A photograph of a stone arch culvert. The structure is built with large, rectangular stone blocks. A black corrugated metal pipe is visible through the archway. The culvert is situated on a grassy slope, and a small pond of water is in the foreground, reflecting the structure. The background shows more greenery and a road.

**Rehabilitation of Stone Arch Culverts  
Henry County US 24 and State Route 424**

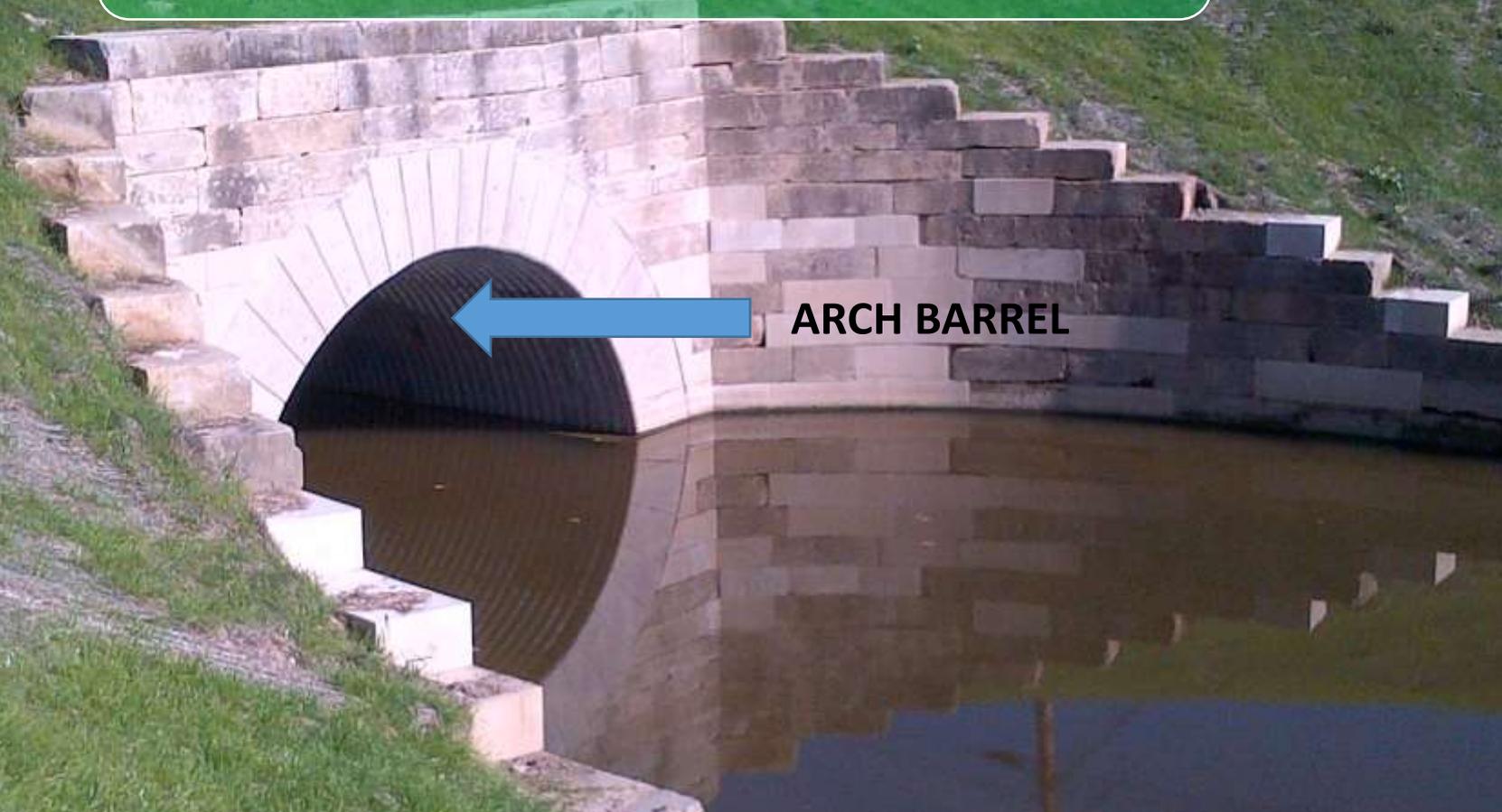
**Mike Benton, P.E. – ODOT District 2  
Matt Schroeder – Miller Bros. Construction**

**Rehabilitation of Stone Arch Culverts  
Henry County US 24 and State Route 424**

 **ARCH RING**

**Mike Benton, P.E. – ODOT District 2  
Matt Schroeder – Miller Bros. Construction**

# Rehabilitation of Stone Arch Culverts Henry County US 24 and State Route 424



ARCH BARREL

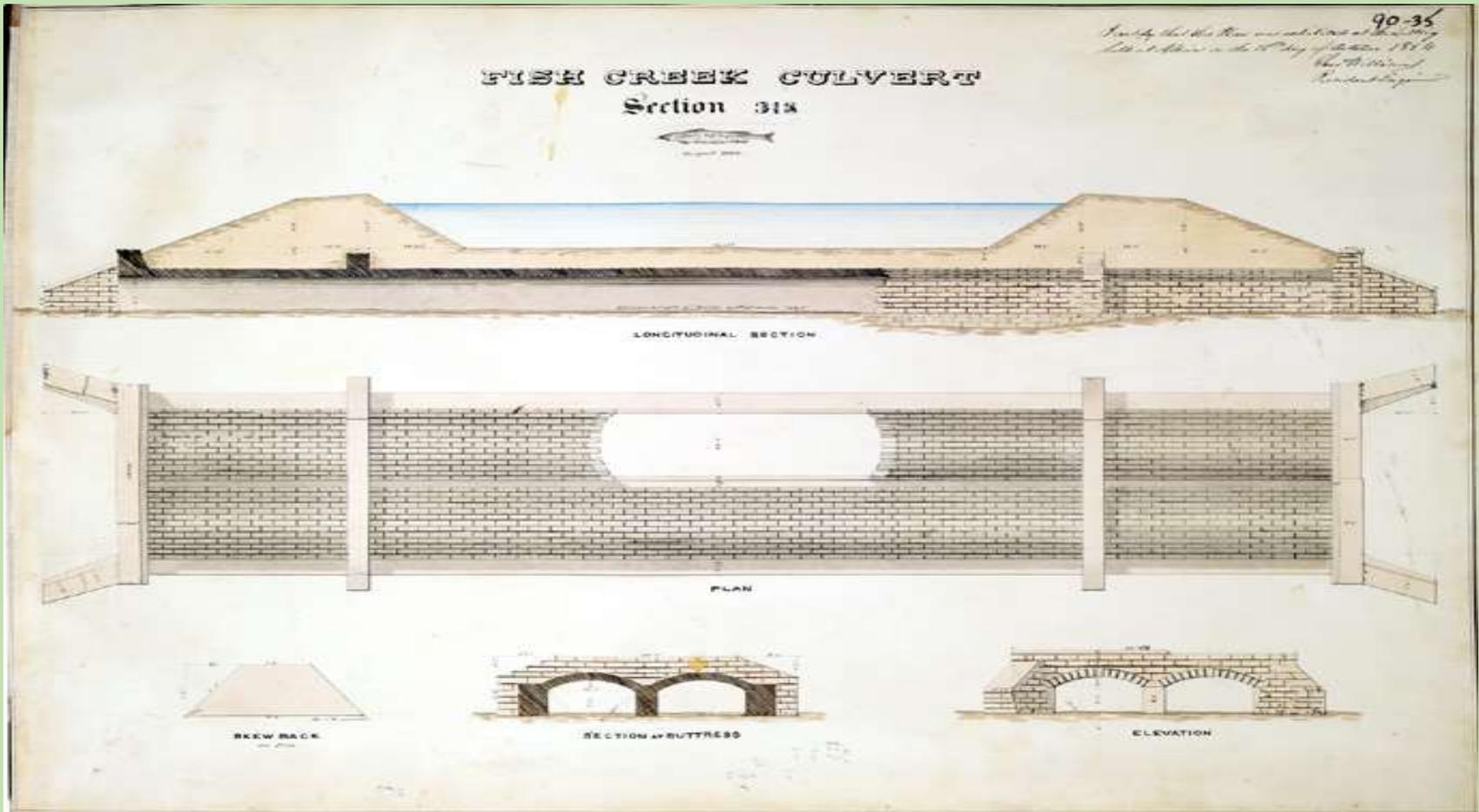
Mike Benton, P.E. – ODOT District 2  
Matt Schroeder – Miller Bros. Construction

# ODOT PID 88197 Scope

- Rehabilitate 8 stone arch culverts as part of former US 24 Abandonment
- Meet ODNR and State Historical Preservation Office (SHPO) expectations
- Meet Henry County Engineer's expectations
- Meet Napoleon's expectations

# History

- Stone Arches originally constructed in mid-1800's
- Served as aqueducts under Miami and Erie Canal



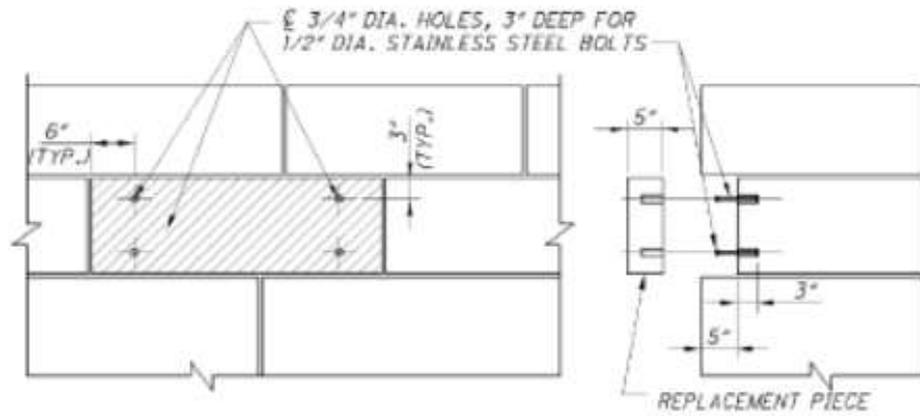
# CHALLENGES

- Several differing site conditions, most notably existing foundation
- Amount of replacement block needed grossly underestimated
- Arch Ring repairs thicker than estimated
- In-Stream work restrictions: Jan.1 – Jun.30
- High water events
- One site required road closure within Napoleon;  
Route to Hospital

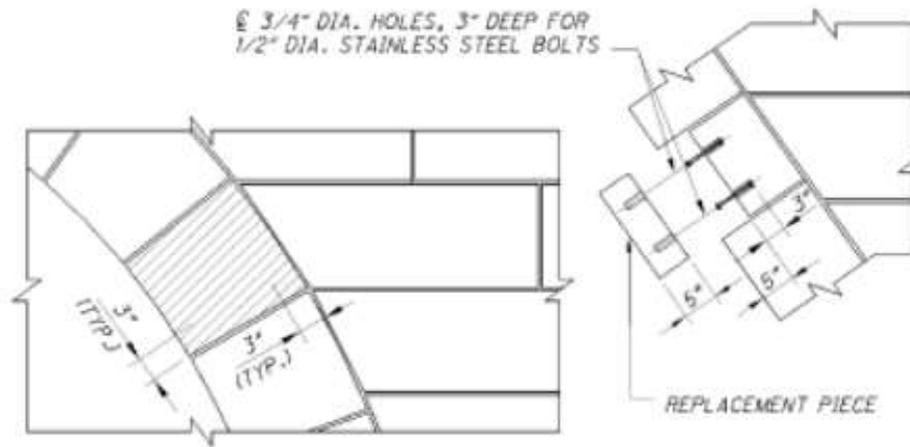


# Site Specific Scopes: S1, S2, S6, S8

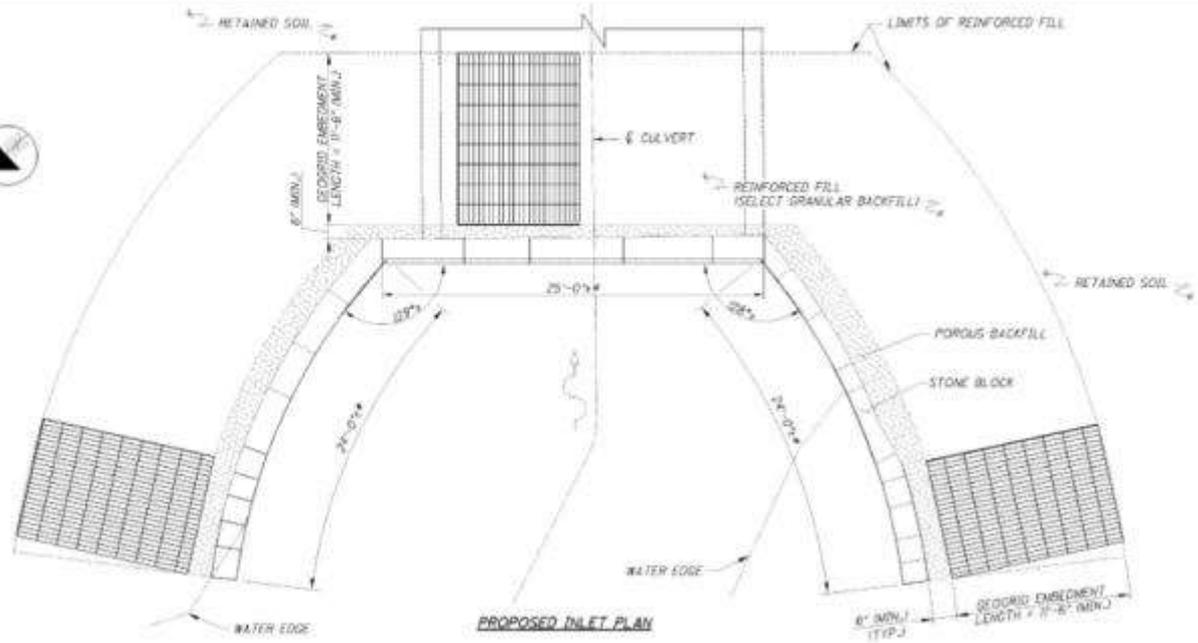
- Excavate down and remove inlet wingwalls/headwall block
- Arch ring repair
- Replace limestone block as necessary and reconstruct
- Install wire wall MSE system for backfill behind wingwalls/headwalls



REPAIR OF ERODED STONE FACING

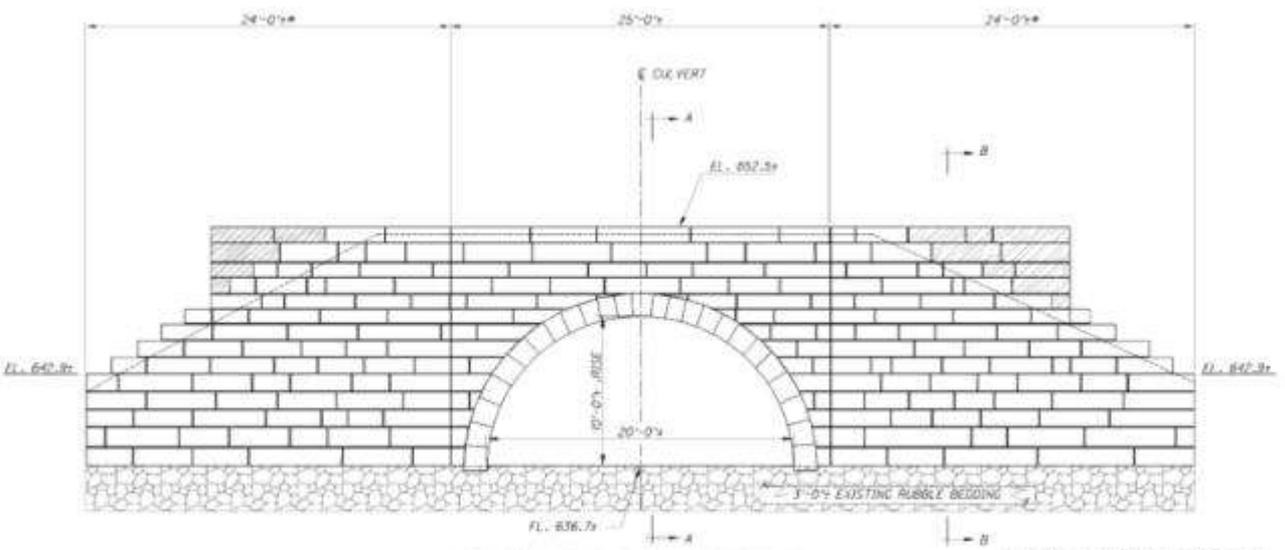


REPAIR OF ARCH RING



**NOTES:**

1. WINGWALL STONE BLOCK PATTERN BELOW THE EXISTING GROUND SHALL BE FIELD VERIFIED BY THE CONTRACTOR.
2. THE RECONSTRUCTED STONE WINGWALLS SHALL MATCH CLOSELY THE EXISTING STONE BLOCK PATTERN.
3. FOR SECTIONS 4-4 & B-B, SEE SHEET 02/10.



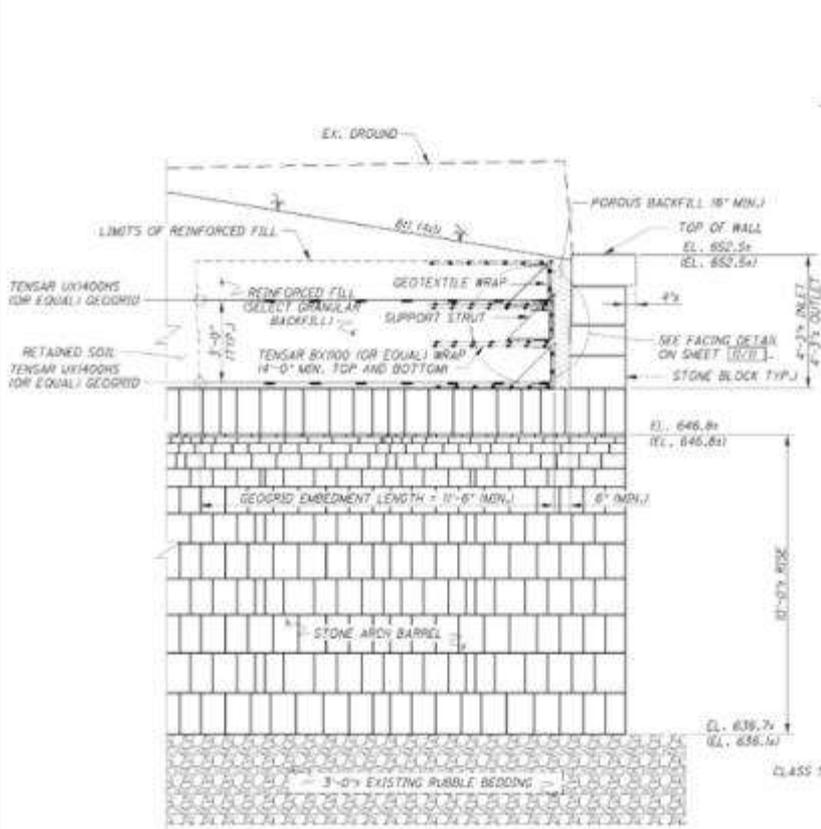
**PROPOSED INLET ELEVATION (DEVELOPED VIEW)**

\* - MEASURED ALONG FRONT FACE OF WALL

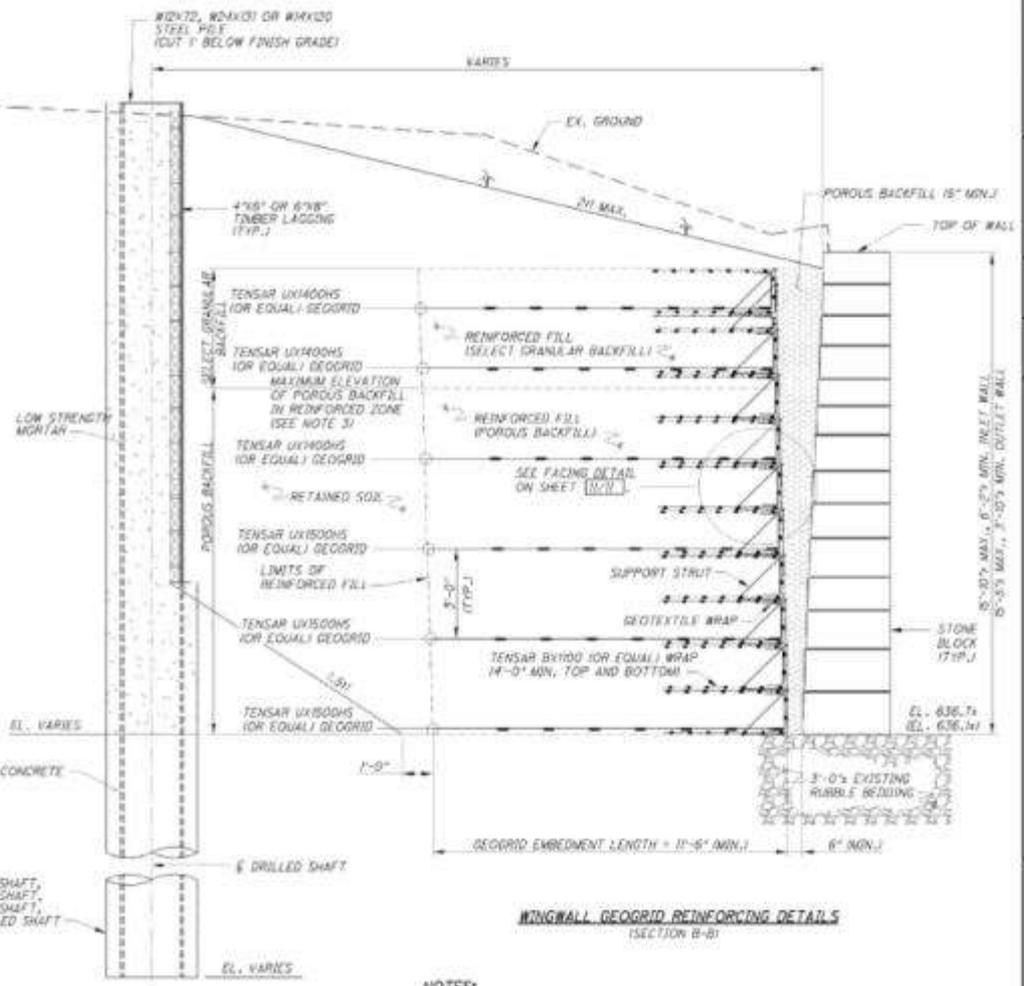
**LEGEND:**

- GEGRID
- EXISTING RUBBLE BEDDING
- POROUS BACKFILL
- OPTIONAL
- GLASS C CONCRETE

PROJECT NO. 24/19  
 COUNTY OF CALHOUN  
 BRIDGE NO. 424  
 S. R. 424 OVER OBSERVAUS CREEK  
 DATE: DEC 2019  
 DRAWN BY: J. J. JAMES  
 CHECKED BY: J. J. JAMES  
 SCALE: AS SHOWN  
 SHEET NO. 37 OF 39



**HEADWALL GEORGRID REINFORCING DETAILS**  
SECTION A-A



**WINGWALL GEORGRID REINFORCING DETAILS**  
SECTION B-B

- LEGEND:**
- EXISTING RUBBLE BEDDING
  - POROUS BACKFILL
  - LOW STRENGTH MORTAR

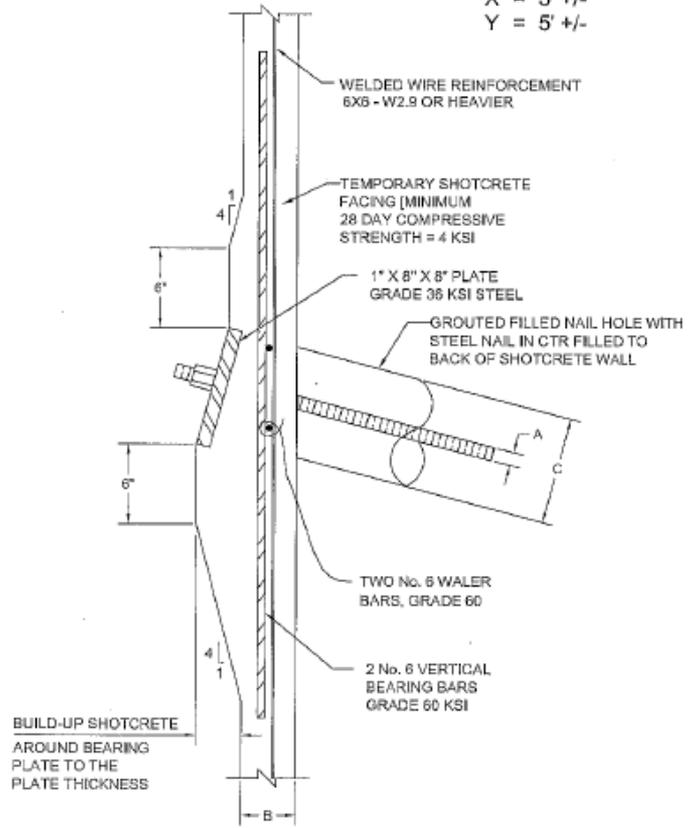
- 74" DIA. DRILLED SHAFT,  
30" DIA. DRILLED SHAFT,  
38" DIA. DRILLED SHAFT,  
OR 40" DIA. DRILLED SHAFT

GEORGRID SHOWN SCHEMATIC

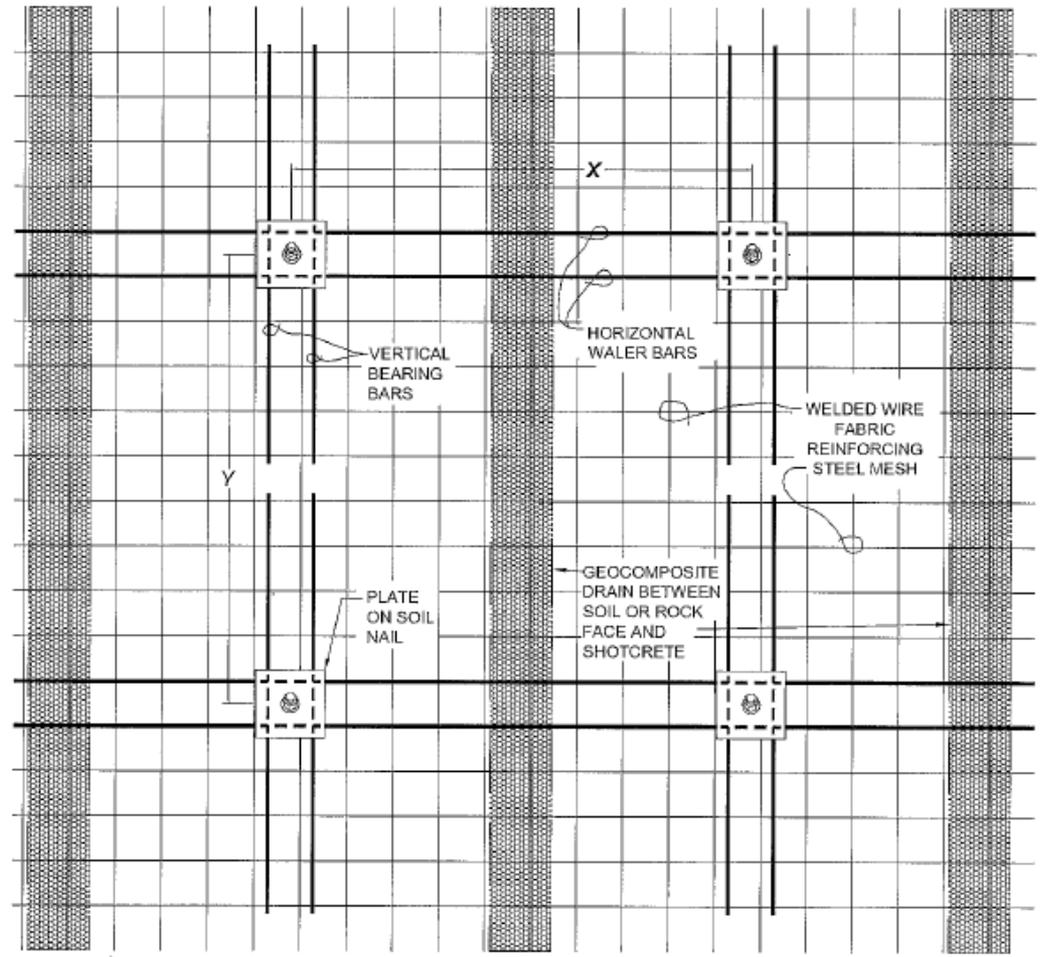
- NOTES:**
1. ELEVATIONS AND DIMENSIONS SHOWN IN ( ) ARE FOR OUTLET.
  2. FOR LOCATION OF SECTIONS A-A & B-B, SEE SHEETS (A/R) & (T/O).
  3. INSTALL POROUS BACKFILL IN REINFORCED ZONE BELOW TOP OF ARCH RING.
  4. THE COST ASSOCIATED WITH GEORGRID REINFORCING INCLUDING ALL LABOR, EQUIPMENT, MATERIAL AND INCIDENTALS NECESSARY TO INSTALL GEORGRID REINFORCING FILL ARE INCLUDED WITH ITEM B40 - MECHANICALLY STABILIZED EARTH WALL FOR PAYMENT.

**DIMENSIONS**

- A = 1.0"
- B = 4" +/-
- C = 6" +
  
- X = 5' +/-
- Y = 5' +/-



**TEMPORARY WALL BEARING PLATE CONNECTION DETAILS PROFILE**  
N.T.S.



**SOIL NAIL WALL TYPICAL ELEVATION VIEW**  
N.T.S.



DESIGNED BY:  
**ES** Geiter Engineering, Inc.  
 Civil, Geotechnical and Structural  
 1412 Elmwood/Highland Ave.  
 Marietta, Ohio 45750  
 (724) 742-4429  
 EIT Reg. No. 19130



8/13/2013 9:56

# S1 Benien Creek Before



# S1 Benien Creek After



# S2 Co. Ditch 970 Before



# S2 Co. Ditch 970 After



# S6 Dry Creek Before



3/14/2013 13:48

# S6 Dry Creek After



# S8 Belly Creek Before



3/20/2013 10:43

# S8 Belly Creek After



# Site Specific Scopes: S3

- Replace Inlet Reinforced Concrete Headwalls/Wingwalls

## Actual Work: S3

- Replace Inlet Reinforced Concrete Headwalls/Wingwalls
- Re-line Outer 20' of Barrel with Corrugated Metal Arch

# S3 Garret Creek Before



# S3 Garret Creek Re-Line



# S3 Garret Creek After



# Site Specific Scopes: S7

- Repair Eroded Stone Facing
- Reset Misaligned Blocks

## Actual Work: S7

- Excavate down and remove inlet/outlet wingwalls/headwall block
- Arch ring repair
- Replace block as necessary and reconstruct

# S7 Bad Creek Inlet Before



3/20/2013 10:22

# S7 Bad Creek Inlet After



# S7 Bad Creek Outlet Before



3/20/2013 10:31

# S7 Bad Creek Outlet After



# Site Specific Scope: S4 Oberhaus Creek

- Dewater work area.
- Disassemble existing stone block headwalls, wingwalls and arch. Catalogue and reference good blocks and replace damaged or missing blocks then reassemble.
- Existing waterline relocation.
- Existing sanitary sewer relocation.
- Incidental storm sewer work.
- Replace road and pavement.

# Masonry Subcontractor

- Harry S. Peterson
- Requirements: Minimum 5 Years Experience in Masonry Construction for Historic Preservation
- Shall Employ Skilled Masons and Helpers
- Utilized Limestone and Concrete Block

## *'Houston..... we have a problem'*

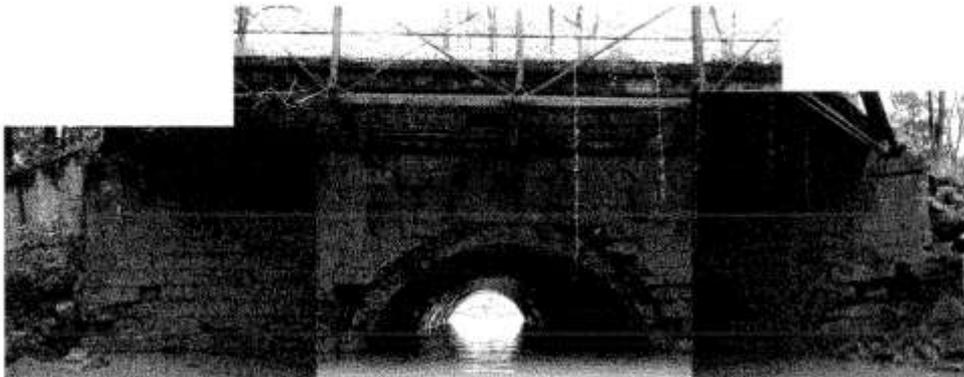
Plans indicated the blocks were sitting on 2' of stone base. Once the work area was dewatered it was discovered that the entire structure (headwalls, wingwalls and arch) are sitting on large wooded timbers. At that point ODOT was notified of change of existing conditions and work was suspended until an alternate plan was developed. The existing timbers were tested and the results indicated that they were in good condition.

# Actual Work: S4 Oberhaus Creek

- Install 18'x7'8" CMP arch liner inside existing arch.
  - Liner sat on CIP footings placed on top of existing timbers.
  - Footings were doveled into existing blocks.
  - Liner was assembled outside the arch and pulled into place with steel cable block & tackle and dozer.
  - Void between the existing arch and liner was filled with LSM. Special procedure so as not to damage the liner
- Pour a new CIP arch ring to match the previous.
- Install wire MSE walls.
- Remove and reassemble headwalls & wingwalls.



# Original Plan Sheet



EXISTING INLET ELEVATION (DEVELOPED VIEW)



EXISTING OUTLET ELEVATION (DEVELOPED VIEW)

## SEQUENCE OF CONSTRUCTION:

- (1) Dewatering - BEFORE THE RECONSTRUCTION WORK COMMENCES, THE TWO ENDS OF THE STONE ARCH CULVERTS ARE TO BE "DAMMED". THE NORMAL CHANNEL FLOW SHALL BE "ROUTED" THROUGH A CONDUIT BY PUMPING.
- (2) UNCLASSIFIED EXCAVATION, AS PER PLAN - THE DISMANTLING OF THE EXISTING STONE BLOCKS OF THE INLET HEADWALL AND WINGWALLS SHALL BE PERFORMED CONCURRENTLY WITH THE REQUIRED EXCAVATION OF THE EXISTING ROADWAY AND EMBANKMENT INCLUDING TREE REMOVAL. HEAVY EQUIPMENT THAT HAS THE POTENTIAL TO CAUSE DAMAGE TO THE EXISTING STONE ARCH BARREL SHALL NOT BE PERMITTED TO LOCATE DIRECTLY OVER THE CULVERT. THE EXCAVATED MATERIAL, WHICH HAS HIGH ORGANIC CONTENT, SHALL BE DISPOSED OFF SITE.
- (3) DISMANTLING THE EXISTING STONE ARCH STRUCTURE - ALL EXISTING HEADWALL AND WINGWALL STONE BLOCKS, AND THOSE OF THE EXISTING ARCH BARREL, ARE TO BE CAREFULLY DISMANTLED DOWN TO THE "SUBSLE BEDDING" AND STORED INSIDE THE DESIGNATED CONTRACTOR STAGING AREA. DETERIORATED OR DAMAGED STONE BLOCKS SHALL BE REPLACED WITH NEW LIMESTONE BLOCKS MEETING SPECIFICATION FOR MATERIALS SET FORTH IN THE GENERAL STRUCTURE NOTES ON SHEET [2/2].
- (4) RECONSTRUCTION OF THE EXISTING ARCH BARREL - THE RECONSTRUCTED ARCH BARREL SHALL BE COMPOSED OF THE EXISTING NATURAL STONE BLOCKS PER THE PLAN AND ELEVATION VIEWS SHOWN ON THE PLANS. NO MORTAR IS ALLOWED. IT SHALL ALSO HAVE THE SAME SPAN (20 FEET) AND RISE (10 FEET), AS WELL AS THE SAME ARCH RING DESIGN PATTERN AT THE TWO ENDS, AS THE EXISTING. REPLACE ALL DAMAGED OR DETERIORATED NATURAL STONE BLOCKS WITH NEW CONCRETE STONE BLOCKS SUPPLIED BY AN ODOT-APPROVED SUPPLIER. THE LONGITUDINAL LENGTH OF THE RECONSTRUCTED STONE ARCH CULVERT ON EITHER SIDE OF THE RIGHT OF WAY CENTERLINE SHALL BE AS INDICATED ON THE PLANS. SHOP DRAWINGS FOR THE BRACINGS USED TO RECONSTRUCT THE ARCH BARREL SHALL BE PREPARED BY AN ODOT REGISTERED PROFESSIONAL ENGINEER, AND SUBMITTED TO THE DISTRICT FOR APPROVAL AT LEAST 14 DAYS PRIOR TO THE ARCH BARREL RECONSTRUCTION.
- (5) RECONSTRUCTION OF THE EXISTING HEADWALLS AND WINGWALLS - THE RECONSTRUCTED HEADWALLS AND WINGWALLS AT BOTH INLET AND OUTLET ENDS SHALL BE COMPOSED OF THE EXISTING NATURAL STONE BLOCKS PER THE PLAN AND ELEVATION VIEWS SHOWN ON THE PLANS. NO MORTAR IS ALLOWED. REPLACE ALL DAMAGED OR DETERIORATED NATURAL STONE BLOCKS WITH NEW CONCRETE STONE BLOCKS SUPPLIED BY AN ODOT-APPROVED SUPPLIER.
- (6) BACKFILLING - THE BACKFILL MATERIAL SHALL BE PER CMS ITEM 203. THE MAXIMUM LIFT FOR EACH BACKFILL SHALL NOT BE MORE THAN 12". THE BACKFILL OVER THE STONE ARCH BARREL SHALL BE COMPACTED WITH HAND-OPERATED COMPACTOR.
- (7) EXCAVATION BRACING - SEE ITEM 803, COFFERDAMS AND EXCAVATION BRACING, AS PER PLAN NOTE ON SHEET [2/2].
- (8) EXISTING STORM PIPES - THE THREE STORM PIPES THAT ARE CURRENTLY DRAINING OVER THE WINGWALLS AT THE OUTLET (SEE PHOTO ON LEFT AND RIGHT) SHALL BE ROUTED TO DRAINAGE AT THE ENDS OF THE RECONSTRUCTED WINGWALLS.

## NOTE:

SEE GENERAL STRUCTURE NOTES FOR ADDITIONAL REQUIREMENTS.

ODOT PROJECT NO. 18-0000 COLUMBIAN ENGINEERING CONSULTANTS, INC. 400 WEST 10TH AVENUE, SUITE 100 DENVER, CO 80202-3100	SHEET NO. 01/2 OF 02 DATE: 08/14/2018 DRAWN BY: JLM CHECKED BY: JLM PROJECT NO. 18-0000
EXISTING INLET & OUTLET VIEWS BRIDGE NO. 18H-024-R07A S.P. 024 OVER OBERLIUS CREEK	DIVISION: 1811 SECTION: 01 DRAWING: 01/2
18H-024/R07A STONE ARCHES PFD NO. 1811Y	5 / 11 16 029

# Revised Plan Sheet



EXISTING INLET ELEVATION (DEVELOPED VIEW)



EXISTING OUTLET ELEVATION (DEVELOPED VIEW)



- (3) DISMANTLING THE EXISTING STONE ARCH HEADWALLS AND WINGWALLS - ALL EXISTING HEADWALL AND WINGWALL STONE BLOCKS ARE TO BE CAREFULLY DISMANTLED DOWN TO THE TIMBER MATTING AND STORED INSIDE THE DESIGNATED CONTRACTOR STAGING AREA. DETERIORATED OR DAMAGED STONE BLOCKS SHALL BE REPLACED WITH NEW LIMESTONE BLOCKS MEETING SPECIFICATION FOR MATERIALS SET FORTH IN THE GENERAL STRUCTURES NOTES ON SHEET 2/11.
- (4) CONSTRUCTION OF THE MULTI-PLATE ARCH - CONSTRUCTION OF THE MULTI-PLATE ARCH SHALL INCLUDE CONSTRUCTION OF CONCRETE FOOTINGS BEARING ON THE TIMBER MATS AS SHOWN ON PLAN SHEET 5A/11, ERECTION OF THE STEEL, MULTI- PLATE ARCH, INSTALLATION OF WEEPHOLES, AND GROUTING OF THE REMAINING GAP BETWEEN THE PROPOSED MULTI-PLATE ARCH AND THE EXISTING STONE ARCH.

## SEQUENCE OF CONSTRUCTION:

- (1) DEWATERING - BEFORE THE RECONSTRUCTION WORK COMMENCES, THE TWO ENDS OF THE STONE ARCH CULVERTS ARE TO BE "DAMMED". THE NORMAL CHANNEL FLOW SHALL BE ROUTED THROUGH A CONDUIT BY PUMPING.
- (2) UNCLASSIFIED EXCAVATION, AS PER PLAN - THE DISMANTLING OF THE EXISTING STONE BLOCKS OF THE INLET HEADWALL AND WINGWALLS SHALL BE PERFORMED CONCURRENTLY WITH THE REQUIRED EXCAVATION OF THE EXISTING ROADWAY AND EMBANKMENT INCLUDING TREE REMOVAL. HEAVY EQUIPMENT THAT HAS THE POTENTIAL TO CAUSE DAMAGE TO THE EXISTING STONE ARCH BARREL SHALL NOT BE PERMITTED TO LOCATE DIRECTLY OVER THE CULVERT. THE EXCAVATED MATERIAL, WHICH HAS HIGH ORGANIC CONTENT, SHALL BE DISPOSED OF OFF SITE.



(3) DISMANTLING THE EXISTING STONE ARCH STRUCTURE - ALL EXISTING HEADWALL AND WINGWALL STONE BLOCKS, AND THOSE OF THE EXISTING ARCH BARREL, ARE TO BE CAREFULLY DISMANTLED DOWN TO THE MIDDLE BEDDING AND STORED INSIDE THE DESIGNATED CONTRACTOR STAGING AREA. DETERIORATED OR DAMAGED STONE BLOCKS SHALL BE REPLACED WITH NEW LIMESTONE BLOCKS MEETING SPECIFICATION FOR MATERIALS SET FORTH IN THE GENERAL STRUCTURE NOTES ON SHEET 2/11.

(4) RECONSTRUCTION OF THE EXISTING ARCH BARREL - THE RECONSTRUCTED ARCH BARREL SHALL BE COMPOSED OF THE EXISTING NATURAL STONE BLOCKS PER THE PLAN AND ELEVATION VIEWS SHOWN ON THE PLANS. NO MORTAR IS ALLOWED. IT SHALL ALSO HAVE THE SAME SPAN (20 FEET) AND RISE (8 FEET), AS WELL AS THE SAME ARCH RING DESIGN PATTERN AT THE TWO ENDS, AS THE EXISTING. REPLACE ALL DAMAGED OR DETERIORATED NATURAL STONE BLOCKS WITH NEW CONCRETE STONE BLOCKS SUPPLIED BY AN ODOT-APPROVED SUPPLIER. THE LONGITUDINAL LENGTH OF THE RECONSTRUCTED STONE ARCH CULVERT ON EITHER SIDE OF THE RIGHT OF WAY CENTERLINE SHALL BE AS INDICATED ON THE PLANS. SHOP DRAWINGS FOR THE BRACINGS USED TO RECONSTRUCT THE ARCH BARREL SHALL BE PREPARED BY AN OHIO REGISTERED PROFESSIONAL ENGINEER, AND SUBMITTED TO THE DISTRICT FOR APPROVAL AT LEAST 14 DAYS PRIOR TO THE ARCH BARREL RECONSTRUCTION.

(5) RECONSTRUCTION OF THE EXISTING HEADWALLS AND WINGWALLS - THE RECONSTRUCTED HEADWALLS AND WINGWALLS AT BOTH INLET AND OUTLET ENDS SHALL BE COMPOSED OF THE EXISTING NATURAL STONE BLOCKS PER THE PLAN AND ELEVATION VIEWS SHOWN ON THE PLANS. NO MORTAR IS ALLOWED. REPLACE ALL DAMAGED OR DETERIORATED NATURAL STONE BLOCKS WITH NEW CONCRETE STONE BLOCKS SUPPLIED BY AN ODOT-APPROVED SUPPLIER.

(6) BACKFILLING - THE BACKFILL MATERIAL SHALL BE PER CMS ITEM 203. THE MAXIMUM LIFT FOR EACH BACKFILL SHALL NOT BE MORE THAN 12". THE BACKFILL OVER THE STONE ARCH BARREL SHALL BE COMPACTED WITH HAND-OPERATED COMPACTOR.

(7) EXCAVATION BRACING - SEE ITEM 503, COFFERDAMS AND EXCAVATION BRACING, AS PER PLAN NOTE ON SHEET 2/21.

(8) EXISTING STORM PIPES - THE THREE STORM PIPES THAT ARE CURRENTLY DRAINING OVER THE WINGWALLS AT THE OUTLET (SEE PHOTO ON LEFT AND RIGHT) SHALL BE ROUTED TO DRAINAGE AT THE ENDS OF THE RECONSTRUCTED WINGWALLS.

## NOTE:

SEE GENERAL STRUCTURE NOTES FOR ADDITIONAL REQUIREMENTS.

DATE	BY	REVISION
01/12	01/12	1
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01/12	01/12	100

EXISTING INLET & OUTLET VIEWS  
 BRIDGE NO. HEN-24-424-1078  
 S.R. 424 OVER CREEK

HEN-24/424 STONE ARCHES  
 P.D. NO. 68197





**S4 Outlet before**

# S4 Cofferdam set & site dewatered



# S4 Timbers



# S4 Timbers





**S4 Excavation**

# S4 CMP Liner installation



**S4 Complete**



# Actual Work: S5 Turkeyfoot Creek

- Original Work Non-Performed; Re-added to contract due to success of S4 work
- Install 32'8" x 13'3" CMP arch liner inside existing arch.
  - Liner sat on CIP footings placed on top of existing timbers.
  - Footings were doveled into existing blocks.
  - Liner was assembled outside the arch and pulled into place with steel cable block & tackle and dozer.
  - Void between the existing arch and liner was filled with LSM. Special procedure so as not to damage the liner
- Pour a new CIP arch ring to match the previous.
- Install wire MSE walls.
- Remove and reassemble headwalls & wingwalls.

# S5 Before



3/14/2013 13:23



**S5 CMP Liner installation**

# S5 Cast-in-place Arch Ring



**S5 Complete**



# Turkeyfoot Creek at its worst



- Work Start: 3/26/2013; Original Completion: 1/1/2014; Actual Work Complete: 5/28/2015
- Bid Cost = \$5,247,539.88
- Current Cost = \$8,947,402.25
- Exceptional partnering and cooperation between ODOT, Contractors, Henry County, City of Napoleon
- Questions????

Mike Benton, ODOT:

**Michael.Benton@dot.ohio.gov**

Matt Schroeder, Miller Bros. Construction:

**Mattschroeder@mbcholdings.com**