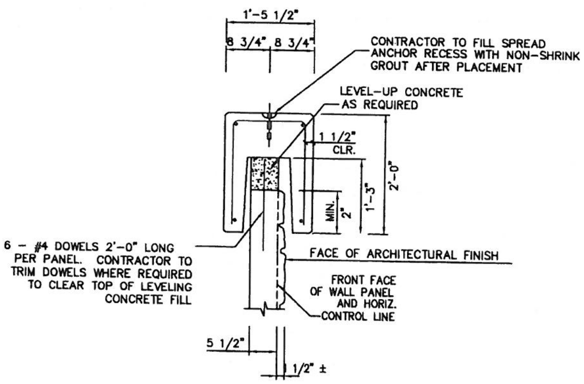
DESIGNED BY:	XX
PROJECT ENGR:	KPB
CHECKED BY:	XX

REV.	DATE	DESCRIPTION

PROJECT NAME	DICK HENDERSON BRIDGE OVER KANAWHA RIVER	DATE	1-10-2012
LOCATION	ST. ALBANS AND NITRO WEST VIRGINIA	CONTRACT NO.	15530
OWNER	WVDOT - DOH	DRAWING NO.	7 OF 9
DRAWING COVERS	MSE WALL DETAILS	SCALE	AS SHOWN

C:\xxx

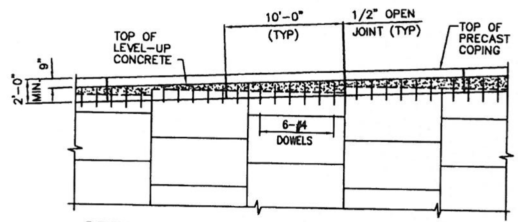


PRECAST COPING SECTION

SCALE: 1" = 1'- 0"

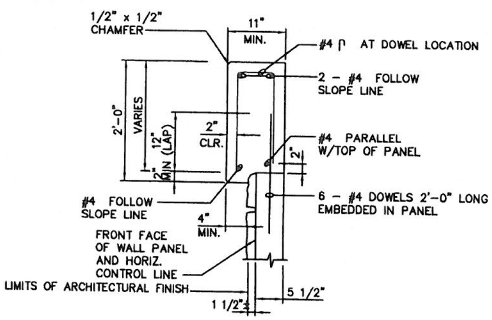
NOTE:

STANDARD COPING UNIT IS 10'-0" LONG WITH SQUARE ENDS.



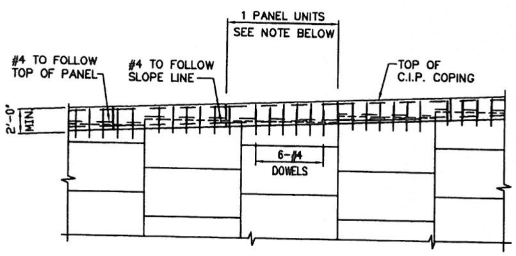
PRECAST COPING – PARTIAL ELEVATION

SCALE: NONE



C.I.P. CONCRETE COPING

SCALE: 1" = 1'- 0"

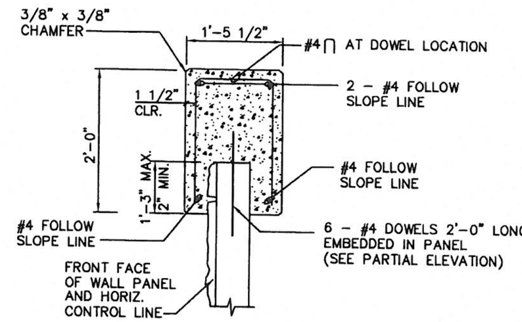


C.I.P. COPING – PARTIAL ELEVATION

SCALE: 3/16" = 1'- 0"

NOTE:

ONE-HALF INCH CHAMFERED (CONTROL) JOINTS SHOULD BE PLACED AT EVERY PANEL INTERVAL COINCIDING WITH EVERY PANEL JOINT. ONE-HALF INCH EXPANSION JOINTS SHOULD BE PLACED AT EVERY FOUR-PANEL INTERVAL WHEREBY ALL LONGITUDINAL REINFORCEMENT SHALL BE FIELD CUT TWO INCHES (2") SHORT OF EACH SIDE OF THE EXPANSION JOINTS.



C.I.P. CONC. COPING SECTION TO MATCH PRECAST COPING

SCALE: 1" = 1'- 0"

NOTES:

1. CONC. = CLASS B
2. STEEL = ASTM A615 GRADE 60, EPOXY COATED
3. ALL LONGITUDINAL BARS ARE #4
4. EXPANSION JOINTS (1/2") SHALL BE EVERY 3 PANEL UNITS
5. CONSTRUCTION JOINTS (1/2") SHALL BE AT EACH PANEL JOINT (EXCEPT FOR PANELS LESS THAN 8 FT)

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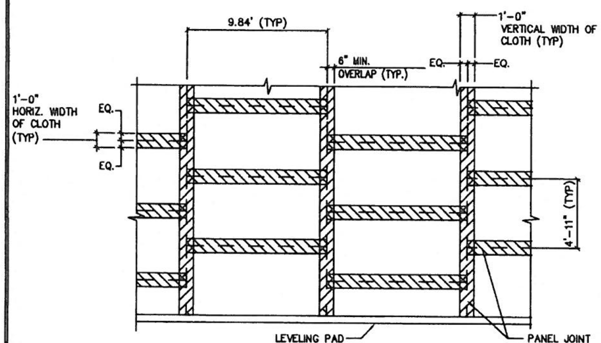
DESIGNED BY: XX	PROJECT NAME	DICK HENDERSON BRIDGE OVER KANAWHA RIVER	DATE 1-10-2012
PROJECT ENGR: KPB	LOCATION	ST. ALBANS AND NITRO WEST VIRGINIA	CONTRACT NO. 15530
CHECKED BY: XX	OWNER	WVDOT – DOH	DRAWING NO. 8 OF 9
REV. / DATE / DESCRIPTION	DRAWING COVERS	MSE WALL COPING DETAILS	SCALE AS SHOWN

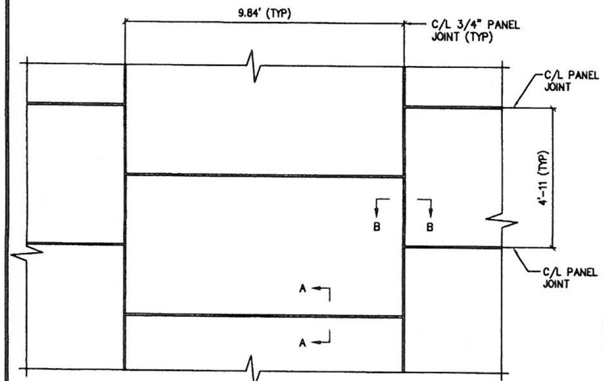
C:\XXX



NOTE:
STRIPS OF FILTER CLOTH SHALL BE PLACED ON BACK FACE OF PANEL, OVER PANEL JOINTS. FILTER CLOTH SHALL BE ADHERED TO BACK FACE OF PANELS USING AN ADHESIVE COMPOUND SUPPLIED BY THE REINFORCED EARTH COMPANY.

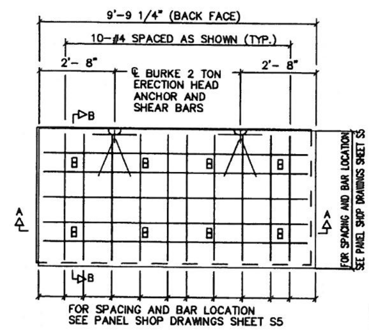
FILTER CLOTH DETAIL
PARTIAL ELEVATION – BACK FACE
RECTANGULAR LARGE PANELS

SCALE: 1/4"=1'-0"



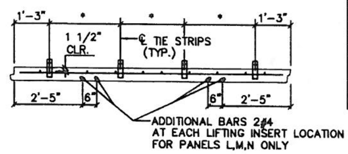
TYPICAL PANEL LAYOUT
PARTIAL ELEVATION – FRONT FACE
RECTANGULAR LARGE PANELS

SCALE: 1/2=1'-0"



FOR SPACING AND BAR LOCATION SEE PANEL SHOP DRAWINGS SHEET S5

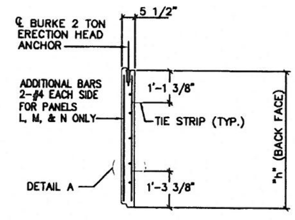
ELEVATION – BACK FACE



* FOR TIE STRIP SPACING SEE PANEL SHOP DRAWINGS SHEET S3

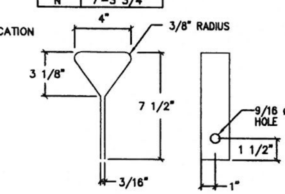
SECTION A–A

SCALE: 1/2" = 1'-0"



SECTION B–B

PANEL TYPE	"h"
A	4'-10 1/4"
C	1'-9 1/2"
D	2'-4 3/4"
E/S	3'- 0 1/4"
F	3'-7 1/2"
G	4'-3"
K	5'-5 3/4"
L/P	6'-1"
M	6'-8 1/2"
N	7'-3 3/4"



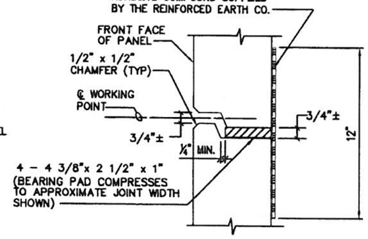
TIE STRIP DETAIL

SCALE: 3"=1'-0"

NOTES:

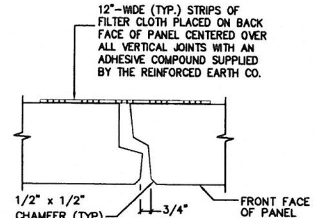
1. PRECAST CONCRETE SHALL BE AIR ENTRAINED, NORMAL WEIGHT, WITH A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 4000 PSI.
2. REINFORCING BARS SHALL BE ASTM A615 GRADE 60, (AASHTO M31) (EPOXY COATED)
3. 1/2" x 1/2" CHAMFER SHALL BE PROVIDED ON ALL EXPOSED EDGES (FRONT FACE ONLY). CHAMFER IS OPTIONAL ON BOTTOM EDGE OF BOTTOM PANELS.
4. ALL PANEL TYPES AND OTHER RELATED ELEMENTS WILL BE DETAILED ON SHOP DRAWINGS.
5. ALL PANELS SHALL HAVE TWO (2) LIFTING INSERTS OF TWO-TON CAPACITY EACH – BURKE OR EQUIVALENT.
6. PANEL DESIGN THICKNESS IS 5-1/2". THE THICKNESS OF CONCRETE WILL INCREASE BY UP TO 1 1/2" FOR THE ASHLAR STONE FORM LINER FINISH.
7. REINFORCED EARTH WALL PANELS SHALL HAVE AN ASHLAR STONE FORM LINER FINISH. CORNER ELEMENTS SHALL HAVE A PLAIN SMOOTH FORM FINISH.
8. BOLT SETS SHALL BE ASTM A-449 (FORMALLY ASTM A-325), GALVANIZED AS PER ASTM A-153.
9. FILTER FABRIC FOR PANEL JOINTS SHALL CONFORM TO AASHTO M288 SUBSURFACE DRAINAGE, CLASS 2 OR BETTER. MINIMUM LAP SHALL BE 4".
10. "BEARING BLOKS" SHALL BE EPDM RUBBER PADS WITH DUROMETER HARDNESS OF 80±5, CONFORMING TO ASTM D2000.
11. SHIMS SHALL BE EPDM RUBBER PADS WITH DUROMETER HARDNESS OF 80±5, CONFORMING TO ASTM D2000. NOMINAL DIMENSION OF SHIM IS 50mm X 85mm X 5mm THICK.
12. TIE STRIPS SHALL BE ASTM A1011 (FORMERLY A-570) GRADE 50, 10 GAGE, GALVANIZED AS PER ASTM A-123 OR A-153.
13. SEE CONSTRUCTION MANUAL FOR ADDITIONAL INFORMATION.
14. REINFORCING STRIPS SHALL BE 50mm WIDE AND 4mm THICK, AND SHALL CONFORM TO THE PHYSICAL AND PROPERTIES OF ASTM A-572 GRADE 65. GALVANIZATION SHALL BE APPLIED IN ACCORDANCE WITH ASTM A-123 OR AASHTO M111 (610 g/m^2).
15. 1/2" ø ASTM A449 BOLT (FORMERLY ASTM A325) GALVANIZED. AASHTO M-291, GRADE DH (GRADE 2 DH ASTM A-563) NUT, ASTM F-436 WASHER GALVANIZED IN ACCORDANCE WITH AASHTO M-232 (ASTM A153).

PANEL THICKNESS	REINFORCEMENT DESIGNATION	PANEL REINFORCEMENT (FOR PANEL TYPE "A")	MAXIMUM ALLOWABLE HORIZONTAL STRESS AT FACING (KSF)
5 1/2" (MIN.)	R4	10-#4 VERTICAL 5-#4 HORIZONTAL	3.5

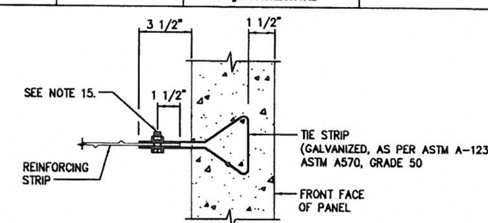


SECTION A–A
HORIZONTAL JOINT

SCALE: 3"=1'-0"



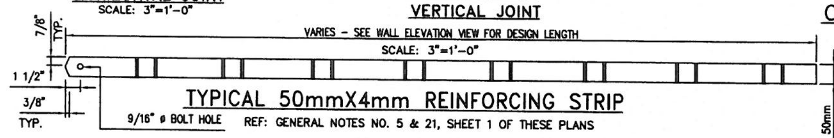
SECTION B–B
VERTICAL JOINT



CONNECTION DETAIL

SCALE: 3"=1'-0"

CERTIFIED WITH RESPECT TO THE INTERNAL STABILITY OF REINFORCED EARTH STRUCTURES ONLY



TYPICAL 50mmX4mm REINFORCING STRIP

REF: GENERAL NOTES NO. 5 & 21, SHEET 1 OF THESE PLANS

The design contained on these drawings is based on information provided by the owner. On the basis of this information, The Reinforced Earth Company has designed, and is responsible for the internal stability of the structure only. External stability, including foundation (bearing capacity and settlement) and slope (global) stability, is the responsibility of the owner.

REINFORCED EARTH®
8614 Westwood Center Drive, Vienna, VA 22182 (703) 821-1175

DESIGNED BY: XX			PROJECT NAME	DICK HENDERSON BRIDGE OVER KANAWHA RIVER	DATE 1-10-2012
PROJECT ENGR: KPB			LOCATION	ST. ALBANS AND NITRO WEST VIRGINIA	CONTRACT NO. 15530
CHECKED BY: XX			OWNER	WVDOT – DOH	DRAWING NO. 9 OF 9
REV.	DATE	DESCRIPTION	DRAWING COVERS	STD. MSE WALL DETAILS	SCALE AS SHOWN

C:\XXX

menard
Ground Improvement Specialists

February 24, 2012

Kokosing Construction Company
886 McKinley Ave
Columbus, OH 43222
T: (614) 228-1029
F: (614) 228-7065

Sent via email to kao@kokosing.biz

Subject: Executive Summary for Installation of CMC™ (Controlled Modulus Column) Ground Improvement
Dick Henderson Bridge Replacement (Menard File No. 11309)
St. Albans, WV

Dear Mr. Ohl:

As requested, Menard USA (Menard) has prepared some draft/sample information to assist in the approval of CMCs for support of the Dick Henderson Bridge approach embankments. Menard has imposed preliminary CMC layouts/configurations over the footprint of the MSE walls, as shown on plan sheets 7 and 9 of 128. These plan sheets show typical CMC spacing's and how that spacing changes as the amount of fill decreases away from the abutments. The general purpose of this layout is to provide an understanding of how a CMC system will be detailed beneath the proposed bridge approaches. More refined drawings will be provided as a part of our detailed design package.

Included in this submittal are two (2) plan sheets (mentioned in the above paragraph), as well as a sample CMC Means and Methods and a Technical description of the CMC installation process. Please note that the information provided in this submittal is preliminary and not for construction. These documents have not been modified to completely address this specific project, nor do they represent exactly how this information will be presented as this project is further developed.

It is our understanding that the elevation information requested by the DOT has been addressed by the drawings provided by RECO. Working bench elevations and top of CMC elevations have been addressed between our previous submittals and the preliminary drawings provided by RECO.

We appreciate the opportunity to offer you this information and we look forward to working with you on this project. Should additional information or clarifications to the proposed ground improvement system be required, please do not hesitate to contact us.

Respectfully Submitted,
MENARD

Jason Griffin, P.G.
Estimating Manager

MENARD

Dick Henderson Bridge
St. Albans, WV
Controlled Modulus Columns
Means & Methods – SAMPLE

Means and Methods
St. Albans, WV

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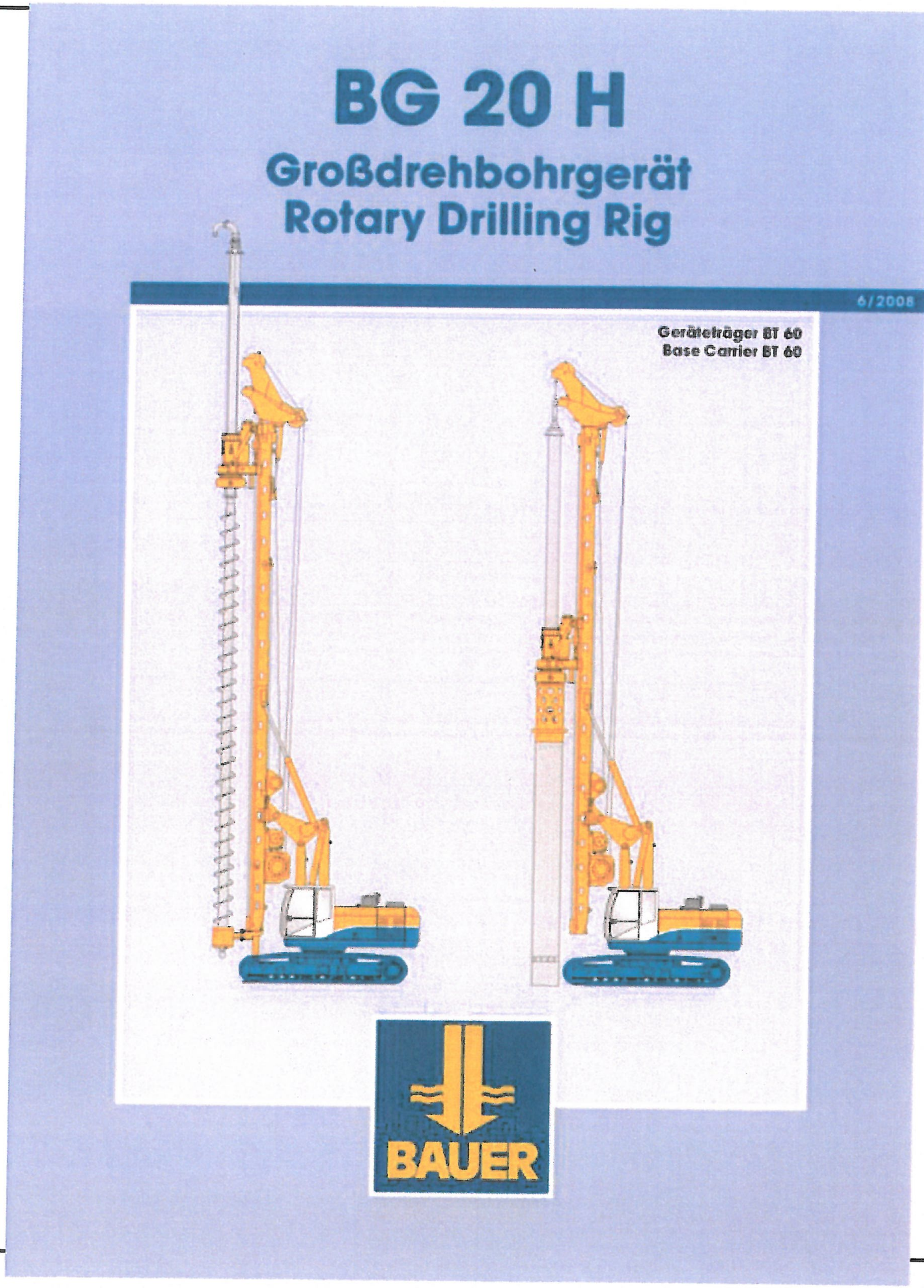
1. - EQUIPMENT

Menard will perform the installation of the CMC using a rig type similar to the following:

BG - 20H

This rig will be attached to a mobile Schwing grout pump.

TYPICAL SET-UP:


BG 20 H
Großdrehbohrgerät
Rotary Drilling Rig
6/2008
Geräteträger BT 60
Base Carrier BT 60
BAUER

Abmessungen — Dimensions

Die BG 20 H, ein Gerät mit einem Einsatzgewicht von ca. 60 t und einem Drehmoment von 200 kNm dient zur Herstellung von

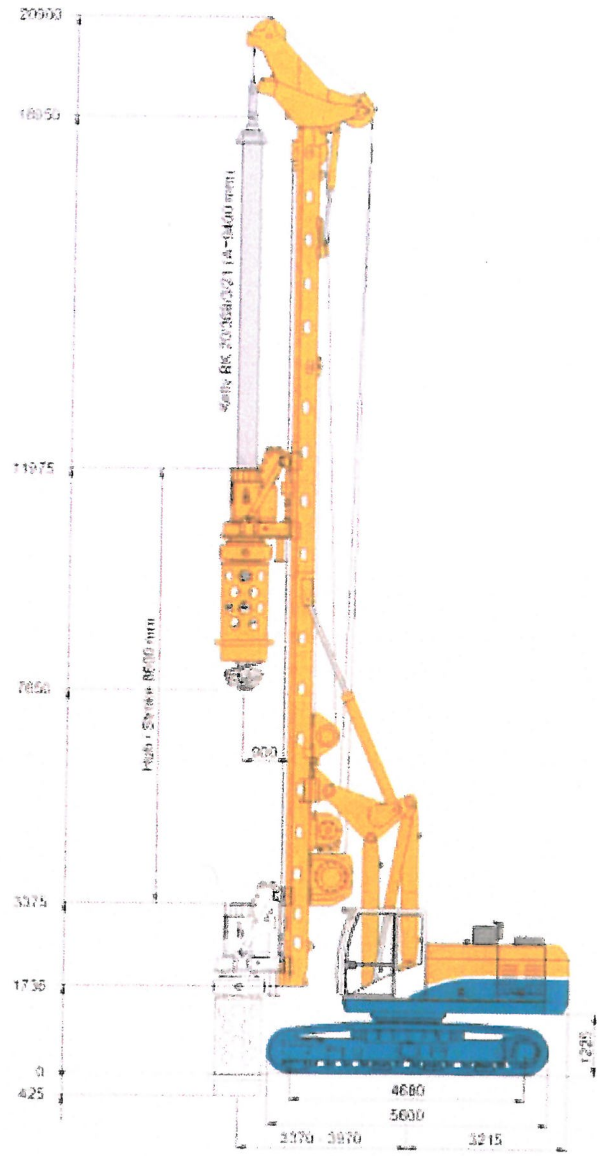
- verrohrten Bohrungen (Eindrehen des Bohrrohres mit dem Drehgetriebe oder mit angebauter Verrohrungsmaschine)
- unverrohrten, flüssigkeitsgestützten Bohrungen
- Bohrungen mit langer Hohlschnecke (SOB) - mit oder ohne Kellyverlängerung
- Sonderverfahren wie VdW-Bohren, Verdrängerbohrungen, Soil-Mixing-Verfahren (SMW und CSM)

Das Trägergerät BT 60 wird von Bauer Maschinen geplant und gebaut. Der Motor und das Hydraulikaggregat sind längs eingebaut. Diese Bauweise gewährleistet optimale Luftführung, niedrige Transporthöhe und optimale Kühlleistung bis 40° Außentemperatur.

The BG 20 H rotary drilling rig has an operating weight of approx. 60 t and a torque of 200 kNm. It is ideally suited for:

- Drilling cased boreholes (installation of casing by rotary drive or optionally by hydraulic oscillator - both are powered by the drilling rig)
- Drilling uncased deep boreholes that are stabilised by drilling fluid
- Drilling boreholes with long hollow stem augers (CFA system), with or without kelly extensions
- Special drilling systems, such as FDW piles, displacement piles, soil mixing wall systems (SMW and CSM)

The base carrier BT 60 is designed and built by Bauer Maschinen. The engine and the hydraulic power pack are mounted in longitudinal direction. Such a construction principle ensures optimal air flow, low transport height, optimal cooling capacity at 40° ambient temperature.



Bohrverfahren mit Serienausstattung:

Kellybohren (ohne Verrohrungsmaschine)

SOB-Verfahren (hydraulisch und elektrisch vorgerüstet)

FDP Verdrängerbohren (hydraulisch und elektrisch vorgerüstet)

Drilling processes with standard equipment:

Kelly drilling (without casing oscillator)

CFA drilling (pre-equipped with hydraulic and electric installations)

FDP Full-Displacement-Piling (pre-equipped with hydraulic and electric installations)

menard

Project	Dick Henderson Bridge		
Date	February 24, 2012	By	Zack Kovacs
Approved		By	
Page 6 of 27		Revision	- SAMPLE

Subject Means & Methods

GUHMA Monitoring Device

For each CMC, the drill rig operator can monitor the following parameters. These can also be recorded by the on-board computer:

- CMC Rig Number
- Length of CMC
- CMC Number/Diameter
- Speed of Withdrawal
- Grouting Pressure or Grout Strokes
- Rotation Speed
- Torque
- Drilling Start/End Time
- Speed of Penetration
- Theoretical/Actual Grout Volume
- Pull-Down Force (or crowd)
- Overbreak Percentage

The three principal parameters: depth, volume of concrete (corresponding to the number of strokes from pump) and torque at the CMC tip, will be recorded by the operator on his hand-written drill log sheet to provide additional data backup. Additionally, the CMC number (per the shop drawings), and any noteworthy comments for conditions or situations encountered while drilling will be recorded on the handwritten log (sample attached below).

DGI-MENARD

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Sustainable Technology

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CMC Drill Log

Jobsite		DATE	
RIG:		TOOL SIZE	

CMC NUMBER	Start Time	Finish Time	Drilling Length	PUMP STROKES	Torque at tip	Check Plumb	Comments
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
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27							
28							
29							
30							

30 columns per page

Sample CMC Computer Log

Menard
CMC

menard

Job Site Data:

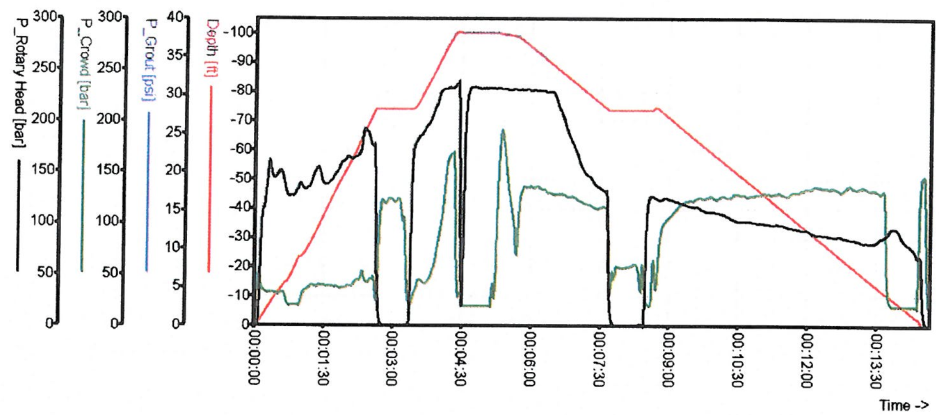
Project name:
Location:
Client:
Contract Number:
Drill Rig:

Data for CMC No: 1553

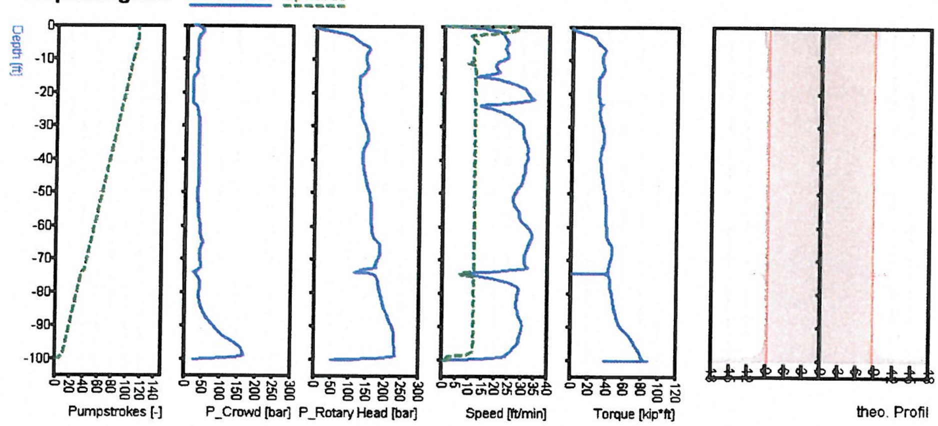
Date: 6/23/2010
Starttime: 11:19:05 AM
Endtime: 11:33:43 AM
Totaltime: 00:14:38
Pausetime: 00:00:00

CMC length: 100.32 ft
CMC diameter: 17.7 inch
Theo. Volume: 171.4 ft³
Act. Volume: 189.2 ft³
Overbreak: 10.4 %

Timediagram



Depthdiagram downwards upwards



A submittal will be prepared under separate cover (GUHMA On-Board Computer Printout Results) explaining how to interpret the data shown above. A CMC computer log (such as that shown above) will be produced for every CMC installed as part of this project.

MOBILE CONCRETE PUMP - SCHWING WP 1000X

Technical Specs

Concrete Output	70 cu. yds/ hr.	54 M3 / hr.
Max. Pressure on Concrete	1100 psi.	76 BAR
Max. Horz. Pumping Distance*	1160 ft.	354 m
Max. Vert Pumping Distance*	330 ft.	100 m
Max. Aggregate Size *	1.5 in.	38 mm

Pump Specs

Type of Valve	"Long Rock"	
Max Pump Strokes per Minute	35	
Pump Cylinder Diameter	7 in.	180 mm.
Differential Cylinder Diameter	3.54 in.	90 mm
Pump Cylinder Stroke Length	39 in.	1000 mm
Diameter of Discharge	5 in.	125 mm
Capacity of Receiving Hopper	11 cu. ft.	.31 cu. m
Charging Hopper-Height	51 in.	1300 mm

Engine Specs

Engine Deutz BF4M2012C @ 2,500 RPM	133 H.P.	99 KW
Electric Engine Option @ 1,800 RPM	100 H.P.	75 KW
Fuel Tank Capacity	30 gal.	113 L.
Hydraulic Tank Capacity	70 gal.	265 L.

2. - METHOD STATEMENT: CMC INSTALLATION PROCEDURE

2.1 Principal Activity

This method statement covers the general procedure that will be adopted to provide ground improvement for the support of the Dick Henderson Bridge. Ground improvement consists of the installation of CMCs from the working pad elevation to an approximate depth of 50 ft. The working pad surface elevation will range from 585.5' msl to 590.2' msl.

Drill depth will vary from CMC to CMC and shall be determined based upon the drill rig information as monitored by the drill operator as well as the data received and evaluated during the installation of the test elements. The CMC layout will be done based upon the results of the design calculations.

2.2 General Description of the CMC Technology

When compressible soils are encountered under the foundations of a project, several solutions are usually evaluated:

- If the compressible soils are shallow enough, excavation and replacement with compacted structural fill can be a viable solution
- Deep foundations such as driven steel, precast concrete, and auger-cast piles
- Ground improvement solutions such as Stone Columns, Dynamic Compaction, Wick Drains or Controlled Modulus Columns (CMCs).

Deep foundations are structural rigid elements that are used to bring the load from the structure to competent layers below (bedrock, dense residual soils) by 'bridging' the compressible soft soils. Because the load in each element is highly concentrated, they need to have direct contact with the surface loads and the structure to be able to transmit these loads either through an end-bearing condition, skin-friction, or a combination of the two. They are designed to provide minimal settlement and they require the use of a structurally rigid system such as structural slabs, grade beams and pile caps, which tends to add extra costs to the overall cost of a structure. These elements are usually heavily reinforced to meet code requirements and are directly attached to the structure.

While "deformable" ground improvement solutions (vibrocompaction, dynamic compaction) are often very cost-attractive as compared to a deep foundation alternative, the expected and observed settlements are typically greater than that of rigid deep foundations. In the case of Stone Columns for example, the ratio of stiffness between the soil and the stone column determines the ratio of load shared between the soil and the element and therefore the magnitude of settlement resulting from the load of the structure. One of the advantages of a ground improvement solution is that by greatly reducing the load concentration in each element, it does not require the structure to be as rigid as with a deep foundation solution. The structure can usually be designed as if it was founded on competent ground with a slab-on-grade and spread footing.

Controlled Modulus Column (CMC) technology bridges the gap between these two different approaches by reducing the global deformability of a soil mass using semi-rigid soil reinforcement columns. The soil - CMC mass behaves as a composite mass of greater stiffness than the initial untreated ground reducing settlements induced by the weight of the structure within allowable ranges. CMC's are not intended to directly support the loads imposed by the structure, but to improve the soil globally in order to control settlement. The dimensions, spacing, and material of the CMC's are based upon the development of an optimal combination of support from the columns and the soil mass to limit settlements for the project within the allowable range, and to obtain the requested value for the equivalent composite deformation modulus of the improved soil.

- CMC technology has the following features:
- Material is grouted in place with the use of a displacement auger
- Deformation modulus is 100 - 3,000 times that of soil.
- Soil properties are improved between the columns in granular soils thanks to the displacement drilling process.
- Virtually no spoils are generated by the drilling process, which eliminates the risk of disposal of contaminated soils.

CMCs are usually installed 1 to 3 ft below the bottom of the slab of the structure or under an embankment or an MSE wall. A layer of compacted granular material called the Load Transfer Platform (LTP) is installed above the top of the CMCs and below the slab on grades or embankment after completion of the CMC elements. The main purpose of the LTP is to transfer the load from the structure to the CMCs without the requirement for grade beams and pile caps. The load is transferred to the CMC through arching within the high phi angle LTP and through side friction below the top of the CMCs. The system is generally designed to transfer 50 to 95% of the load to the CMCs while the remainder of the load goes on the soils between the CMCs. The ratio of load sharing is dependent on the type and stiffness of the soils between CMCs as well as the allowable settlement for the structure. In the case of a building, because the CMCs are totally disconnected from the structure, utilities can be easily installed directly under the slab without the need to hang pipes. Slab thicknesses can range in thickness from 5" without reinforcement to 8 to 10" with light reinforcement or steel mesh depending on the loads and design requirements for the structure.

Under individual spread footings, CMCs are usually installed in groups of elements terminated 6" to 12" below the bottom of the footing. The number of elements installed below each footing is governed by the ability of the surrounding soils to share the load with the CMC elements while maintaining deformations within acceptable tolerances. A lean mix or compacted granular material is placed between the top of the CMC and the bottom of the footings and no pile cap or structural connection to the footing is required.

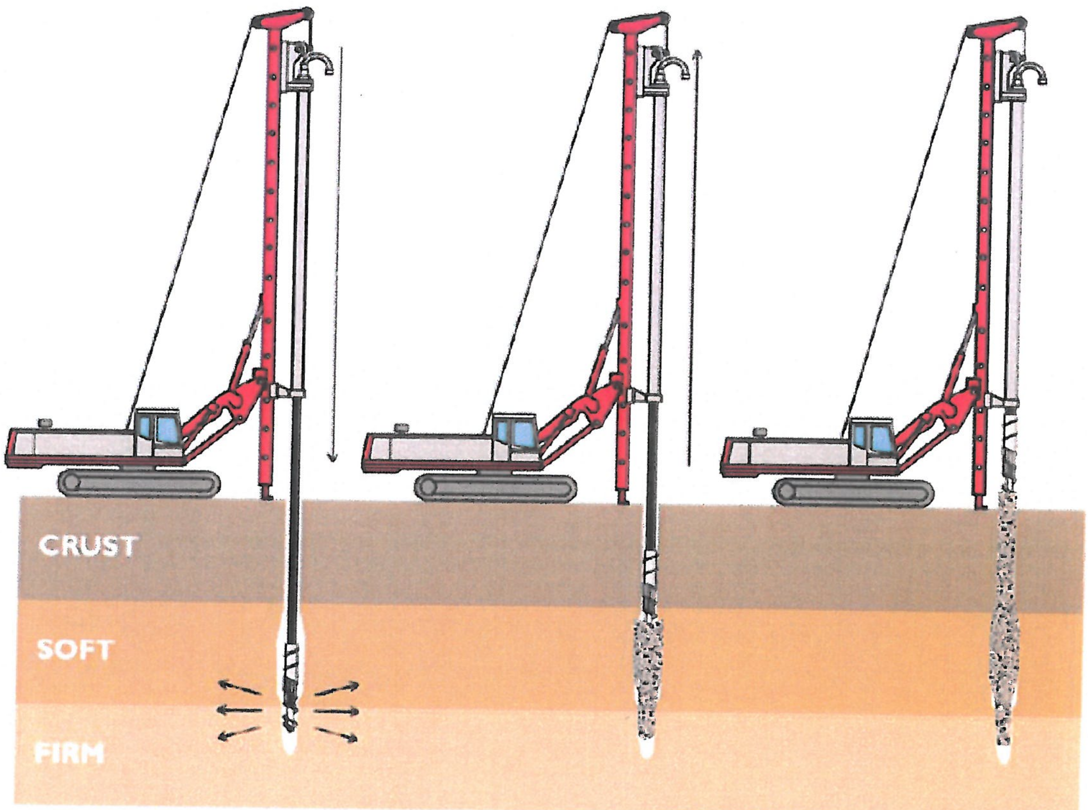
CMCs can also accommodate moderate uplift conditions by placing a centralized bar in each element, as required.

The CMC technology is also well suited to very soft soil conditions such as organic clays, peat or even municipal solid waste. Contrary to stone columns that require a minimum lateral confinement to avoid bulging when loaded, CMCs have no such limitations thanks to the use of a lean sanded grout and can therefore be installed in very soft soils.

Additionally, CMC's do not generate vibrations during installation, which allows for construction in urban areas or close to sensitive existing structures.

Method of Construction of CMC

CMCs are installed using a specially designed displacement auger that displaces the soil laterally without generating spoils or creating vibrations. The displacement auger is hollow, which allows placement of the specially designed grout column as the auger is withdrawn. The grout for a CMC element is incorporated with enough back pressure to avoid collapse of the gap left by the auger during withdrawal. The intent is to fill the gap left by the auger to create a column of diameter at least identical to the auger. The auger is advanced by laterally displacing laterally the surrounding soils, powered by equipment with large torque capacity and high static down thrust.



CMC Installation Schematic

Upon reaching the desired depth, grout or mortar is pumped through the hollow stem of the auger and into the soil cavity as the auger is withdrawn. The rate of withdrawal of the auger during grouting is controlled by the operator ensuring a consistent width column without the possibility of "necking" taking place.

With a conventional auger, "negative displacement" or stress relief around the auger is inevitable. This creates a movement of the surrounding soils toward an active (Ka) condition which are loosened by the augering process. This creates a risk of necking within the column. Conversely, with Menard's CMC displacement auger, the effect is opposite: the soil adjacent to the auger is displaced laterally by the displacement stem portion of the auger (positioned at the base of a full-length Kelly bar) and brought to a denser passive (Kp) state of stresses. Stress relief does not occur and the risks of necking the CMC are virtually nonexistent.

The entire process operates essentially without spoils, which permits work on environmentally unfriendly sites by eliminating the risk of handling and disposing of contaminated in-situ material.

Quality control of the CMC is ensured by laboratory compressive strength tests of grout, vertical load tests on isolated columns and by monitoring the following installation parameters:

- Speed of rotation and advancement/withdrawal of the auger.
- Torque, down-thrust (crowd) during the drilling phase
- Depth of element
- Pressure and/or volume of grout or mortar.

The grout pressure is monitored by a sensor located at the top of the concrete line in the swivel attached to the mast drilling head. As an added safety factor the CMCs are usually installed using a target overbreak of 5 to 10% in the volume of grout.

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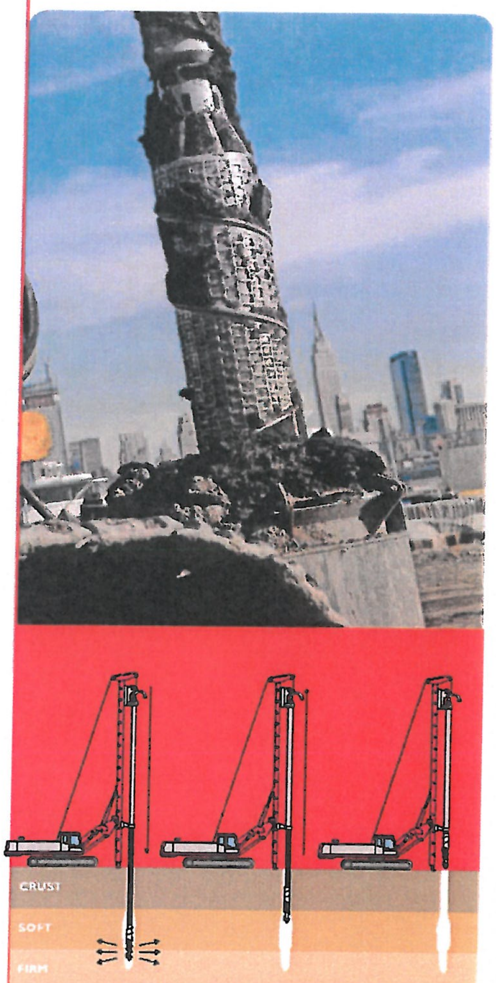
Ground Improvement Specialists

Overview of Technique

Controlled Modulus Columns™



Controlled Modulus Columns (CMCs) are grouted columns formed using an auger that displaces soil laterally, producing very little spoil. As the auger is extracted, a column is formed using pressure grouting to achieve a predetermined stiffness ratio with the surrounding ground.

Controlled Modulus Columns™ (CMCs) are an environmentally sound and economical solution for strengthening soft ground when construction needs to begin within days instead of months. CMCs consist of grouted inclusions that work together with the surrounding soil to provide a stiff composite ground mass. CMCs are well adapted to high surface loading conditions and strict settlement requirements and are used to support slabs-on-grade, isolated footings, and embank-ments on compressible clays, fills and organic soils.

Controlled Modulus Columns Applications

- Warehouses
- Industrial Facilities
- Storage Tanks
- Port Facilities
- MSE Retaining Walls
- Bridge Abutments
- Roadway Embankments
- Railway Embankments

Menard Controlled Modulus Columns

Menard uses a patented CMC technology that reinforces soil by drilling a hollow auger into the soft soil and installing a cement-based grout column using pressure through the hollow auger. The combined effect of densification and reinforcement improves characteristics of the soft ground resulting in a composite system.

CMCs are installed using a specially designed auger that displaces the soil laterally, with virtually no vibration and no spoil, eliminating the need to dispose of contaminated soil. The auger is screwed into the soil to the required depth which increases the density of the surrounding soil and, as a result increases its load bearing capacity. During the auger extraction process, a column is developed by pressure-grouting to stiffen and treat the surrounding soil. The result is a composite ground improvement system where the column reinforcements and the surrounding soil share the loads.

CMCs were developed by Menard's French affiliate, Menard Soltraitement, in 1994 and are patented in the US. The two companies have installed over 5 million feet of CMCs on hundreds of projects in North America and around the world.

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Bridgeville, PA 15017
Tel 412.257.2750

www.menardusa.com

Subject Means & Methods

2	3
1	

1 - View of CMC rigs

2 - Detail of grout pumping unit

3 - Detail of displacement auger

2.3 General Construction Sequence

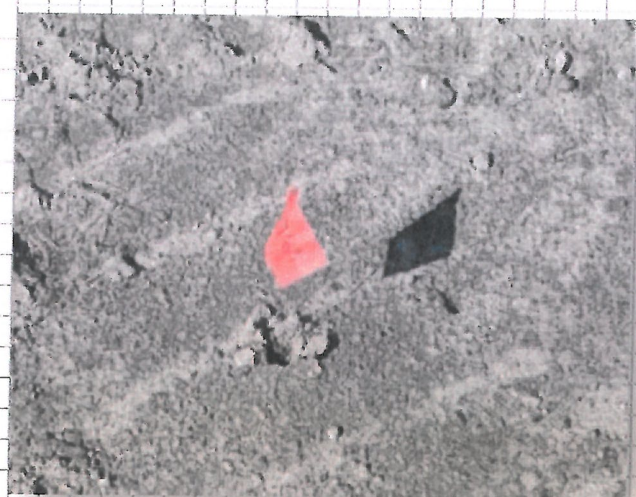
For this project, the CMC work will consist of the following typical construction sequence:

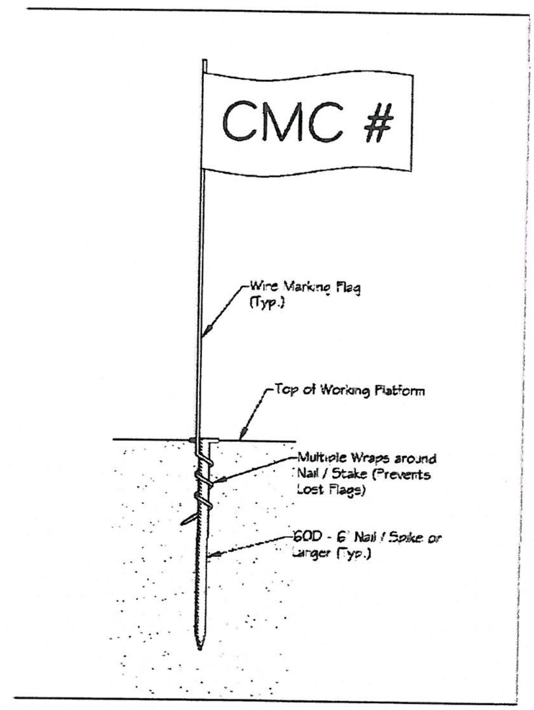
1) Placement of a minimum 1 ft working pad by the General Contractor at the elevation set by Menard. The platform shall provide a suitable all-weather continuous access to the site and a leveled free draining and stable working platform during mobilization and demobilization and at all times during the progress of the work for our specialized heavy equipment. The working platform shall not turn into mud under adverse conditions. The working platform shall be made of a granular material that conforms to the specifications of the Load Transfer Platform (Specifications submitted in Design / Drawings under separate cover) and shall be reasonably compact to provide adequate support for CMC equipment. The installation of the working pad shall cause minimum disturbance to the existing ground.
2) CMC grid spacing locations shall be located and staked out with utility pin flags wrapped around nails indicating the CMC number as shown on the shop drawings. The nails are required to hold the flags, as this prevents the CMC equipment from tearing up and destroying previously laid out flag locations. (See picture below)
3) Extra care shall be taken when placing CMCs in close proximity to existing structures.
4) CMCs will be installed from atop the working pad to such a depth as required to found the elements in a suitable bearing stratum, as per the geotechnical borings. For this project the bearing stratum will be the stiff sand layers underlying the fill and soft clays. The installation work will be done using techniques outlined in plan notes and within this submittal.
5) Upon reaching the target depth, we will begin to retract the tool allowing for the incorporation of excess grout directly above the termination elevation.
6) Once bottom grout pressure has been established, the auger will be extracted simultaneously with the pumping of the grout until enough grout is left in the auger/Kelly bar to complete the column.
7) Execution of the final part of the fill operation to reach final grade includes installation of the Load Transfer Platform per Menard's requirements

The construction sequence for CMC is provided in greater detail in the following section.

2.4 Construction Sequence for Execution of Controlled Modulus Columns

1) Setting out of each future CMC using surveyor's flags attached to nails (See Figure below). The numbering system for the elements is illustrated on the Menard shop drawings. Tolerance on the location of the CMCs shall not exceed 6 inches from the location indicated in the drawings.





2) For each CMC:

   a) The displacement auger is drilled into the ground to the pre-determined required depth by rotation and pull-down. For this project, the CMCs will be terminated in the stiff sandy clay as indicated in the geotechnical report. Soil will be displaced laterally instead of being extracted. The minimum diameter of the auger shall be 12.5 inches, as the drawings indicate, and the tip of the auger will be closed by a sacrificial shoe or a sliding end-tip. Initial end-drilling parameters will be based on the results of the installation of CMC test elements, and shall serve as the basis for the initial termination and depth target criteria. The drilling parameters during auger penetration into the competent substratum (torque, rotation speed, vertical speed of penetration, downward thrust, etc.) shall be compared with the soil data in order to verify adequacy of the target values. Successful completion of the load test(s) will be used to justify the final selection of production CMC termination criteria.

b) Deviance from the vertical shall remain within 2%. This shall be controlled by the operator.

c) When the prescribed depth is reached, pull-down is stopped, but rotation continues. Once grout flow is started, the tip will be lifted approximately 6" to 12" above the bearing stratum. The pumping of grout at this elevation will continue until a positive pressure is achieved. This pressure signifies that the soil above the bearing stratum has been adequately grouted.

d) The auger is then extracted while the grout is pumped through the stem. The grout filling process shall be continuous in order to ensure the integrity of the column. Grout placement shall be completed in a single pour. If a CMC is being poured while a truck runs out of grout, the auger shall be re-penetrated into the fresh grout at least 3 ft before resuming grouting operations with another ready-mix truck. The auger is withdrawn while maintaining clockwise rotation. The speed of extraction is controlled by the operator in conjunction with the monitoring device to ensure that the required diameter is maintained and that the column is continuous.

e) At the end of auger extraction, pumping can be stopped when the volume of material remaining in the follower tubes and in the auger is sufficient to finish the filling of the column by gravity.

f) Proceed to next CMC.

3) When required (under footings, for example), the top of each CMC will be cut-off using an auger attached to a bobcat or equivalent to the prescribed depth of cut-off as established in the design. A cut-off chart will be provided beforehand, indicating the prescribed cutoff elevation for each element. The elevation will be determined using a laser level.

3. - DESIGN OF CONTROLLED MODULUS COLUMNS

Method of Analysis and Design

A detailed analysis and design of the Controlled Modulus Columns for this project are submitted under separate cover. The design package includes a discussion of the scenarios modeled, hand calculations and computer modeling outputs.

4. - METHOD FOR OVERCOMING OBSTRUCTIONS

If obstacles are encountered that prevent the penetration of the auger, a procedure shall be discussed and approved on-site between the representatives of Menard and the Owner and/or Geotechnical Engineer. This could include relocation of the CMC, installation of additional CMC's or physical excavation and removal of the obstruction(s). Any removal of obstructions (by others) must be performed in a manner that does not cause any damage to adjacent CMCs.

The typical procedure for an obstructed column is to make an additional attempt on either side of the obstructed element. If this does not resolve the issue, the rig shall move to a different location while a remedial plan is formulated. If the amount of obstructed CMC's becomes excessive, either complete removal of the obstructions will be required or additional CMCs will need to be added with the obstruction being bridged through the use of grade beams or other structural units.

All holes left open shall be filled with CMC grout up to the elevation of the working pad.

5. - EXCAVATION AND PLACEMENT OF LTP

Protection of CMCs (by Others)

Excavation conducted after CMC installation shall be performed in such a way that soil directly under the CMC supported footing is not undermined. If the footing is inadvertently undermined, the soil shall be re-compacted or replaced with lean mix backfill. The backfill shall be made of the same material as is used for the LTP and shall be compacted in 9" lifts maximum to 95% of the modified proctor maximum density.

Excavation of CMC's (by Others)

- Each footing shall be excavated to within +0 in / -6 in of planned base footing elevation. This includes using a flat/smooth blade on the excavators that exposes the last six (6) inches of the footing excavation. No footing excavation shall commence until seven (7) days have elapsed from the time of installation of the CMC's under the footings. While excavating, efforts shall be made by the Footing Contractor not to break off any top of CMC's, nor disturb the soil matrix between the CMC's. The top of each CMC shall be exposed at the bottom of the footing to +0/-6" from the footing base elevation with hand excavation if necessary, so as to minimize the risk of damage to the CMC's and the disturbance of the soils between CMC's.
- Strip all organic or unsuitable material, debris and other detrimental material from the surface of the excavation.
- Maintain the post-installation CMC area so that the sub-grade is kept free of water. If the sub-grade is disturbed or loose material is removed, compact the sub-grade with LTP material prior to placement of footing using small vibration equipment (plate compactor or jumping jacks). Sub-grade shall not be disturbed or excavations left exposed for more than one day. Compacted LTP material shall be placed within 24 hours of excavation to protect the sub-grade. If over-excavation and replacement of loose soils exceeds three (3) inches, CMC contractor should be contacted and a remediation plan shall be discussed and agreed upon within seven (7) days.
- Ensure a clean surface between the top of the CMC and the bottom of approved LTP material.
- Footing concrete shall be placed immediately following approval of the complete footing excavation work. Every effort should be made to place concrete footing the same day that the excavation takes place. The Project Engineer shall verify and document the following:
    - The footing excavation has been kept free of water and has not been disturbed. Protection (fill or mud - as necessary) has been placed.
    - All the CMC's have been exposed and no CMC has been broken. Or if a CMC has been broken, proper remediation of the CMC has been carried out.

Load Transfer Platform (LTP)

Before starting construction of the LTP in any area, a period of seven (7) days must elapse from the time of installation of the CMCs in the area or until the grout has reached the design strength. This requirement is to allow for proper curing of the CMC grout and to avoid damages to the top of the CMC. If any CMC top is broken during the placement of the LTP, the CMC contractor shall immediately be notified and LTP placement shall be stopped in the area. The CMC contractor shall propose a remediation solution within 2 days of being notified. Placement of the LTP in the area shall resume only if all parties are in agreement with the remediation solution and the remediation has taken place.

Prior to placement of the LTP, a sample shall be submitted to the CMC Contractor's engineer for approval. Any change in source and type of material throughout the job requires approval from the CMC contractor's engineer.

The LTP material shall be placed in lifts not exceeding 9 (nine) inches at any time and shall be compacted to obtain at least a density of 95% of Modified Proctor Density as determined by ASTM D1557 (AASHTO T 180). The LTP material shall be MDOT DGA Class 21A. The first lift shall be 6 inches thick and any subsequent lift shall not exceed 9 inches. For the LTP, a minimum of one density test per 5,000 sf shall be performed by an independent agency paid by Others. A gradation sieve analysis shall be performed at the beginning of the job and for every change in source and/or type of material.

6. - GROUT MIX DESIGN

A straight sand-grout/no-coarse concrete mix is the most appropriate mix to use for this type of inclusion, and our preference is to use a sand-grout mix, to ensure pumpability. CMC grout shall consist of Portland cement grout having a minimum compressive strength of at least 3,000 psi at 28 days. The slump shall be 8 inches +/- 2 inches, with no air entrainment, and compatible to concrete pumping equipment. The grout will be produced in a ready-mix concrete plant and be delivered on site by ready-mix concrete trucks directly to the concrete pumps attached to the CMC rig.

A setting time of 24 hours - necessary to allow the CMCs to cure to a sufficient stiffness - shall be respected; during this period no work, passage or activity of any kind are allowed on the treated platform where the CMCs have been installed without prior approval by Menard. In particular, the timing of the backfilling for the construction of the LTP and any footings needs to be considered and specific criteria should be developed.
See attached for the proposed grout mix design for use on this project, Menard reserves the right to modify this mix as needed. As long as the 28-day compressive strength and the slump requirements are met, the grout mix is acceptable for use on this project.

Control Tests:

At least one set of test specimens shall be made (by Others) for compressive strength for each 100 cubic yard or portion thereof that grout mixture placed that day. A set of test specimens shall consist of 6 specimens (3" x 6" or 4" x 8" are acceptable) for testing 2 specimens at 7 days and 2 specimens at 28 days (2 samples in reserve for testing at 56 days if required). Test specimens shall be molded and cured in accordance with ASTM C 31 and tested in accordance with ASTM C 39. Results of all strength tests shall be reported to Menard. Slump tests shall be performed (by Others) at a rate of two times per working day.