NORTHERN CONCRETE PIPE

SUBMITTAL

Revision 2

Dan's Excavating

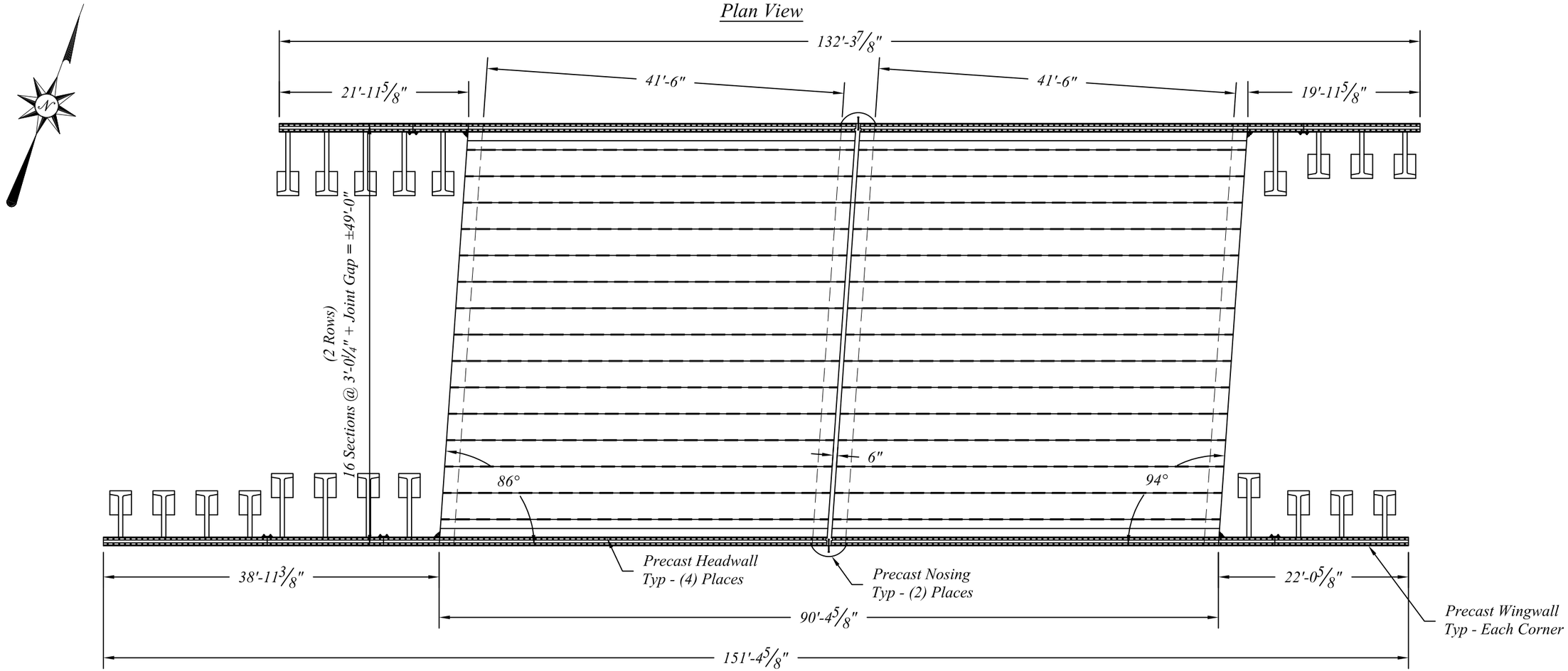
Antietam Avenue over Dequindre Cut Greenway
BRO 82022 / 83945 A

42' x 13' Precast Concrete Hy-Span Bridge

10 Sep 07

MDOT

Plan View



Notes:

Hy-Span Sections To Be Manufactured To Applicable ASTM C-1504 and AASHTO 2002 LFD Standard Specifications for Highway Bridges w/ HS-20 Loading And 1.0 to 2.0' Of Earth Cover. Live Load Plus Impact Deflection Does Not Exceed 1/1000 of Span Length.

Steel Reinforcing To Have A Yield Strength Of 60 ksi (min). Concrete Compressive Strength To Be 5000 psi (min) w/ 6.5% Entrained Air ±1.5%.

Joints To Be Sealed w/ 1½" EZ-Stik, Wrapped w/11" Wide Cadilloc Wrap And Covered w/ 24" Wide Filter Fabric.

Maximum Recommended Anchor Load For Burke #79172 Spread Anchor Is 17 Tons Each.

Cables Required For Unloading And Installation To Be Provided By Contractor.

Each Section Will Weigh Approximately 52,200 Lbs.
Heaviest Lift Will Be Approximately 26.5 Tons.

Installation: Contractor To Set First Section In The Center Of Footing Keyway. Following Sections To Be Placed Against Previous Sections As Tightly As Possible While Maintaining Alignment In The Footing Keyway For All Sections. Contractor To Grout Full Length Each Side Of Footing Keyway After Installation Of All Sections. The Grout Must Be Cured Prior To Backfill Being Placed.

MDOT
S02 of 82-22-97 / 83945 A

NORTHERN CONCRETE PIPE

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Bay City, MI 48706
1 800 222 9918

5281 Lansing Road
Charlotte, MI 48813
1 800 874 9701

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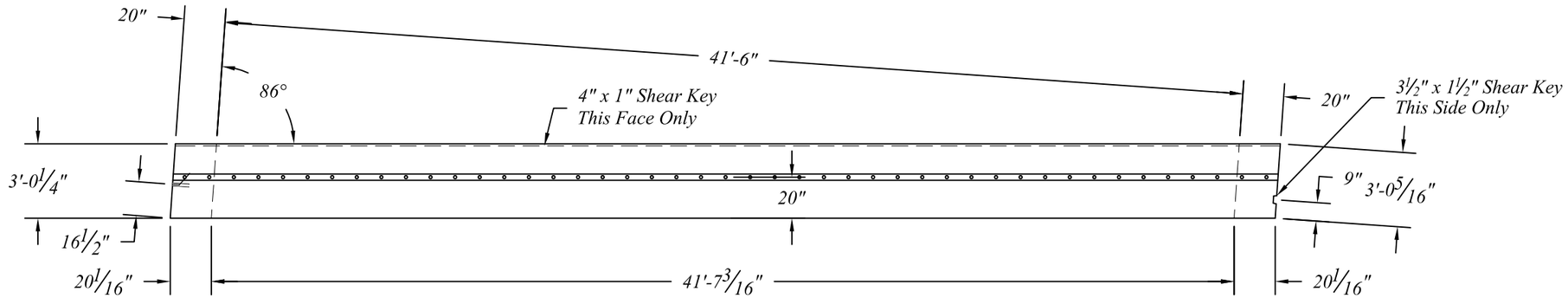
Dan's Excavating
Shelby Twp, MI

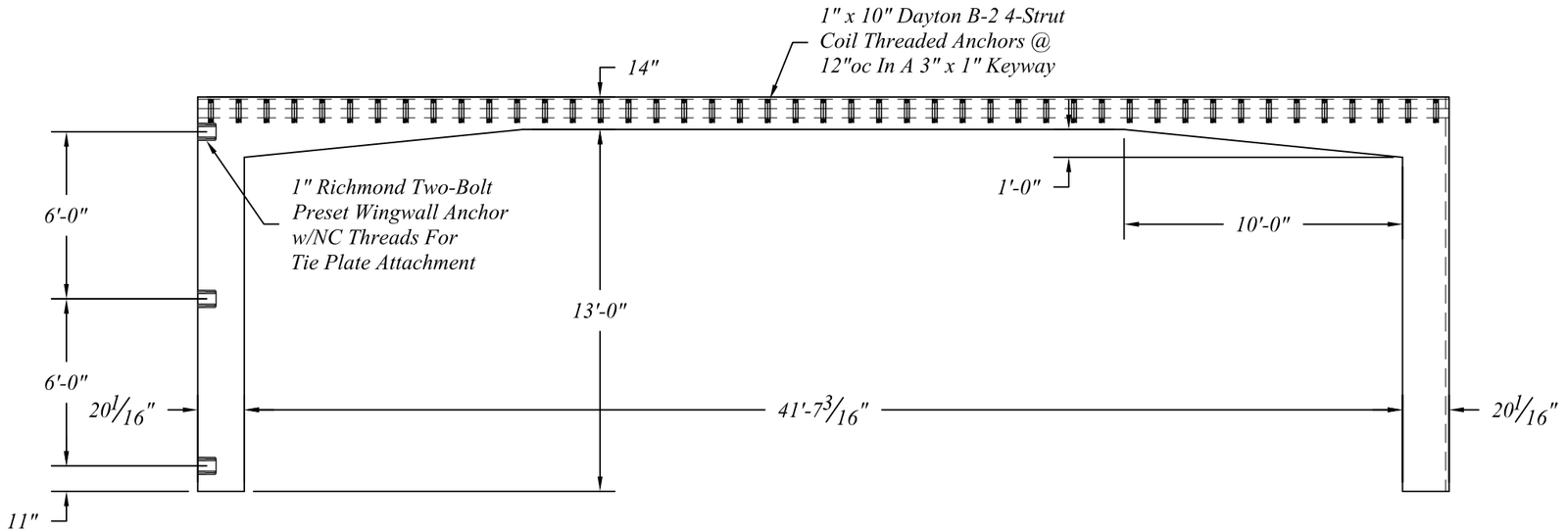
Antietam Avenue over Dequindre Cut Greenway

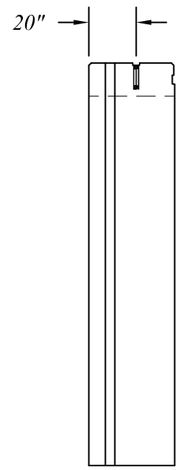
Date	Revised	Rev. No.	Drawn By	Scale	
31 Jul 07	10 Sep 07	1	BmG	1 : 150	2 of 10

Northeast & Southwest End Sections

(2 Sections Required)







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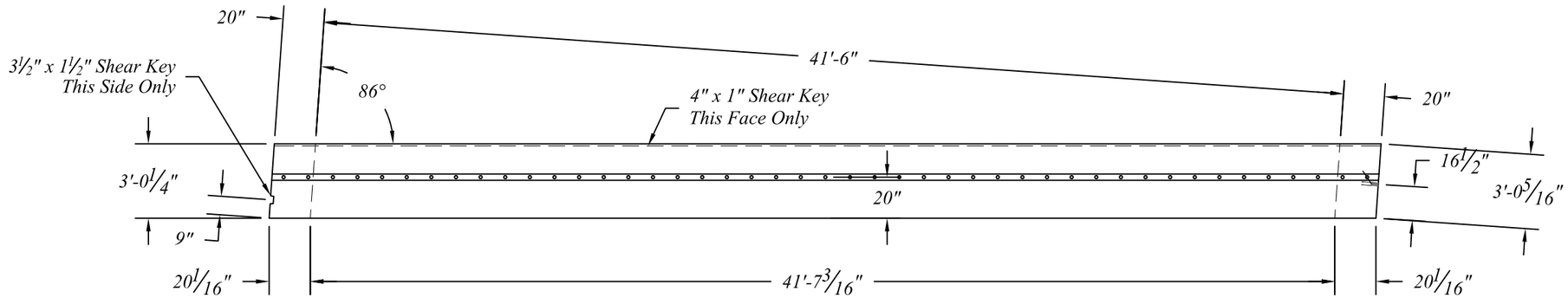
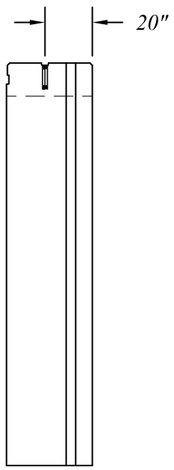
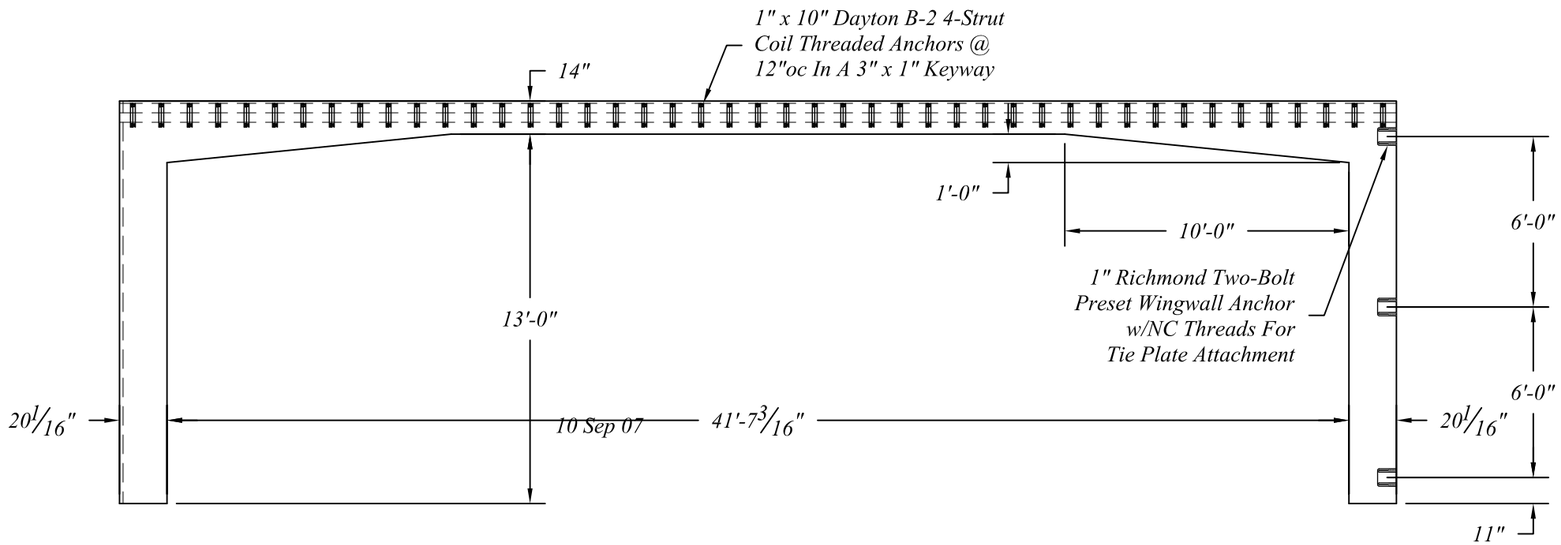
Northwest & Southeast End Sections

(2 Sections Required)







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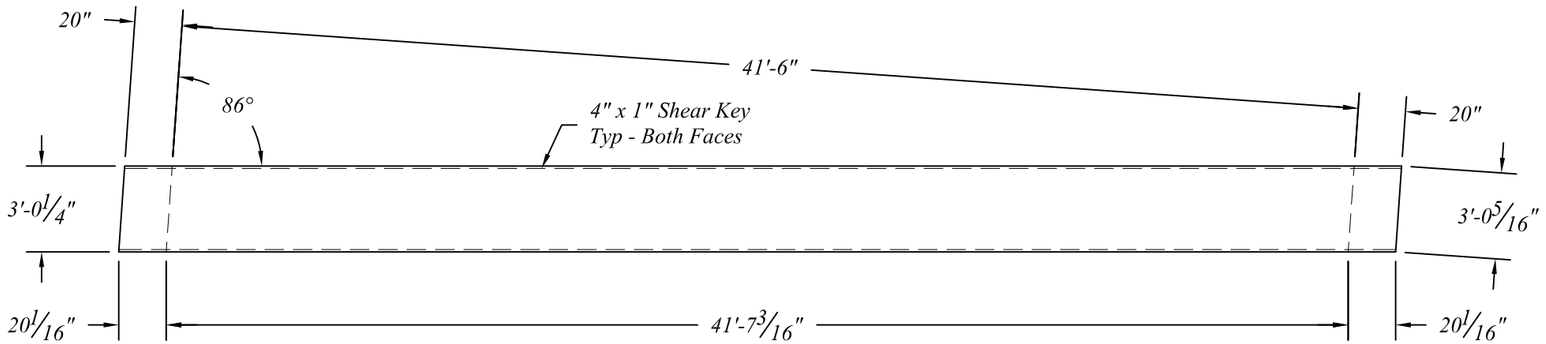
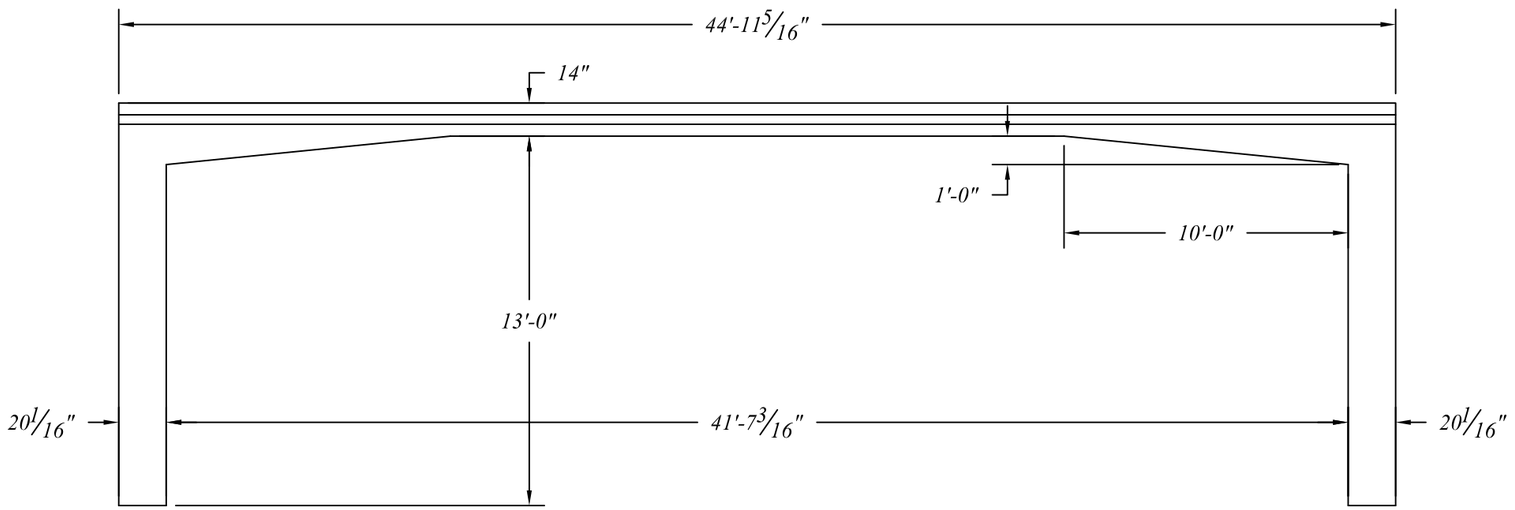
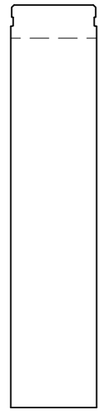
Standard Sections

(28 Sections Required)







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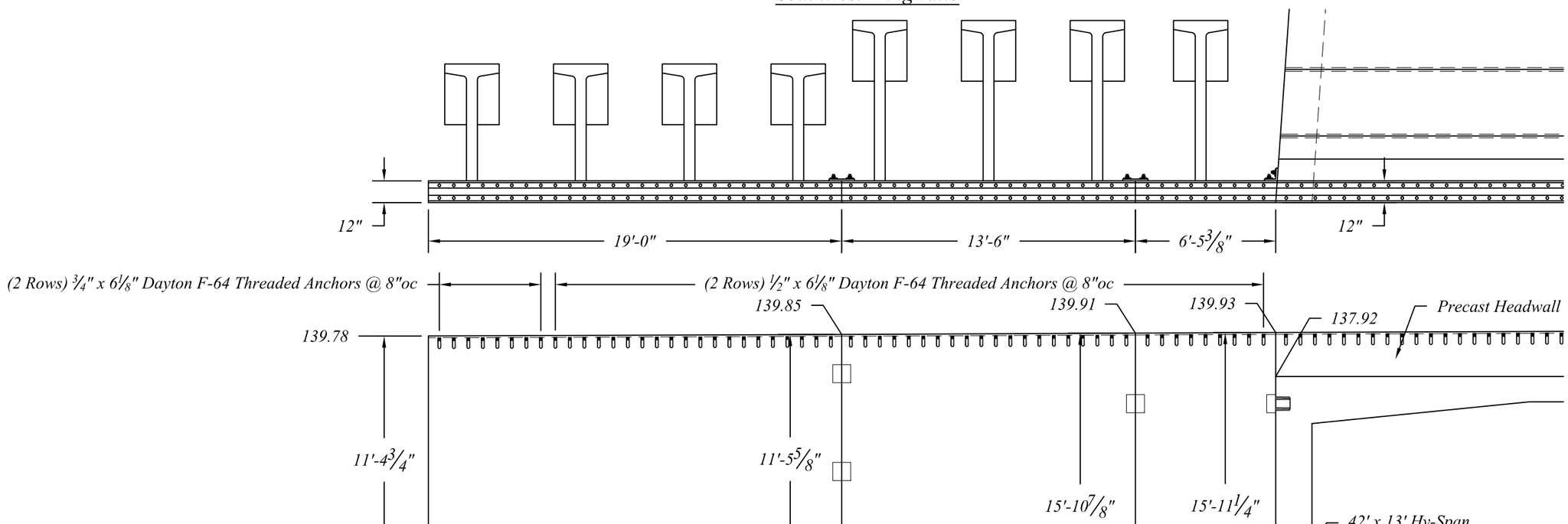
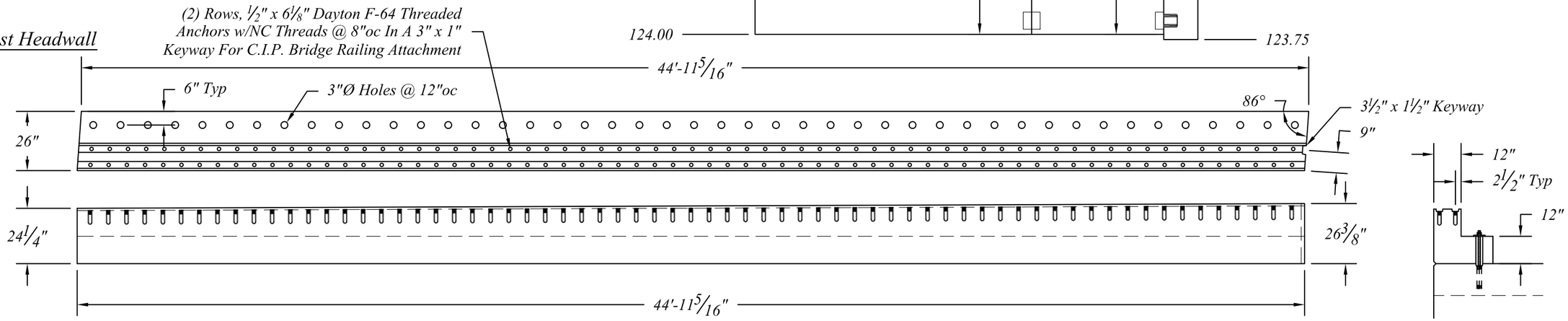
Southwest Wingwalls



Southwest Headwall



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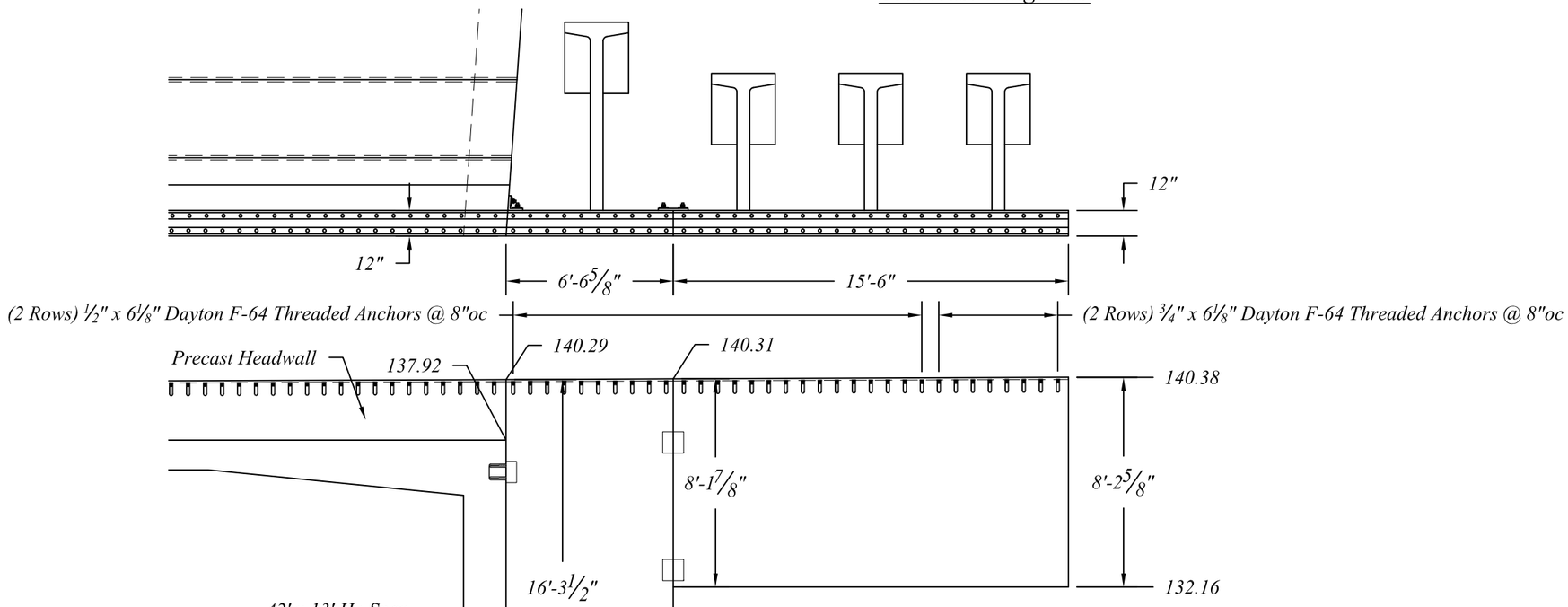
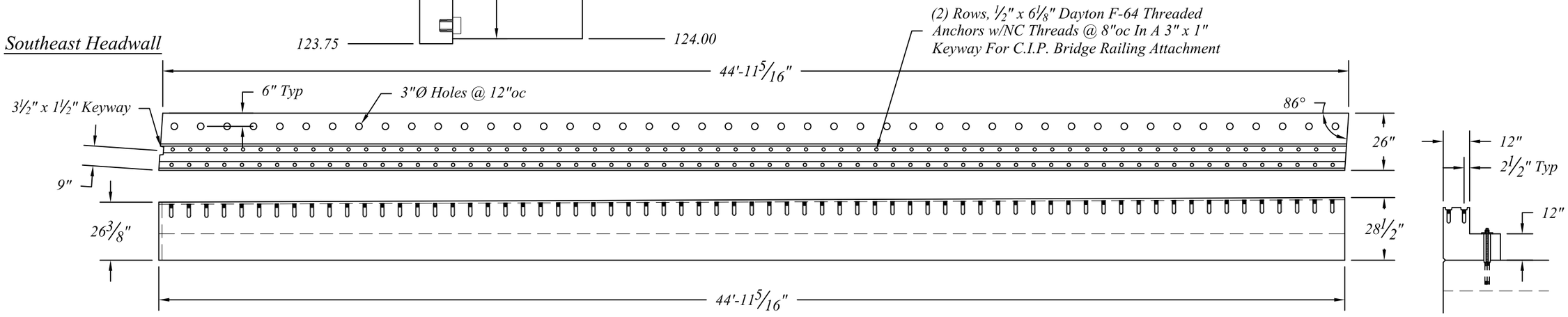
Southeast Wingwalls



Southeast Headwall



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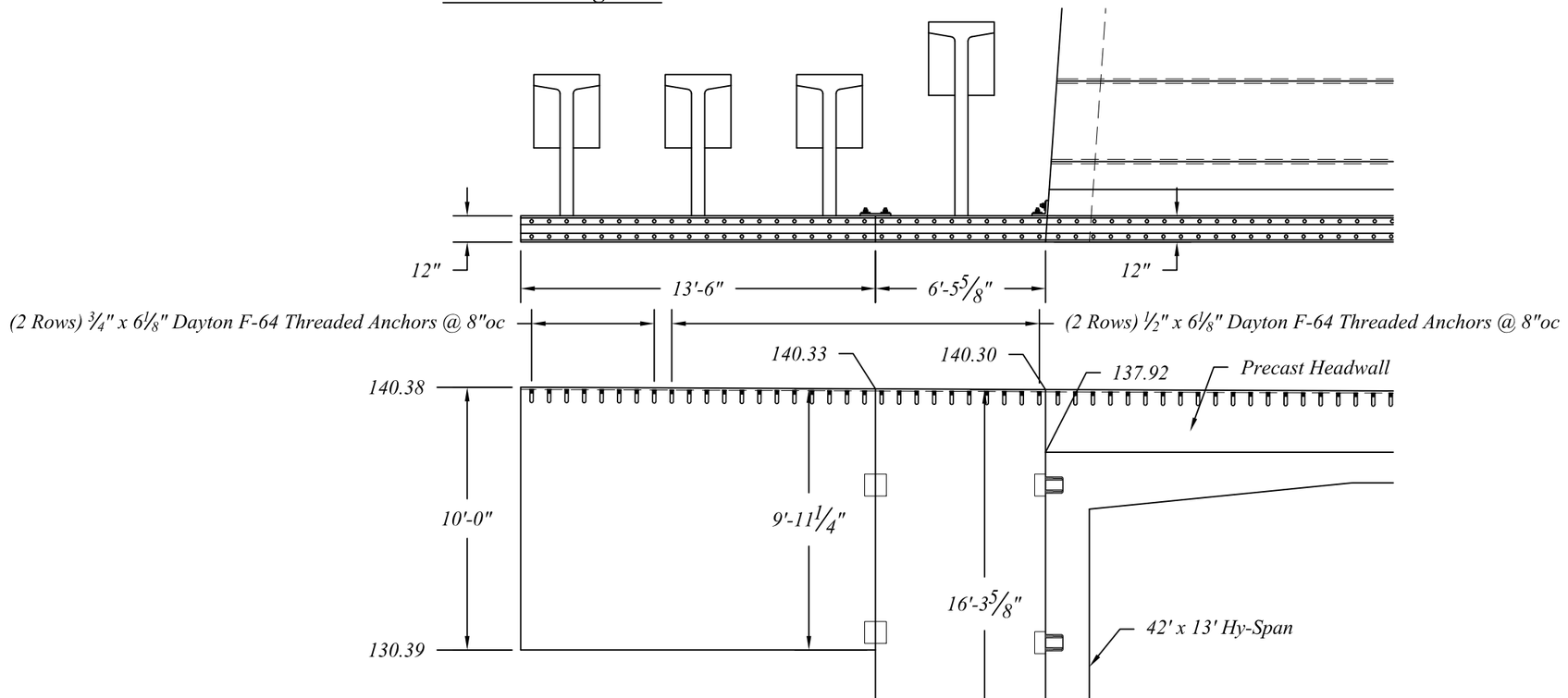
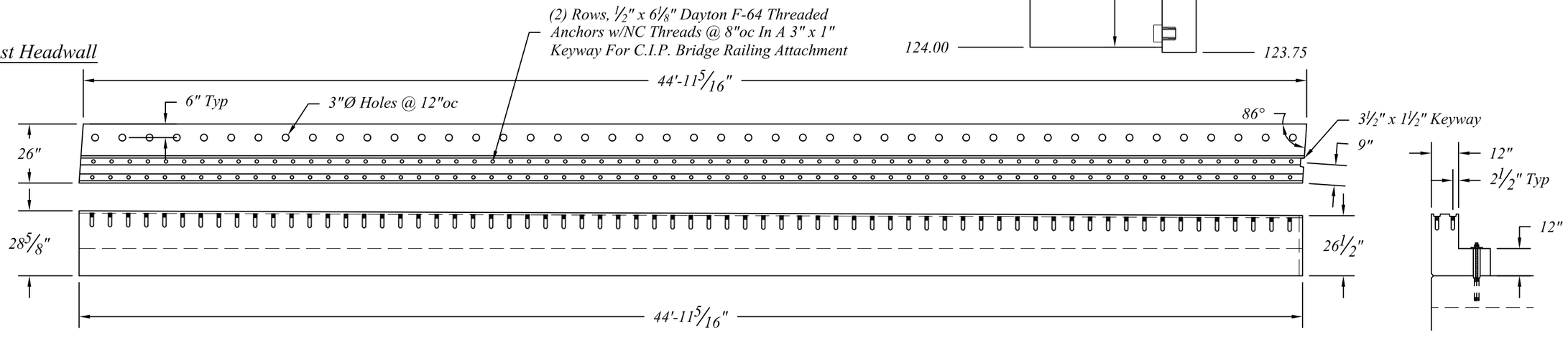
Northeast Wingwalls



Northeast Headwall



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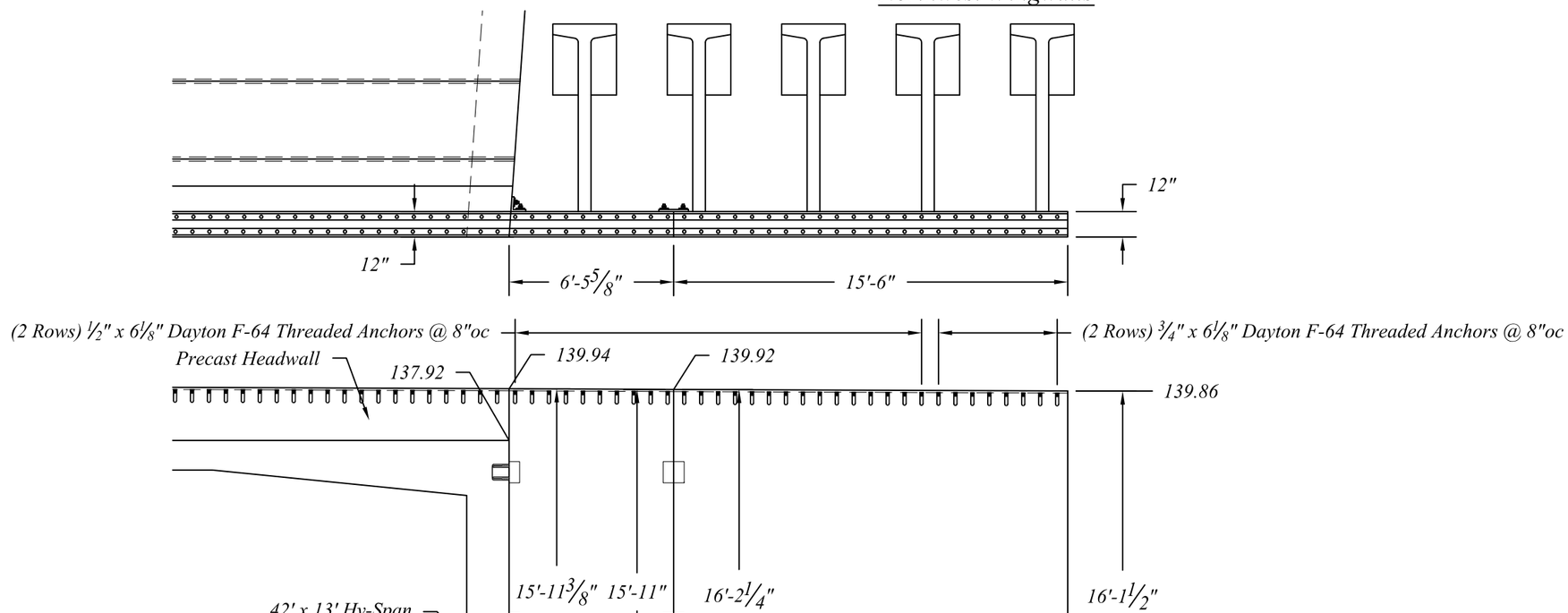
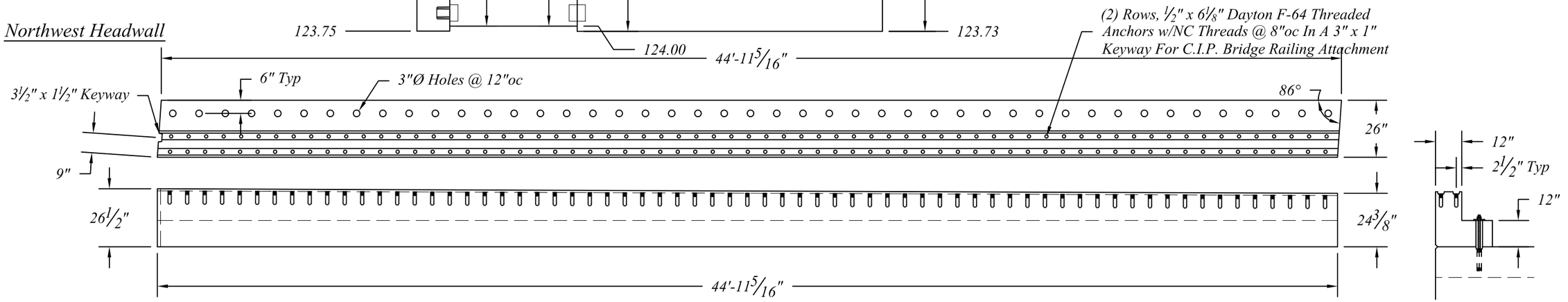
Northwest Wingwalls



Northwest Headwall



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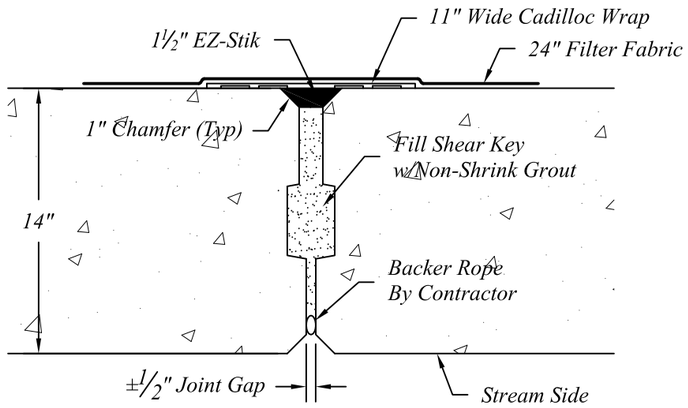
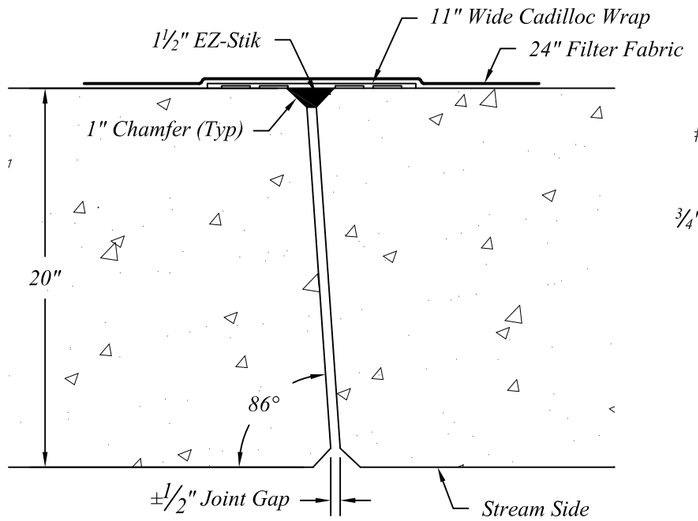
Typical Joint Detail

(Across Top Slab)

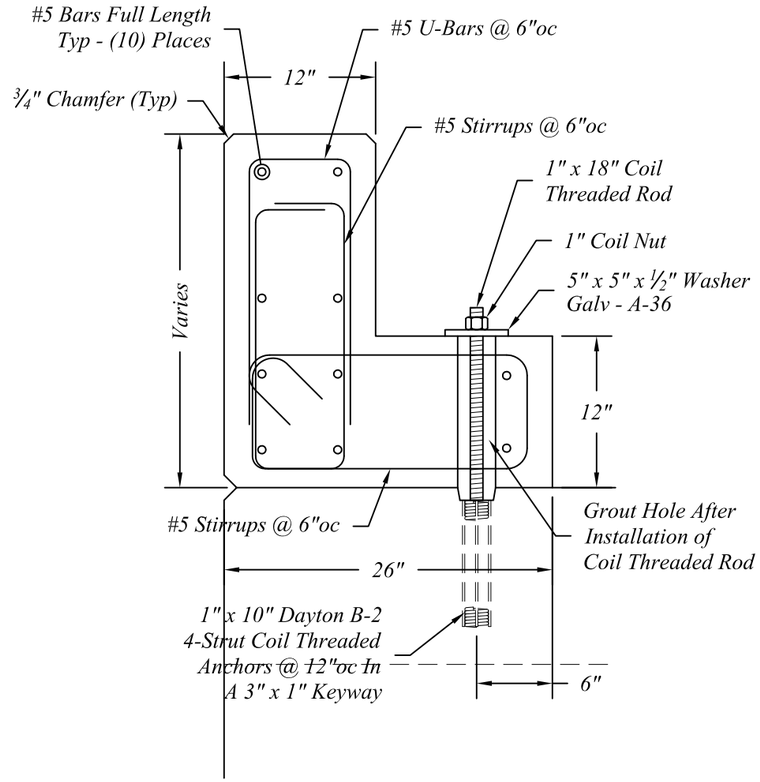


Typical Joint Detail

(Down Each Leg)



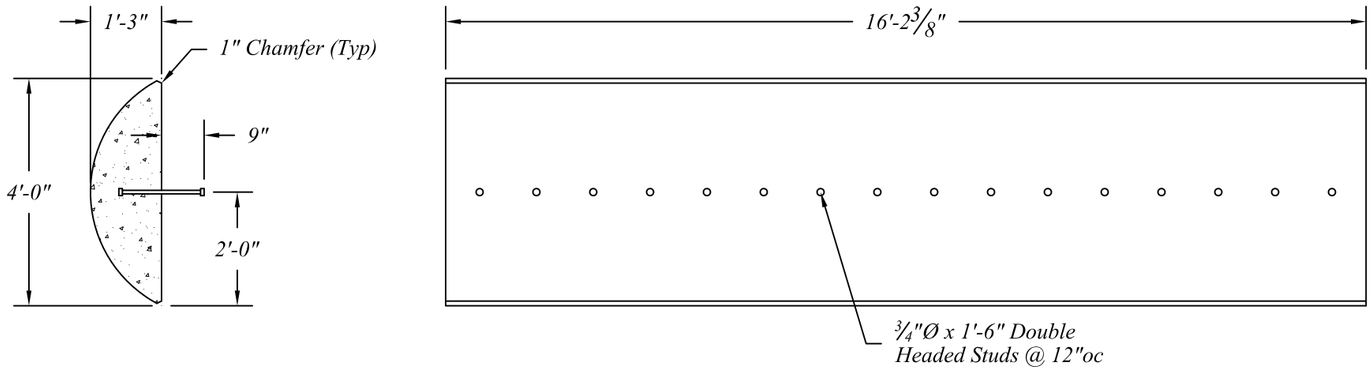
Precast Headwall Reinforcing Detail



Threaded Anchors For
Parapet Railing Connection
Not Shown For Clarity.

Precast Nosing Detail

(2 Required)



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WINGWALL DESIGN FOR:
ANTIETAM AVENUE OVER
DEQUINDRE CUT GREENWAY
SHELBY TWP, MICHIGAN

PRECAST WINGWALLS

Structural Design Drawings
Hydraulic / Scour Design by Others

NOTE:
REFER TO NORTHERN CONCRETE PIPE SUBMITTAL DRAWINGS
DATED 20 AUGUST 2007 FOR STRUCTURE LAYOUT AND DETAILS

SHEET NO.	TITLES
S-0.1	GENERAL NOTES AND SPECIFICATIONS
S-0.2	GENERAL NOTES AND SPECIFICATIONS
S-1	SOUTHWEST WINGWALL – SHOP DRAWING
S-2	SOUTHEAST WINGWALL – SHOP DRAWING
S-3	NORTHEAST WINGWALL – SHOP DRAWING
S-4	NORTHWEST WINGWALL – SHOP DRAWING
S-5	WINGWALL REINFORCEMENT TYPE C – SHOP DRAWING
S-6	WINGWALL REINFORCEMENT TYPE E – SHOP DRAWING
S-7	CONNECTION DETAILS – SHOP DRAWING

SIMPSON GUMPERTZ & HEGER
Engineering of Structures and Building Enclosures
Simpson Gumpertz & Heger Inc. 781.907.9000
41 Seyon Street, Building 1, Suite 500 fax: 781.907.9009
Waltham, Massachusetts 02453 www.sgh.com

STATE OF MICHIGAN
TIMOTHY J. McGRATH
ENGINEER
No. 45330
LICENSED PROFESSIONAL ENGINEER

7 Sep 07

Timothy J. McGrath P.E. #45330
Seal

Revisions:	No.	Date
	1	
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Sheet Title: INDEX DRAWING

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7925 EMPIRE PARKWAY
MACEDONIA, OHIO 44056
PHONE: 330-467-7890
FAX: 330-468-2258

MICHIGAN
WAYNE COUNTY
WINGWALL DESIGN FOR:
ANTIETAM AVENUE OVER
DEQUINDRE CUT GREENWAY
SHELBY TWP, MICHIGAN

Design By: MCR/JMP	Job No: 070002.30
Drawn By: KMG	Sheet No: S-00
Check By: TJM	
Date: 09/07/07	

SPECIFICATIONS FOR DESIGN AND MANUFACTURE OF HANSON ARCH CULVERTS, HEADWALLS, AND WINGWALLS

1. DESCRIPTION

This work consists of constructing a Wingwall system in accordance with these specifications and in reasonably close conformity with the lines, grades, design, and dimensions shown on the plans or as established by the Project Engineer.

2. DESIGN

2.1 The precast elements are designed in accordance with the following standards:

American Association of State Highway and Transportation Officials (AASHTO) "LRFD Bridge Design Specifications", 4th Edition, adopted 2007.

2.2 MATERIALS – CONCRETE

The concrete for the precast elements shall be composed of portland cement, fine and coarse aggregates, admixtures and water. Minimum design concrete strength is as shown on drawings.

3.1 Portland cement – Shall conform to the requirements of ASTM Specifications C150 Type I, Type II, or Type III cement.

3.2 Coarse aggregate – Shall consist of stone having a maximum size of 1 in. Aggregate shall meet requirements for ASTM C33.

3.3 Water reducing admixture – The manufacturer may submit for approval by the Engineer, a water–reducing admixture for the purpose of increasing workability and reducing the water requirements for the concrete.

3.4 Calcium chloride – The addition to the mix of calcium chloride or admixtures containing chloride is not permitted.

3.5 Cement content shall not be less than 564 lb/ cu. yd.

4. MATERIALS – STEEL REINFORCEMENT AND HARDWARE

All reinforcing steel for the precast elements shall be fabricated and placed in accordance with the drawings. Reinforcement areas shall not be less than shown on the drawings.

4.1 Steel Reinforcement – Reinforcement shall be welded wire fabric conforming to ASTM Specification A185 or A497 with a minimum yield strength of 65,000 psi, or deformed bars conforming to ASTM A615, Grade 60. Longitudinal distribution reinforcement may consist of welded wire fabric or deformed bars. Circumferential wires in a wire fabric sheet shall not be spaced less than 2 in. or more than 4 in. Longitudinal wires shall not be spaced more than 8 in. The spacing center to center of longitudinal distribution steel for inside or outside reinforcement in the top slab shall not be more than 16 in.

4.2 Inserts and other hardware shall be submitted to the Engineer for approval prior to manufacture.

5. FABRICATION

5.1 Concrete design strength shall be as shown on the drawings. Concrete in all precast elements shall reach design strength prior to shipping to the project, but in not more than 28 days.

5.2 Forms – Concrete forms shall be sufficiently rigid and accurate to maintain the dimensions of all elements within the permissible variations given in Section 6. All casting surfaces shall be of a smooth material.

5.3 Handling – Handling devices or holes shall be permitted in each precast element to facilitate handling and setting.

5.4 Storage – The precast elements shall be stored in such a manner to prevent cracking or damage.

5.5 Placement of Reinforcement – Reinforcement shall be of size and type shown on the drawings. Welded wire fabric shall contain sufficient longitudinal wires extending through the precast element to maintain the shape and position of the reinforcement. Longitudinal distribution reinforcement may be welded wire fabric or deformed bars and shall be not more than 3 in. from the ends of the precast element.

6. PERMISSIBLE VARIATIONS

6.1 Wingwalls & Headwalls

6.1.1 Wall Thickness – The wall thickness shall not be less than that shown in the design by more than 1/2 in.

6.1.2 Length / Height of Wall Sections – The length and height of the wall shall not vary from that shown in the design by more than 1/2 in.

6.1.3 Position of Reinforcement – The maximum variation in position of the reinforcement shall be ±1/2 in. In no case shall the cover over the reinforcement be less than 1–1/2 in.

6.1.4 Steel areas greater than those required shall not be cause for rejection.

7. TESTING AND INSPECTION

7.1 Type of Test Specimen – Concrete compressive strength shall be determined from compression tests made on cylinders or cores. For cylinder testing, a minimum of four cylinders shall be taken during each production run. For core testing, one core shall be cut from each of 3 precast elements selected at random from each production group. A production group shall be defined as 15 or fewer precast wingwalls of a particular size and production run. For each continuous production run, each group of 15 precast elements of a single size or fraction thereof shall be considered separately for the purpose of testing and acceptance. A production run shall be considered continuous if not interrupted for more than 3 consecutive days.

7.2 Compression Testing – Cylinders shall be made and tested as prescribed by the ASTM C39 Specification. Cores shall be obtained and tested for compressive strength in accordance with the provisions of the ASTM C497 Specification.

7.3 Acceptability of Cylinder Tests – When the average compressive strength of all cylinders tested is equal to or greater than the design compressive strength, and not more than 10% of the cylinders tested have a compression strength less than the design concrete strength, and no cylinder tested has a compressive strength less than 80% of the design compressive strength, then the lot shall be accepted. When the compressive strength of the cylinders tested does not conform to this acceptance criterion, the acceptability of the lot may be determined as described in section 7.4 below. Failure of any of the 28–day test cylinders to meet 90% of the minimum compressive strength requirement can be cause for rejection.

7.4 Acceptability of Core Tests – The compressive strength of the concrete in each group of precast elements as defined in Section 7.1, is acceptable when the core test strength is equal to or greater than the design concrete strength. When the compressive strength of the core tested is less than the design concrete strength, the precast element from which that core was taken may be recored. When the compressive strength of the recore is equal to or greater than the design concrete strength, the compressive strength of the concrete in that group is acceptable.

7.4.1 When the compressive strength of any core is less than the design concrete strength, the precast element from which that core was taken shall be rejected. Two precast elements from the remainder of the group shall be selected at random and one core shall be taken from each. If the compressive strength of both cores is equal to or greater than the design concrete strength, the compressive strength of the remainder of that group of culverts is acceptable. If the compressive strength of either of the two cores tested is less than the design concrete strength, the remainder of the group of precast elements shall be rejected or, at the option of the manufacturer, each culvert of the remainder of the group shall be cored and accepted individually, and any of these elements that have cores with less than the design concrete strength shall be rejected.

7.4.2 Plugging Core Holes – The core holes shall be plugged and sealed by the manufacturer in a manner such that the culvert will meet all of the test requirements of this specification. Precast elements so sealed shall be considered satisfactory for use.

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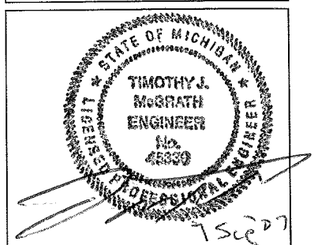
Engineering of Structures and Building Enclosures
Simpson Gumpertz & Heger Inc. 781.907.9000
41 Seyon Street, Building 1, Suite 500 fax 781.907.9009
Waltham, Massachusetts 02453 www.sgh.com



Timothy J. McGrath P.E. #45330
Seal

Revisions:

No.	Date
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Sheet Title: GENERAL NOTES AND SPECIFICATIONS

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PHONE: 330-467-7890
FAX: 330-468-2258

WAYNE COUNTY MICHIGAN

WINGWALL DESIGN FOR:
ANTIETAM AVENUE OVER
DEQUINDRE CUT GREENWAY
SHELBY TWP, MICHIGAN

Design By: MCR/JMP	Job No: 070002.30
Drawn By: KMG	Sheet No: S-0.1
Check By: TJM	
Date: 09/07/07	

8. WORKMANSHIP AND FINISH

The precast elements shall be substantially free of fractures. The ends of the precast arch units shall be normal to the walls and centerline of the arch section, within the limits of the variations given in Section 6, except where beveled ends are specified. The faces of the wingwalls shall be parallel to each other, within the limits of variations given in Section 6 above. The surface of the precast elements shall be a smooth steel form or troweled surface. Trapped air pockets causing surface defects shall be considered as apart of a smooth steel form finish.

9. REPAIRS

Precast elements may be repaired, if necessary, because of imperfections in manufacture or handling damage and will be acceptable if, in the opinion of the purchaser, the repairs are sound, properly finished, and cured, and the repaired section conforms to the requirements of this specification.

10. INSPECTION

The quality of materials, the process of manufacture, and the finished precast elements shall be subject to inspection by the purchaser.

11. REJECTION

Precast elements shall be subject to rejection on account of any of the specification requirements. Individual elements may be rejected because of any of the following:

11.1 Fractures or cracks passing through the wall, except for a single end crack that does not exceed one half the thickness of the wall.

11.2 Defects that indicate proportioning, mixing, and molding not in compliance with the specifications.

11.3 Excessive honeycombing or open texture.

11.4 Damaged ends, when such damage would prevent making a satisfactory joint.

12. CONSTRUCTION REQUIREMENTS

12.1 Placement of the Precast Elements – The precast elements shall be placed as shown on the drawings. Special care shall be taken in setting the elements to the true line and grade. The wingwalls shall be set on 6 in. x 6 in. masonite or steel shims. A minimum of 1/2 in. gap shall be provided between the footing and the bottom of the wall. The gap shall be filled with cement grout (Portland cement and water or cement mortar composed of one part Portland cement and three parts of sand, by volume, and water, 3,000 psi minimum compressive strength).

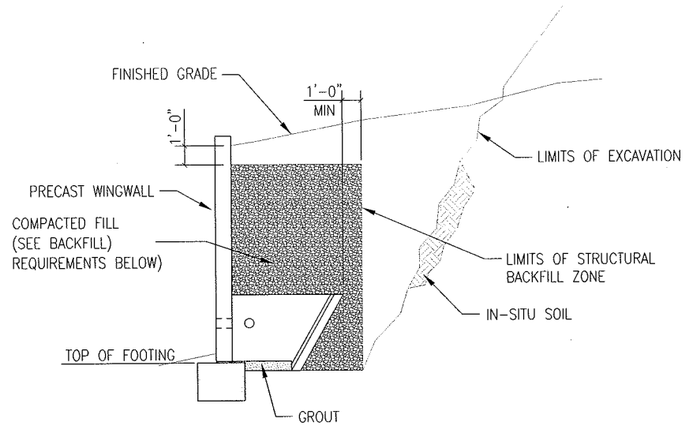
PROJECT ENGINEER: MICHIGAN DEPARTMENT OF TRANSPORTATION

THIS BRIDGE HAS BEEN DESIGNED FOR GENERAL SITE CONDITIONS WHICH ASSUMES THAT THE SOILS ARE NOTE AGGRESSIVE TOWARD THE CONCRETE. THE PROJECT ENGINEER SHALL BE RESPONSIBLE FOR THE SUITABILITY OF THE STRUCTURE FOR THE EXISTING SITE AND FOR THE HYDRAULIC EVALUATION, INCLUDING SCOUR AND CONFIRMATION OF SOIL CONDITIONS.

ALL ELEVATIONS ARE TO BE CONFIRMED AND/OR PROVIDED BY THE ENGINEER OF RECORD AND VERIFIED BY THE GENERAL CONTRACTOR PRIOR TO PLACING ANY CONCRETE OR PRECAST ELEMENTS.

CONTRACTOR IS RESPONSIBLE FOR THE INSTALLATION OF ALL MISCELLANEOUS ITEMS INCLUDING, BUT NOT LIMITED TO: HANDRAILS, PERFORATED PIPE, LIGHTPOLES, AND VENEER PER THE ENGINEER OF RECORDS SPECIFICATIONS. ALL ITEMS SHALL BE INSTALLED PER THE MANUFACTURERS SPECIFICATIONS.

DESIGN LOADS: EARTH LOAD + 2 FT LIVE LOAD SURCHARGE, MAX. 4:1 BACKFILL SLOPE
GUARDRAIL LOADS: PEDESTRIAN LOADING ONLY
NOTE: GUARDRAILS BY OTHERS



WINGWALL BACKFILL REQUIREMENTS
N.T.S.

MAX WALL HEIGHT	ACCEPTABLE MATERIAL INSIDE C.B.Z.	ACCEPTABLE MATERIAL OUTSIDE C.B.Z.
≥ 12'-0"	A1, A3 *	**
< 12'-0"	A1, A2-4, A2-5, A3 *	**

* SEE BACKFILL DESCRIPTIONS FOR LIMITS ON A-3 MATERIALS
** EMBANKMENT MATERIAL PER PROJECT SPECIFICATIONS.

BACKFILL DESCRIPTIONS

GROUP CLASSIFICATION	A-1		A-3*	A2-4	A2-5
	A-1-a	A-1-b			
SIEVE ANALYSIS, PERCENT PASSING:					
No. 10	50 MAX.			-----	-----
No. 40	30 MAX.	50 MAX.	51 MIN.	-----	-----
No. 200	15 MAX.	25 MAX.	10 MAX.	35 MAX.	35 MAX.
CHARACTERISTICS OF FRACTION PASSING:					
No. 40					
LIQUID LIMIT					
PLASTICITY INDEX	6 MAX.		N.P.	10 MAX.	10 MAX.
USUAL TYPES OF SIGNIFICANT CONSTITUENT MATERIALS:	STONE FRAGMENTS, GRAVEL AND SAND		FINE SAND	SILTY OR CLAYEY GRAVEL AND SAND	SILTY OR CLAYEY GRAVEL AND SAND
GENERAL RATING AS SUBGRADE:	EXCELLENT TO GOOD			EXCELLENT TO GOOD	EXCELLENT TO GOOD

NOTE:
1. FOR A3 SOILS, A MAXIMUM OF 50% OF THE PARTICLE SIZES MAY PASS THE 0.150 MM (NO. 100) SIEVE.
2. ALL BACKFILL MATERIAL SHALL BE FREE OF ORGANIC MATERIAL, ROCK FRAGMENTS LARGER THAN 3 INCHES IN THE GREATEST DIMENSION AND FROZEN LUMPS.

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STATE OF MICHIGAN * TIMOTHY J. McGRATH ENGINEER No. 45330 * PROFESSIONAL ENGINEER
7-5-07

Timothy J. McGrath P.E. #45330
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Sheet Title: GENERAL NOTES AND SPECIFICATIONS

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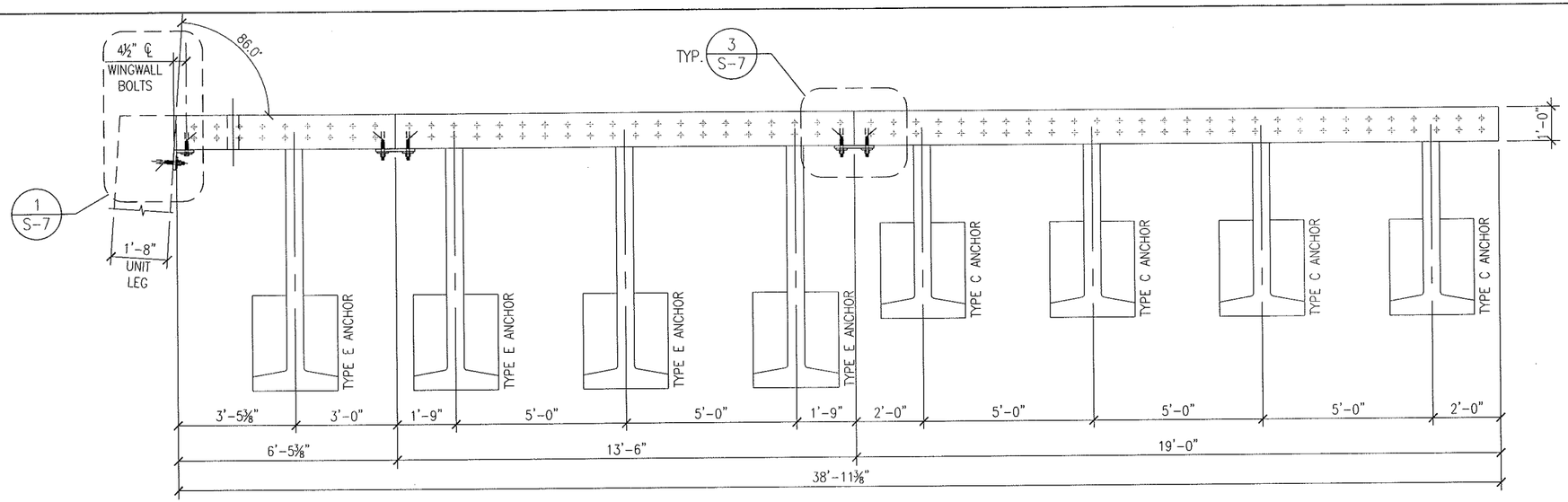
MICHIGAN
WAYNE COUNTY
WINGWALL DESIGN FOR:
ANTIETAM AVENUE OVER
DEQUINDRE CUT GREENWAY
SHELBY TWP, MICHIGAN

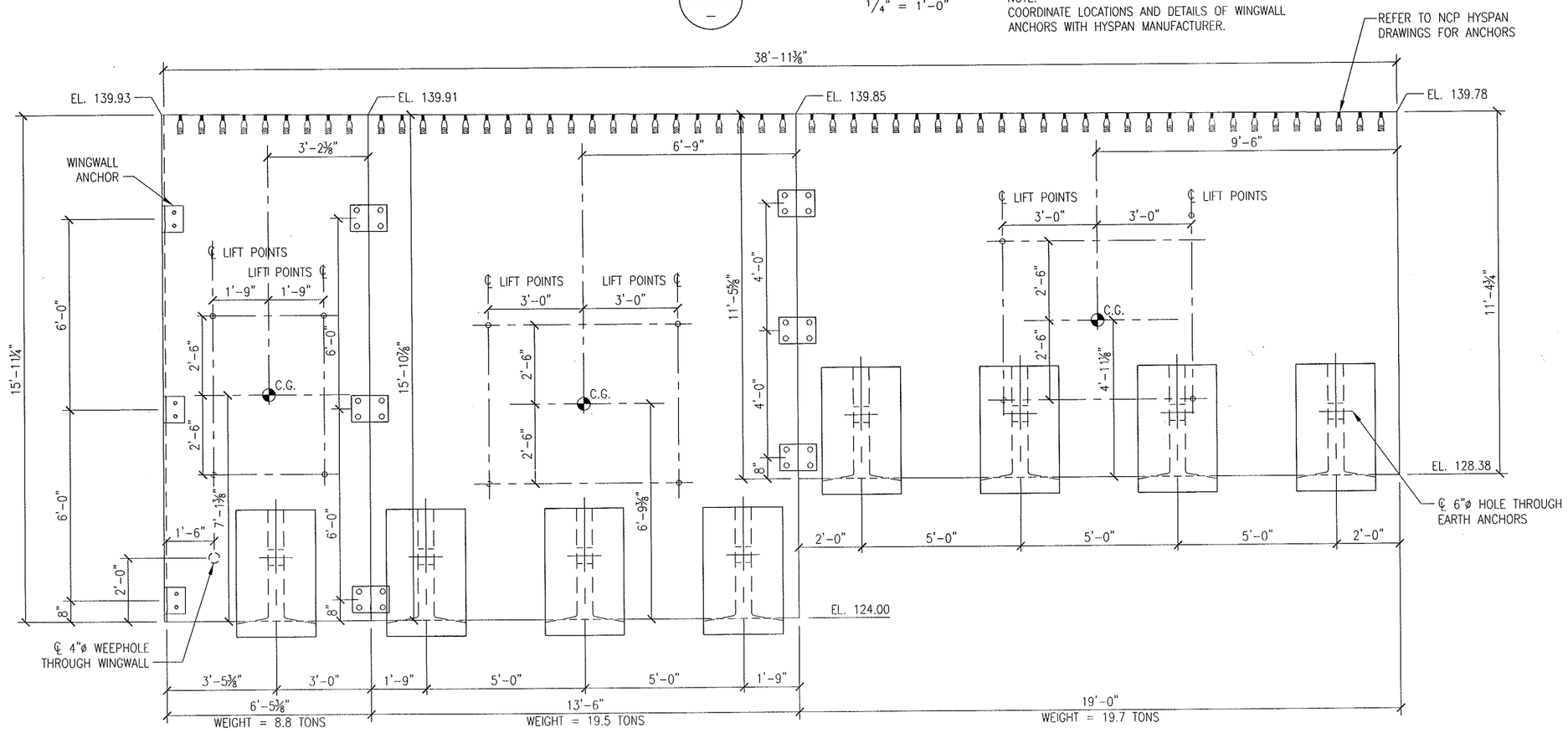
Design By: MCR/JMP	Job No: 070002.30
Drawn By: KMG	Sheet No: S-0.2
Check By: TJM	
Date: 09/07/07	



1 / – PLAN

¼" = 1'-0"

NOTE:
COORDINATE LOCATIONS AND DETAILS OF WINGWALL ANCHORS WITH HYSPAN MANUFACTURER.



SOUTHWEST WINGWALL ELEVATION

¼" = 1'-0"

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ENGINEER
No. 45330
LICENSED PROFESSIONAL ENGINEER
7 Sept 07

Timothy J. McGrath P.E. #45330
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Sheet Title: SOUTHWEST WINGWALL SHOP DRAWING

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MICHIGAN
WAYNE COUNTY

WINGWALL DESIGN FOR:
ANTIETAM AVENUE OVER
DEQUINDRE CUT GREENWAY
SHELBY TWP, MICHIGAN

Design By: MCR/JMP	Job No: 070002.30
Drawn By: KMG	Sheet No: S-1
Check By: TJM	
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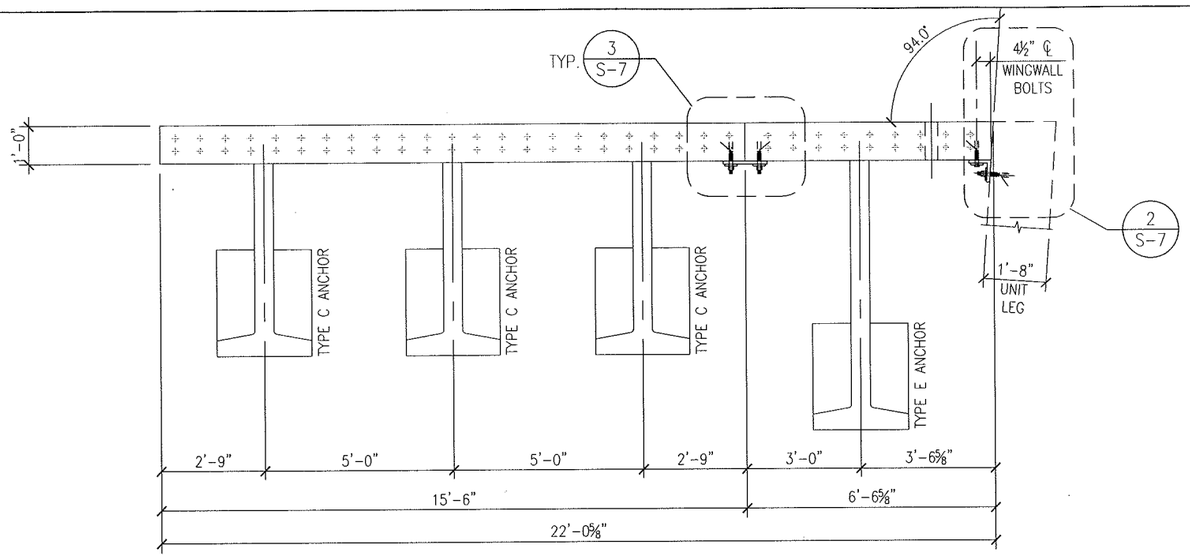
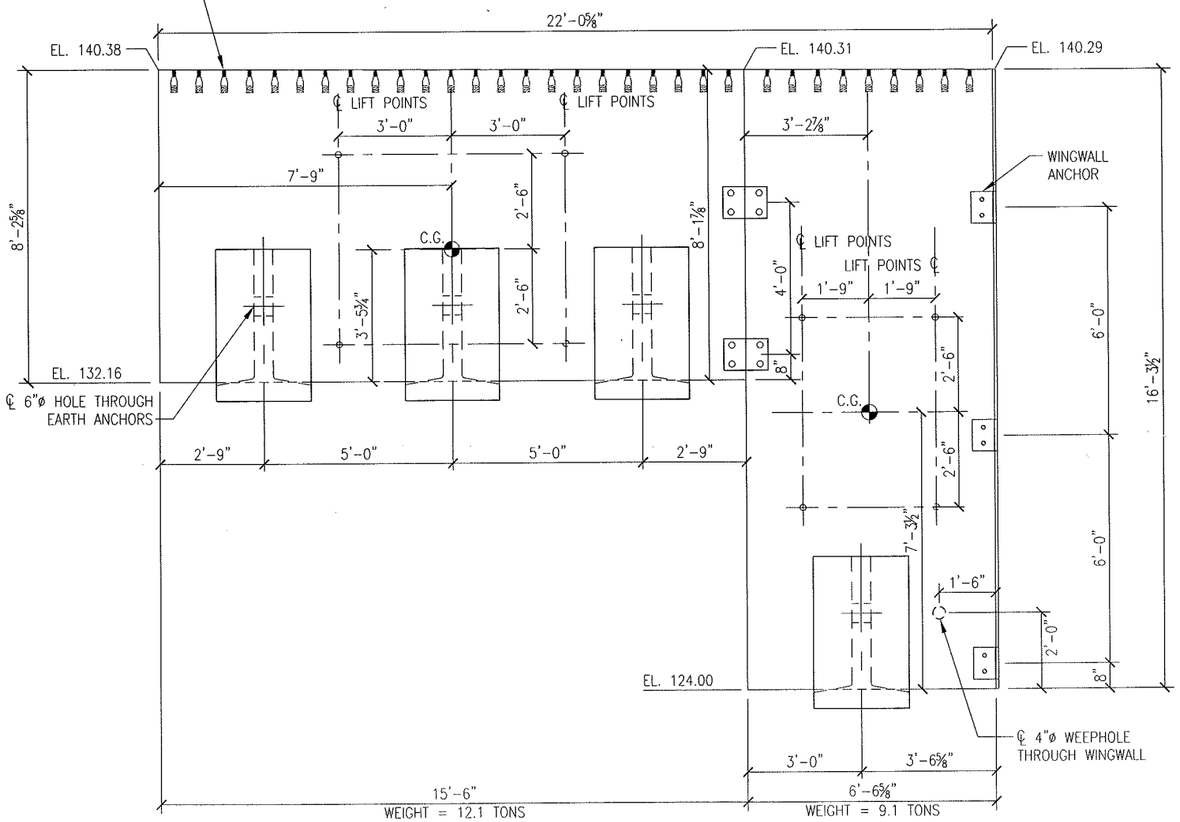


1 / – PLAN

1/4" = 1'-0"

NOTE:
COORDINATE LOCATIONS AND DETAILS OF WINGWALL ANCHORS WITH HYSPAN MANUFACTURER.



SOUTHEAST WINGWALL ELEVATION

1/4" = 1'-0"

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Sheet Title: SOUTHEAST WINGWALL SHOP DRAWING

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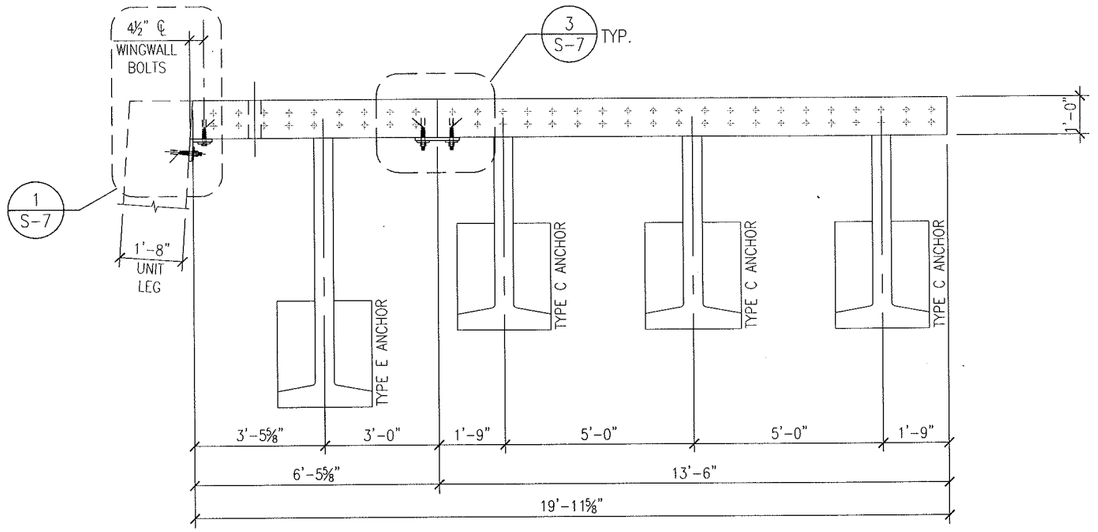
WAYNE COUNTY

WINGWALL DESIGN FOR:
ANTIETAM AVENUE OVER
DEQUINDRE CUT GREENWAY
SHELBY TWP, MICHIGAN

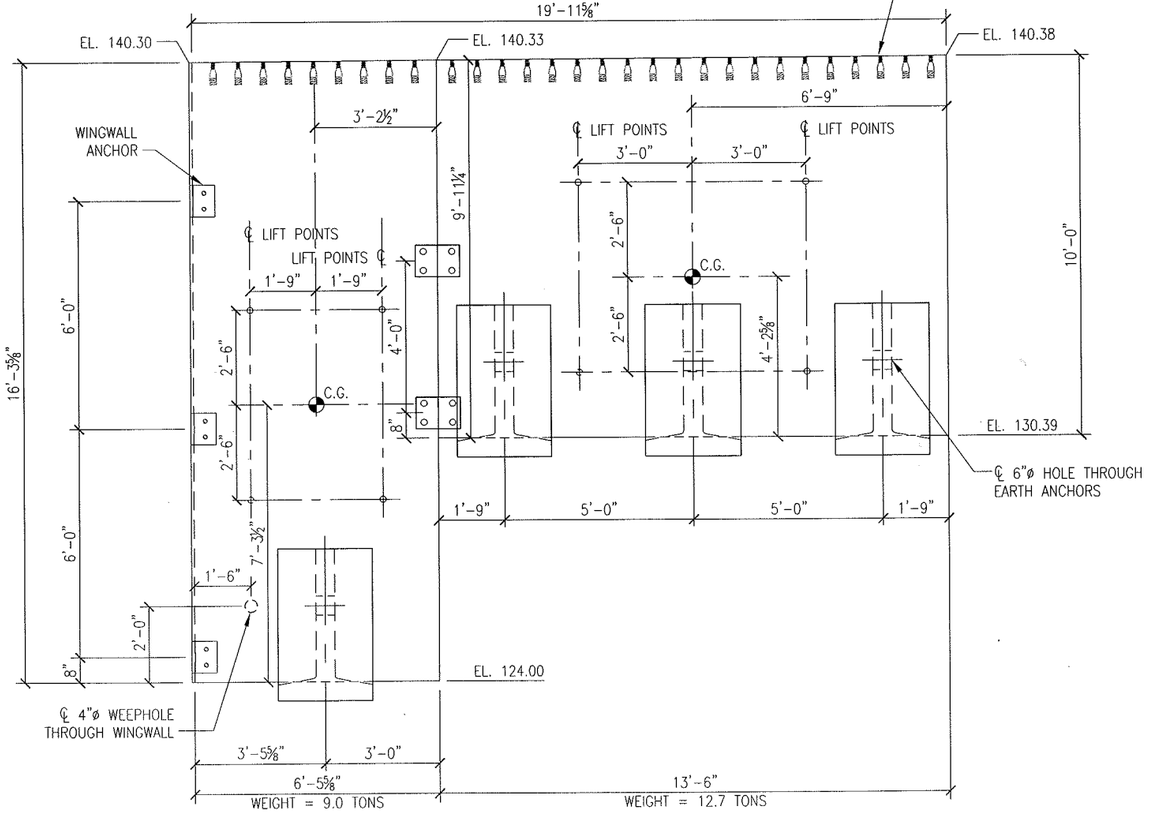
Design By: MCR/JMP	Job No: 070002.30
Drawn By: KMG	Sheet No: S-2
Check By: TJM	
Date: 09/07/07	



1 / – PLAN

1/4" = 1'-0"

NOTE:
COORDINATE LOCATIONS AND DETAILS OF WINGWALL ANCHORS WITH HYSPAN MANUFACTURER.



NORTHEAST WINGWALL ELEVATION

1/4" = 1'-0"

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STATE OF MICHIGAN
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7 Sep '07

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Sheet Title: NORTHEAST WINGWALL SHOP DRAWING

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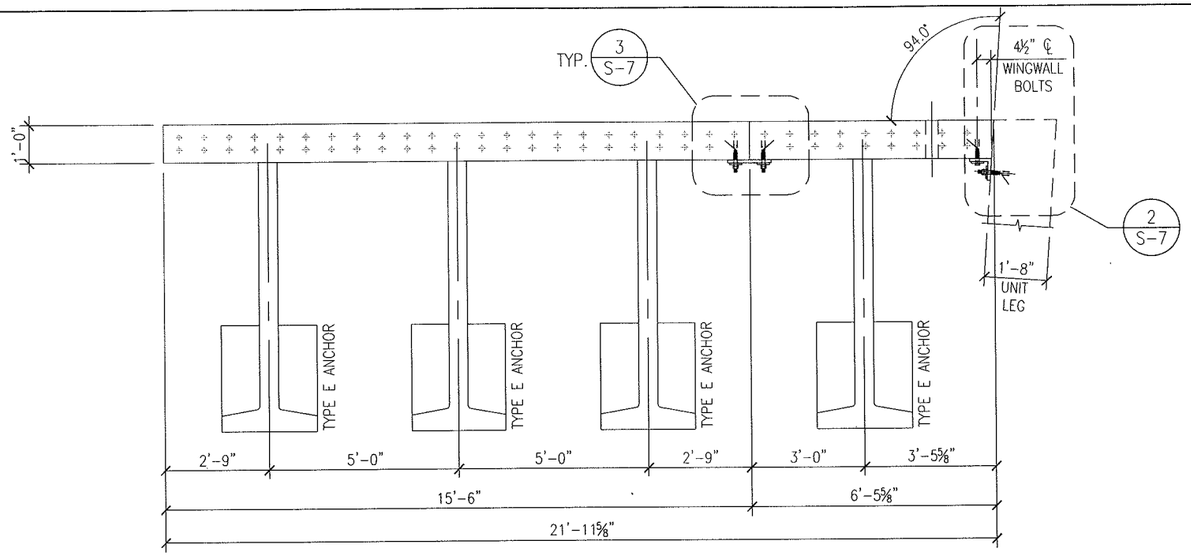
MICHIGAN
WAYNE COUNTY

WINGWALL DESIGN FOR:
ANTIETAM AVENUE OVER
DEQUINDRE CUT GREENWAY
SHELBY TWP, MICHIGAN

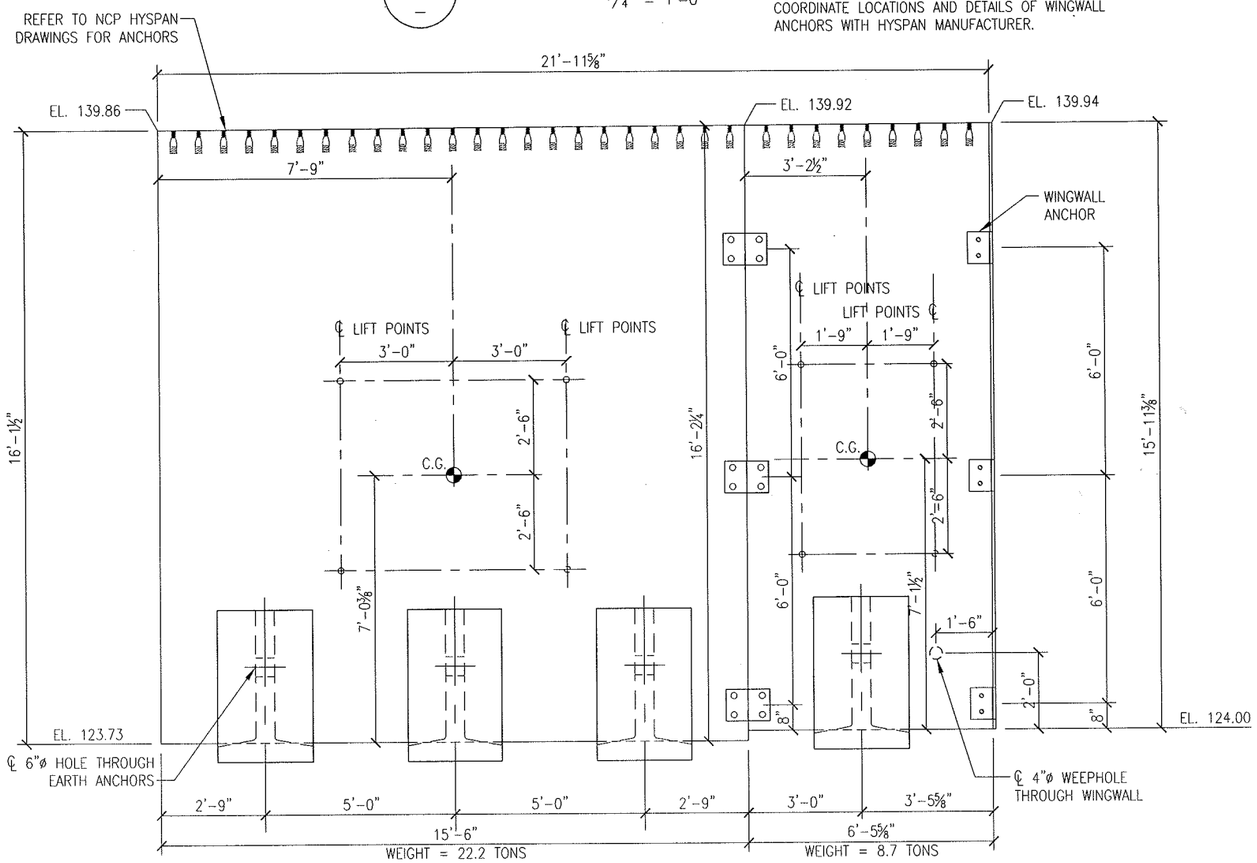
Design By: MCR/JMP	Job No.: 070002.30
Drawn By: KMG	Sheet No.: S-3
Check By: TJM	
Date: 09/07/07	



1 — PLAN

¼" = 1'-0"

NOTE:
COORDINATE LOCATIONS AND DETAILS OF WINGWALL ANCHORS WITH HYSPAN MANUFACTURER.



NORTHWEST WINGWALL ELEVATION

¼" = 1'-0"

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Sheet Title: NORTHWEST WINGWALL SHOP DRAWING

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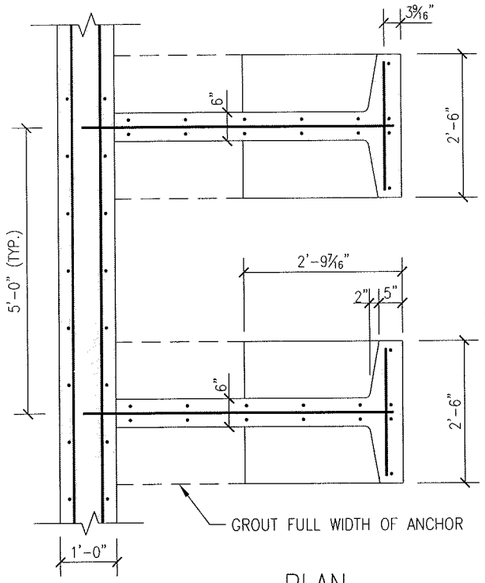
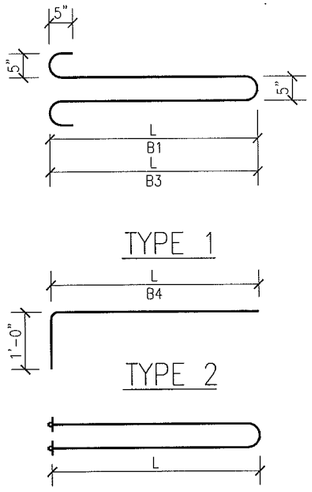
MICHIGAN
WAYNE COUNTY

WINGWALL DESIGN FOR:
ANTIETAM AVENUE OVER
DEQUINDRE CUT GREENWAY
SHELBY TWP, MICHIGAN

Design By: MCR/JMP	Job No: 070002.30
Drawn By: KMG	Sheet No: S-4
Check By: TJM	
Date: 09/07/07	

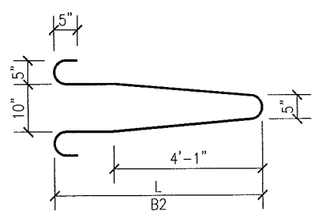


PLAN



HEADED REBAR CAN BE PURCHASED BY CONTACTING RICHMOND SCREW ANCHOR COMPANY. USE A MINIMUM EMBEDMENT LENGTH OF $7\frac{1}{2}$ INCHES.

ALTERNATE OPTIONS DETAIL



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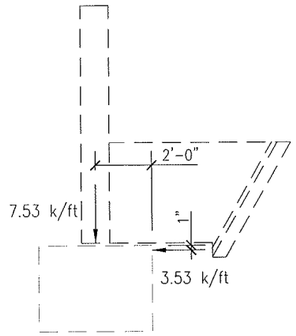
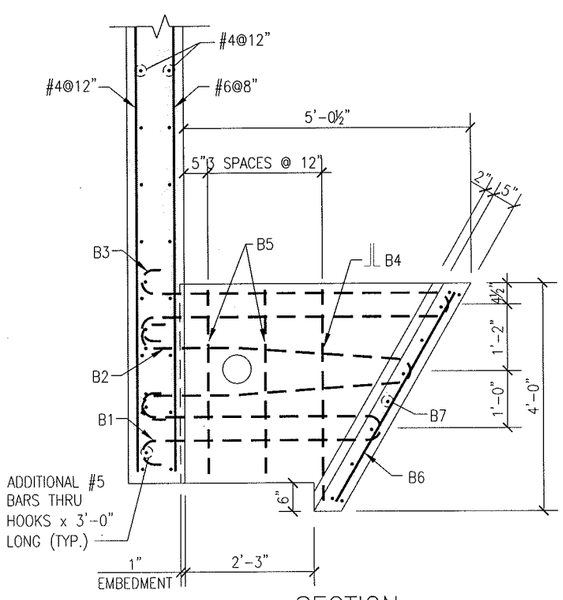


1/– WINGWALL LOADS APPLIED TO FOOTING (SERVICE LOADS) N.T.S.



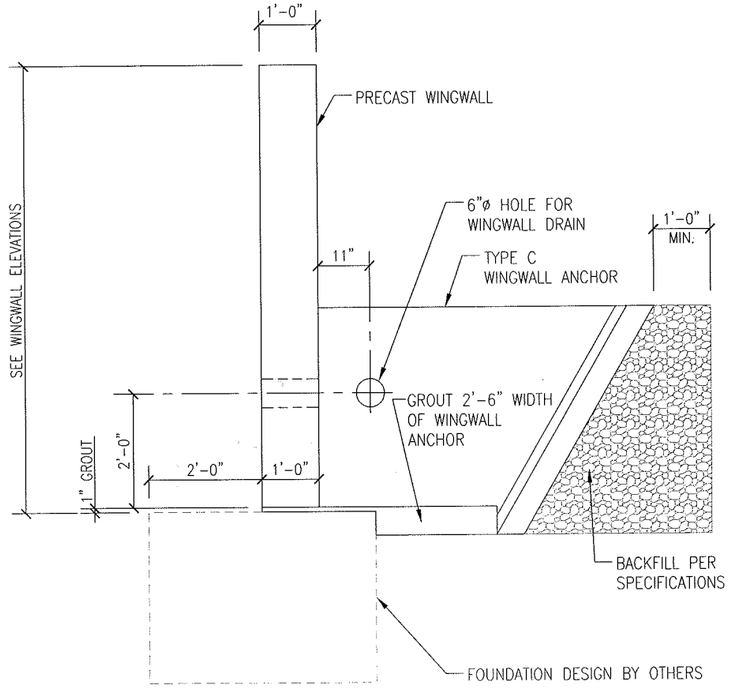
SECTION

BAR LIST					
MARK	QTY.	SIZE	L	TYPE	LENGTH
B1	1	5	4'-2"	1	----
B2	1	5	4'-8"	3	----
B3	1	5	5'-5"	1	----
B4	2	4	3'-8"	2	----
B5	4	4	----	STRAIGHT	3'-2"
B6	4	4	----	STRAIGHT	4'-2"
B7	7	5	----	STRAIGHT	2'-2"

STANDARD CLEARANCE = 2"

NOTES:

CONCRETE FOR WINGWALLS & EARTH ANCHORS SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 5500 PSI. ALL REINFORCING STEEL SHALL CONFORM TO ASTM 615 – GRADE 60.



2/S-2 SECTION $\frac{3}{8}$" = 1'-0"

TYPICAL DETAILS – PRECAST WINGWALL AND EARTH ANCHOR – TYPE C

$\frac{3}{8}$" = 1'-0"

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STATE OF MICHIGAN LICENSED PROFESSIONAL ENGINEER
TIMOTHY J. McGRATH ENGINEER No. 45330
7 Sept 07

Timothy J. McGrath P.E. #45330

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Sheet Title: WINGWALL REINFORCEMENT TYPE C SHOP DRAWING

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WAYNE COUNTY MICHIGAN

WINGWALL DESIGN FOR:
ANTIETAM AVENUE OVER
DEQUINDRE CUT GREENWAY
SHELBY TWP, MICHIGAN

Design By	Job No.
MCR/JMP	070002.30
Drawn By	Sheet No.
KMG	S-5
Check By	
TJM	
Date	
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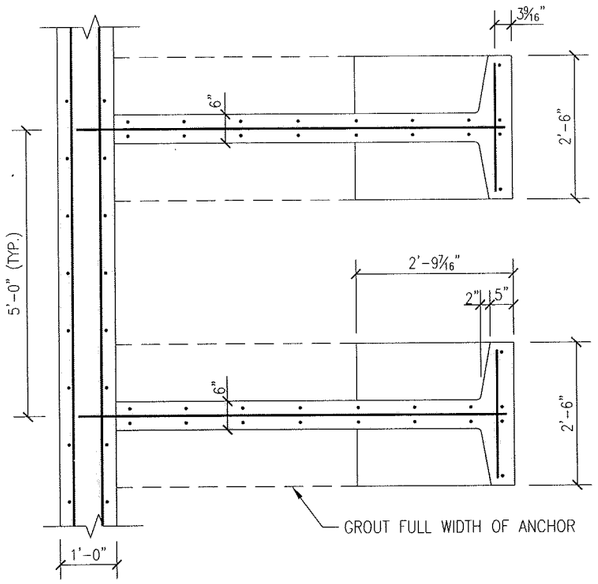
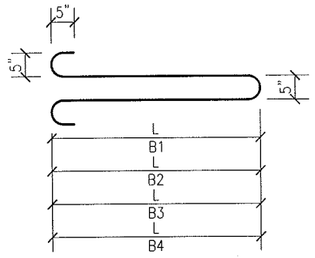
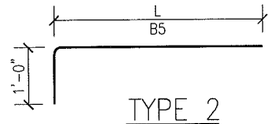


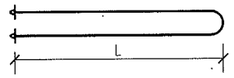
PLAN



TYPE 1

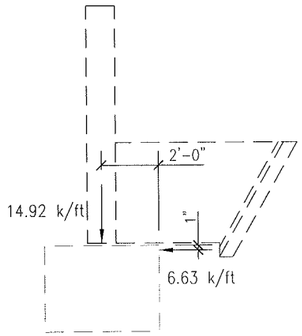


TYPE 2

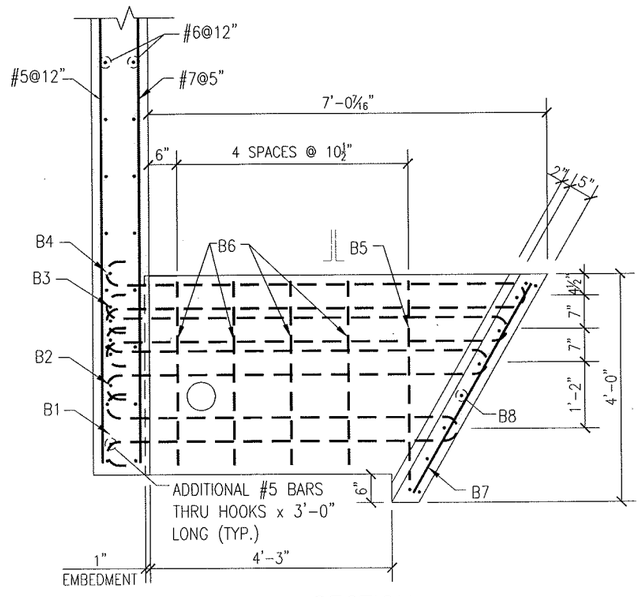


HEADED REBAR CAN BE PURCHASED BY CONTACTING RICHMOND SCREW ANCHOR COMPANY. USE A MINIMUM EMBEDMENT LENGTH OF $7^1/_2$ INCHES.

ALTERNATE OPTIONS DETAIL



1 / – WINGWALL LOADS APPLIED TO FOOTING (SERVICE LOADS) N.T.S.



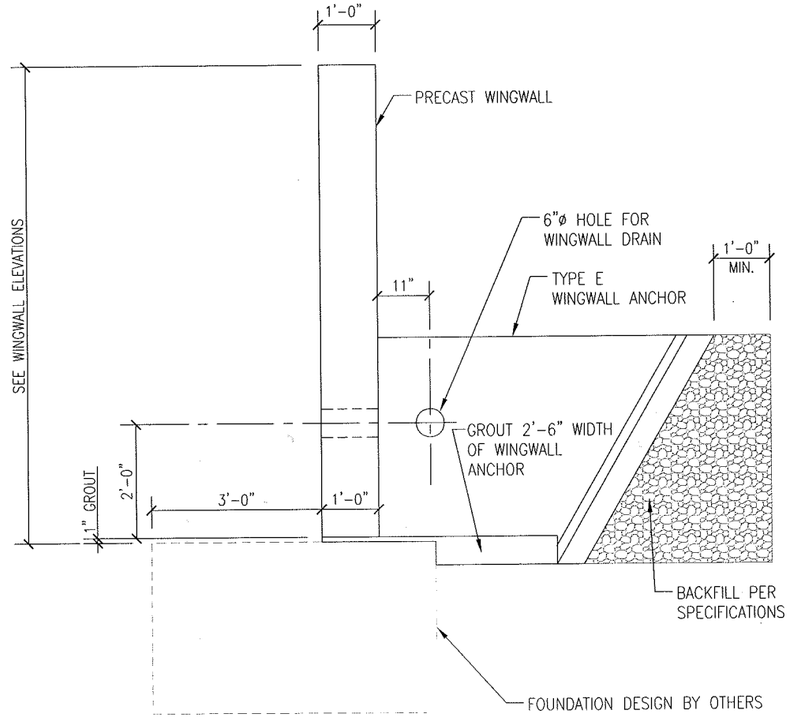
SECTION

BAR LIST					
MARK	QTY.	SIZE	L	TYPE	LENGTH
B1	1	6	6'-1"	1	----
B2	1	6	6'-10"	1	----
B3	1	6	7'-2"	1	----
B4	1	6	7'-6"	1	----
B5	2	5	3'-8"	2	----
B6	8	5	----	STRAIGHT	3'-2"
B7	4	5	----	STRAIGHT	4'-2"
B8	10	5	----	STRAIGHT	2'-2"

STANDARD CLEARANCE = 2"

NOTES:

CONCRETE FOR WINGWALLS & EARTH ANCHORS SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 5500 PSI. ALL REINFORCING STEEL SHALL CONFORM TO ASTM 615 – GRADE 60.



2 / S-2 SECTION $^3/_8$" = 1'-0"

TYPICAL DETAILS – PRECAST WINGWALL AND EARTH ANCHOR – TYPE E

$^3/_8$" = 1'-0"

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15 Sep 07

Timothy J. McGrath P.E. #45330

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Sheet Title: WINGWALL REINFORCEMENT TYPE E SHOP DRAWING

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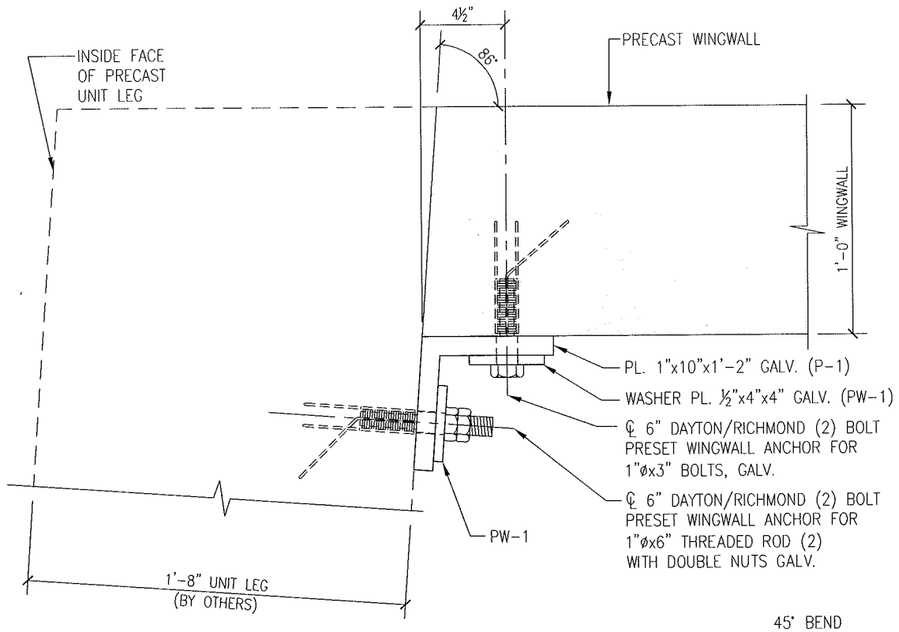
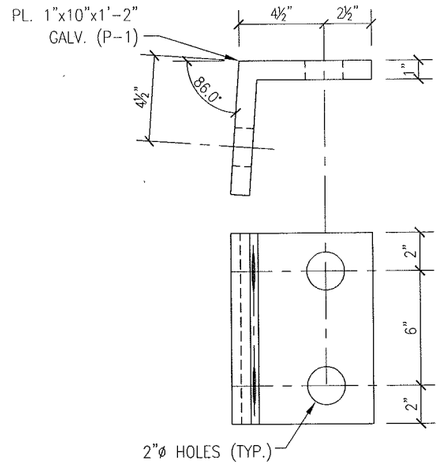
WAYNE COUNTY MICHIGAN

WINGWALL DESIGN FOR: ANTIETAM AVENUE OVER DEQUINDRE CUT GREENWAY SHELBY TWP, MICHIGAN

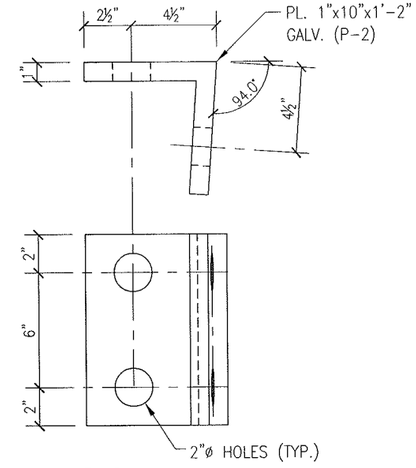
Design By: MCR/JMP	Job No: 070002.30
Drawn By: KMG	Sheet No: S-6
Check By: TJM	
Date: 09/07/07	



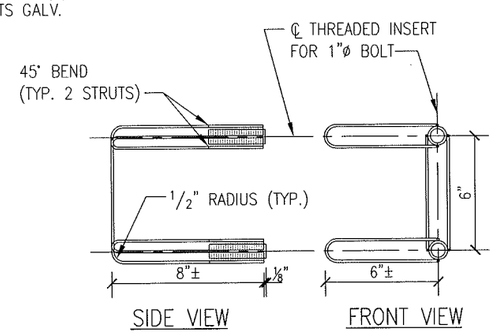
1/S-1 DETAIL AT UNIT LEG
1½" = 1'-0"



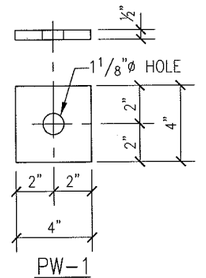
P-1
1½" = 1'-0"
(GALVANIZED PER ASTM A153)



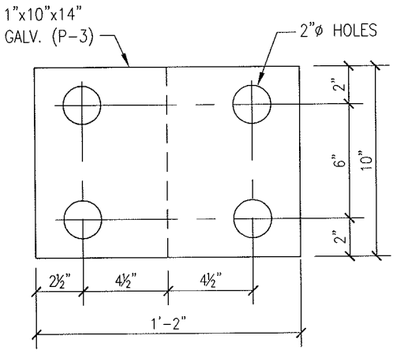
P-2
1½" = 1'-0"
(GALVANIZED PER ASTM A153)



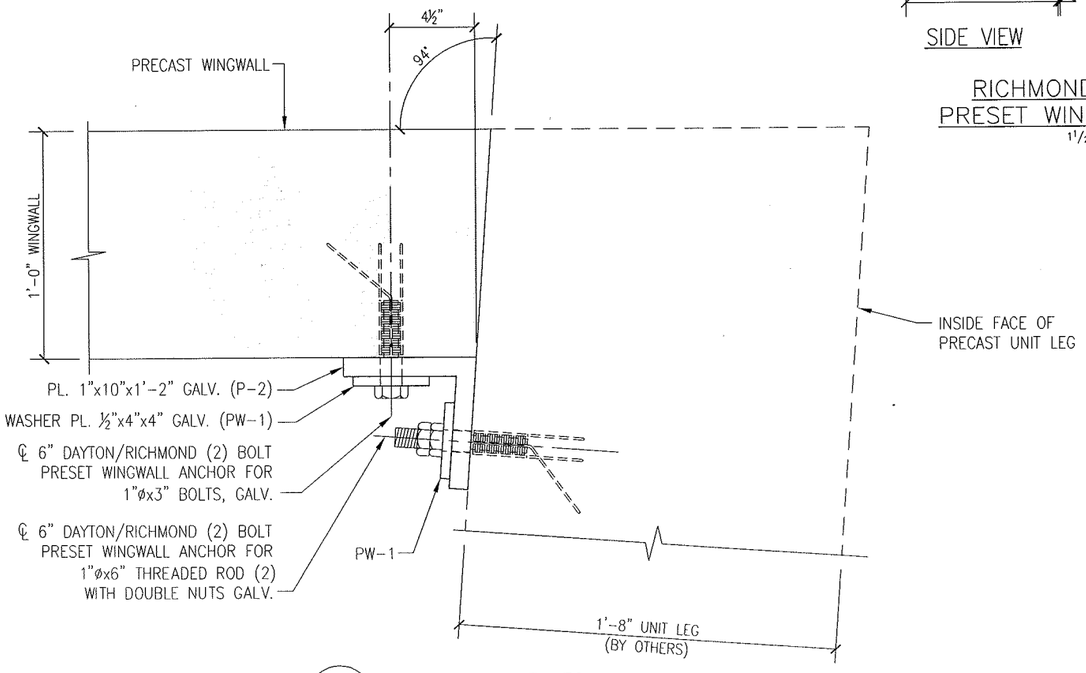
RICHMOND TWO- BOLT PRESET WING WALL ANCHOR
1½" = 1'-0"



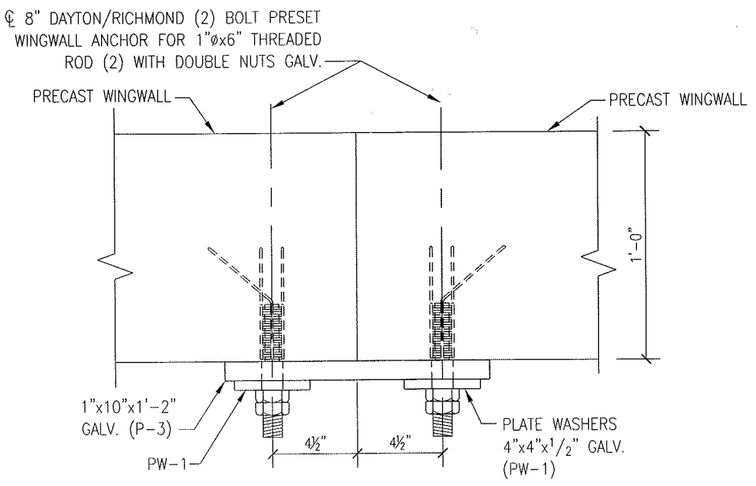
PW-1
1½" = 1'-0"
(℄ WASHER, ½"x4"x4")
(GALVANIZED PER ASTM A153)



P-3
1½" = 1'-0"
(℄ 1"x10"x14")
(GALVANIZED PER ASTM A153)



2/S-2 DETAIL AT UNIT LEG
1½" = 1'-0"



3/S-1 DETAIL AT WINGWALLS
1½" = 1'-0"

SIMPSON GUMPERTZ & HEGER
Engineering of Structures and Building Enclosures
Simpson Gumpertz & Heger Inc. 781.907.9000
41 Seyon Street, Building 1, Suite 500 fax 781.907.9009
Waltham, Massachusetts 02453 www.sgh.com

STATE OF MICHIGAN
TIMOTHY J. McGRATH
ENGINEER
No. 45330
LICENSED PROFESSIONAL ENGINEER

Timothy J. McGrath P.E. #45330
Seal

Revisions:

No.	Date
1	
2	
3	
4	
5	
6	
7	

Sheet Title: CONNECTION DETAILS SHOP DRAWING

Producer: HANSON PIPE & PRODUCTS, Inc.
7925 EMPIRE PARKWAY
MACEDONIA, OHIO 44056
PHONE: 330-467-7890
FAX: 330-468-2258

WAYNE COUNTY MICHIGAN

WINGWALL DESIGN FOR:
ANTIETAM AVENUE OVER
DEQUINDRE CUT GREENWAY
SHELBY TWP, MICHIGAN

Design By: MCR/JMP	Job No: 070002.30
Drawn By: KMG	Sheet No: S-7
Check By: TJM	
Date: 09/07/07	

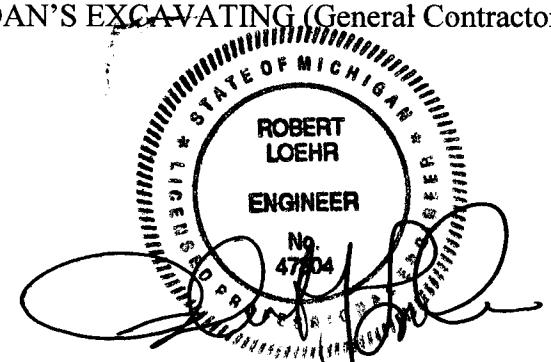
PRECAST REINFORCED CONCRETE 3-SIDED CULVERT AND HEAD WALL UNITS
ANTIETAM AVENUE OVER DEQUINDRE CUT GREENWAY
SHELBY TWP, MI
BRO 82022– 83945 A
MICHIGAN DEPARTMENT OF TRANSPORTATION

STRUCTURAL DESIGN CALCULATIONS
FOR

42'SPAN x 13'RISE PRECAST CONCRETE 3-SIDED CULVERT
WITH 2'-0" Max CROWN COVER & HS 20-44 LIVE LOAD

FOR:
MANUFACTURER:
NORTHERN CONCRETE PIPE CO, INC
BAY CITY, MI.

HYSPAN SYSTEMS, INC.
AND
DAN'S EXCAVATING (General Contractor)



FOR PRECAST ONLY

Date: Aug 24, 2007

The above engineer's seal indicates that the design represented herein was prepared in accordance with the AASHTO 2002 LFD design specifications referenced in the calculations.

Prepared By:

Robert J. Loehr, P.E., S.E.
Structural Engineer
ABNA of Illinois, Inc.
327 Missouri Ave. Suite 625
East St. Louis, IL 62221
(314-454-0222 Ext 1113)

ANTIETAM AVENUE OVER DEQUINDRE CUT GREENWAY

Design Summary Date: 08-24-07

The precast concrete 3-sided culvert units in this project are designed to support their own weight plus crown cover of 2' plus live load.

Live load is HS20-44 parallel to span. Interstate Loading (or Alternate Military) is not considered in this design. Impact loading of 20% of live load was taken for the given cover. Maximum calculated design deflection due to live load + impact is xxx" which is less than the allowable of L/1000 = 0.498"(1/2"). The superimposed dead load of 272 psf for 1.95' max crown cover. (9" Concrete @150pcf, 4" Aggregate @ 135pcf and 139.76'-136.64' -14"slab -13" pavement = 0.87' granular @125pcf).

A rigid frame elastic analysis computer software program STAAD was used to compute the forces and deflection. Please see sheet 3 for a more detailed description of the analysis. The 3-sided precast produces less vertical load on the substructure but more horizontal load than arch span units. SEE SHT. 8
The 2002 AASHTO Design Specifications for Roads and Bridges and Interim Specifications were used for factored load and service load.
FOR TIE PL'S SEE SHTS. 35-38

Self weight load factor = 1.3
Superimposed dead load factor = 1.3
Live load factor = 2.17; Impact = 1.2 for 1.5'average cover

Concrete strength used: 5,000psi 28-day compressive strength minimum

Reinforcement properties: 60ksi yield strength for mild reinforcement, 65ksi yield strength for welded wire fabric---smooth or deformed wire
Coating of reinforcement is "black bar"

Field Requirements: 1) Grouting all handling holes, slab and footing shear keys
2) Bedding and backfill per project specifications
3) Mastic and joint seals per project requirements
4) Tie plates in top slab to prevent rotation of narrow pieces.

Strength Reduction Factors: Reinforcement = 0.95 Shear = 0.90

NOT INCLUDED IN THIS DESIGN:

1) Design of guardrail or handrail and/or connections of railing (except head wall) to precast concrete.
2) Allowable soil pressures or acceptability of soil conditions at site.
3) Hydraulic or scour requirements
4) Lifting and handling devices
5) Means or methods of construction
6) Construction site and precast plant safety

EXECUTIVE SUMMARY HY-SPAN 3-SIDED PRECAST CONCRETE CULVERT DESIGN

A. GENERAL ANALYSIS

1. 3-sided structure is modeled as a rigid frame with elastic section properties and pin-connected bases (rotation permitted but vertical and horizontal forces are restrained).
2. Lateral (thrust) forces due to gravity dead and live loads on the structure are resisted by the compacted earth backfill against the legs and footings. Grouted shear keys at bases engage the legs and foundations.
3. Lateral (hydrostatic) forces due to earth pressures are resisted by the vertical legs (which function as beams and columns), the passive earth pressure on the legs and pile caps, lateral pile capacities and the frame stiffness such that no assumed horizontal movement occurs.
4. Forces exerted on the foundations by the design dead and live loads are listed in the calculations—**sheet 8 of 38** Hy-Span and ABNA Engineering, Incorporated accept responsibility for the structural design of the *precast sections only.*

B. DESIGN

1. Structure is designed as reinforced concrete per Section 8 AASHTO 2002 "Standard Specifications for Highway Bridges" LOAD FACTOR METHOD."
2. Per AASHTO, when span lengths for design are center of members (geometric center of slab to geometric center of legs) the forces are calculated at the face of supports.
3. Haunches longer than their 1' - 0" depth compose an integral part of the concrete section and increase the section's capacity for flexure, shear, torsion and deflection.
4. Critical sections investigated for design are: top of leg at haunch intersection, slab at face of leg, slab at mid haunch, slab at end of haunch and midspan of slab.
5. Minimum reinforcement is determined by the capacity required to resist the loads and stresses imposed and by AASHTO Sections 16.8.5.8 and 8.1.7.1. Maximum reinforcement is per Section 8.16.3.1.
6. Shear reinforcement is not required (all sections are treated as slabs) when shear strength ΦV_n exceeds the factored shear force (V_{LF}) at the sections considered. When the cover exceeds 2'-0", allowable shear may be increased 50%.
7. Understrength factors Φ (phi) are: 0.95 for flexure, 0.9 for shear and 0.7 for axial loads.
8. AASHTO Section 8.16.6.7 applies to 3-sided culverts.
9. AASHTO Section 6 applies to 3-sided culverts especially Section 6.4.
10. Design live load is **HS-20-44**, not including interstate tandem.
11. Distribution of live wheel loads is per Section 3.24.3.2 Case B with S = face of legs (clear span) parallel to centerline of roadway. Primary reinforcement (A_{s1}, A_{s4}, A_{s5}, A_{s7}, and A_{s8}) is placed parallel to the centerline of roadway and spacing is measured at right angles to the centerline of roadway. Distribution reinforcement (A_{s2}, A_{s3} and A_{s6}) is placed parallel to the lay length (skew length, if skewed). Maximum spacing of bars is 12". For cover > 2'-0", distribution reinforcement is > or = 0.125sq.in./ft.
12. Impact loading is per AASHTO Section 3.8.2 including Section 3.8.2.3.
13. The following material properties are utilized: concrete 28-day strength 5,000 psi, reinforcing bars Grade 60 yield = 60,000 psi, and WWF 65,000 psi yield.
14. The quantity "z" in Equation (8-61) for crack control is < or = 130 kips per inch for severe exposure without thrust factors. Maximum spacing of primary longitudinal A_{s4} and A_{s5} reinforcement set at 6" satisfies the criteria.

WITNESSES

WITNESSES TO CP2: 2 INCH MAGNAIL SET IN HMA NEAR ℄ ANTIETAM AVENUE 100 FT WEST OF BRIDGE
NORTHING: 5048.11 EASTING: 10083.24
STA 8+58.28 ; OFF 5.06 FT LT

S 80° E	TOP CENTER FIRE HYDRANT	40.1 FT
S 30° E	NW CORNER OF CATCH BASIN	16.45 FT
S 40° W	CENTER LIGHT POLE	58.1 FT
N 30° W	NE CORNER OF CATCH BASIN	8.2 FT

WITNESSES TO CP3: 2 INCH MAGNAIL FOUND IN CONCRETE ISLAND AT EAST SIDE OF ANTIETAM & ST. AUBIN INTERSECTION
NORTHING: 5193.8426 EASTING: 10395.8944
STA 12+01.62 ; OFF 29.25 FT RT

N 10° E	CENTER LIGHT MANHOLE	2.3 FT
N 70° E	BACK OF CURB	6.2 FT
S 20° E	BACK OF CURB	17.7 FT
S 70° W	BACK OF CURB	7.65 FT

BENCH MARKS

BM 100 EL = 138.85
ARROW AT TOP OF FIRE HYDRANT IN NORTH MEDIAN OF INTERSECTION OF ANTIETAM AVENUE AND ORLEANS STREET

NORTHING: 4975.19 EASTING: 9878.88
STATION: 6+45.33 ; OFFSET: 46.76 FT LT

BM 200 EL = 138.29
DETROIT MONUMENT 39-357 FOUND IN NORTHEAST QUADRANT OF ANTIETAM AVENUE AND ST. AUBIN STREET

NORTHING: 5237.38 EASTING: 10371.44
STATION: 12+02.71 ; OFFSET: 20.61 FT LT

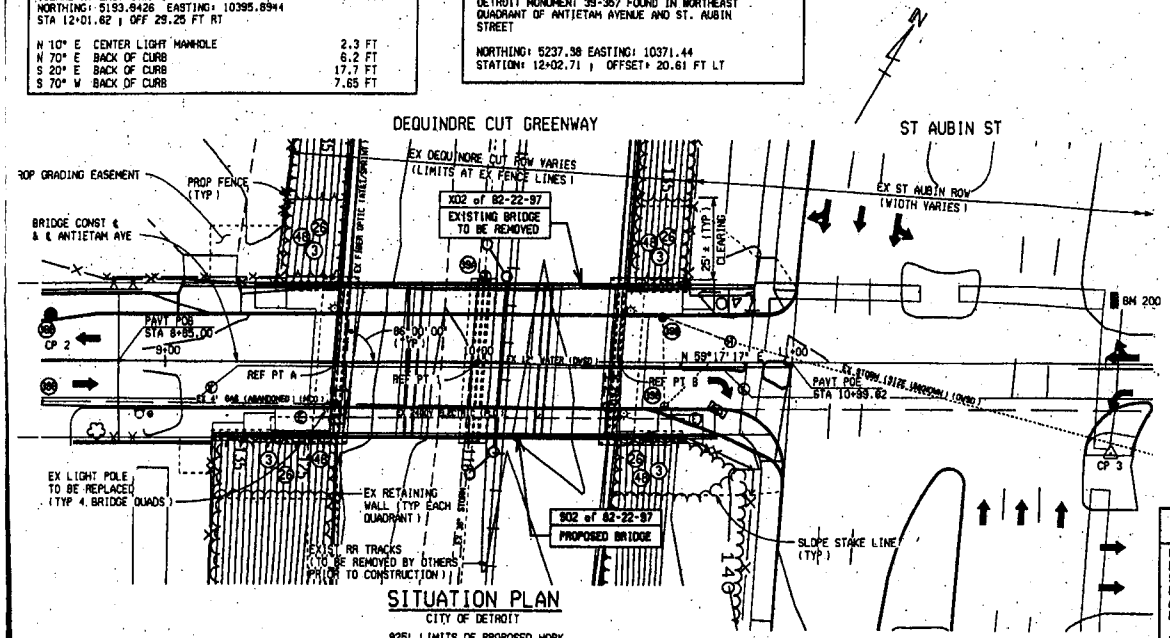
EXISTING STRUCTURE

THE EXISTING STRUCTURE IS A 3 SPAN BRIDGE WITH A TOTAL SPAN LENGTH OF 85 FEET. THE EXISTING SUPERSTRUCTURE CONSISTS OF CONCRETE ENCASED ROLLED STEEL BEAMS. THE ABUTMENTS ARE ON PILES AND THE PIERS ARE ON SPREAD FOOTINGS. THE BRIDGE WAS BUILT IN 1930.

EROSION AND SEDIMENTATION CONTROL MEASURES

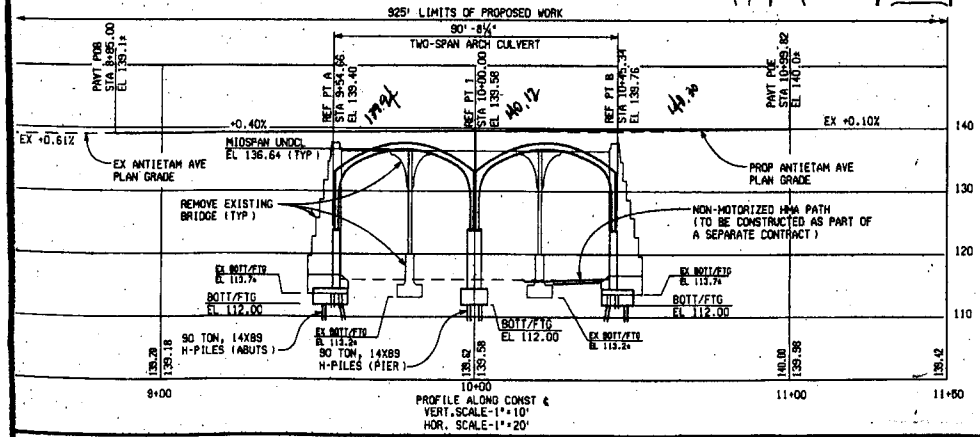
				KEY NO.
*	100	Ft	Erosion Control, Silt Fence	29
	4	Ea	Erosion Control, Inlet Protection, Fabric Drop	194
	4	Ea	Erosion Control, Inlet Protection, Geotextile and Stone	196
	200	Syd	Slope Restoration	3
	200	Syd	Mulch Blanket	48

* PLACE AS DIRECTED BY THE ENGINEER

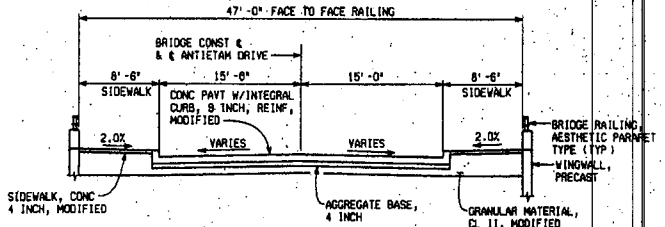


SITUATION PLAN

CITY OF DETROIT



PROFILE ALONG CONST ℄
VERT. SCALE-1"=10'
HOR. SCALE-1"=20'



TYPICAL APPROACH SECTION

UTILITIES

CITY OF DETROIT, PUBLIC LIGHTING DEPT (PLD) 9449 GRINNELL DETROIT, MI 48213 ATTN.: STAN TOPOLEWSKI PHONE NO.: (313) 267-7228	ELECTRIC, LIGHTING
CITY OF DETROIT DETROIT WATER & SEWERAGE DEPT (DWSD) J MADISON BLDG 1420 WASHINGTON BLVD., SUITE 100 DETROIT, MI 48226 ATTN.: MICHAEL KUBIAN PHONE NO.: (313) 967-1508	WATER, SEWER
DTE ENERGY MICHIGAN CONSOLIDATED GAS CO. (MCG) MAIN REPLACEMENT TEAM, 2ND FLOOR 3200 HOBSON DETROIT, MI 48201 ATTN.: PAUL HARTMAN PHONE NO.: (313) 577-7236	GAS
AT&T 2152 S. 114TH STREET WEST ALLIS, WI 53227 ATTN: JOHN KOTZ PHONE NO.: (414) 290-8927	FIBER OPTIC
SPRINT 5600 NORTH RIVER ROAD ROSEMONT, IL 60018 ATTN: GERRY CRAIN PHONE NO.: (847) 318-3010	FIBER OPTIC

NOTES:

THE WORK COVERED BY THESE PLANS INCLUDES CLEARING, GRUBBING, EARTH EXCAVATION, MAINTAINING TRAFFIC, TRAFFIC IMPROVEMENTS, REMOVAL OF THE EXISTING BRIDGE, CONSTRUCTION OF THE PROPOSED BRIDGE AND APPROACHES TO THE LIMITS SHOWN.

THE CONTRACTOR SHALL LOCATE ALL ACTIVE UNDERGROUND UTILITIES PRIOR TO STARTING WORK AND SHALL CONDUCT HIS OPERATIONS IN SUCH A MANNER AS TO ENSURE THAT THOSE UTILITIES NOT REQUIRING RELOCATION WILL NOT BE DISTURBED.

ANTIETAM AVENUE TRAFFIC IS TO BE DETOURED OVER OTHER EXISTING ROADS.

PLAN ELEVATIONS REFER TO CITY OF DETROIT DATUM.

TOPOGRAPHY SHOWN HERE REPRESENTS CONDITIONS EXISTING AT THE TIME THE FIELD SURVEY WAS MADE. HOWEVER, THESE CONDITIONS MAY HAVE BEEN MATERIALLY ALTERED BY THE OPERATIONS OF OTHERS PRIOR TO THIS CONTRACT.

DESCRIPTION	DATE	BY

DLZ | CITY OF DETROIT

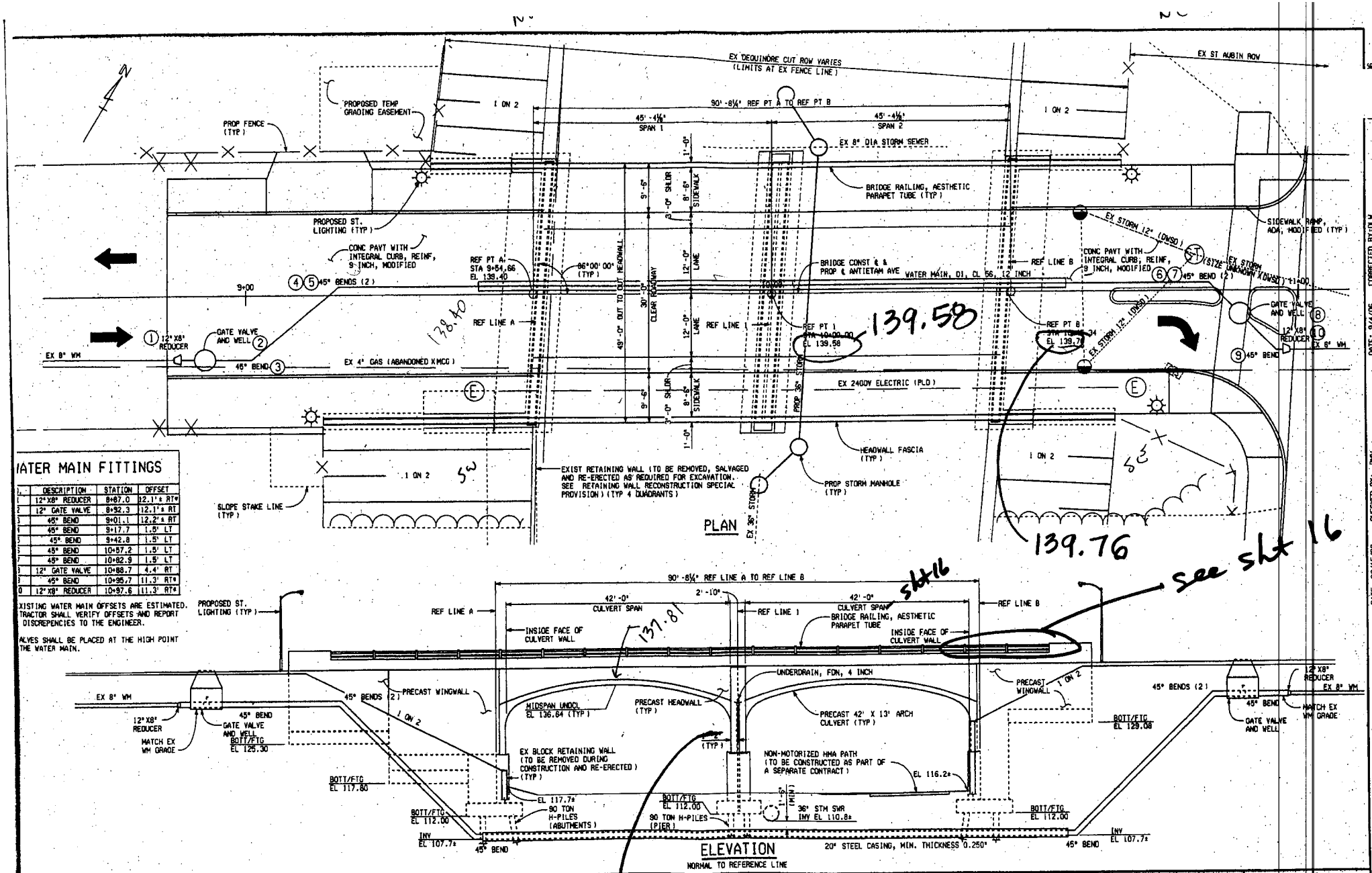
ANTIETAM AVENUE OVER DEQUINDRE CUT GREENWAY

GENERAL PLAN OF SITE

DATE: 4/13/07
DLZ JOB NO. 0041-6083-00

DATE: 9/7/06
CORRECTED BY: TNB
DATE: 5/5/06
BY: BMW
DATE: 05/18/06
DRAWN BY: bmw
FILE NAME: antsitem3.dgn

SHEET 4



WATER MAIN FITTINGS

	DESCRIPTION	STATION	OFFSET
1	12"X8" REDUCER	8+87.0	12.1'± RT*
2	12" GATE VALVE	8+92.3	12.1'± RT
3	45° BEND	9+01.1	12.2'± RT
4	45° BEND	9+17.7	1.5' LT
5	45° BEND	9+42.8	1.5' LT
6	45° BEND	10+57.2	1.5' LT
7	45° BEND	10+82.9	1.5' LT
8	12" GATE VALVE	10+88.7	4.4' RT
9	45° BEND	10+95.7	11.3' RT*
10	12"X8" REDUCER	10+97.6	11.3' RT*

EXISTING WATER MAIN OFFSETS ARE ESTIMATED. TRACTOR SHALL VERIFY OFFSETS AND REPORT DISCREPENCIES TO THE ENGINEER.

VALVES SHALL BE PLACED AT THE HIGH POINT OF THE WATER MAIN.

DESCRIPTION	DATE	BY

DLZ | CITY OF DETROIT

ANTIETAM AVENUE OVER DEQUINDRE CUT GREENWAY

MDOT JOB NO. 83948A | STRUCTURE NO. S02 of S2-22-97

GENERAL PLAN OF STRUCTURE

DATE: 4/13/07

DLZ JOB NO. 0841-6083-00

SHEET NO. 7 OF 48

CORRECTED BY: DLW

DATE: 9/4/06

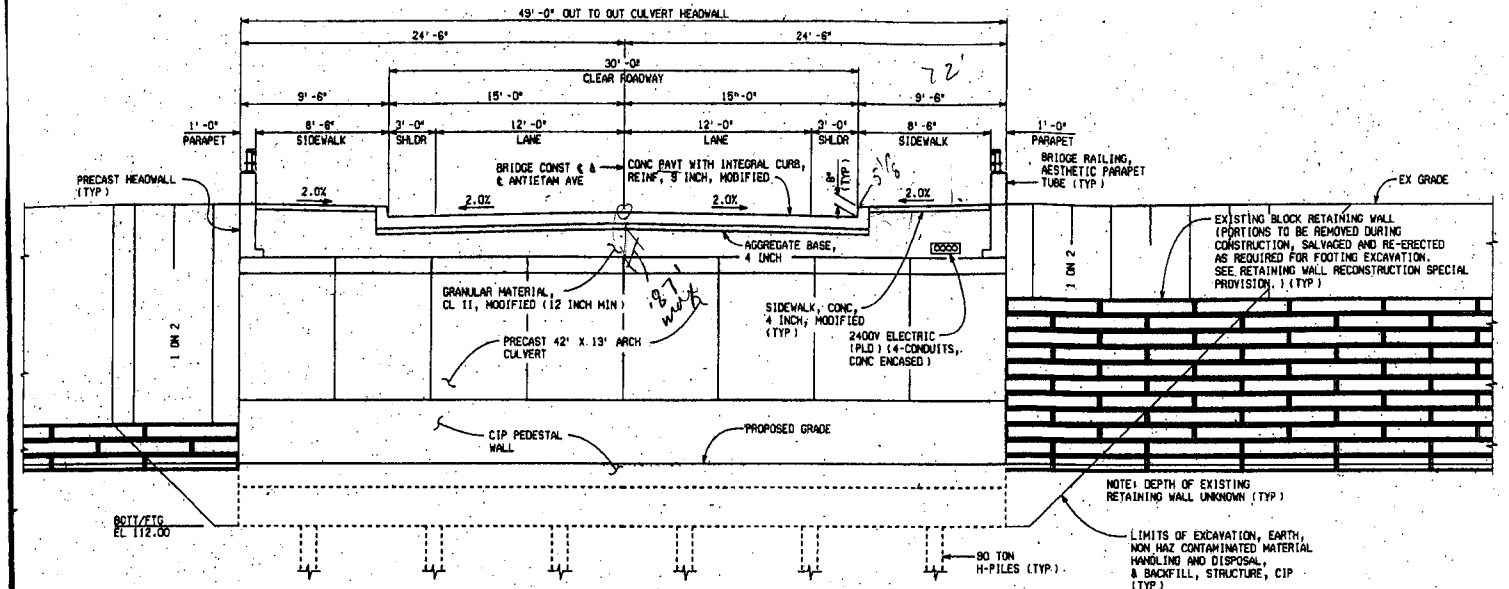
CHECKED BY: BMW

DATE: 06/15/06

DRAWN BY: bmw

FILE NAME: genplan-st.dgn

5



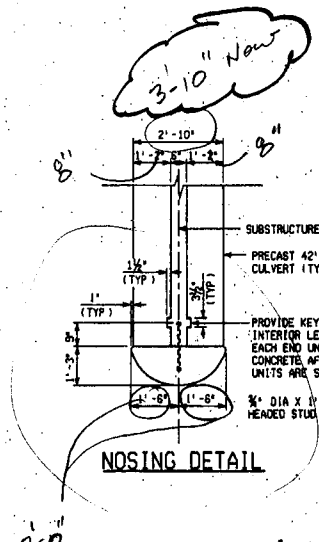
TYPICAL DECK SECTION

LOOKING UPSTATION

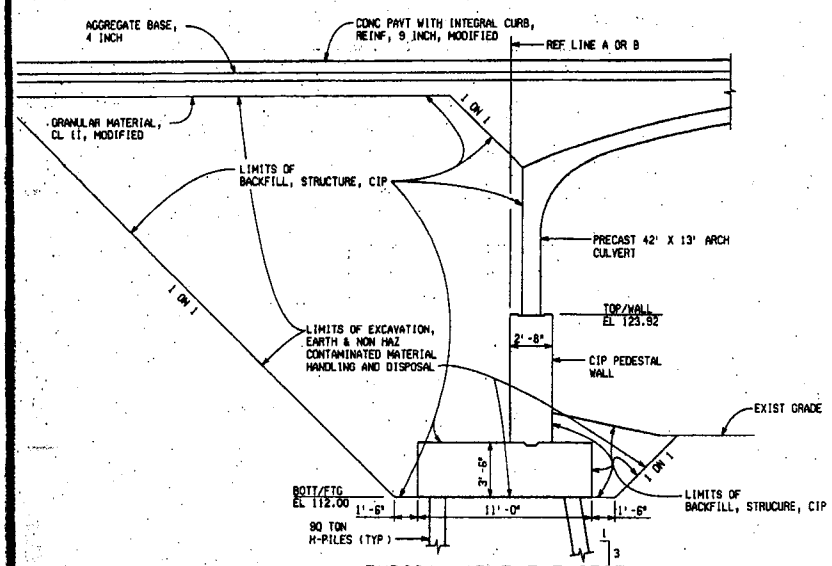
MISCELLANEOUS QUANTITIES

1	LS	Structures, Rem
4190	Cyd	Backfill, Structure, CIP
2000	Cyd	Non Haz Contaminated Material Handling and Disposal
200	Cyd	Excavation, Earth
242	Ft	Water Main, DI, CL 56, 12 inch
* 400	SFt	Retaining Wall Reconstruction
100	Ft	Culv, Precast Three-Sided or Arch, 42 foot by 13 foot, Modified
1228	SFt	Wingwall, Precast

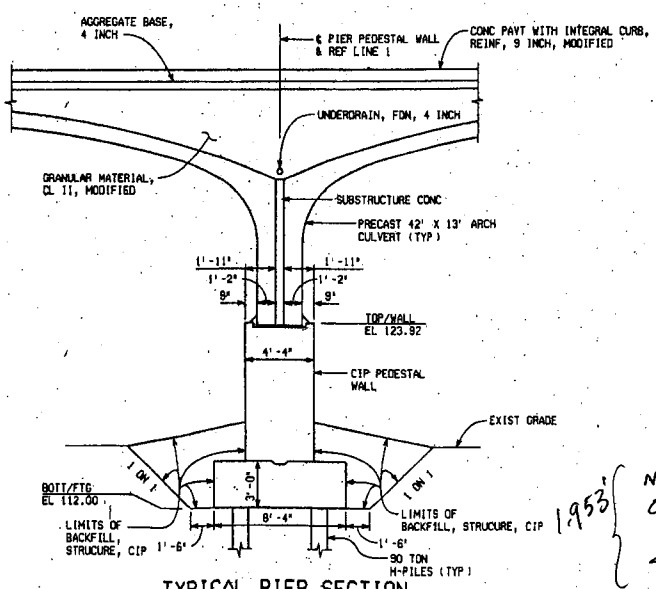
* AS DIRECTED BY THE ENGINEER



NOSING DETAIL



TYPICAL ABUTMENT SECTION



TYPICAL PIER SECTION

NOTES:

THE DESIGN OF THIS STRUCTURE IS BASED ON CURRENT AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES HS20-44. LIVE LOAD PLUS IMPACT DEFLECTION DOES NOT EXCEED 1/1000 OF SPAN LENGTH. THE LOAD FACTOR METHOD OF DESIGN WAS USED FOR THIS STRUCTURE.

SEE DLZ SHEET 11 OF 48 FOR UNDERDRAIN OUTLET DETAILS.

design

1,953' MAX Cover ℄: 9" Conc Pav't + 4" Aggreg Base

139.76' − 13"/12 − 136.64' − 14 5/16 / 12 (.87')

DESCRIPTION	DATE	BY

DLZ

CITY OF DETROIT

ANTIETAM AVENUE OVER DEQUINDRE CUT GREENWAY

MDOT JOB NO. 83948A | STRUCTURE NO. S02 of 82-22-97

GENERAL PLAN OF STRUCTURE

DATE: 4/13/07

DLZ JOB NO. 0041-6063-00

SHEET NO. 3 OF 48

DATE: 06/15/06

DRAWN BY: Lmw

FILE NAME: antietam-st2.dgn

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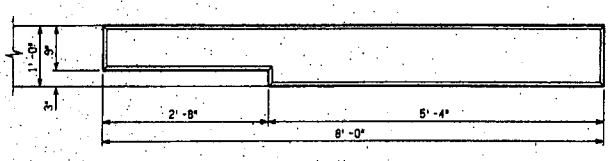
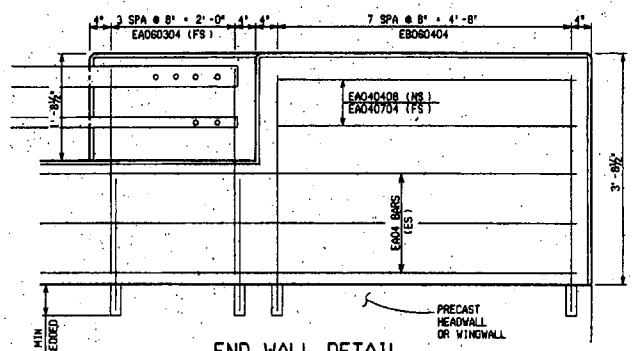


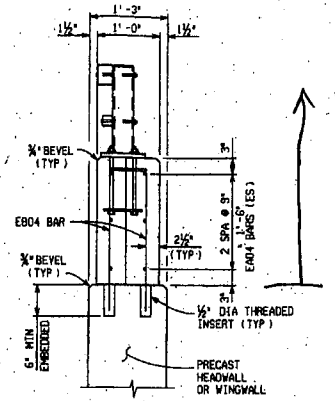
PLAN - END WALL

AESTHETIC PARAPET TUBE



END WALL DETAIL

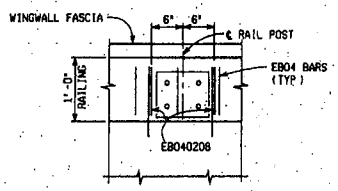
AESTHETIC PARAPET TUBE



SECTION A-A

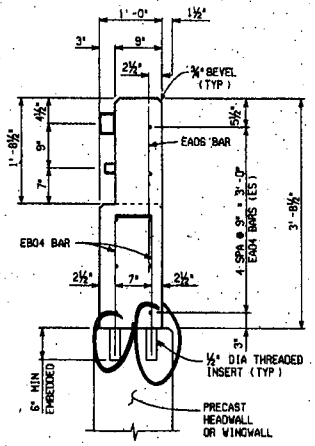
(FULL CONCRETE AREA)

by cont. ? grow



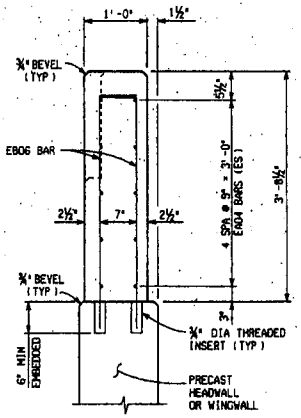
RAIL POST DETAIL

(TYP 38 POSTS)



SECTION AT END WALL

(TUBE CONNECTION AREA)



SECTION AT END WALL

(FULL CONCRETE AREA)

MISCELLANEOUS QUANTITIES		
282	Ft	Bridge Railing, Aesthetic Parapet Tube
5	Cyd	Conc, Grade D

NOTES:

NS DENOTES NEAR SIDE.

FS DENOTES FAR SIDE.

ES DENOTES EACH SIDE.

FOR BEVEL AND MOLDING DETAILS, SEE STANDARD PLAN B-103 SERIES.

WORK THIS SHEET WITH SHEET 15 OF 48.

DESCRIPTION	DATE	BY

DLZ | CITY OF DETROIT | ANTIETAM AVENUE OVER DEQUINDRE CUT GREENWAY | SUPERSTRUCTURE DETAILS

DATE: 4/13/07

DLZ JOB NO. 05-1-8053-00

DATE: 9/12/06

TED BY: DLW

DATE: 9/06/06

CHECKED BY: BMW

DATE: 8/08/06

DRAWN BY: BMW

LE NAME: antietam-dk2.dgn

7

ABNA Engineering, Inc.

JOB NUMBER: _____ BY: _____ DATE: _____

SUBJECT: _____ CHK'D BY: _____ DATE: _____

Wearing Surface & Superimposed DL

Sheet 7: Crown Elev. Pt B = 139.76'
Bot. of 3-Sided = 136.64'
Δ = 3.12'

Sheet 8: 9" Conc. Pav't + 4" Aggreg Base = 13"
Slab for 3-Sided = 14"
Δ = 3.12' − (13" + 14") = 0.87' Granular say 11"
Total Cover = .87' + 13" = 1.953' ~ 2'
Superimp. DL = 9/12(.150) + 4/12(.135) + 11"/12(.125) = 272
say 272 psf

Reactions on Substructure:

Vertical: DL (Hy Span) = $\frac{16.9^K}{2}$ + SDL .272 × $\frac{44.94}{2}$ = 14.6^K

ABUT. LL (0% Impact) = $\frac{3.5^K \times 2.25}{1.2}\left(1+\frac{43.27-14}{43.27}+\frac{43.27-28}{43.27}\right)$ = 5.2^K
VERT. TOTAL = 19.8^K

Horiz: DL (Hy Span) = 2.58^K
SDL = 3.47^K } 6.05^K
LL (0% Imp.) = 2.85/1.2 = 2.38^K } 8.43^K TOTAL HORIZ.

PIER: 2 × 14.6^K = 29.2^K DL + SDL
6" GROUT = (2' + 14.17') .5 × .15 = 1.2^K } 30.4^K VERT D.L.
LL = $\frac{3.5^K}{1.2} + 1.25 \times \frac{3.5}{1.2}\left(\frac{44.94+.25-14}{44.94+.25}\right)$ = 5.4^K
TOTAL @ PIER 35.8^K VERT

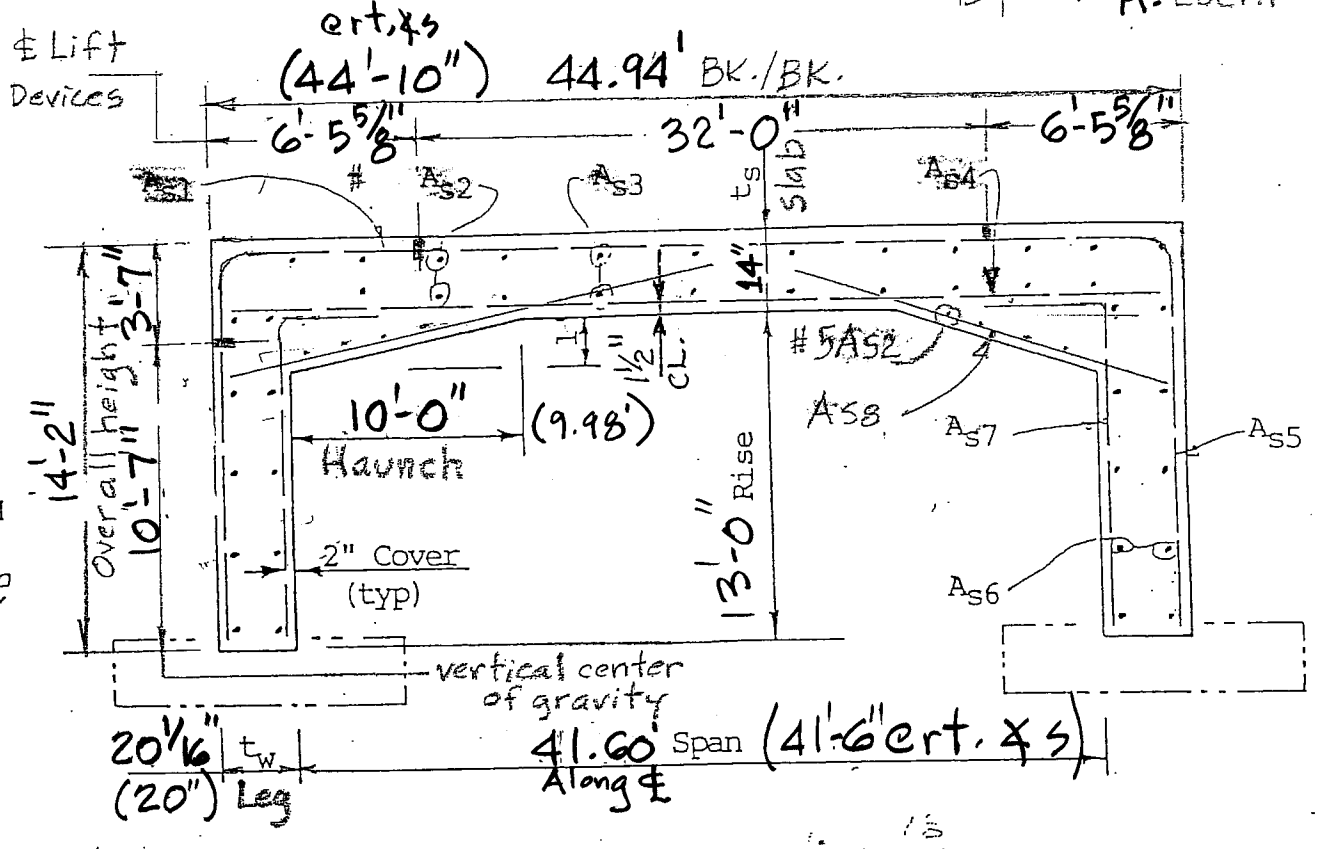
Horiz. = 2.38^K
(DL cancel each other)

→ LOADS ARE PER LINEAL FT. OF FOUNDATION

Project : Antietam Ave.

Date : 08-25-07

By : R. Loehr



Hy-Span™ Structure

Design Requirements for Hy-Span™ Structures
AASHTO HS20 Loading
Pavement with 2' Earth Cover

Piece Length = 3'-0¼" crt. ℄s

$A_{CONC.}$ = 44.8333 × 14.167' − 41.5' × 13' + 10 cos 4° × 1'

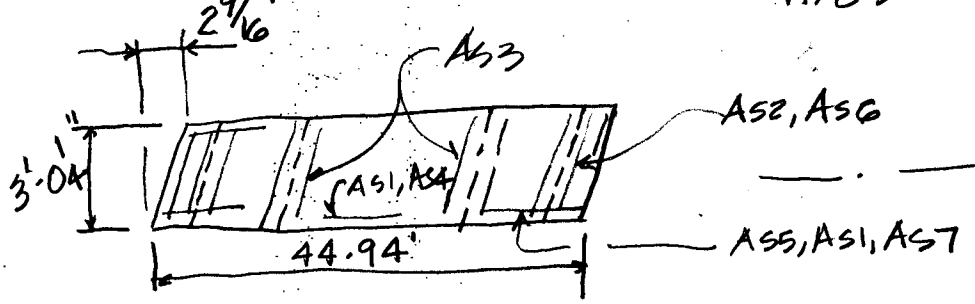
= 105.62 ft² per ft. lay length

Weight per Foot = $A_{CONC.}$ × 160 pcf

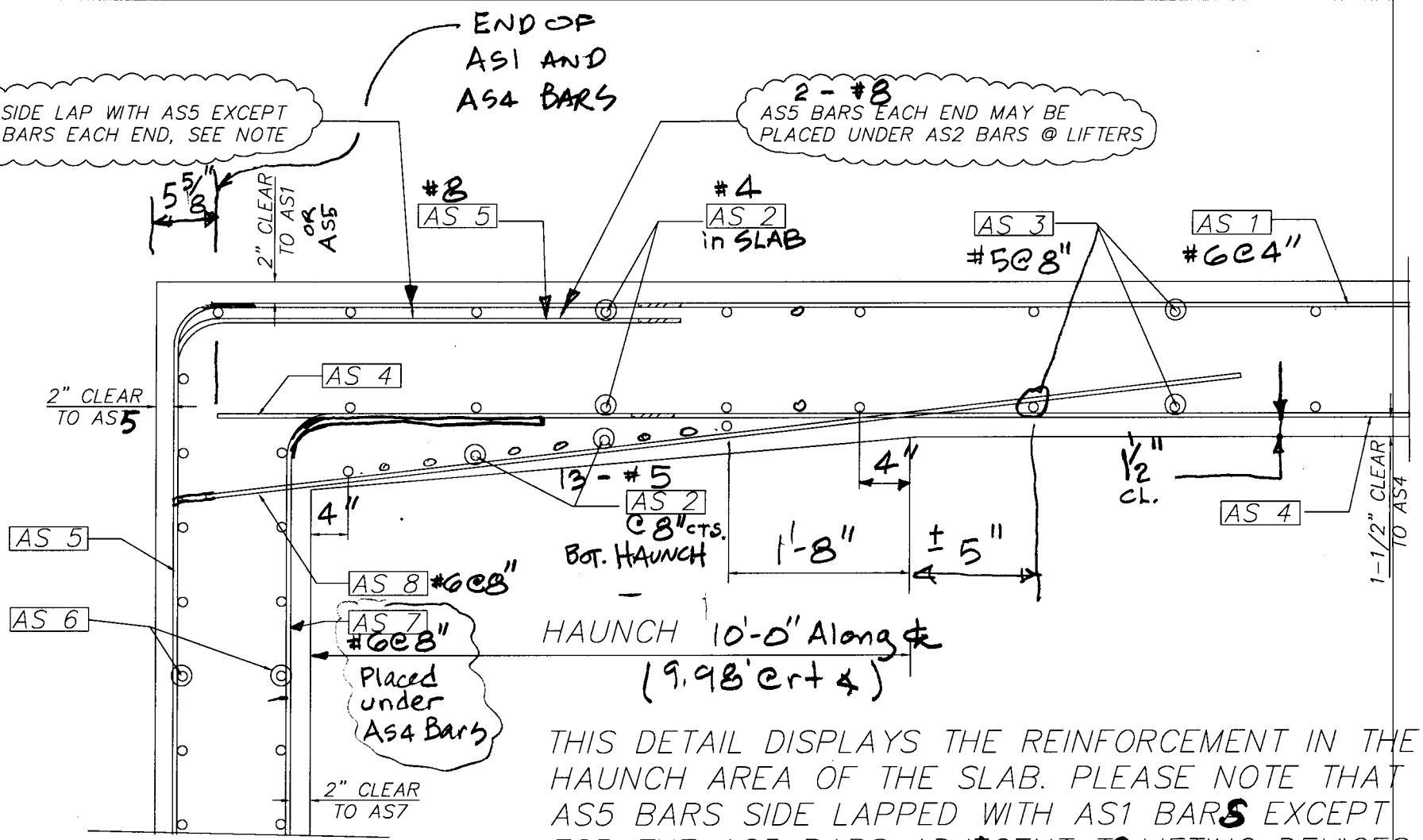
= 16,900 lbs/ft. (51,200 lbs.)

Volume (one piece) = $A_{CONC.}$ × PieceLength/27

= 11.85 cubic yards/piece



PLAN

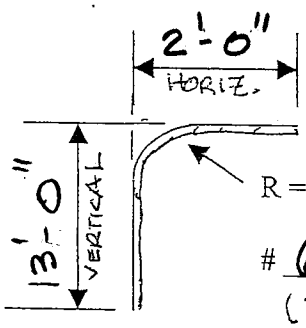


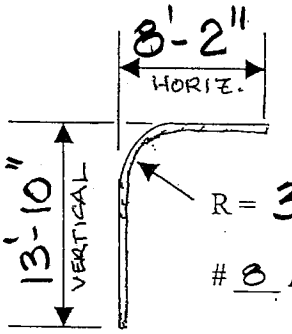
THIS DETAIL DISPLAYS THE REINFORCEMENT IN THE HAUNCH AREA OF THE SLAB. PLEASE NOTE THAT AS5 BARS SIDE LAPPED WITH AS1 BARS EXCEPT FOR THE AS5 BARS ADJACENT TO LIFTING DEVICES

ABNA Engineering, Inc.

Sheet 11 of ____

Client: Hy-Span Systems, Inc. / NORTHERN CONC Designer: R. Loehr, P.E.
Project: Michigan: Antietam Ave. / Dequindre Cut Greenway
41'-7 3/16" clear along ℄; 44.94' BK/BK Along ℄
Subject: Culvert Reinforcement
Date: 8-24-07
Job No.: ____





R = Radius of Bend

Skew Angle: 4°
Nominal Size Overall: 44'-10" x 14'-2" crt.'s
Lay Length (Along Stream): 2 spans of 49' (98.24' Total)
Shipping Length: ~45'-2"
Volume of Concrete: 11.85 (x32 = 379.2) cu. yds.
Weight (160-pcf unit weight): 51,200 lbs. Each

REQUIRED REINFORCING STEEL AREAS PER LINEAL FOOT

As1 1.26 in.²
As2 0.48 in.² Average for Section
As3 0.336 in.²
As4 1.60 in.²
As5 2.36 in.²
As6 0.48 in.²
As7 0.48 in.²
As8 0.60 in.²

REINFORCEMENT EACH UNIT (_____ lbs. total)

AREA PROVIDED	TOTAL	SIZE	SPACING	LENGTH
As1 1.32 in.²	9	# 6 @	4" cts.	44'-0" STR. CENTERED ON LENGTH
.525 avg. { As2 0.29 in.² x2	60	T. + B. SLAB # 4 @		
0.46 in.²	26	# 5 BOT. @ HAUNCH	8" cts.	2'-9" STR.
As3 0.46 in.²	64	# 5 @	8" cts.	2'-9" STR.
As4 1.8 in.²	9	# 7 @	4" cts.	44'-0" STR. CENTERED ON LENGTH
As5 2.37 in.²	18	# 8 @	4" cts.	22'-0" BENT
As6 .49 in.²	92	# 5 @	7 1/2" cts.	2'-9" STR.
As7 0.66 in.²	10	# 6 @	8" cts.	15'-0" BENT
As8 0.66 in.²	10	# 6 @	8" cts.	13'-0" STR.

41'-6"

Design Computations ~~42~~ X 13

Designer RT Date 8-23-07 Sheet No
Checker RJL Date 8-24-07 Job No 2007-182

Leg	Impact	Cover	Haunches	slab d
20"	20%	~~1.5~~ 2.0'	10'	14"

LOAD FACTORS

SELF DL	**1.30**
SUPIMP DL	**1.30**
MLL+Imp	**2.17**

2' COVER & 20% IMPACT LOAD CASE FOR MAXM SF

	Joint 2	Joint 4/18	Joint 6/16	Joint 8/14	Joint 11
$M_{self\ DL}$	30.99	29.80	12.25	-0.84	-11.74
$M_{supimp\ DL}$	41.62	40.55	17.91	-0.71	-16.60
M_{LL+I}	34.23	34.26	18.65 ✓	-6.83	-18.20
$M_{SERVICE}$	106.84	104.61	48.81	-8.38	-46.54
M_{LF}	**168.67**	**165.80**	**79.68**	**-16.84**	**-76.34**
	~169	~166	~80		~77

$V_{self\ DL}$	-2.28	4.49	3.07	2.02	
$V_{s\ DL+Ws\ DL}$	-3.47	5.48	4.21	2.94	
V_{LL+I}	-2.85	5.93	4.65	4.21	
$V_{service}$	-8.60	15.90	11.93	9.17	
V_{LF}	**-13.66**	**25.83**	**19.55**	**15.58** ✓	
d	17.5"	23.5"	17.5"	11.5"	
1.53d	< 26.8K OK	< 35.9K O.K.	< 26.8K O.K.	17.6K	

NOTE + Moments indicate tension on top or outside face
− " " " " bottom or inside "

ABNA Engineering, Inc.

JOB NUMBER: _____ BY: _____ DATE: _____

SUBJECT: _____ CHK'D BY: _____ DATE: _____

Joint 2 M_{LF} = M_{SER} =

AS5

SPACING = (36¼ - 4¼) = 32

USING 9-#8 BARS. SPACING = 4"

$A_s = \frac{12}{4} \times 0.79 = 2.37$ in² $d = 20 - 2 - 8/16 = 17.5$

$\rho = 0.01128$

$\phi M_n = \phi A_s \cdot d * F_y (1 - 0.6 \rho f_y/f'_c)/12$

$= 0.95 \times 2.37 \times 60 (1 - 0.6 \times 0.01128 \times 60/5) \times 17.5/12$

$= 181.0$ K-ft > 154

$M_{SER} = 95.81$ K-ft

$J = 0.890$

$f_s = M_{ser}/A_s j d = 95.81 \times 12/(2.37 \times 0.890 \times 17.5) = 31.14$ ksi

$F_{s(allowable)} = \frac{Z}{\sqrt[3]{2 d_c^2 s}} = \frac{130}{\sqrt[3]{2 \times 2.5^2 \times 4}} = 35.29$ ksi OK

JOINT 11

AS4

$M_{LF} = 76.4$ K-ft $M_{SER} = 46.6$ K-ft

Try #7 @ 4", $A_s = 1.80$ in² $d = 14 - 1.5 - 7/16 = 12.06$"

$\rho = 1.80/(12 \times 12.06) = .01244$

$\phi M_n = 0.95 \times 12.06 \times 1.8 \times 60 (1 - 0.6 \times \rho \times 60/5)$

$= 93.8$ K ft > 76.4 K-ft

JOINT 6 (close to the center of Haunch)

AS1 $M_{LF} = 67.02$, $d = 20 - 2 - 1/2 = 17.5$" (for #8 bars)

A_s (#6 @ 4") $= 1.32$ in² $\rho = .006286$

$\phi M_n = 0.95 \times 0.9 \times 60 \times 17.5 \times (1 - 0.6 \times \rho \times 60/5)/12$

$= 104.7$ K-ft > 79.7 K-ft O.K. $f_s = 27.9$ ksi OK < 35.3 $Z = 130$

Extend AS5 BARS $15 d_b = 15 \times 1 = 15$" beyond pt 6

LOAD - 3 - EP

14

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**************************************************
*                                                *
*           STAAD.Pro                            *
*           Version  2004    Bld 1004.US         *
*           Proprietary Program of               *
*           Research Engineers,  Intl.           *
*           Date=    AUG 24, 2007                *
*           Time=    14:42:12                    *
*                                                *
*      USER ID: ABNA Engineering, Inc.           *
**************************************************
```

```
    1. STAAD PLANE
INPUT FILE: 41.6' x 13HySpan10' HAUNCH.STD
    2. START JOB INFORMATION
    3. JOB NAME 41.6'X 13' MI 3 SIDED HYSPAN 20" LEGS 14" SLAB
    4. JOB CLIENT HYSPAN SYSTEMS-NORTHERN CONCRETE PIPE CO.
    5. JOB NO 2007-NEW
    6. JOB PART CREEK HS20 DESIGN
    7. JOB COMMENT 3-SIDED CULVERT FRAME
    8. JOB COMMENT COVERS: 2'@ 120 PCF
    9. JOB COMMENT HS20 LIVE LOAD
   10. JOB COMMENT LOAD FACTOR DESIGN PER AASHTO 2002
   11. ENGINEER NAME RJL RBT
   12. ENGINEER DATE 8 AUG 07
   13. END JOB INFORMATION
   14. INPUT WIDTH 79
   15. UNIT FEET KIP
   16. JOINT COORDINATES
   17. 1 0 0 0; 2 0 12 0; 3 0 13.04 0; 4 0.836 13.083 0; 5 3 13.192 0; 6 5.5 13.316 0
   18. 7 7.5 13.416 0; 8 10.836 13.586 0; 9 15 13.583 0; 10 18 13.583 0
   19. 11 21.64 13.583 0; 12 25.28 13.583 0; 13 28.28 13.583 0; 14 32.45 13.583 0
   20. 15 35.78 13.416 0; 16 37.786 13.316 0; 17 40.286 13.192 0; 18 42.45 13.083 0
   21. 19 43.28 13.04 0; 20 43.28 12 0; 21 43.28 0 0
   22. MEMBER INCIDENCES
   23. 1 1 2; 2 2 3; 3 3 4; 4 4 5; 5 5 6; 6 6 7; 7 7 8; 8 8 9; 9 9 10; 10 10 11
   24. 11 11 12; 12 12 13; 13 13 14; 14 14 15; 15 15 16; 16 16 17; 17 17 18; 18 18 19
   25. 19 19 20; 20 20 21
   26. DEFINE MATERIAL START
   27. ISOTROPIC MATERIAL1
   28. E 552096
   29. POISSON 0.1667
   30. DENSITY 0.160013
   31. DAMP 2.8026E-044
   32. END DEFINE MATERIAL
   33. UNIT INCHES KIP
   34. MEMBER PROPERTY AMERICAN
   35. 1 2 19 20 PRIS AX 240.72 IZ 8072
   36. 3 18 PRIS AX 312 IZ 17576
   37. 4 17 PRIS AX 294 IZ 14706
   38. 5 16 PRIS AX 258 IZ 9938
   39. 6 15 PRIS AX 222 IZ 6331
   40. 7 14 PRIS AX 186 IZ 3723
```

~~41. 8 TO 13 PRIS AX 168 IZ 2744~~
42. CONSTANTS
43. MATERIAL MATERIAL1 MEMB 1 TO 20
44. PRINT MEMBER INFORMATION

15

MEMBER INFORMATION

MEMBER	START JOINT	END JOINT	LENGTH (INCH)	BETA (DEG)	RELEASES
1	1	2	144.000	0.00	
2	2	3	12.480	0.00	
3	3	4	10.045	0.00	
4	4	5	26.001	0.00	
5	5	6	30.037	0.00	
6	6	7	24.030	0.00	
7	7	8	40.084	0.00	
8	8	9	49.968	0.00	
9	9	10	36.000	0.00	
10	10	11	43.680	0.00	
11	11	12	43.680	0.00	
12	12	13	36.000	0.00	
13	13	14	50.040	0.00	
14	14	15	40.010	0.00	
15	15	16	24.102	0.00	
16	16	17	30.037	0.00	
17	17	18	26.001	0.00	
18	18	19	9.973	0.00	
19	19	20	12.480	0.00	
20	20	21	144.000	0.00	

********** END OF DATA FROM INTERNAL STORAGE **********

```
 45. SUPPORTS
 46. 1 21 PINNED
 47. UNIT FEET KIP
 48. LOAD 1 DEAD LOAD
 49. SELFWEIGHT Y -1
 50. LOAD 2 SUPERIMPOSED DEAD LOAD OF 272 PSF TOP SLAB 2' COVER
 51. MEMBER LOAD
 52. 3 TO 18 UNI GY -.272
 53. LOAD 3 LOADTYPE [redacted] TITLE LATERAL EARTH PRESSURE
 54. MEMBER LOAD
 55. 1 LIN GX 0.474 0.113
 56. 2 LIN GX 0.113 0.082
 57. 19 LIN GX -0.082 -0.113
 58. 20 LIN GX -0.113 -0.474
 59. LOAD 4 LIVE LOAD HS20 20% IMP WHEEL AT CENTERLINE
 60. MEMBER LOAD
 61. 11 CON GY -3.5 0
 62. 7 CON GY -3.5 0.14
 63. 15 CON GY -0.9 0.14
 64. LOAD 5 LIVE LOAD HS20 20% IMP WHEEL AT END HAUNCH JT 8
```

17

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65. MEMBER LOAD
66. 8 CON GY -3.5 0
67. 11 CON GY -3.5 3.196
68. 16 CON GY -0.9 1.05
69. LOAD 6 LIVE LOAD HS20 20% IMP WHEEL AT FACE OF JT 4
70. MEMBER LOAD
71. 4 CON GY -3.5 0
72. 8 CON GY -3.5 4
73. 13 CON GY -0.9 0.556
74. PERFORM ANALYSIS PRINT LOAD DATA
```

P R O B L E M S T A T I S T I C S

NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS = 21/ 20/ 2
ORIGINAL/FINAL BAND-WIDTH= 1/ 1/ 6 DOF
TOTAL PRIMARY LOAD CASES = 6, TOTAL DEGREES OF FREEDOM = 59
SIZE OF STIFFNESS MATRIX = 1 DOUBLE KILO-WORDS
REQRD/AVAIL. DISK SPACE = 12.0/ 16823.5 MB

18

LOADING 1 DEAD LOAD

SELFWEIGHT Y -1.000

ACTUAL WEIGHT OF THE STRUCTURE = 16.809 KIP

LOADING 2 SUPERIMPOSED DEAD LOAD OF 272 PSF TOP SLAB 2' COVER

MEMBER LOAD - UNIT KIP FEET

MEMBER	UDL	L1	L2	CON	L	LIN1	LIN2
3	-0.272 GY	0.00	0.84				
4	-0.272 GY	0.00	2.17				
5	-0.272 GY	0.00	2.50				
6	-0.272 GY	0.00	2.00				
7	-0.272 GY	0.00	3.34				
8	-0.272 GY	0.00	4.16				
9	-0.272 GY	0.00	3.00				
10	-0.272 GY	0.00	3.64				
11	-0.272 GY	0.00	3.64				
12	-0.272 GY	0.00	3.00				
13	-0.272 GY	0.00	4.17				
14	-0.272 GY	0.00	3.33				
15	-0.272 GY	0.00	2.01				
16	-0.272 GY	0.00	2.50				
17	-0.272 GY	0.00	2.17				
18	-0.272 GY	0.00	0.83				

LOADING 3 LOADTYPE NONE TITLE LATERAL EARTH PRESSURE

MEMBER LOAD - UNIT KIP FEET

MEMBER	UDL	L1	L2	CON	L	LIN1	LIN2
1						0.474	0.113 GX
2						0.113	0.082 GX
19						-0.082	-0.113 GX
20						-0.113	-0.474 GX

LOADING 4 LIVE LOAD HS20 20% IMP WHEEL AT CENTERLINE

MEMBER LOAD - UNIT KIP FEET

MEMBER	UDL	L1	L2	CON	L	LIN1	LIN2
11				-3.500 GY	0.00		
7				-3.500 GY	0.14		
15				-0.900 GY	0.14		

LOADING 5 LIVE LOAD HS20 20% IMP WHEEL AT END HAUNCH JT 8

MEMBER LOAD - UNIT KIP FEET

MEMBER	UDL	L1	L2	CON	L	LIN1	LIN2
8				-3.500 GY	0.00		
11				-3.500 GY	3.20		
16				-0.900 GY	1.05		

LOADING 6 LIVE LOAD HS20 20% IMP WHEEL AT FACE OF JT 4

MEMBER LOAD - UNIT KIP FEET

MEMBER	UDL	L1	L2	CON	L	LIN1	LIN2
4				-3.500 GY	0.00		
8				-3.500 GY	4.00		
13				-0.900 GY	0.56		

********** END OF DATA FROM INTERNAL STORAGE **********

75. PRINT MEMBER FORCES

20

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
1	1	1	8.40	-2.58	0.00	0.00	0.00	0.00
		2	-5.20	2.58	0.00	0.00	0.00	-30.99
	2	1	5.89	-3.47	0.00	0.00	0.00	0.00
		2	-5.89	3.47	0.00	0.00	0.00	-41.62
	3	1	0.00	2.25	0.00	0.00	0.00	0.00
		2	0.00	1.27	0.00	0.00	0.00	1.53
	4	1	4.79	-2.68	0.00	0.00	0.00	0.00
		2	-4.79	2.68	0.00	0.00	0.00	-32.12
	5	1	4.21	-2.85	0.00	0.00	0.00	0.00
		2	-4.21	2.85	0.00	0.00	0.00	-34.23
	6	1	6.03	-1.89	0.00	0.00	0.00	0.00
		2	-6.03	1.89	0.00	0.00	0.00	-22.65
2	1	2	5.20	-2.58	0.00	0.00	0.00	30.99
		3	-4.92	2.58	0.00	0.00	0.00	-33.67
	2	2	5.89	-3.47	0.00	0.00	0.00	41.62
		3	-5.89	3.47	0.00	0.00	0.00	-45.23
	3	2	0.00	-1.27	0.00	0.00	0.00	-1.53
		3	0.00	1.37	0.00	0.00	0.00	0.15
	4	2	4.79	-2.68	0.00	0.00	0.00	32.12
		3	-4.79	2.68	0.00	0.00	0.00	-34.90
	5	2	4.21	-2.85	0.00	0.00	0.00	34.23
		3	-4.21	2.85	0.00	0.00	0.00	-37.20
	6	2	6.03	-1.89	0.00	0.00	0.00	22.65
		3	-6.03	1.89	0.00	0.00	0.00	-24.61
3	1	3	2.83	4.78	0.00	0.00	0.00	33.67
		4	-2.82	-4.49	0.00	0.00	0.00	-29.80
	2	3	3.77	5.70	0.00	0.00	0.00	45.23
		4	-3.75	-5.48	0.00	0.00	0.00	-40.55
	3	3	1.37	-0.07	0.00	0.00	0.00	-0.15
		4	-1.37	0.07	0.00	0.00	0.00	0.09
	4	3	2.92	4.64	0.00	0.00	0.00	34.90
		4	-2.92	-4.64	0.00	0.00	0.00	-31.01
	5	3	3.07	4.06	0.00	0.00	0.00	37.20
		4	-3.07	-4.06	0.00	0.00	0.00	-33.81
	6	3	2.19	5.93	0.00	0.00	0.00	24.61
		4	-2.19	-5.93	0.00	0.00	0.00	-19.65
4	1	4	2.81	4.49	0.00	0.00	0.00	29.80
		5	-2.78	-3.78	0.00	0.00	0.00	-20.83
	2	4	3.75	5.48	0.00	0.00	0.00	40.55
		5	-3.72	-4.89	0.00	0.00	0.00	-29.31
	3	4	1.37	-0.07	0.00	0.00	0.00	-0.09
		5	-1.37	0.07	0.00	0.00	0.00	-0.06

21

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	4	4	2.91	4.64	0.00	0.00	0.00	31.01
		5	-2.91	-4.64	0.00	0.00	0.00	-20.95
	5	4	3.06	4.06	0.00	0.00	0.00	33.81
		5	-3.06	-4.06	0.00	0.00	0.00	-25.01
	6	4	2.19	5.93	0.00	0.00	0.00	19.65
		5	-2.01	-2.43	0.00	0.00	0.00	-14.37
5	1	5	2.77	3.79	0.00	0.00	0.00	20.83
		6	-2.74	-3.07	0.00	0.00	0.00	-12.25
	2	5	3.72	4.89	0.00	0.00	0.00	29.31
		6	-3.68	-4.21	0.00	0.00	0.00	-17.91
	3	5	1.37	-0.07	0.00	0.00	0.00	0.06
		6	-1.37	0.07	0.00	0.00	0.00	-0.23
	4	5	2.91	4.65	0.00	0.00	0.00	20.95
		6	-2.91	-4.65	0.00	0.00	0.00	-9.32
	5	5	3.06	4.06	0.00	0.00	0.00	25.01
		6	-3.06	-4.06	0.00	0.00	0.00	-14.85
	6	5	2.01	2.44	0.00	0.00	0.00	14.37
		6	-2.01	-2.44	0.00	0.00	0.00	-8.27
6	1	6	2.74	3.07	0.00	0.00	0.00	12.25
		7	-2.71	-2.57	0.00	0.00	0.00	-6.60
	2	6	3.68	4.21	0.00	0.00	0.00	17.91
		7	-3.66	-3.67	0.00	0.00	0.00	-10.02
	3	6	1.37	-0.07	0.00	0.00	0.00	0.23
		7	-1.37	0.07	0.00	0.00	0.00	-0.37
	4	6	2.91	4.65	0.00	0.00	0.00	9.32
		7	-2.91	-4.65	0.00	0.00	0.00	-0.02
	5	6	3.06	4.06	0.00	0.00	0.00	14.85
		7	-3.06	-4.06	0.00	0.00	0.00	-6.72
	6	6	2.01	2.44	0.00	0.00	0.00	8.27
		7	-2.01	-2.44	0.00	0.00	0.00	-3.40
7	1	7	2.72	2.57	0.00	0.00	0.00	6.60
		8	-2.68	-1.88	0.00	0.00	0.00	0.84
	2	7	3.66	3.67	0.00	0.00	0.00	10.02
		8	-3.61	-2.76	0.00	0.00	0.00	0.71
	3	7	1.37	-0.07	0.00	0.00	0.00	0.37
		8	-1.37	0.07	0.00	0.00	0.00	-0.60
	4	7	2.92	4.64	0.00	0.00	0.00	0.02
		8	-2.74	-1.15	0.00	0.00	0.00	4.31
	5	7	3.06	4.06	0.00	0.00	0.00	6.72
		8	-3.06	-4.06	0.00	0.00	0.00	6.83
	6	7	2.01	2.43	0.00	0.00	0.00	3.40
		8	-2.01	-2.43	0.00	0.00	0.00	4.73
8	1	8	2.58	2.02	0.00	0.00	0.00	-0.84
		9	-2.58	-1.24	0.00	0.00	0.00	7.63

22

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	2	8	3.47	2.94	0.00	0.00	0.00	-0.71
		9	-3.47	-1.81	0.00	0.00	0.00	10.60
	3	8	1.37	0.00	0.00	0.00	0.00	0.60
		9	-1.37	0.00	0.00	0.00	0.00	-0.60
	4	8	2.68	1.29	0.00	0.00	0.00	-4.31
		9	-2.68	-1.29	0.00	0.00	0.00	9.66
	5	8	2.85	4.21	0.00	0.00	0.00	-6.83
		9	-2.85	-0.71	0.00	0.00	0.00	9.79
	6	8	1.89	2.53	0.00	0.00	0.00	-4.73
		9	-1.89	0.97	0.00	0.00	0.00	14.71
9	1	9	2.58	1.24	0.00	0.00	0.00	-7.63
		10	-2.58	-0.68	0.00	0.00	0.00	10.51
	2	9	3.47	1.81	0.00	0.00	0.00	-10.60
		10	-3.47	-0.99	0.00	0.00	0.00	14.79
	3	9	1.37	0.00	0.00	0.00	0.00	0.60
		10	-1.37	0.00	0.00	0.00	0.00	-0.60
	4	9	2.68	1.29	0.00	0.00	0.00	-9.66
		10	-2.68	-1.29	0.00	0.00	0.00	13.52
	5	9	2.85	0.71	0.00	0.00	0.00	-9.79
		10	-2.85	-0.71	0.00	0.00	0.00	11.91
	6	9	1.89	-0.97	0.00	0.00	0.00	-14.71
		10	-1.89	0.97	0.00	0.00	0.00	11.81
10	1	10	2.58	0.68	0.00	0.00	0.00	-10.51
		11	-2.58	0.00	0.00	0.00	0.00	11.74
	2	10	3.47	0.99	0.00	0.00	0.00	-14.79
		11	-3.47	0.00	0.00	0.00	0.00	16.60
	3	10	1.37	0.00	0.00	0.00	0.00	0.60
		11	-1.37	0.00	0.00	0.00	0.00	-0.60
	4	10	2.68	1.29	0.00	0.00	0.00	-13.52
		11	-2.68	-1.29	0.00	0.00	0.00	18.20
	5	10	2.85	0.71	0.00	0.00	0.00	-11.91
		11	-2.85	-0.71	0.00	0.00	0.00	14.49
	6	10	1.89	-0.97	0.00	0.00	0.00	-11.81
		11	-1.89	0.97	0.00	0.00	0.00	8.29
11	1	11	2.58	0.00	0.00	0.00	0.00	-11.74
		12	-2.58	0.68	0.00	0.00	0.00	10.50
	2	11	3.47	0.00	0.00	0.00	0.00	-16.60
		12	-3.47	0.99	0.00	0.00	0.00	14.79
	3	11	1.37	0.00	0.00	0.00	0.00	0.60
		12	-1.37	0.00	0.00	0.00	0.00	-0.60
	4	11	2.68	1.29	0.00	0.00	0.00	-18.20
		12	-2.68	2.21	0.00	0.00	0.00	10.14
	5	11	2.85	0.71	0.00	0.00	0.00	-14.49
		12	-2.85	2.79	0.00	0.00	0.00	15.51

23

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	6	11	1.89	-0.97	0.00	0.00	0.00	-8.29
		12	-1.89	0.97	0.00	0.00	0.00	4.77
12	1	12	2.58	-0.68	0.00	0.00	0.00	-10.50
		13	-2.58	1.24	0.00	0.00	0.00	7.63
	2	12	3.47	-0.99	0.00	0.00	0.00	-14.79
		13	-3.47	1.81	0.00	0.00	0.00	10.60
	3	12	1.37	0.00	0.00	0.00	0.00	0.60
		13	-1.37	0.00	0.00	0.00	0.00	-0.60
	4	12	2.68	-2.21	0.00	0.00	0.00	-10.14
		13	-2.68	2.21	0.00	0.00	0.00	3.49
	5	12	2.85	-2.79	0.00	0.00	0.00	-15.51
		13	-2.85	2.79	0.00	0.00	0.00	7.13
	6	12	1.89	-0.97	0.00	0.00	0.00	-4.77
		13	-1.89	0.97	0.00	0.00	0.00	1.87
13	1	13	2.58	-1.24	0.00	0.00	0.00	-7.63
		14	-2.58	2.02	0.00	0.00	0.00	0.83
	2	13	3.47	-1.81	0.00	0.00	0.00	-10.60
		14	-3.47	2.94	0.00	0.00	0.00	0.70
	3	13	1.37	0.00	0.00	0.00	0.00	0.60
		14	-1.37	0.00	0.00	0.00	0.00	-0.60
	4	13	2.68	-2.21	0.00	0.00	0.00	-3.49
		14	-2.68	2.21	0.00	0.00	0.00	-5.74
	5	13	2.85	-2.79	0.00	0.00	0.00	-7.13
		14	-2.85	2.79	0.00	0.00	0.00	-4.51
	6	13	1.89	-0.97	0.00	0.00	0.00	-1.87
		14	-1.89	1.87	0.00	0.00	0.00	-5.42
14	1	14	2.68	-1.89	0.00	0.00	0.00	-0.83
		15	-2.71	2.57	0.00	0.00	0.00	-6.60
	2	14	3.61	-2.76	0.00	0.00	0.00	-0.70
		15	-3.66	3.67	0.00	0.00	0.00	-10.02
	3	14	1.37	0.07	0.00	0.00	0.00	0.60
		15	-1.37	-0.07	0.00	0.00	0.00	-0.37
	4	14	2.78	-2.08	0.00	0.00	0.00	5.74
		15	-2.78	2.08	0.00	0.00	0.00	-12.67
	5	14	2.99	-2.65	0.00	0.00	0.00	4.51
		15	-2.99	2.65	0.00	0.00	0.00	-13.33
	6	14	1.98	-1.77	0.00	0.00	0.00	5.42
		15	-1.98	1.77	0.00	0.00	0.00	-11.32
15	1	15	2.71	-2.58	0.00	0.00	0.00	6.60
		16	-2.74	3.07	0.00	0.00	0.00	-12.27
	2	15	3.66	-3.67	0.00	0.00	0.00	10.02
		16	-3.68	4.22	0.00	0.00	0.00	-17.94
	3	15	1.37	0.07	0.00	0.00	0.00	0.37
		16	-1.37	-0.07	0.00	0.00	0.00	-0.23

24

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	4	15	2.78	-2.08	0.00	0.00	0.00	12.67
		16	-2.83	2.98	0.00	0.00	0.00	-18.53
	5	15	2.99	-2.65	0.00	0.00	0.00	13.33
		16	-2.99	2.65	0.00	0.00	0.00	-18.65
	6	15	1.98	-1.77	0.00	0.00	0.00	11.32
		16	-1.98	1.77	0.00	0.00	0.00	-14.87
16	1	16	2.74	-3.07	0.00	0.00	0.00	12.27
		17	-2.77	3.79	0.00	0.00	0.00	-20.86
	2	16	3.68	-4.22	0.00	0.00	0.00	17.94
		17	-3.72	4.90	0.00	0.00	0.00	-29.34
	3	16	1.37	0.07	0.00	0.00	0.00	0.23
		17	-1.37	-0.07	0.00	0.00	0.00	-0.06
	4	16	2.83	-2.98	0.00	0.00	0.00	18.53
		17	-2.83	2.98	0.00	0.00	0.00	-25.98
	5	16	2.99	-2.65	0.00	0.00	0.00	18.65
		17	-3.03	3.55	0.00	0.00	0.00	-26.58
	6	16	1.98	-1.77	0.00	0.00	0.00	14.87
		17	-1.98	1.77	0.00	0.00	0.00	-19.31
17	1	17	2.78	-3.79	0.00	0.00	0.00	20.86
		18	-2.81	4.49	0.00	0.00	0.00	-29.82
	2	17	3.72	-4.89	0.00	0.00	0.00	29.34
		18	-3.75	5.48	0.00	0.00	0.00	-40.58
	3	17	1.37	0.07	0.00	0.00	0.00	0.06
		18	-1.37	-0.07	0.00	0.00	0.00	0.09
	4	17	2.83	-2.98	0.00	0.00	0.00	25.98
		18	-2.83	2.98	0.00	0.00	0.00	-32.43
	5	17	3.04	-3.54	0.00	0.00	0.00	26.58
		18	-3.04	3.54	0.00	0.00	0.00	-34.26
	6	17	1.98	-1.77	0.00	0.00	0.00	19.31
		18	-1.98	1.77	0.00	0.00	0.00	-23.14
18	1	18	2.82	-4.49	0.00	0.00	0.00	29.82
		19	-2.83	4.78	0.00	0.00	0.00	-33.67
	2	18	3.76	-5.48	0.00	0.00	0.00	40.58
		19	-3.77	5.70	0.00	0.00	0.00	-45.23
	3	18	1.37	0.07	0.00	0.00	0.00	-0.09
		19	-1.37	-0.07	0.00	0.00	0.00	0.15
	4	18	2.83	-2.97	0.00	0.00	0.00	32.43
		19	-2.83	2.97	0.00	0.00	0.00	-34.90
	5	18	3.04	-3.54	0.00	0.00	0.00	34.26
		19	-3.04	3.54	0.00	0.00	0.00	-37.20
	6	18	1.98	-1.77	0.00	0.00	0.00	23.14
		19	-1.98	1.77	0.00	0.00	0.00	-24.61
19	1	19	4.92	2.58	0.00	0.00	0.00	33.67
		20	-5.19	-2.58	0.00	0.00	0.00	-30.99

25

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KIP FEET

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	2	19	5.89	3.47	0.00	0.00	0.00	45.23
		20	-5.89	-3.47	0.00	0.00	0.00	-41.62
	3	19	0.00	1.37	0.00	0.00	0.00	-0.15
		20	0.00	-1.27	0.00	0.00	0.00	1.53
	4	19	3.11	2.68	0.00	0.00	0.00	34.90
		20	-3.11	-2.68	0.00	0.00	0.00	-32.12
	5	19	3.69	2.85	0.00	0.00	0.00	37.20
		20	-3.69	-2.85	0.00	0.00	0.00	-34.23
	6	19	1.87	1.89	0.00	0.00	0.00	24.61
		20	-1.87	-1.89	0.00	0.00	0.00	-22.65
20	1	20	5.19	2.58	0.00	0.00	0.00	30.99
		21	-8.40	-2.58	0.00	0.00	0.00	0.00
	2	20	5.89	3.47	0.00	0.00	0.00	41.62
		21	-5.89	-3.47	0.00	0.00	0.00	0.00
	3	20	0.00	1.27	0.00	0.00	0.00	-1.53
		21	0.00	2.25	0.00	0.00	0.00	0.00
	4	20	3.11	2.68	0.00	0.00	0.00	32.12
		21	-3.11	-2.68	0.00	0.00	0.00	0.00
	5	20	3.69	2.85	0.00	0.00	0.00	34.23
		21	-3.69	-2.85	0.00	0.00	0.00	0.00
	6	20	1.87	1.89	0.00	0.00	0.00	22.65
		21	-1.87	-1.89	0.00	0.00	0.00	0.00

********** END OF LATEST ANALYSIS RESULT **********

76. PRINT JOINT DISPLACEMENTS

26

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
9	1	0.00034	-0.18345	0.00000	0.00000	0.00000	-0.00094
	2	0.00045	-0.25214	0.00000	0.00000	0.00000	-0.00133
	3	0.00016	0.01723	0.00000	0.00000	0.00000	0.00005
	4	0.05141	-0.22203	0.00000	0.00000	0.00000	-0.00091
	5	0.03201	-0.22898	0.00000	0.00000	0.00000	-0.00097
	6	0.05538	-0.17766	0.00000	0.00000	0.00000	-0.00053
10	1	0.00020	-0.21093	0.00000	0.00000	0.00000	-0.00056
	2	0.00026	-0.29089	0.00000	0.00000	0.00000	-0.00080
	3	0.00009	0.01875	0.00000	0.00000	0.00000	0.00003
	4	0.05126	-0.24666	0.00000	0.00000	0.00000	-0.00043
	5	0.03186	-0.25631	0.00000	0.00000	0.00000	-0.00053
	6	0.05528	-0.18657	0.00000	0.00000	0.00000	0.00002
11	1	0.00002	-0.22349	0.00000	0.00000	0.00000	0.00000
	2	0.00002	-0.30862	0.00000	0.00000	0.00000	0.00000
	3	-0.00001	0.01939	0.00000	0.00000	0.00000	0.00000
	4	0.05107	-0.24915	0.00000	0.00000	0.00000	0.00036
	5	0.03166	-0.26554	0.00000	0.00000	0.00000	0.00013
	6	0.05515	-0.17433	0.00000	0.00000	0.00000	0.00052
12	1	-0.00015	-0.21093	0.00000	0.00000	0.00000	0.00056
	2	-0.00021	-0.29089	0.00000	0.00000	0.00000	0.00080
	3	-0.00010	0.01874	0.00000	0.00000	0.00000	-0.00003
	4	0.05089	-0.21665	0.00000	0.00000	0.00000	0.00106
	5	0.03147	-0.24323	0.00000	0.00000	0.00000	0.00091
	6	0.05502	-0.14406	0.00000	0.00000	0.00000	0.00084
13	1	-0.00030	-0.18346	0.00000	0.00000	0.00000	0.00094
	2	-0.00041	-0.25215	0.00000	0.00000	0.00000	0.00133
	3	-0.00018	0.01723	0.00000	0.00000	0.00000	-0.00005
	4	0.05074	-0.17252	0.00000	0.00000	0.00000	0.00134
	5	0.03131	-0.20108	0.00000	0.00000	0.00000	0.00137
	6	0.05492	-0.11097	0.00000	0.00000	0.00000	0.00098
14	1	-0.00050	-0.12825	0.00000	0.00000	0.00000	0.00120
	2	-0.00068	-0.17477	0.00000	0.00000	0.00000	0.00167
	3	-0.00028	0.01365	0.00000	0.00000	0.00000	-0.00009
	4	0.05054	-0.10471	0.00000	0.00000	0.00000	0.00128
	5	0.03109	-0.12765	0.00000	0.00000	0.00000	0.00145
	6	0.05477	-0.06247	0.00000	0.00000	0.00000	0.00089
15	1	0.00171	-0.08130	0.00000	0.00000	0.00000	0.00111
	2	0.00238	-0.10972	0.00000	0.00000	0.00000	0.00152
	3	-0.00055	0.00977	0.00000	0.00000	0.00000	-0.00010
	4	0.05267	-0.05901	0.00000	0.00000	0.00000	0.00097
	5	0.03357	-0.07472	0.00000	0.00000	0.00000	0.00115
	6	0.05619	-0.03191	0.00000	0.00000	0.00000	0.00061
16	1	0.00290	-0.05581	0.00000	0.00000	0.00000	0.00100
	2	0.00402	-0.07484	0.00000	0.00000	0.00000	0.00136
	3	-0.00072	0.00721	0.00000	0.00000	0.00000	-0.00011
	4	0.05365	-0.03776	0.00000	0.00000	0.00000	0.00078
	5	0.03476	-0.04921	0.00000	0.00000	0.00000	0.00096
	6	0.05677	-0.01908	0.00000	0.00000	0.00000	0.00045

LL + I Deflection

$L/1000 = \frac{41.6' \times 12}{1000}$

$= .5''$

ABNA Engineering, Inc.

JOB NUMBER: _____ BY: _____ DATE: _____

SUBJECT: SHEAR CHK'D BY: _____ DATE: _____

CHECK FOR SHEAR

IN LEG $V_{LF} = 12.91^{K}$

$\phi V_c = 0.9 \times 12 \times 17.5 \times 2\sqrt{5000}/1000$ ✓

$= 26.7^{K} > 12.91$ OK

IN SLAB

V_{LF} @ 8 $= 14.3^{K}$ Thickness $= 14''$

$\phi V_c = 0.9 \times 12 \times 11.5 \times 2\sqrt{5000}/1000$ ✓

$= 17.56\ K > 14.3^{K}$ OK

IN HAUNCH (Jt. 6)

V_{LF} @ 6 $= 17.9^{K}$

$\phi V_c = 0.9 \times 12 \times 17.96 \times 2\sqrt{5000}/1000$ ✓

$= 27.4^{K} > 17.9\ K$ OK

As7, $20 \times 12 \times 0.002 = 0.48$ ✓

USE #6 @ 8" cts $A_{s(provided)} = 0.66\ in^2$

As8, $26 \times 12 \times 0.002 = 0.62$

USE #6 @ 8" cts $A_{s(provided)} = 0.66\ in^2$ ✓

As6, same as As7

As3 $14 \times 12 \times 0.002 = 0.336\ in^2$ ✓

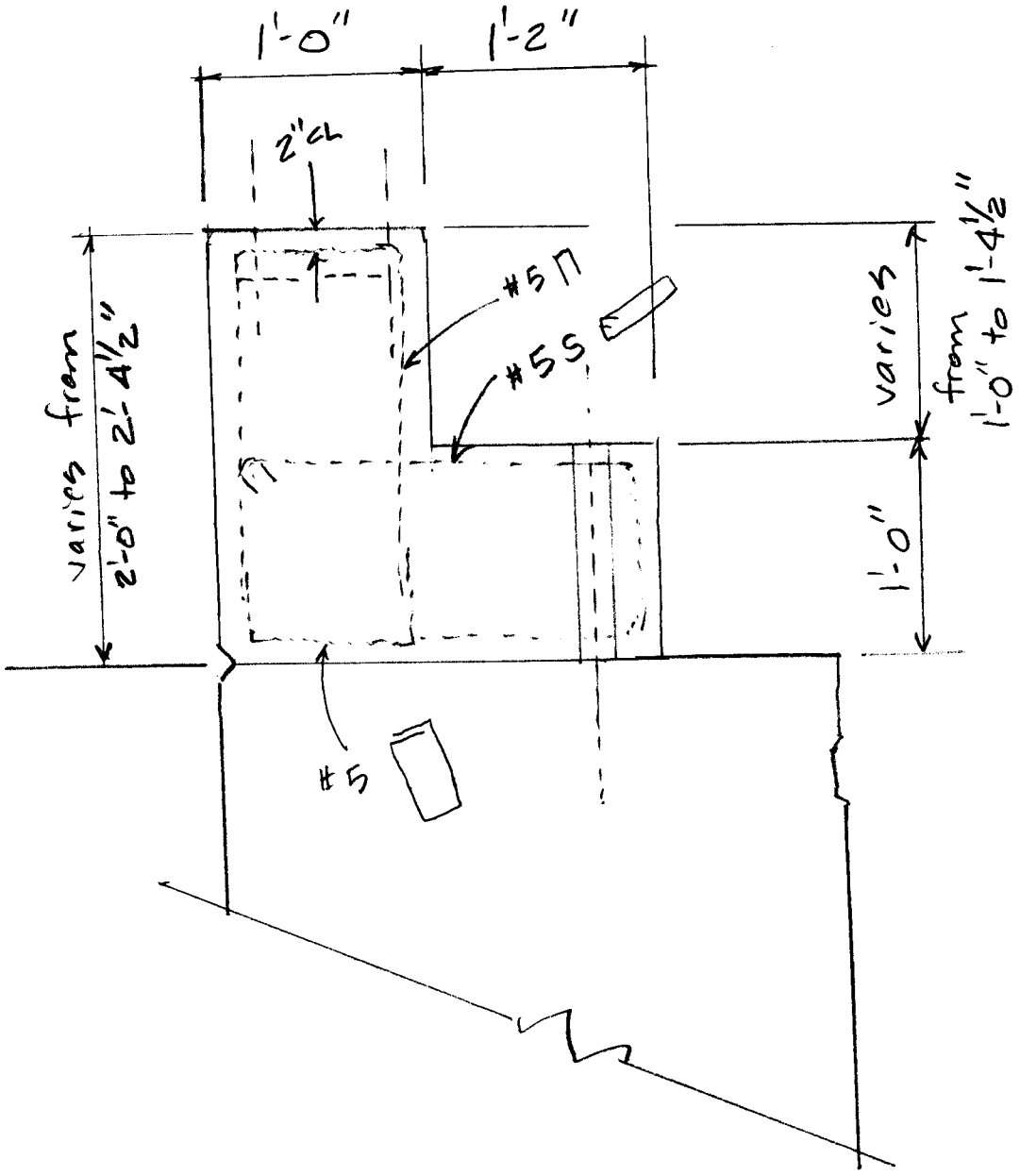
USE #5 @ 8" $A_s = 0.46$

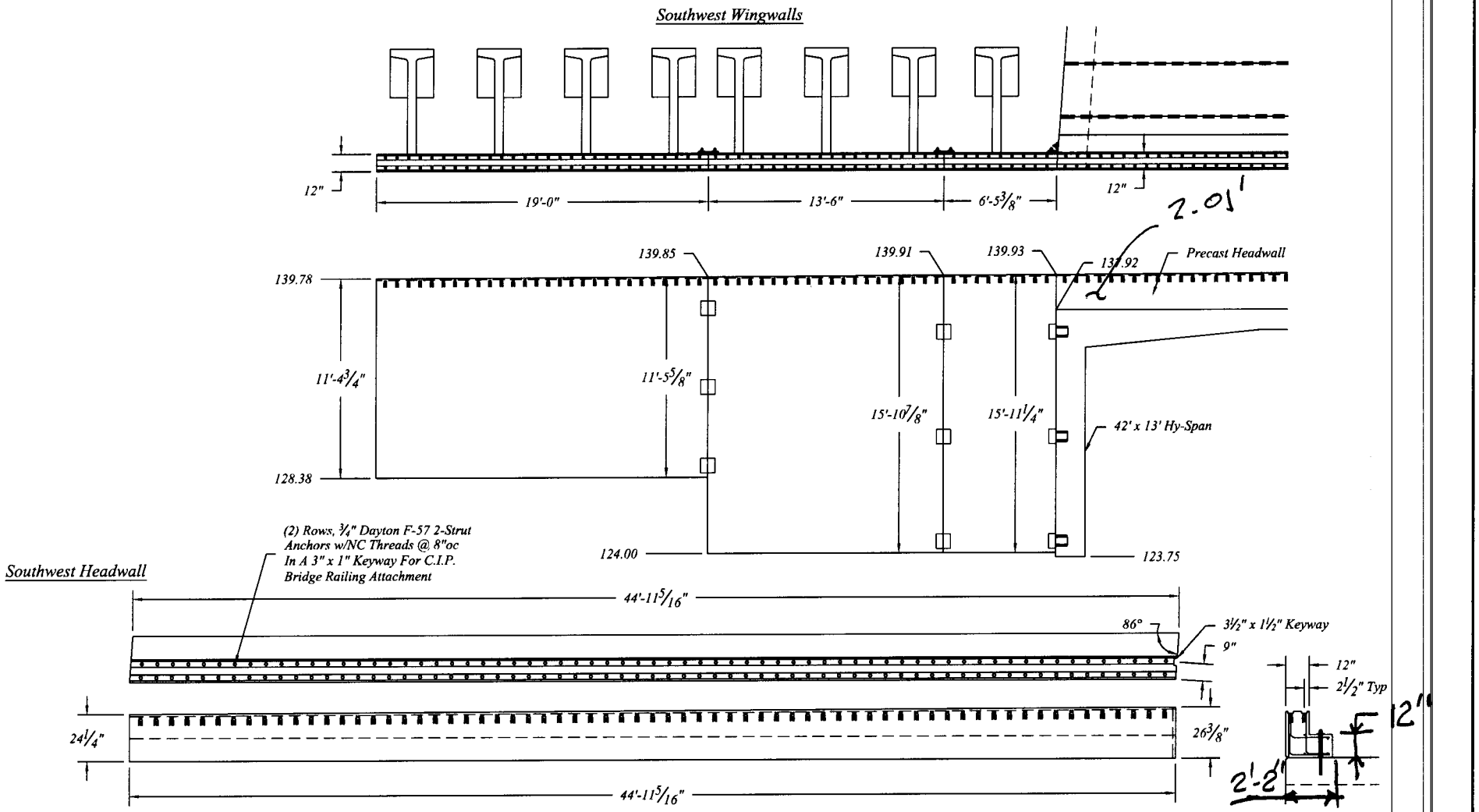
As2 $20 \times 12 \times 0.002 = 0.48\ in^2$ ✓

USE # @ 8 $A_{s(provided)} = 0.46$

HEAD WALL DESIGN

Lateral earth pressure is relatively insignificant compared to vehicle loads.
The critical reinforcement is the roadway side vertical reinforcement.





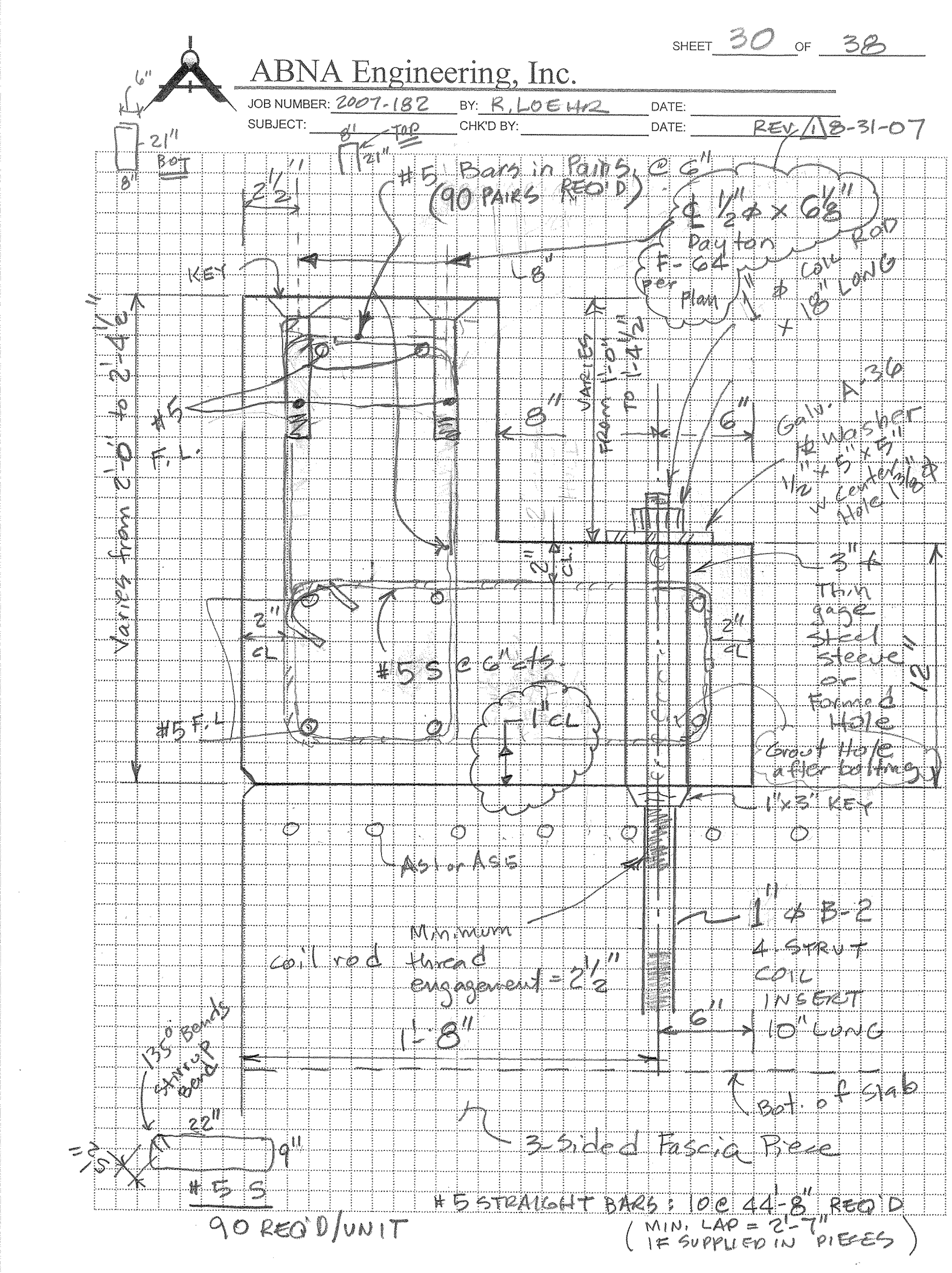
South H. wall vary from 2.37' (east) to 2.01' (west)

29

ABNA Engineering, Inc.

JOB NUMBER: 2007-182 BY: R. LOEHR DATE:

SUBJECT: CHK'D BY: DATE: REV. 1 8-31-07



90 REQ'D/UNIT

#5 STRAIGHT BARS: 10 @ 44'-8" REQ'D
(MIN. LAP = 2'-7" IF SUPPLIED IN PIECES)

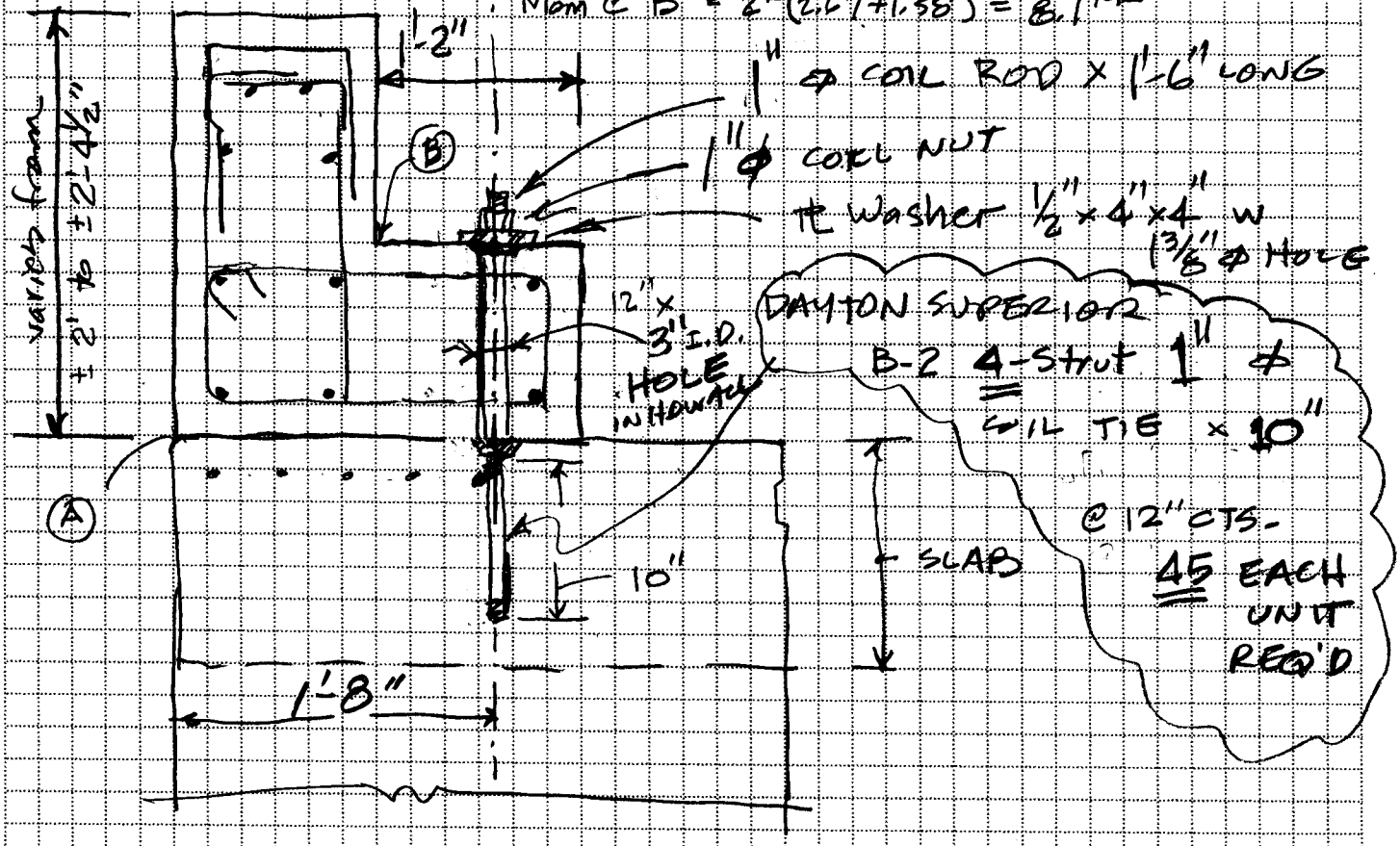
ABNA Engineering, Inc.

JOB NUMBER: _____ BY: _____ DATE: _____

SUBJECT: _____ CHK'D BY: _____ DATE: _____

Dead Load Resist Mom @ A
2.0'×1.0'×.15×.5'
+ 1.0'×1.0'×.15'×1.5' = .37 K-FT

Design moment = $\frac{10^K}{5'}(2.67' + 2.38') =$
@ A
+ 40 pcf fluid + 60 psf surcharge
$= .040 \times 2.38' \times .5 \times 2.38' \times 1/3$
$+ .060 \times 2.38^2 \times .5$
Shear = $2^K + .11^K + .14^K = 2.25^K$ ∴ $10.1^{K-FT} + 26^{K-FT} = 10.36^{K-FT} - .37 = \boxed{10}$
Mom @ B = $2^K(2.67 + 1.38') = 8.1^{K-FT}$



Resistive Force needed, in Bolt Tension Per Foot:
$10^{K-FT} / 1.667$ use 1.5 $= 6.7$ KIPS ⇒ Use 1" ϕ coil B-2
< 18K safe load o.k.

A_{s1}, A_{s5}, A_{s4}	2 1/8"	6 1/8"	10 1/8"	14 1/8"	18 1/8"	22 1/8"

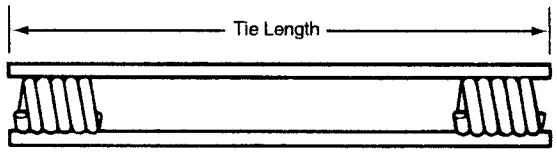
Bars in Headwalls: $M_B = 8.1^{K-FT} \times 2.17 = 17.6^{K-FT}$
Try # 5 @ 6" = .62 in^2 $d = 12 - 2 - 5/16 = 9.68"$
$\rho = .0052$
$\phi M_n = .9 \times .62 \times \frac{d}{12}(1 - .6\rho\frac{60}{f'})\,60ksi = 25.7^{K-FT} >> 17.6^{K-FT}$ o.k.

B-1 Two Strut Coil Tie and B-2 Four Strut Coil Tie

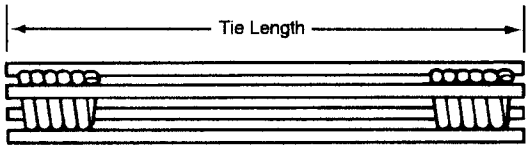
Dayton Superior B-1 and B-2 Coil Ties are strong, versatile resistance welded ties designed to take the abuse encountered in medium and heavy concrete construction. The coil tie is an extremely simple tie that is capable of servicing many applications and uses in the field. It can be used with or without cones or combined with coil rod to form an adjustable tie. The coil threads are fast acting and self-cleaning.

B-2 Four Strut Coil Tie Couplers are available and are used in conjunction with D-18 Inside Rods to compensate for form variations.

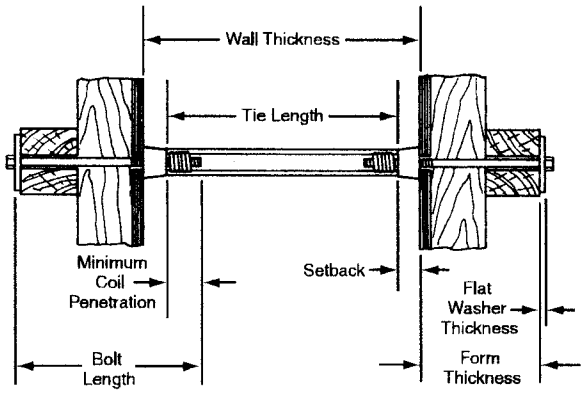
To determine the required coil tie length, subtract two times the desired or specified setback from the wall thickness. [Wall thickness - (2x setback) = coil tie length].



B-1 Two Strut Coil Tie



B-2 Four Strut Coil Tie and B-2 Four Strut Coil Tie Coupler

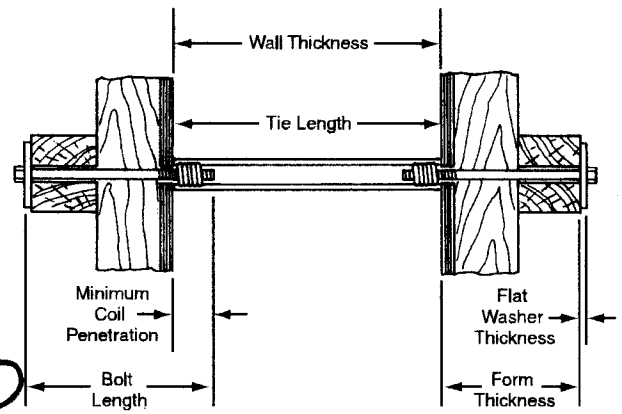


Coil Tie with Loose (Spreader) Cones

Cones are generally used when wall thickness is very thick or an architectural finish is specified.

B-1 and B-2 Coil Tie Selection Chart			
Type	**Bolt Diameter**	**Number of Strut Wires**	**Safe Working Load Tension (lbs.)**
B-1 Standard	**1/2"**	**2**	**4,500**
B-1 Heavy	1/2"	2	6,750
B-1 Standard	**3/4"**	**2**	**6,750**
B-1 Heavy	3/4"	2	9,000
B-1 Standard	**1"**	**2**	**13,500**
B-2 Standard	1"	4	18,000
B-2 Standard	**1-1/4"**	**4**	**27,000**
B-2 Coupler 8"	1/2"	4	9,000
B-2 Coupler 12"	**3/4"**	**4**	**18,000**

SWL provides a factor of safety of approximately 2 to 1.
Warning: See Page 62 for minimum bolt length.



Coil Tie as Spreader and Tie

The coil tie can be used as a combination tie and form spreader when it is not necessary to keep the ends of the tie back from the face of the concrete. If a number of form reuse is contemplated, standard cut washers should be used at the tie ends to protect the form face.

To Order:
Specify: (1) quantity, (2) name, (3) safe working load, (4) bolt diameter, (5) tie length, (6) wall thickness, (7) setback.

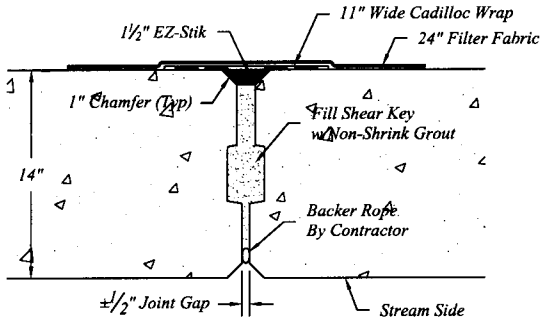
Example:
3,000 pcs. B-1 Standard Coil Tie, 4,500 lbs. SWL, 1/2" diameter, 12" long for a 14" wall, 1" setback.

USE

33

PRECAST NOSINGS

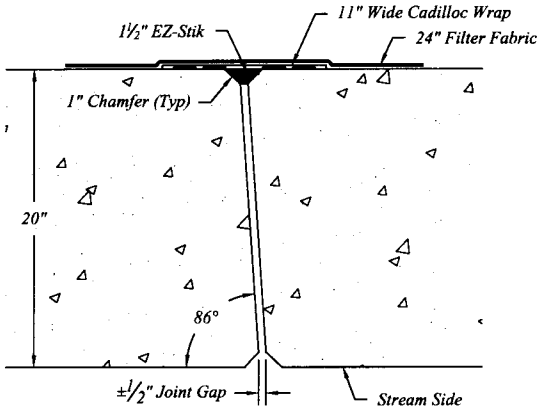
Typical Joint Detail
(Across Top Slab)



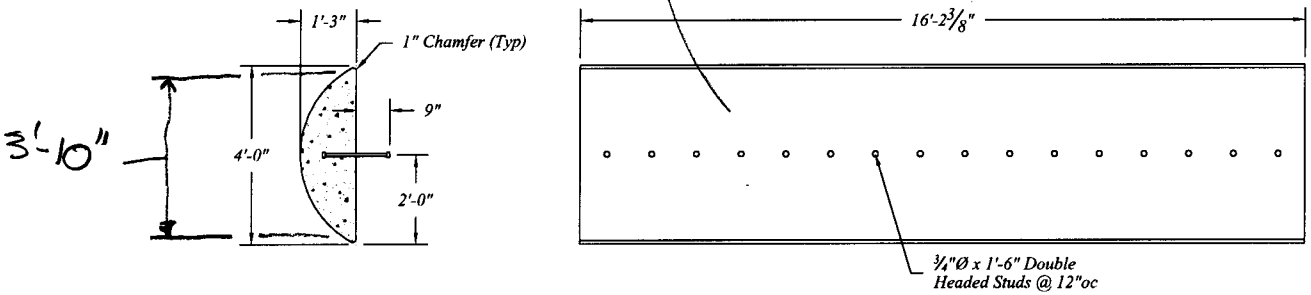
SEE REINF. DET. SHEET ATTACHED

4x4/W4.5xW4.5 FULL LENGTH @ 2" C-C

Typical Joint Detail
(Down Each Leg)



Precast Nosing Detail
(2 Required)



MDOT
S02 of 82-22-97 / 83945 A

401 Kelton Street
Bay City, MI 48706
1 800 222 9918

5281 Lansing Road
Charlotte, MI 48813
1 800 874 9701

Proposed - 42' x 13' Precast Concrete Hy-Span Bridge

Dan's Excavating
Shelby Twp, MI

Antietam Avenue over
Dequindre Cut Greenway

Date	Revised	Rev. No.	Drawn By	Scale	
31 Jul 07	20 Aug 07	1	BmG	NTS	10 of 10

ABNA Engineering, Inc.

JOB NUMBER: _____ BY: _____ DATE: _____

SUBJECT: _____ CHK'D BY: _____ DATE: _____

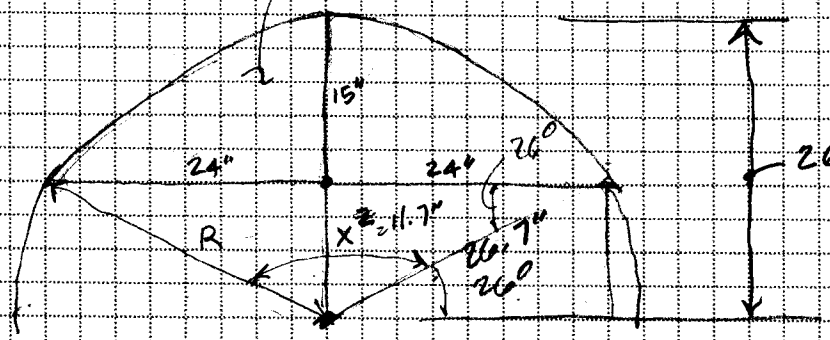
PRECAST NOSING

πr^2

$A_{CONC.} = \frac{2 \times 64}{180} \left(\pi + \frac{26.7}{2}\right)^2$ in^2

$= 796.3$ in^2

$= 5.53$ ft^2



$R^2 = 24^2 + x^2$

$(15+x)^2 = 24^2 + x^2$

$225 + 30x + x^2 = 576 + x^2$

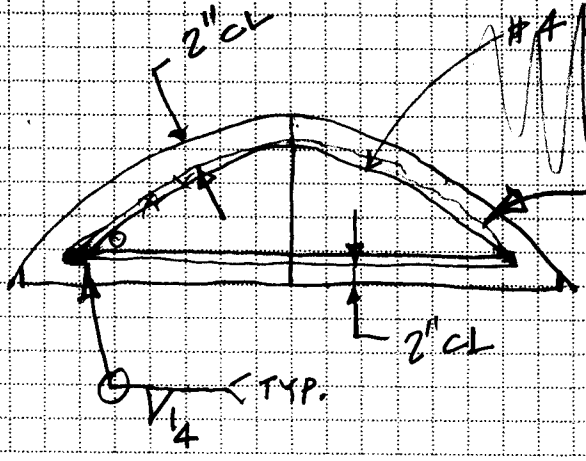
$-225 \quad -225$

$30x = 351$

$x = 11.7$

$R = 15 + x = 26.7"$

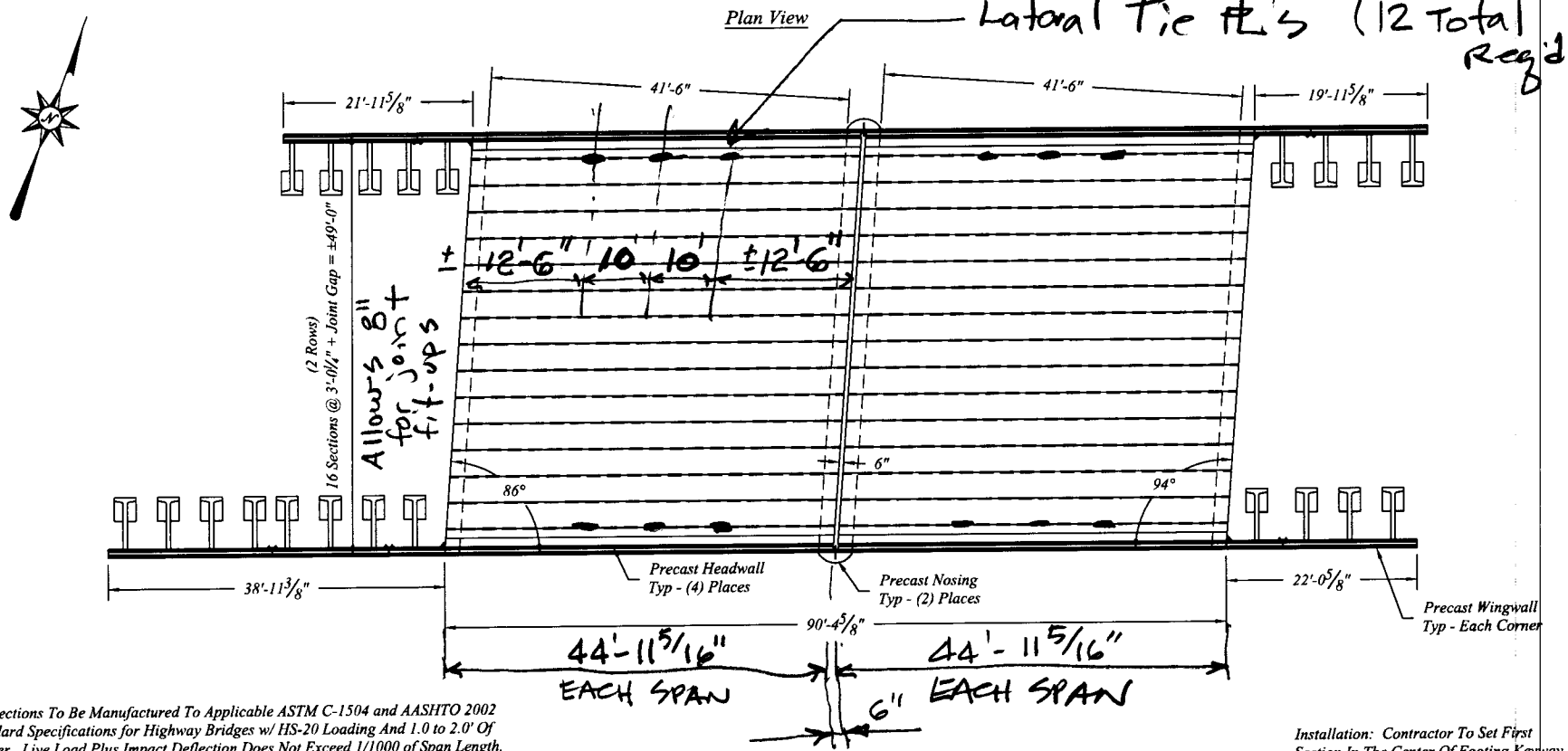
FOR SHIPPING + HANDLING



#4 ALTERNATE Grade 40 or 60 BARS

OR 4x4 / W4.5 x W4.5

OR 6x6 / W6.5 x W6.5



Notes:

Hy-Span Sections To Be Manufactured To Applicable ASTM C-1504 and AASHTO 2002 LFD Standard Specifications for Highway Bridges w/ HS-20 Loading And 1.0 to 2.0' Of Earth Cover. Live Load Plus Impact Deflection Does Not Exceed 1/1000 of Span Length.

Steel Reinforcing To Have A Yield Strength Of 60 ksi (min). Concrete Compressive Strength To Be 5000 psi (min) w/ 6.5% Entrained Air ±1.5%.

Joints To Be Sealed w/ 1½" EZ-Stik, Wrapped w/11" Wide Cadilloc Wrap And Covered w/ 24" Wide Filter Fabric.

Maximum Recommended Anchor Load For Burke #79172 Spread Anchor Is 17 Tons Each.

Cables Required For Unloading And Installation To Be Provided By Contractor.

Each Section Will Weigh Approximately 52,200 Lbs 51,200
Heaviest Lift Will Be Approximately 26.5 Tons.

Installation: Contractor To Set First Section In The Center Of Footing Keyway. Following Sections To Be Placed Against Previous Sections As Tightly As Possible While Maintaining Alignment In The Footing Keyway For All Sections. Contractor To Grout Full Length Each Side Of Footing Keyway After Installation Of All Sections. The Grout Must Be Cured Prior To Backfill Being Placed.

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Proposed - 42' x 13' Precast Concrete Hy-Span Bridge					
Dan's Excavating Shelby Twp, MI			Antietam Avenue over Dequindre Cut Greenway		
Date: 31 Jul 07	Revised: 20 Aug 07	Rev. No.: 1	Drawn By: BmG	Scale: 1 : 150	2 of 10

98.24' Lay Length

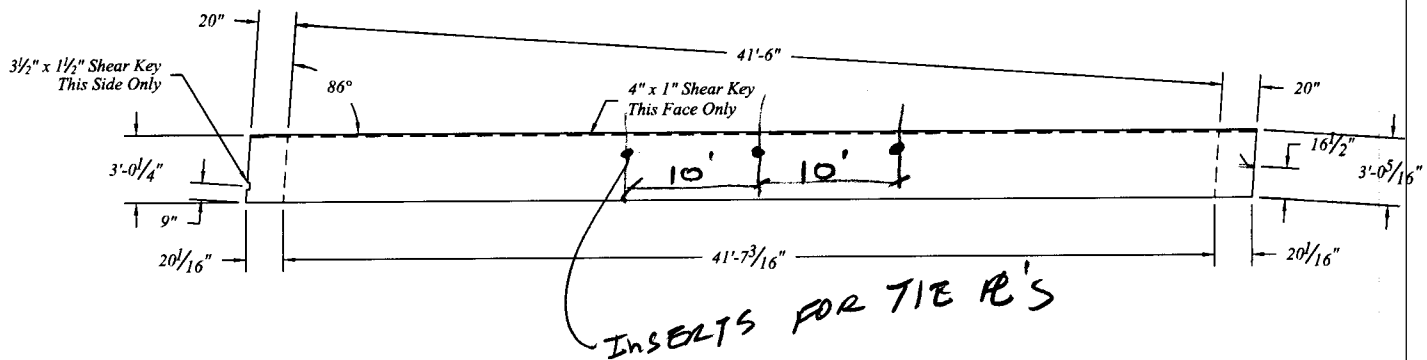
PROVIDE TIE #'S IN EXTERIOR UNITS PRIOR TO CONSTRUCTING HEAD WALLS

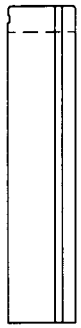
THE PLATES IN DECK

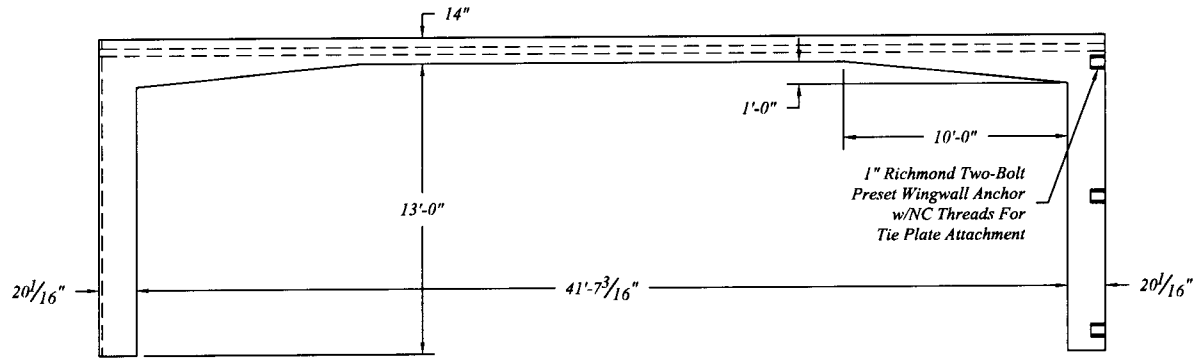
1/25

Northwest & Southeast End Sections

(2 Sections Required)







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Shelby Twp, MI

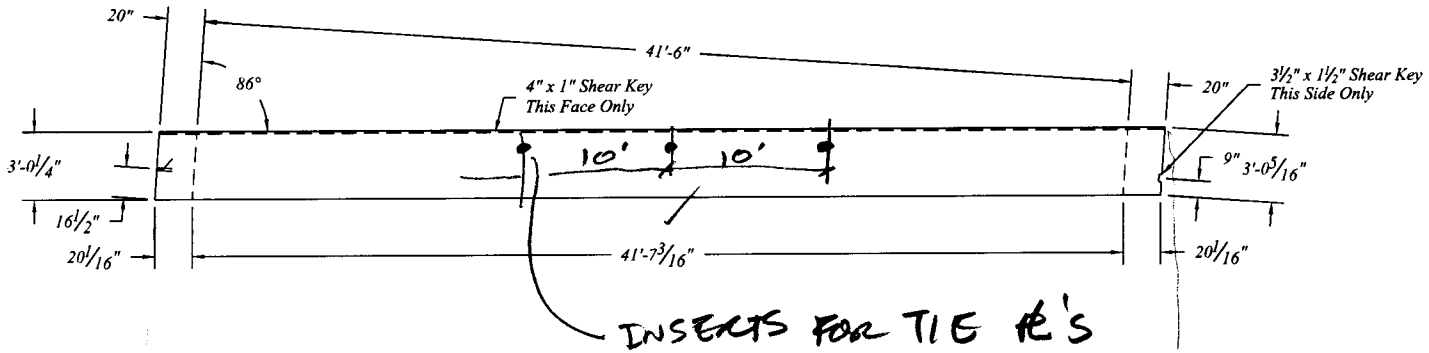
Antietam Avenue over
Dequindre Cut Greenway

Date	Revised	Rev. No.	Drawn By	Scale	
31 Jul 07	20 Aug 07	1	BmG	³⁄₁₆" = 1'	4 of 10

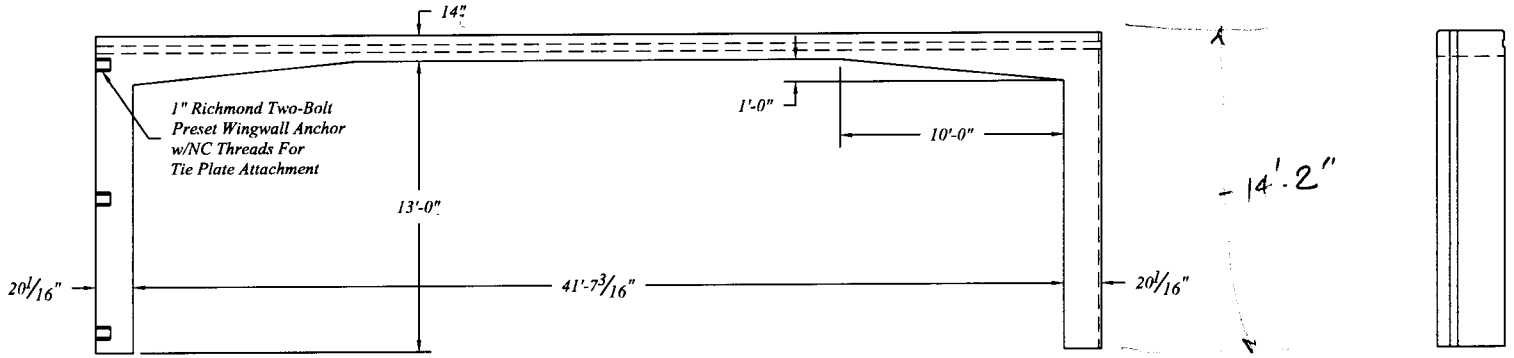
44'-10" BK/BK @ rt. ∡s = 44.9428' along ℄

Northeast & Southwest End Sections
(2 Sections Required)

= 44'-11 5/16"

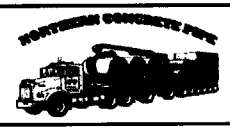


INSERTS FOR TIE ℄'S



A CONC. = 44.8333' x 14.167' + 10 x 1
− 41.5' x 13' = 105.64 □'

MDOT
S02 of 82-22-97 / 83945 A



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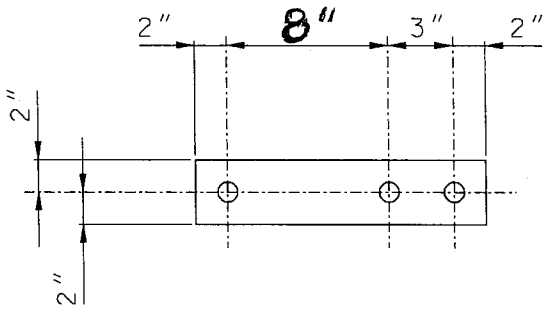
Shelby Twp, MI

Antietam Avenue over
Dequindre Cut Greenway

Date	Revised	Rev. No.	Drawn By	Scale	
31 Jul 07	20 Aug 07	1	BmG	3/16" = 1'	3 of 10

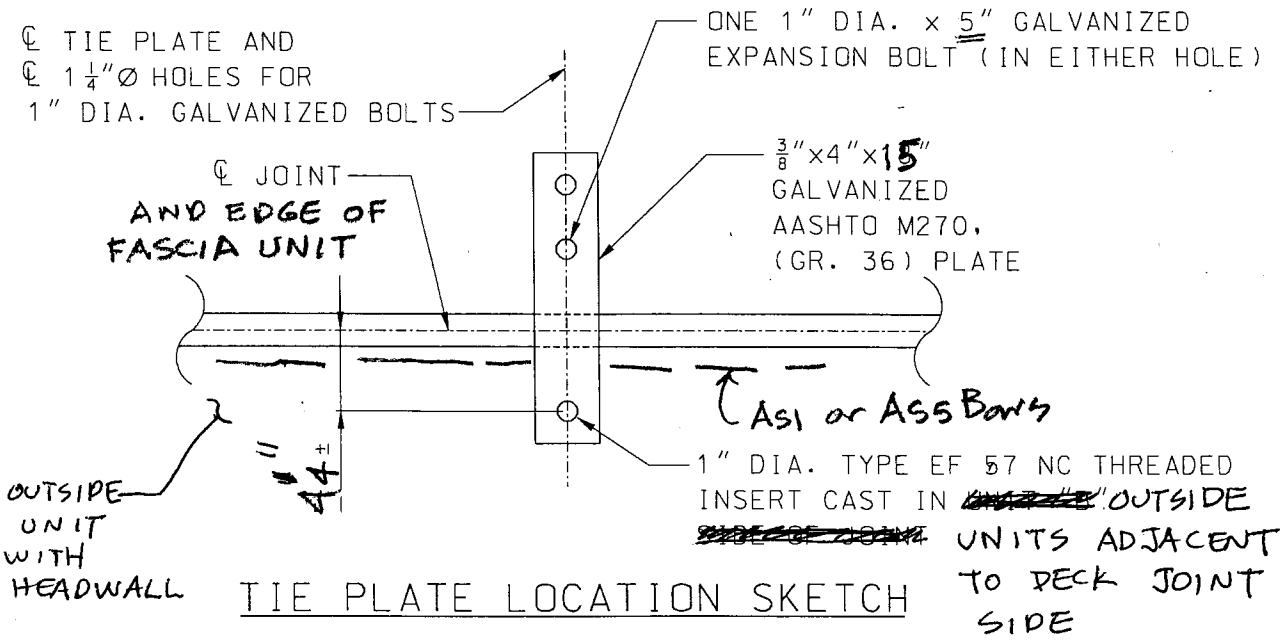
11.85

13



TIE PLATE

12 REQ'D.



TIE PLATE LOCATION SKETCH