MACK INDUSTRIES, INC.
201 COLUMBIA ROAD
VALLEY CITY, OHIO 44280
(330)483-3111 FAX: (330)483-0412

DATE: 8/2/18

SUBMITTAL DATA

JOB NAME: **ODOT PROJ. 180118 12' X 9' BOX CULVERT**

CUSTOMER: JURGENSON
Attn: Jason

MANUFACTURER: MACK INDUSTRIES, INC.
201 COLUMBIA ROAD
VALLEY CITY, OHIO 44280
PHONE: 330-483-3111
FAX 330-483-0412

MACK INDUSTRIES, INC.

12' X 9' BOX CULVERT

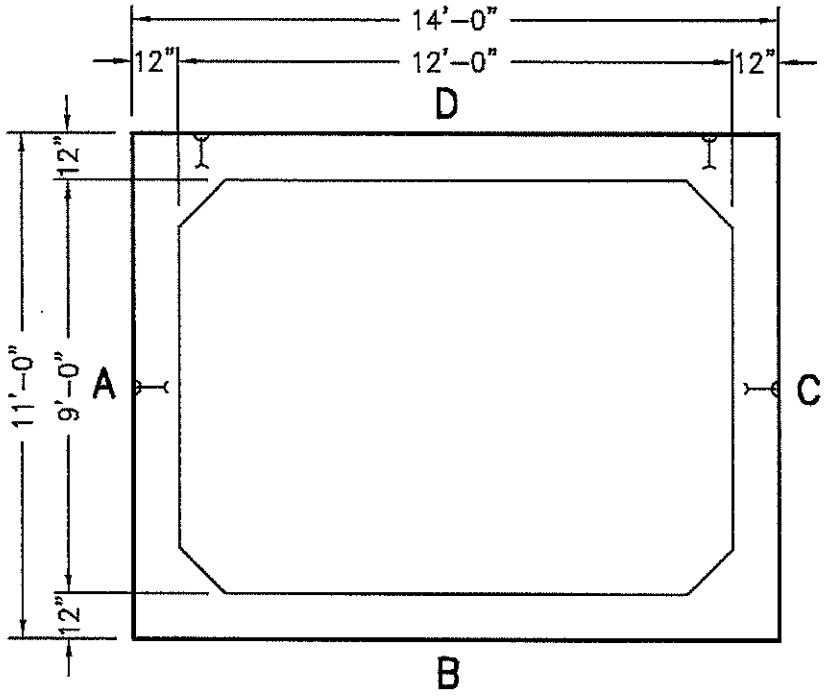
STANDARD SECTION 4 REQ'D.

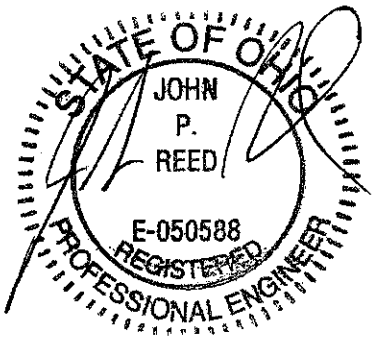
JOB: ODOT PROJ. 180118
JOB NO: CV37920
CUST: JURGENSON

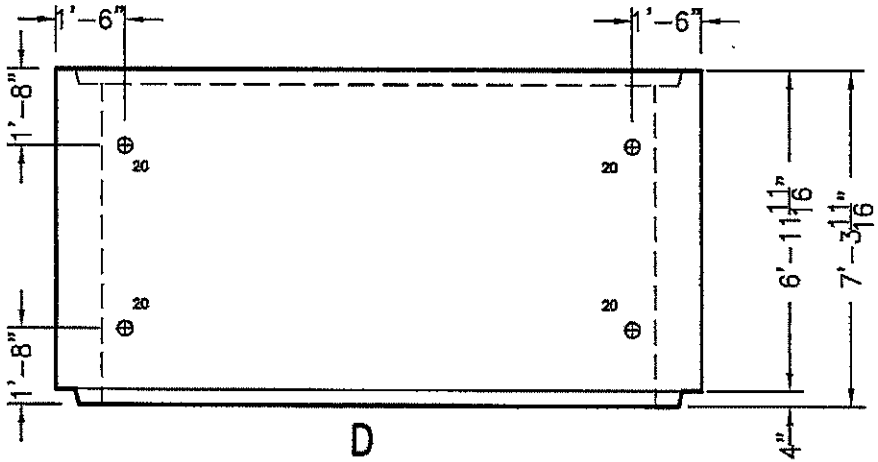
12" THK. TOP + BOTTOM
12" THK. WALLS
12" X 12" HAUNCHES
(6) 20 TON X 10" SWIFT LIFTS

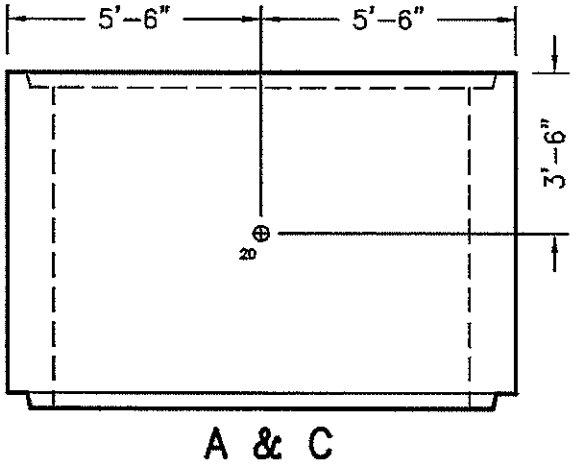
12.40YDS. REGULAR 5000 PSI
6% AIR MINIMUM AFTER CORRECTION

STENCIL ON PIECE:
12' X 9' CONDUIT
HL-93 LOADING, 0'-3' COVER
As1=0.42, As2=0.54, As3=0.54
ODOT PROJ. 180118
HAMILTON COUNTY
MACK INDUSTRIES, VALLEY CITY,OHIO
(DATE OF MANUFACTURE)









EJG
7/23/18

MACK INDUSTRIES, INC.

12' X 9' BOX CULVERT

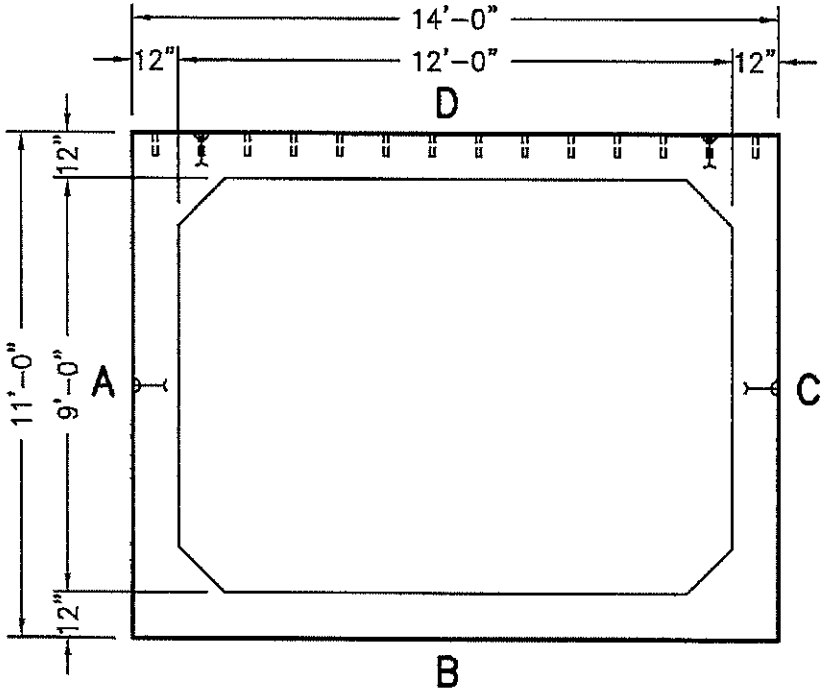
DOWNSTREAM SECTION 1 REQ'D.

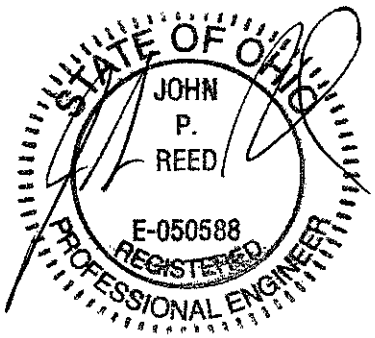
JOB: ODOT PROJ. 180118
JOB NO: CV37920
CUST: JURGENSON

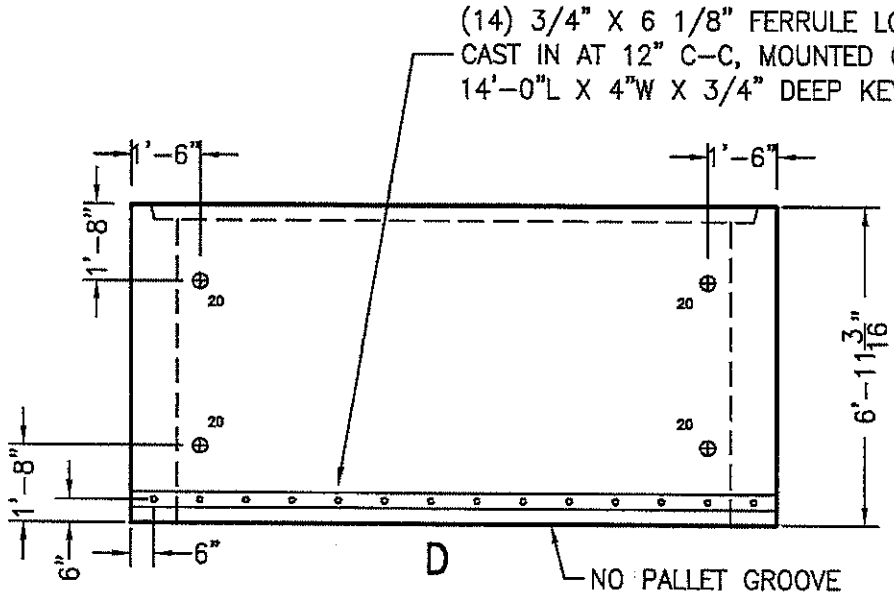
12" THK. TOP + BOTTOM
12" THK. WALLS
12" X 12" HAUNCHES
(6) 20 TON X 10" SWIFT LIFTS

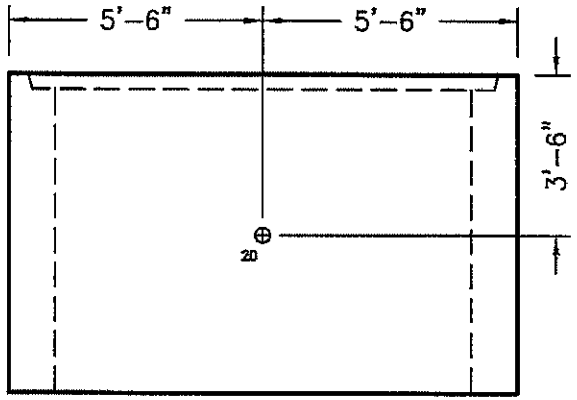
12.40YDS. REGULAR 5000 PSI
6% AIR MINIMUM AFTER CORRECTION

STENCIL ON PIECE:
12' X 9' CONDUIT
HL-93 LOADING, 0'-3' COVER
As1=0.42, As2=0.54, As3=0.54
ODOT PROJ. 180118
HAMILTON COUNTY
MACK INDUSTRIES, VALLEY CITY,OHIO
(DATE OF MANUFACTURE)









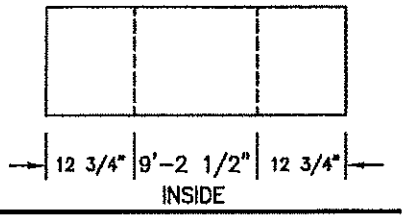
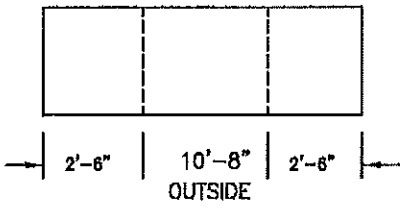
EJG
7/23/18

MACK INDUSTRIES, INC.

12' X 9' BOX CULVERT

JOB: ODOT PROJ. 180118
JOB NO: CV37920
CUST: JURGENSON

HL-93 LOAD RATED
0'-3' EARTH COVER
STANDARD SECTION
4 REQ'D.

	ITEM	QTY.	SIZE	TYPE	DESCRIPTION
As4	A.	2	11'-4" X 6'-9"	4" X 8" D10/D4	
As2/As5	B.	1	12'-8" X 6'-9"	2" X 4" D9/D10	FLAT
As3	C.	1	12'-8" X 6'-9"	2" X 8" D9/D4	FLAT
As1	D.	2	15'-8" X 6'-9"	2" X 8" D7/D4	
As7/As6	E.	1	13'-9" X 6'-9"	4" X 4" D10/D10	FLAT
As8	F.	1	13'-9" X 6'-9"	4" X 8" D10/D4	FLAT

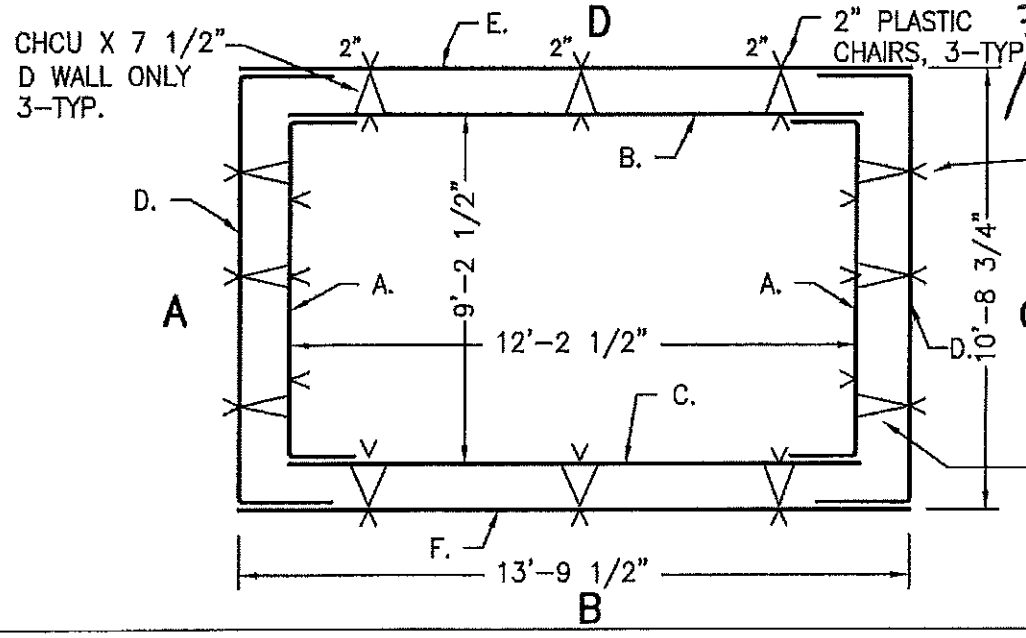
**ADD (2)-#4 X 5'-0" LONG REBARS TO THE TOP & BOTTOM OF ALL SWIFT LIFT CUTOUTS

AREA OF STEEL REQUIRED

As1=0.42 As5=0.29
As2=0.52 As6=0.29
As3=0.45 As7=0.29
As4=0.29 As8=0.29

AREA OF STEEL SUPPLIED

As1=0.42 As5=0.30
As2=0.54 As6=0.30
As3=0.54 As7=0.30
As4=0.30 As8=0.30



STATE OF OHIO
JOHN P. REED
E-050588
REGISTERED
PROFESSIONAL ENGINEER

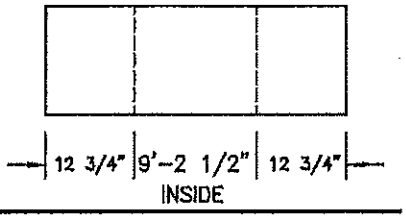
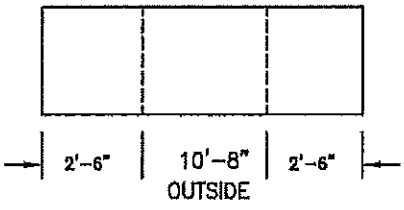
9X12RE

MACK INDUSTRIES, INC.

12' X 9' BOX CULVERT

JOB: ODOT PROJ. 18018
JOB NO: CV37920
CUST: JURGENSON

HL-93 LOAD RATED
0'-3' EARTH COVER
DOWNSTREAM SECTION
1 REQ'D.

	ITEM	QTY.	SIZE	TYPE	DESCRIPTION
As4	A.	2	11'-4" X 6'-5"	4" X 8" D10/D4	
As2/As5	B.	1	12'-8" X 6'-5"	2" X 4" D9/D10	FLAT
As3	C.	1	12'-8" X 6'-5"	2" X 8" D9/D4	FLAT
As1	D.	2	15'-8" X 6'-9"	2" X 8" D7/D4	
As7/As6	E.	1	13'-9" X 6'-9"	4" X 4" D10/D10	FLAT
As8	F.	1	13'-9" X 6'-9"	4" X 8" D10/D4	FLAT

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As4=0.29 As8=0.29

AREA OF STEEL SUPPLIED

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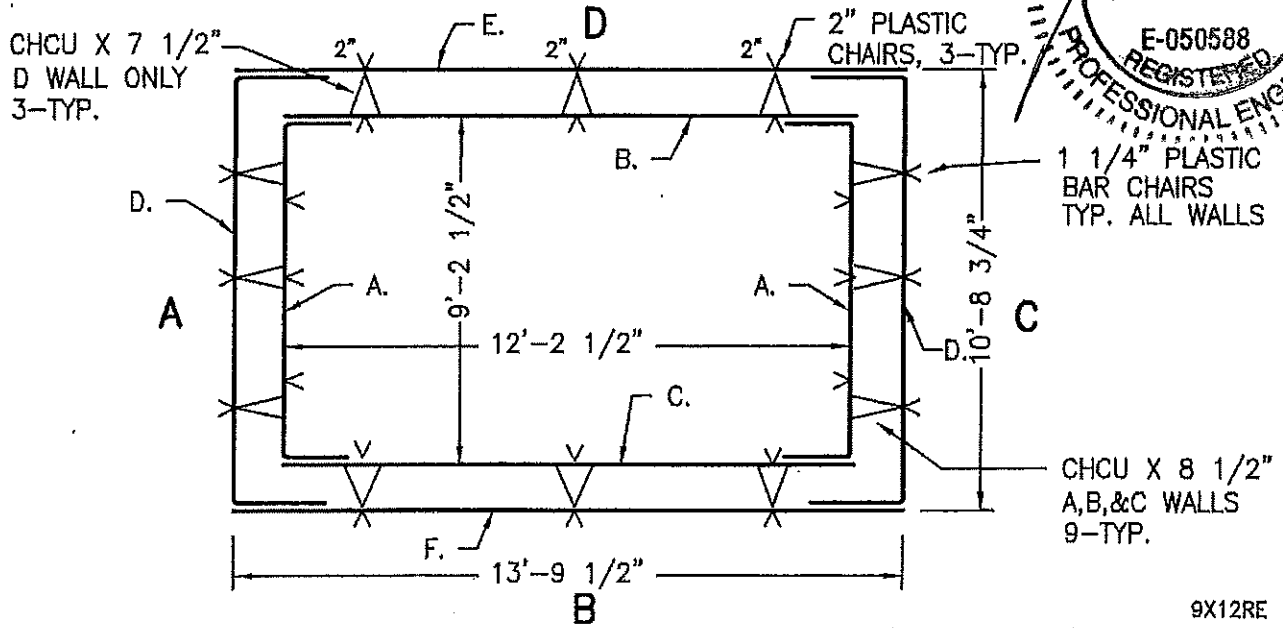
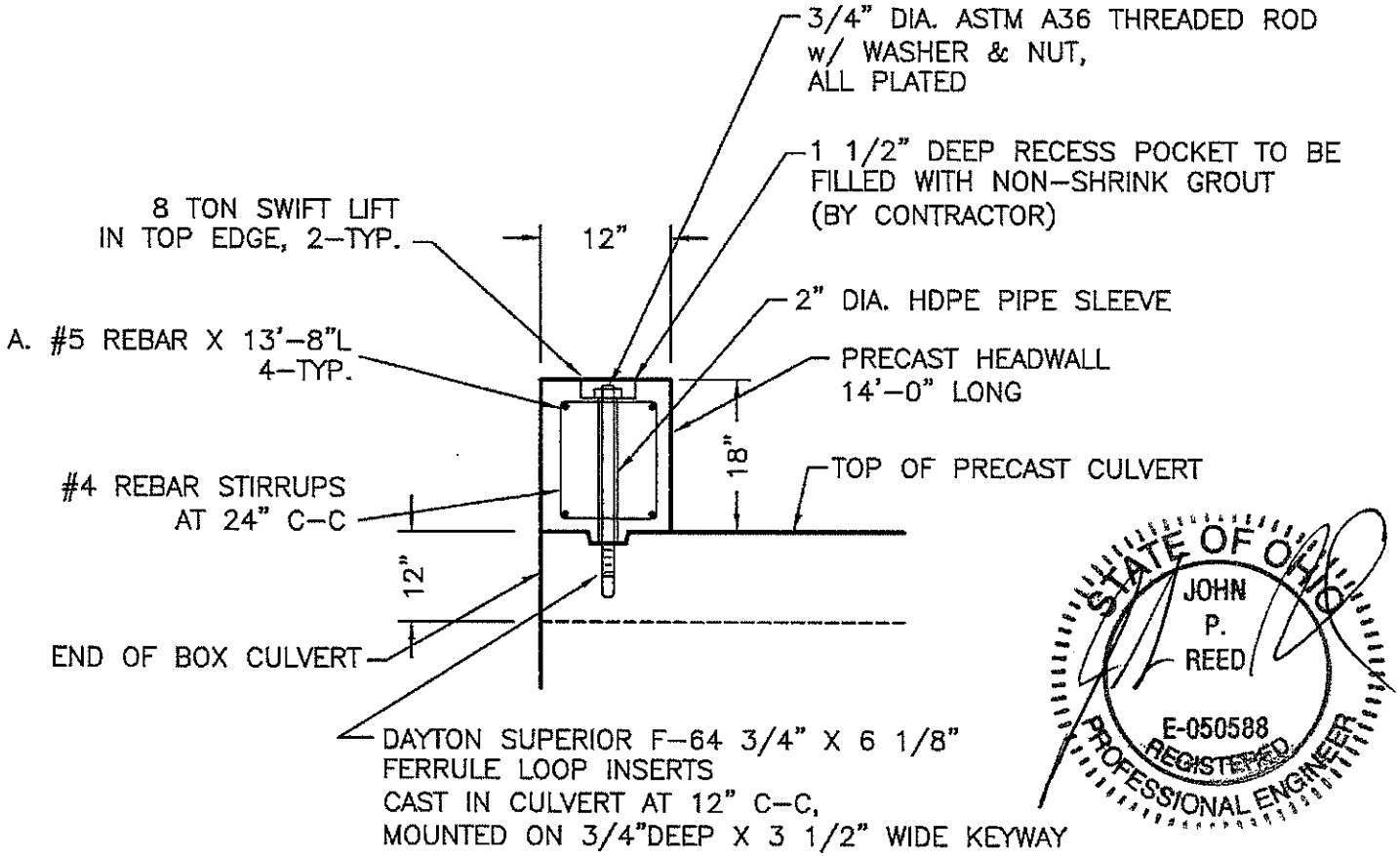
As2=0.54 As6=0.30
As3=0.54 As7=0.30
As4=0.30 As8=0.30

STATE OF OHIO
JOHN P. REED
E-050588
REGISTERED
PROFESSIONAL ENGINEER



9X12RE



ALL #5 EPOXY COATED REINFORCING

A. 4 RODS,
#5 X 13'-8"
STRAIGHT

B. 16 RODS,
#4 X 2'-10"
BENT

JOB: ODOT PROJ. 180118
JOB # CV37920
CUST: JURGENSON

NOTES:

1. REINFORCED PRECAST CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF 5000 PSI AT 28 DAYS.
2. REINFORCING SHALL HAVE A MINIMUM YIELD STRENGTH OF 60,000 PSI AND CONFORM TO ASTM A615.
3. 0.78 YDS. REGULAR 5000 PSI CONCRETE
4. HEADWALL TO BE REMOVABLE
5. POUR ON TOP OF 'DN' SECTION FOR MATCH-CAST FIT

DOWNSTREAM HEADWALL DETAIL

ODOT PROJ. 180118

DRAWN BY:	EJG	SCALE: NTS	DRAWING NO.: CV37920HW
DATE:	7/23/18	REV.	

MACK INDUSTRIES, INC.
201 COLUMBIA ROAD, VALLEY CITY, OHIO 44280 (330) 483-3111

Ohlin & Reed, Inc.
525 N. Cleveland-Massillon Rd.
Suite 001
Akron, OH 44333

Title ODOT Project 180118
Job # : 18243 Dsgnr: AJK
Description....
Wing Walls

Date: 1 AUG 2018

This Wall in File: Z:\Shared Drawings\Mack Industries\ODOT Project 180118\ODOT Project 180118.RPX

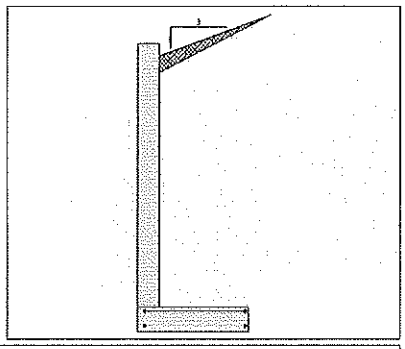
Cantilevered Retaining Wall

Criteria

Retained Height	=	10.17 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	3.00
Height of Soil over Toe	=	43.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	10,000.0 psf
Coulomb Soil Pressure calculation		
Soil Friction Angle	=	30.0 deg
Active Pressure:		
Ka*Gamma (horiz)	=	42.2 psf/ft
Passive Pressure:Kp*Gar	=	576.8 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.600
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	240.0 psf
NOT Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
NOT Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Service Level)
Wind on Exposed Stem (Service Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.38 Ratio < 1.5!
Sliding	=	1.96 OK
Total Bearing Load	=	10,418 lbs
...resultant ecc.	=	17.86 in
Soil Pressure @ Toe	=	6,865 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	10,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	7,853 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	0.0 psi OK
Footing Shear @ Heel	=	57.2 psi OK
Allowable	=	106.1 psi

Sliding Calcs

Lateral Sliding Force	=	4,358.0 lbs
less 50 % Passive Force	= -	2,885.2 lbs
less 100% Friction Force	= -	5,675.0 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

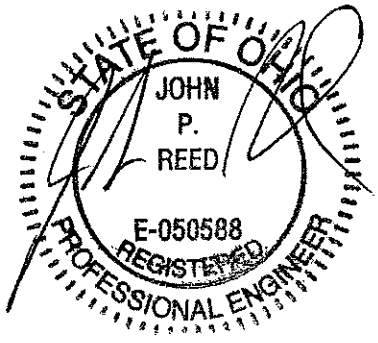
Vertical component of active lateral soil pressure IS considered in the calculation of soil bearing pressures.

Load Factors

Building Code	AASHTO LRFD
Dead Load	1.250
Live Load	1.750
Earth, H	1.350
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		Bottom		
		Stem OK		
Design Height Above Ftg	ft =	0.00		
Wall Material Above "Ht"	=	Concrete		
Design Method	=	LRFD	ASD	LRFD
Thickness	=	12.00		
Rebar Size	=	# 5		
Rebar Spacing	=	8.00		
Rebar Placed at	=	Edge		
Design Data				
fb/FB + fa/Fa	=	0.766		
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	4,108.7		
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	15,894.6		
Moment.....Allowable	=	20,743.3		
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =	33.6		
Shear.....Allowable	psi =	106.1		
Anet (Masonry)	in2 =		139.50	
Rebar Depth 'd'	in =	10.19		
Masonry Data				
f'm	psi =			
Fs	psi =			
Solid Grouting	=			
Modular Ratio 'n'	=			
Wall Weight	psf =	150.0		
Short Term Factor	=			
Equiv. Solid Thick.	=			
Masonry Block Type	=	Medium Weight		
Masonry Design Method	=	ASD		
Concrete Data				
f'c	psi =	5,000.0		
Fy	psi =	60,000.0		



Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.3572 in2/ft	
(4/3) * As :	0.4763 in2/ft	Min Stem T&S Reinf Area 3.073 in2
3sqrt(f'c)bd/fy : 3sqrt(5000)(12)(10.1875)/60000	0.4322 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.288 in2/ft
0.002bh : 0.002(12)(12) :	0.288 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.4322 in2/ft	#4@ 8.33 in #4@ 16.67 in
Provided Area :	0.465 in2/ft	#5@ 12.92 in #5@ 25.83 in
Maximum Area :	2.5978 in2/ft	#6@ 18.33 in #6@ 36.67 in

Footing Dimensions & Strengths

Toe Width	=	0.00 ft
Heel Width	=	5.00
Total Footing Width	=	5.00
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 5,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0020
Cover @ Top 2.00 @ Btm.= 2.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	7,853	0 psf
Mu' : Upward	=	0	3,635 ft-#
Mu' : Downward	=	0	30,706 ft-#
Mu: Design	=	0	27,072 ft-#
Actual 1-Way Shear	=	0.00	57.25 psi
Allow 1-Way Shear	=	51.85	106.07 psi

Toe Reinforcing = # 6 @ 8.00 in
Heel Reinforcing = # 6 @ 8.00 in
Key Reinforcing = None Spec'd

Other Acceptable Sizes & Spacings

Toe: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Heel: #4@ 3.67 in, #5@ 5.69 in, #6@ 8.07 in, #7@ 11.01 in, #8@ 14.50 in, #9@ 18.3
Key: No key defined

Min footing T&S reinf Area 1.44 in2
Min footing T&S reinf Area per foot 0.29 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 8.33 in	#4@ 16.67 in
#5@ 12.92 in	#5@ 25.83 in
#6@ 18.33 in	#6@ 36.67 in

Summary of Overturning & Resisting Forces & Moments

		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#			.....RESISTING..... Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	3,301.7	4.17	13,760.7	Soil Over Heel	=	4,881.6	3.00	14,644.8
Surcharge over Heel	=	1,056.3	6.25	6,603.4	Sloped Soil Over Heel	=	320.0	3.67	1,173.3
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=				* Axial Live Load on Stem	=			
	=				Soil Over Toe	=			
					Surcharge Over Toe	=			
Total		4,358.0	**O.T.M.**	20,364.1	Stem Weight(s)	=	1,600.5	0.50	800.3
	=		=		Earth @ Stem Transitions	=			
Resisting/Overturning Ratio		=	**1.38**		Footing Weight	=	750.0	2.50	1,875.0
Vertical Loads used for Soil Pressure	=	10,418.3 lbs			Key Weight	=			
					Vert. Component	=	1,906.2	5.00	9,531.2
					Total	=	9,458.3 lbs	**R.M.=**	28,024.5

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.407	in

OHLIN & REED, INC.
525 N. CLEVELAND-MASSILLON RD.
SUITE 001 AKRON, OH 44333
330-576-3463

Dowel Anchor Calculation

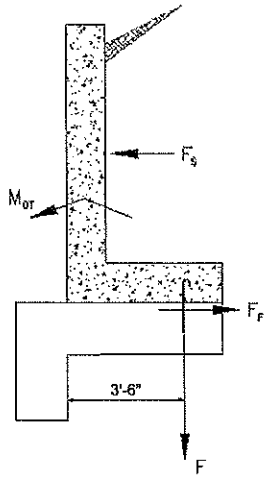
Overturning:

Required factor of safety > 1.5

$M_{OT} := 20364 \quad ft-lbs$

$M_{R.required} := 1.5 \cdot M_{OT} = 30546 \quad \frac{ft-lbs}{ft}$

$M_{R.actual} := 28025 \quad \frac{ft-lbs}{ft}$



Hold-down force required:

$F_H := \frac{M_{R.required} - M_{R.actual}}{3.50} = 720 \quad plf$

Sliding:

Required factor of safety > 1.5

$F_S := 4358 \quad plf$

$F_{R.required} := 1.5 \cdot F_S = 6537 \quad plf$

$F_{R.actual} := 8560 \quad plf \quad > Fs$

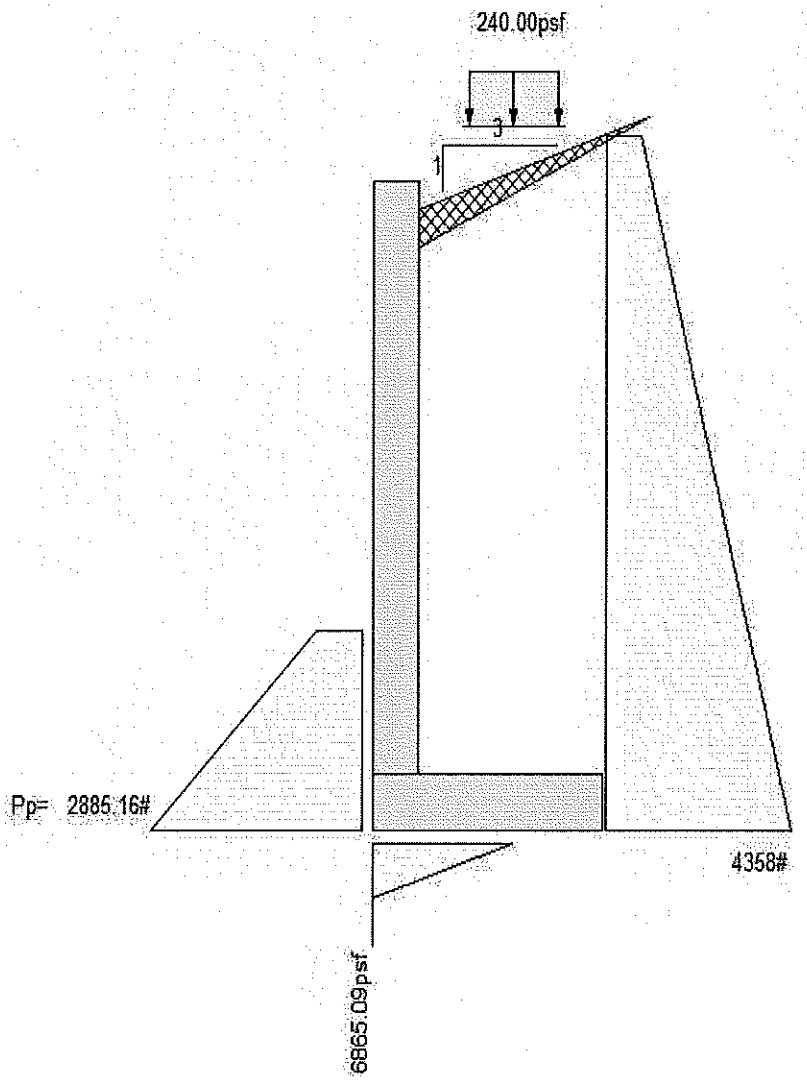
Frictional force required:

$F_f := 0 \quad plf$

Total force required in dowels: (#5 @ 16" o.c.)

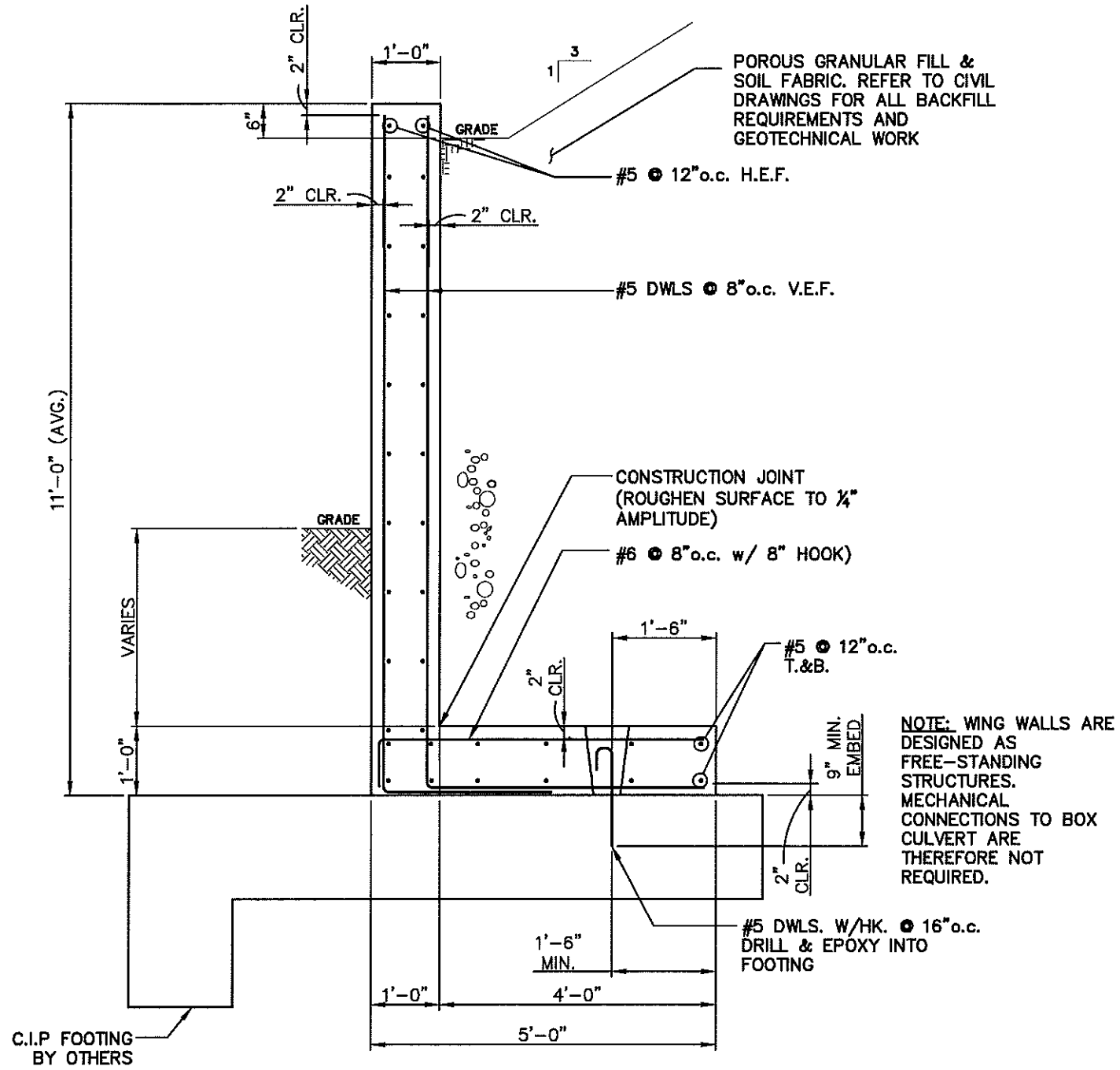
$F_{total} := F_H = 720 \quad plf$

$F_{allow} := 0.23 \cdot 30000 = 6900 \quad plf \quad OK$



LOADING DIAGRAM

PROJECT		JOB NO.	SHEET
ODOT PROJECT 180118	OHLIN & REED	18243	6
SHEET TITLE		DATE	OF
PRECAST WING WALL		8/1/18	6



NOTE: WING WALLS ARE DESIGNED AS FREE-STANDING STRUCTURES. MECHANICAL CONNECTIONS TO BOX CULVERT ARE THEREFORE NOT REQUIRED.

NOTE: C.I.P. FOOTING MUST BE CAPABLE OF SUPPORTING LOAD FROM THE DOWELS. SEE CALCULATION.

REINFORCING DETAILS

N.T.S.

Designation: C1577 – 17

Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD[1]

This standard is issued under the fixed designation C1577; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers single-cell precast reinforced concrete box sections cast monolithically and intended to be used for the construction of culverts and for the conveyance of storm water, industrial wastes and sewage.

NOTE 1—This specification is primarily a manufacturing and purchasing specification. However, standard designs per the AASHTO LRFD Bridge Design Specifications are included and the criteria used to develop these designs are given in Appendix X1. The successful performance of this product depends upon the proper selection of the box section, bedding, backfill, and care that the installation conforms to the construction specifications. The purchaser of the precast reinforced concrete box sections specified herein is cautioned that proper correlation of the loading conditions and the field requirements with the box section specified, and provision for inspection at the construction site, are required.

1.2 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

2. Referenced Documents

2.1 ASTM Standards:[2]

A1064/A1064M Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

A615/A615M Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

A706/A706M Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement

C33/C33M Specification for Concrete Aggregates

C150/C150M Specification for Portland Cement

C260/C260M Specification for Air-Entraining Admixtures for Concrete

C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete

C494/C494M Specification for Chemical Admixtures for Concrete

C497 Test Methods for Concrete Pipe, Manhole Sections, or Tile

C595/C595M Specification for Blended Hydraulic Cements

C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

C822 Terminology Relating to Concrete Pipe and Related Products

C989/C989M Specification for Slag Cement for Use in Concrete and Mortars

C990 Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

C1017/C1017M Specification for Chemical Admixtures for Use in Producing Flowing Concrete

C1116/C1116M Specification for Fiber-Reinforced Concrete

C1602/C1602M Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

C1619 Specification for Elastomeric Seals for Joining Concrete Structures

C1675 Practice for Installation of Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers

C1677 Specification for Joints for Concrete Box, Using Rubber Gaskets

2.2 AASHTO Standards:[3]

AASHTO LRFD Bridge Design Specifications

AASHTO LRFD Bridge Construction Specifications

2.3 ASCE Standard:[4]

ASCE 26–97 Standard Practice for Direct Design of Buried Precast Concrete Box Sections

[1] This specification is under the jurisdiction of ASTM Committee C13 on Concrete Pipe and is the direct responsibility of Subcommittee C13.07 on Acceptance Specifications and Precast Concrete Box Sections.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, http://www.transportation.org.

[4] Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, http://www.asce.org.

3. Terminology

3.1 Definitions—For definitions of terms relating to concrete pipe, see Terminology C822.

4. Designation

4.1 Precast reinforced concrete box sections manufactured in accordance with this specification shall be legibly marked with the specification designation, span, rise, and design earth cover.

TABLE 1 Design Requirements for Precast Concrete Box Sections Under Earth, Dead and HL-93 Live Load Conditions

NOTE 1—Design earth loads and reinforcement areas are based on the weight of a column of earth over the width of the box section multiplied by a soil structure interaction factor as defined in Appendix X1.

NOTE 2—Concrete design strength 5000 psi.

NOTE 3—Steel areas are based on an HL-93 live load without the lane load as permitted by AASHTO, using either the design truck or the design tandem and taking the controlling case.

NOTE 4—The design earth cover indicated is the height of fill above the top of the box section. Design requirements are based on the material and soil properties, loading data, and typical section as included in Appendix X1. For alternative or special designs, see 7.2.

NOTE 5—Design steel area in square inches per linear foot of box section at those locations which are indicated on the typical section shown in Fig. 1.

NOTE 6—The top section designation, for example, 3 ft by 2 ft by 4 in. indicates (interior horizontal span in feet) by (interior vertical rise in feet) by (wall and slab thickness in inches).

NOTE 7—In accordance with the acceptance criteria in 7.2, the manufacturer is not prohibited from interpolating steel area requirements or submitting independent designs for fill heights between noted increments.

NOTE 8—The "M" dimension given in the tables is the required distance that A_{s1} shall be extended into the top and bottom slabs if it is used as reinforcement for the negative moment in these areas. This distance is based on the location where the negative moment in the slab becomes zero, plus an additional development length. Because the live load can be applied at any location along the top slab as the truck drives over it, it is possible for the "M" dimension to exceed one-half the length of the slab.

NOTE 9—(Advisory)—The reinforcing areas are based on 4 inch circumferential wire spacing. Under design conditions where crack control governs, an analysis following the design criteria in Table X1.1 with closer steel spacing may result in a reduction in steel area over those in the table.

3 ft by 2 ft by 4 in.								
Design Earth Cover, ft	Circumferential Reinforcement Areas, in.²/ft							
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	"M," in.
0<2[A]	0.17	0.25	0.16	0.10	0.17	0.17	0.14	
2<3	0.13	0.19	0.18	0.10				31
3-5	0.10	0.11	0.12	0.10				31
10	0.10	0.10	0.10	0.10				31
15	0.10	0.13	0.13	0.10				31
20	0.11	0.17	0.17	0.10				31
25	0.14	0.21	0.21	0.10				31
30	0.17	0.25	0.25	0.10				31
35	0.20	0.29	0.30	0.10				31

[A] Top slab 7 in., bottom slab 6 in.

3 ft by 3 ft by 4 in.								
Design Earth Cover, ft	Circumferential Reinforcement Areas, in.²/ft							
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	"M," in.
0<2[A]	0.17	0.27	0.17	0.10	0.17	0.17	0.14	
2<3	0.10	0.22	0.21	0.10				31
3-5	0.10	0.14	0.14	0.10				31
10	0.10	0.11	0.11	0.10				31
15	0.10	0.14	0.15	0.10				31
20	0.10	0.18	0.19	0.10				31
25	0.10	0.23	0.23	0.10				31
30	0.12	0.27	0.28	0.10				31
35	0.14	0.32	0.32	0.10				31

[A] Top slab 7 in., bottom slab 6 in.

25	0.75	0.92	0.95	0.29				53

12 ft by 8 ft by 12 in.

Design Earth Cover, ft	Circumferential Reinforcement Areas, in.²/ft							
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	"M," in.
0<2	0.29	0.41	0.38	0.29	0.29	0.29	0.29	
2<3	0.33	0.49	0.42	0.29				66
3-5	0.29	0.41	0.38	0.29				59
10	0.34	0.46	0.48	0.29				59
15	0.44	0.61	0.64	0.29				53
20	0.57	0.78	0.81	0.29				53
25	0.69	0.96	0.99	0.29				53

12 ft by 9 ft by 12 in.

Design Earth Cover, ft	Circumferential Reinforcement Areas, in.²/ft							
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	"M," in.
0<2	0.29	0.43	0.40	0.29	0.29	0.29	0.29	
2<3	0.30	0.51	0.45	0.29				66
3-5	0.29	0.43	0.41	0.29				66
10	0.32	0.47	0.51	0.29				59
15	0.42	0.63	0.67	0.29				53
20	0.53	0.81	0.85	0.29				53
25	0.69	0.96	0.99	0.29				53

12 ft by 10 ft by 12 in.

Design Earth Cover, ft	Circumferential Reinforcement Areas, in.²/ft							
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	"M," in.
0<2	0.29	0.45	0.43	0.29	0.29	0.29	0.29	
2<3	0.29	0.54	0.48	0.29				73
3-5	0.29	0.45	0.43	0.29				66
10	0.31	0.49	0.53	0.29				59
15	0.40	0.65	0.70	0.29				53
20	0.51	0.84	0.88	0.29				53
25	0.62	1.03	1.07	0.29				53

12 ft by 11 ft by 12 in.

Design Earth Cover, ft	Circumferential Reinforcement Areas, in.²/ft							
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	"M," in.
0<2	0.29	0.47	0.45	0.29	0.29	0.29	0.29	
2<3	0.29	0.56	0.51	0.29				80
3-5	0.29	0.47	0.46	0.29				73
10	0.29	0.51	0.55	0.29				66
15	0.38	0.67	0.72	0.29				59
20	0.48	0.85	0.91	0.29				53
25	0.59	1.05	1.10	0.29				53

12 ft by 12 ft by 12 in.

Design Earth Cover, ft	Circumferential Reinforcement Areas, in.²/ft							
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	"M," in.
0<2	0.29	0.49	0.48	0.33	0.29	0.29	0.29	
2<3	0.29	0.59	0.53	0.29				93
3-5	0.29	0.49	0.48	0.29				80
10	0.29	0.52	0.58	0.29				73
15	0.37	0.69	0.74	0.29				59
20	0.46	0.87	0.93	0.29				59

5. Basis of Acceptance

5.1 Acceptability of the box sections produced in accordance with Section 7 shall be determined by the results of the concrete compressive strength tests described in Section 11, by the material requirements described in Section 6, and by inspection of the finished box sections.

5.2 Box sections shall be considered ready for acceptance when they conform to the requirements of this specification.

6. Material

6.1 Reinforced Concrete—The reinforced concrete shall consist of cementitious materials, mineral aggregates, admixtures if used, and water, in which steel has been embedded in such a manner that the steel and concrete act together.

6.2 Cementitious Materials:

6.2.1 Cement—Cement shall conform to the requirements for portland cement of Specification C150/C150M or shall be portland blast-furnace slag cement, portland-limestone cement, or portland-pozzolan cement conforming to the requirements of Specification C595/C595M, except that the pozzolan constituent in the Type IP portland-pozzolan cement shall be fly ash.

6.2.2 Fly Ash—Fly ash shall conform to the requirements of Specification C618, Class F or Class C.

6.2.3 Slag Cement—Slag Cement shall conform to the requirements of Grade 100 or 120 of Specification C989/C989M.

6.2.4 Allowable Combinations of Cementitious Materials—The combination of cementitious materials used in concrete shall be one of the following:

6.2.4.1 Portland cement only,

6.2.4.2 Portland blast-furnace slag cement only,

6.2.4.3 Portland-pozzolan cement only,

6.2.4.4 Portland-limestone cement only,

6.2.4.5 A combination of portland cement or portland-limestone cement and fly ash,

6.2.4.6 A combination of portland cement or portland-limestone cement and slag cement, or

6.2.4.7 A combination of portland cement or portland-limestone cement, slag cement, and fly ash, or

6.2.4.8 A combination of portland-pozzolan cement and fly ash.

6.3 Aggregates—Aggregates shall conform to Specification C33/C33M, except that the requirements for gradation shall not apply.

6.4 Admixtures—The following admixtures and blends are allowable:

6.4.1 Air-entraining admixture conforming to Specification C260/C260M;

6.4.2 Chemical admixture conforming to Specification C494/C494M;

6.4.3 Chemical admixture for use in producing flowing concrete conforming to Specification C1017/C1017M; and

6.4.4 Chemical admixture or blend approved by the owner.

6.5 Steel Reinforcement—Reinforcement shall consist of welded wire reinforcement conforming to Specification A1064/A1064M. Circumferential reinforcement areas in Table 1 are based solely on the use of welded wire reinforcement with 4 in. spacing of the circumferential wires. Refer to 12.6 if alternate steel designs utilizing steel bars, Grade 60, in conjunction with or in lieu of welded wire reinforcement are to be submitted for the owner's approval. Longitudinal distribution reinforcement shall consist of welded wire reinforcement or deformed billet-steel bars conforming to either Specification A615/A615M, Grade 60, or Specification A706/A706M, Grade 60.

6.6 Fibers—Synthetic fibers and nonsynthetic fibers shall be allowed to be used, at the manufacturer's option, in concrete pipe as a nonstructural manufacturing material. Synthetic fibers (Type II and Type III) and nonsynthetic fiber (Type I) designed and manufactured specifically for use in concrete and conforming to the requirements of Specification C1116/C1116M shall be accepted.

6.7 Water—Water used in the production of concrete shall be potable or non-potable water that meets the requirements of Specification C1602/C1602M.

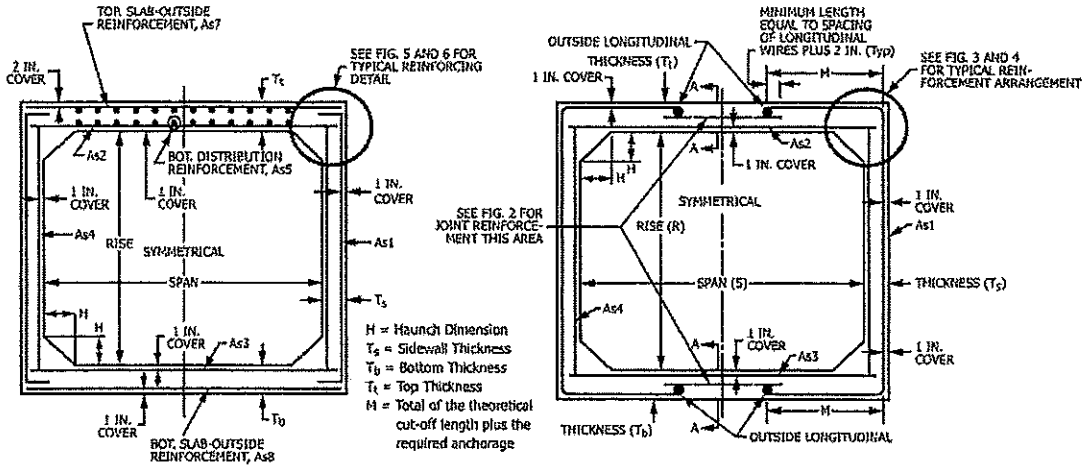
7. Design

7.1 Design Tables—The box section dimensions, compressive strength of the concrete, and reinforcement details shall be as prescribed in Table 1 and Figs. 1-9, subject to the provisions of Section 12. Table 1 sections are designed for combined earth dead load and AASHTO HL-93 live load without the lane load, as permitted by AASHTO. Criteria used to develop Table 1 is given in Appendix X1.

NOTE 2—The tabular designs in this specification were prepared according to the AASHTO LRFD Bridge Design Specifications.

7.2 Modified and Special Designs for Monolithic Structures—The manufacturer shall request approval by the purchaser for modified designs which differ from the designs in Section 7; or special designs for sizes and loads other than those shown in Table 1. When spans are required that exceed those prescribed in Table 1, the design shall be based on the criteria given in Appendix X1. In addition, the span shall be designed to have adequate stiffness to limit deflection as given in Article 2.5.2.6.3 of AASHTO LRFD Bridge Design Specifications.

NOTE 3—(Advisory)—Construction procedures, such as heavy equipment movement or stockpiling of material over or adjacent to a box



Fill Height Less than 2 ft

Fill Height 2 ft and Greater

FIG. 1 Typical Box Sections

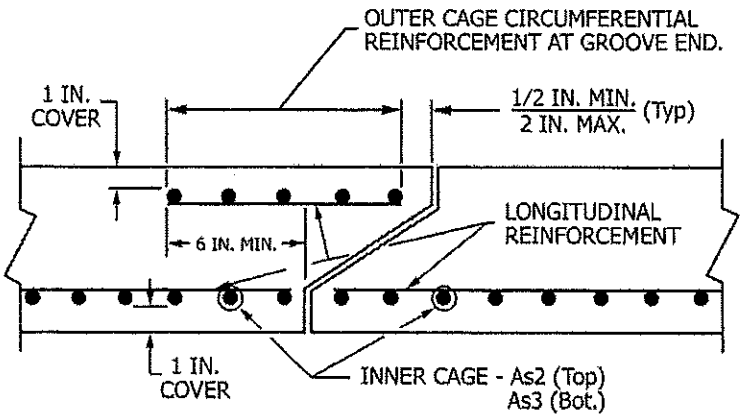


FIG. 2 Section A-A Top and Bottom Slab Joint Reinforcement

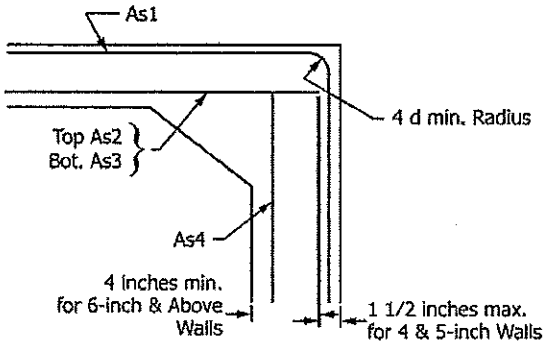


FIG. 3 Detail Inner Reinforcement

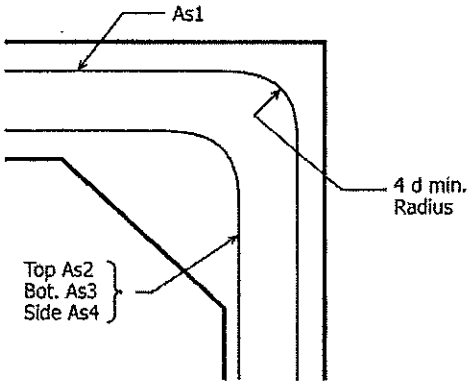


FIG. 4 Detail Option (see Fig. 3)

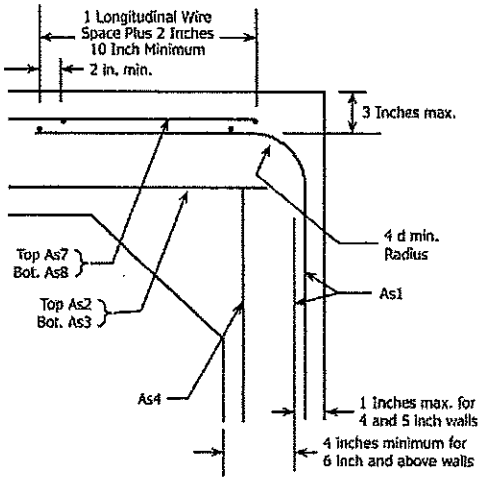


FIG. 5 Detailed Reinforcement Arrangement

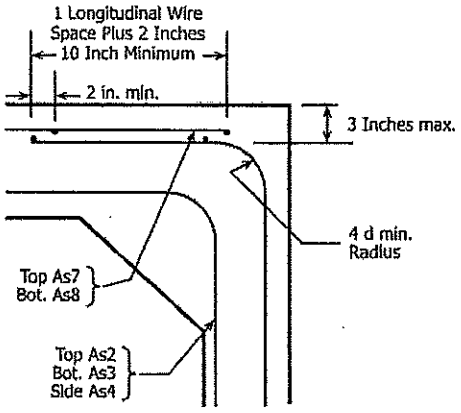


FIG. 6 Detail Option

structure can induce higher loads than those used for the structure's final design. These construction and surcharge loads are allowable as long as the final steel areas in the box are larger than those required for the construction phase. The design engineer shall take into consideration the potential for higher loads induced by construction procedures in determining the final design of the box structure.

7.3 Placement of Reinforcement—The cover of concrete over the circumferential reinforcement shall be 1 in. except for when the box culvert has less than 2 ft of earth cover, then the concrete cover over the top slab reinforcement A_{s7} shall be 2 in. Concrete cover shall be subject to the provisions of Section 12. The inside circumferential reinforcement shall extend into the tongue portion of the joint and the outside circumferential reinforcement shall extend into the groove portion of the joint. The clear distance of the end circumferential wires shall be not

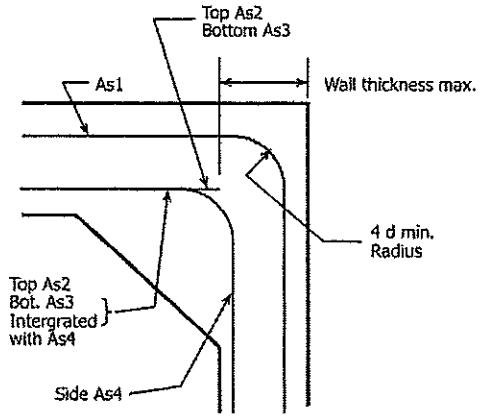


FIG. 7 Alternate Detail (see Fig. 3)

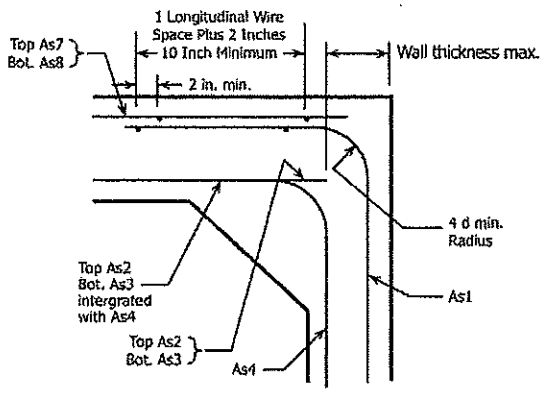


FIG. 8 Alternate Detail (see Fig. 5)

less than ½ in. nor more than 2 in. from the ends of the box section. Reinforcement shall be assembled utilizing any combination of single or multiple layers of welded-wire reinforcement. Multiple layers shall not be separated by more than the thickness of one longitudinal wire plus ¼ in. The multiple layers shall be fastened together to form a single cage. All other specification requirements such as laps, welds, and tolerances of placement in the wall of the box section shall apply to this method of fabricating a reinforcement cage. It is not prohibited for a common reinforcement unit to be utilized for both A_{s2} (or A_{s3}) and A_{s4}, and also for both A_{s7} (or A_{s8}) and A_{s1}, with the largest area requirement governing, bending the reinforcement at the corners and waiving the extension requirements of Fig. 3 and Fig. 5 (see Fig. 4). When a single cage of multiple circumferential steel areas is used for A_{s2} (or A_{s3}) and A_{s4} reinforcement, the slab or wall requiring the larger steel area shall have this additional circumferential steel extending for the full span of the slab or rise of the wall. The welded wire reinforcement shall be composed of circumferential and longitudinal wires meeting the spacing requirements of 7.4 and shall contain sufficient longitudinal wires extending through the box section to maintain the shape and position of reinforcement. Longitudinal distribution reinforcement shall be welded-wire reinforcement or deformed billet-steel bars and shall meet the spacing requirements of 7.4. The ends of the longitudinal distribution reinforcement shall not be more than 2 in. from the ends of the box section. The exposure of the ends of longitudinals, stirrups, and spacers used to position the reinforcement shall not be a cause for rejection.

7.4 Laps, Welds, and Spacing—Splices in the circumferential reinforcement shall be made by lapping. The overlap measured between the outermost longitudinal wires of each reinforcement sheet shall not be less than the space containing two longitudinal wires of each mesh plus 2 in., but not less than 10 in. If A_{s1} is extended to the middle of either slab and connected, welded splices or lapped splices shall be used in the connection. When used, A_{s7} and A_{s8} shall be lapped with A_{s1} as shown in Fig. 5, Fig. 6, or Fig. 8 and are not prohibited from being connected by welding. If welds are made to circumferential reinforcement, they shall be made only to selected circumferential wires that are not less than 18 in. apart along the longitudinal axis of the box section as shown in Fig. 9. Also, when spacers are welded to circumferential wires, they shall be welded only to these selected circumferential wires. There shall be no welding to other circumferential wires, except A_{s4} is not prohibited from being lapped and welded at any location or connected by welding at the corners to A_{s2} and A_{s3}. No welds shall be made to A_{s2} or A_{s3} circumferential wires in the middle third of the span as shown in Fig. 9. When distribution reinforcement is to be fastened to a cage by welding, it shall be welded only to longitudinal wires and only within 18 in. of the end of the box section. If welds are made to Grade 60 reinforcing bars, weldable bars conforming to Specification A706/A706M shall be used. The spacing center to center of the circumferential wires shall not be less than 2 in. nor more than 4 in. The spacing center to center of the longitudinal wires shall not be more than 8 in.

NOTE 4—(Advisory)–The AASHTO LRFD Bridge Design Specifications should be consulted for weld requirements not directly addressed in this standard.

8. Installation

8.1 The successful performance of this product depends upon proper installation as the soil/structure interaction is considered in the design. The effects of this interaction are highlighted in Note 1 and Note 3. The precast reinforced concrete box section/soil system shall be constructed to conform to Practice C1675 for the installation conditions assumed for design and in accordance with the dimensions and requirements specified or shown on the plans. The tabular steel designs in this standard assume compacted sidefill. See Appendix X1 for additional details on design assumptions used to develop the design tables.

9. Joints

9.1 The precast reinforced concrete box sections shall be produced with tongue and groove ends. The ends shall be of such design and the ends of the box sections so formed that the sections can be laid together to make a continuous line of box sections compatible with the permissible variations given in Section 12.

9.2 Joints may conform to the requirements of Specification C1677, Specification C990 or other established joint type as approved by the owner including, but not limited to, mortar,

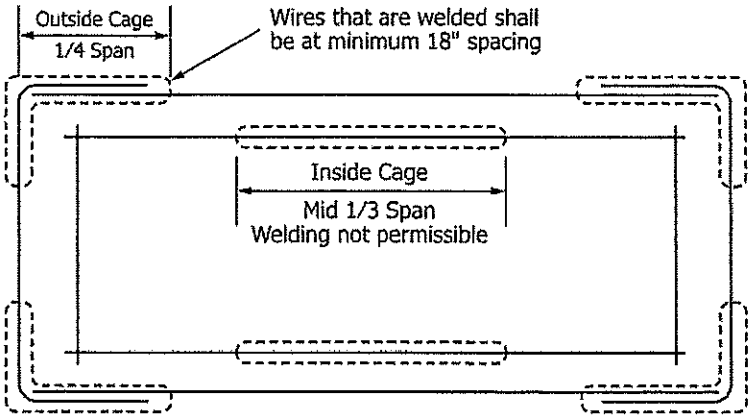


FIG. 9 Critical Zones of High Stress Where Welding is Restricted

sealant or fabric wrapped joints. For joints conforming to Specification C1677, the gasket shall be in accordance with Specification C1619, Class C requirements or for oil resistant properties the gasket shall meet Class D requirements.

9.3 Outer cage circumferential reinforcement as shown in Figs. 1 and 2 shall be placed in the top and bottom slabs at the groove portion of the joint when A_{s1} is not continuous over the span. The minimum area of such reinforcement in square inches per linear foot of box section length shall be the same as the areas specified for A_{s4} in Table 1.

10. Manufacture

10.1 Mixture—The aggregates shall be sized, graded, proportioned, and mixed with such proportions of cementitious materials and water as will produce a thoroughly-mixed concrete of such quality that the box section will conform to the test and design requirements of this specification. All concrete shall have a water-cementitious materials ratio not exceeding 0.53 by weight. Cementitious materials shall be as specified in 6.2 and shall be added to the mix in a proportion not less than 470 lb/yd^3 unless mix designs with a lower cementitious materials content demonstrate that the quality and performance of the box section meet the requirements of this specification.

10.2 Curing—The box sections shall be cured for a sufficient length of time so that the concrete will develop the specified compressive strength by the time of delivery. Any one of the following methods of curing or combinations thereof shall be used:

10.2.1 Steam Curing—The box sections shall be low pressure, steam-cured by a system that will maintain a moist atmosphere.

10.2.2 Water Curing—The box sections shall be water-cured by any method that will keep the sections moist.

10.2.3 Membrane Curing—A sealing membrane conforming to the requirements of Specification C309 shall be applied and shall be left intact until the required concrete compressive strength is attained. The concrete temperature at the time of application shall be within 10°F of the atmospheric temperature. All surfaces shall be kept moist prior to the application of the compounds and shall be damp when the compound is applied.

10.3 Forms—The forms used in manufacture shall be sufficiently rigid and accurate to maintain the box section dimensions within the permissible variations given in Section 12. All casting surfaces shall be of smooth nonporous material.

10.4 Handling—Handling devices or holes are not prohibited in each box section for the purpose of handling and laying.

11. Physical Requirements

11.1 Type of Test Specimen—Compression tests for determining concrete compressive strength shall be allowed to be made on either standard rodded concrete cylinders or concrete cylinders compacted and cured in like manner as the box sections, or on cores drilled from the box section.

11.2 Compression Testing of Cylinders:

11.2.1 Cylinders shall be prepared, cured, and tested in accordance with Section 11 of Test Methods C497. Cylinders shall be exposed to similar curing time and temperature conditions as the manufactured box sections as demonstrated upon request by manufacturer cylinder and box section curing records.

11.2.2 Prepare not less than three test cylinders from each concrete mix used within a group (one day's production) of box sections.

11.2.3 Acceptability on the Basis of Cylinder Test Results:

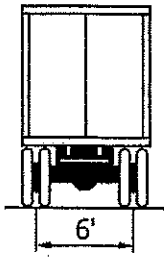
11.2.3.1 When the average compressive strength of all cylinders tested is equal to or greater than the design concrete strength, not more than 10 % of the cylinders tested have a compressive strength less than the design concrete strength, and no cylinder tested has a compressive strength less than 80 % of the design concrete strength, the lot shall be accepted.

11.2.3.2 Box sections that fail to meet the strength requirements under 11.2 shall not be retested under 11.3 without the approval of the purchaser.

11.2.3.3 When the compressive strength of the cylinders is unavailable, the acceptability of the lot shall be determined in accordance with the provisions of 11.3.

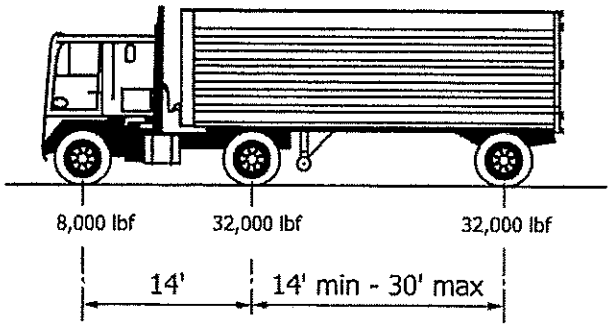
WHEEL SPACING

Design Truck
and
Design Tandem



AXLE LOADS

Design Truck



AXLE LOADS

Design Tandem

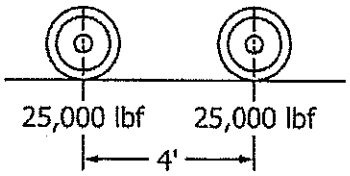
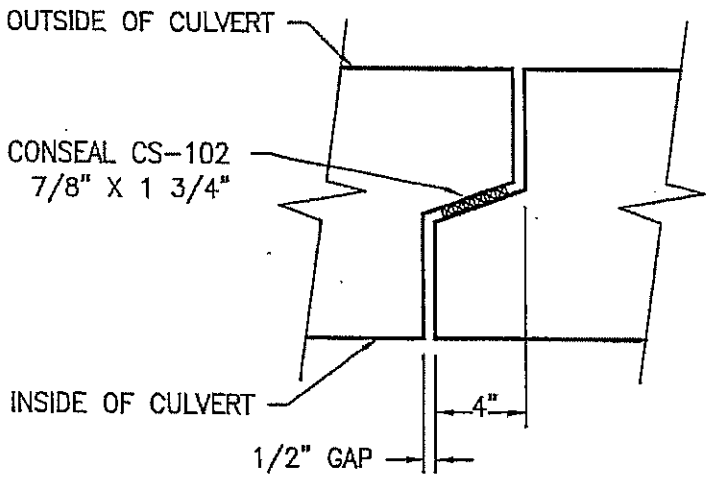


FIG. X1.1 Axle Loads for Box Section Standard Designs



TYPICAL JOINT DETAIL

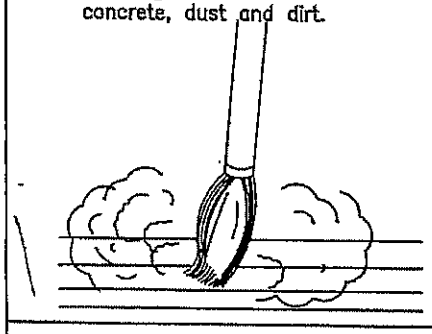
N.T.S.

INSTALLATION PROCEDURES:

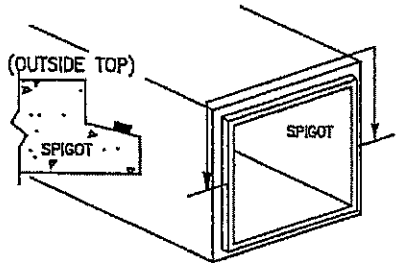
1. CULVERT JOINT SURFACE AREA TO BE CLEAN AND DRY, AND THEN PRIMED WITH CONSEAL CS-75 JOINT PRIMER, PER MANUFACTURER'S RECOMMENDATION.
2. APPLY STRIPS OF 7/8" X 1 3/4" CONSEAL CS-102 SEALANT TO THE UPPER HALF OF SPIGOT AND THE LOWER HALF OF THE BELL GROOVE AT EACH JOINT. ALLOW SUFFICIENT OVERLAP OF CONSEAL TO FORM A JOINED SEAL.
3. SET CULVERT SECTIONS TOGETHER TO WITH-IN A MAXIMUM 1/2" GAP IN THE JOINT. NOTE: RAKE BEDDING GRAVEL AWAY FROM BOTTOM OF JOINT, BEFORE SETTING EACH SECTION, TO KEEP GRAVEL FROM ENTERING THE JOINT.

VERTICAL JOINTS-BOX CULVERTS:

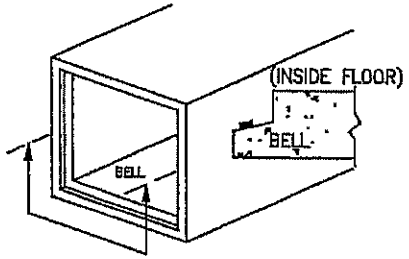
1. Clean concrete surface by brushing off all loose concrete, dust and dirt.



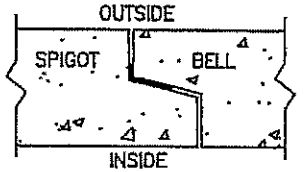
2. Apply ConSeal on upper 180° of spigot in position shown below.



3. Apply ConSeal on lower 180° of bell. Allow suficient over lap with spigot sealant to form a joined seal.



4. Check that joint surfaces are clean. Peel oil protective paper and install bell against spigot.



NOTE:
CULVERT JOINTS ARE TO BE SEALED AS SPECIFIED ON THIS SHEET BY THE CONTRACTOR. THIS SEALING DETAIL IS NOT INTENDED FOR USE IN HOLDING TANK APPLICATIONS.

IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO FOLLOW THE SEALANT MANUFACTURERS APPLICATION INSTRUCTIONS.

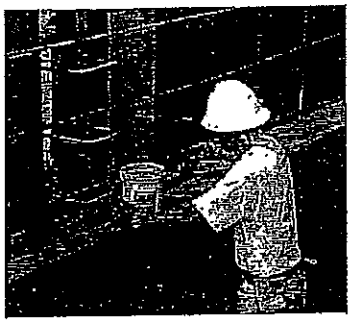
BOX CULVERT SEALING PROCEDURES

DRAWN BY: BK	SCALE:	DRAWING NO.: SEALANT2
DATE: 1-27-95	REV: EJM 1-25-16	

MACK INDUSTRIES INC.
201 COLUMBIA ROAD, VALLEY CITY, OHIO 44280 (330)483-3111

Water-Based Adhesive/Surface Primer

ConSeal
Concrete Sealants Inc.



CS-75

A Highly Adhesive Water-Based Surface Primer for Concrete, Plastic and Metal Surfaces

Applications

For use on concrete, plastic and metal surfaces, ConSeal CS-75 enhances the bonding between preformed sealants and concrete surfaces aiding in the installation process. Conveniently applied at the job site, CS-75 improves adhesion of the sealant to the concrete.

Physical Properties

Description

Color:	Bright Orange
% Solids:	33% minimum
Solvent Type:	Water
Flash Point:	200°F minimum
Weight / Gallon:	8.0 Pounds
Dry Time @ 77°F (25°C):	10 minutes
Dry Time @ 40°F (4°C):	60 minutes
Clean Up:	Soap and Water
Coverage Per Gallon:	Approx. 400 sq ft on wet cast concrete. Coverage diminishes on dry cast concrete.
Appropriate Substrates:	Concrete, Plastic, Metal
Min. Storage Temperature:	40°F (4°C) Product should not be allowed to freeze
Min. Application Temperature:	40°F (4°C)
Surface When Dry:	Tacky

Limited Warranty

This information is presented in good faith, but we cannot anticipate all conditions under which this information and our products, or the products of other manufactures in combination with our products, may be used. We accept no responsibility for results obtained by the application of this information or the safety and suitability of our products, either alone or in combination with other products. Users are advised to make their own tests to determine the safety and suitability of each such product or product combinations for their own purposes. It is the **users' responsibility** to satisfy himself as to the suitability and completeness of such information for this own particular use. We sell this product without warranty, and buyers and users assume all responsibility and liability for loss or damage arising from the handling and use of this product, whether used alone or in combination with other products.

Don't Just Seal It, ConSeal It!

ISO 9001 Registered

Concrete Sealants, Inc. 9325 State Route 201 ✖ Tipp City, OH 45371 ✖ **Toll Free** 800.332.7325
P. 937.845.8776 F. 937.845.3587 ✖ **www.conseal.com**

Butyl Rubber Sealant

ConSeal
Concrete Sealants Inc.

CS-102

Butyl Rubber Sealant for All Precast Concrete Structures - Meets ASTM C-990

Applications

For concrete joints in: Manholes, Concrete Pipe, Vaults, Box Culverts, Septic Tanks, and Vertical Panel Structures. **Not intended for use in expansion joints or joints that move.**

Sealing Properties

- Provides permanently flexible watertight joints.
- Low to high temperature workability: 30°F to 120°F (-1°C to +48°C)
- Rugged service temperature: -30°F to +200°F (-34°C to +93°C)
- Excellent chemical and mechanical adhesion to clean dry surfaces.
- Greater cohesive and adhesive strengths.
- Sealed joints will not shrink, harden or oxidize upon aging.
- Controlled flow resistance for application ease.
- No priming normally necessary. When confronted with difficult installation conditions, such as wet concrete or temperatures below 40°F (4°C), priming the concrete will improve the bonding action. Consult Concrete Sealants for the proper primer to meet your application.

Hydrostatic Strength

ConSeal CS-102 meets the hydrostatic performance requirement as set forth in ASTM C-990 section 10.1 (Performance requirement: 10psi for 10 minutes in straight alignment – in plant, quality control test for joint materials.)

Specifications

ConSeal CS-102 meets or exceeds all of the requirements of Federal Specification SS-S-210 (210-A), AASHTO M-198B, and ASTM C-990-91.

Physical Properties

Description	Spec	Required	CS-102
Color			Black
Specific Gravity, 77°F	ASTM D71	1.15-1.50	1.25
Ductility, 77°F	ASTM D113	5.0 min.	10
Penetration, cone 77°F (25°C), 150 gm, 5 sec.	ASTM D217	50-100 mm	55-60 mm
Penetration, cone 32°F (0°C), 150 gm, 5 sec.	ASTM D217	40 mm min.	40-65 mm
Flash Point, C.O.C., °F	ASTM D92	350°F min.	450°F
Fire Point, C.O.C., °F	ASTM D92	375°F min.	475°F

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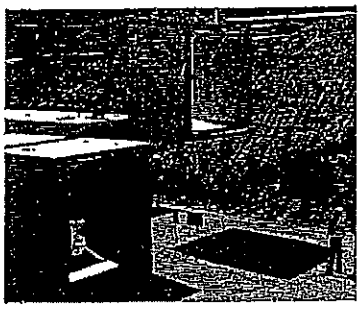
P. 937.845.8776 **F.** 937.845.8587 **Toll Free** 800.332.7325 ▪ **www.conseal.com**

Butyl Rubber Sealant

ConSeal
Concrete Sealants Inc.



CS-102

Butyl Rubber Sealant for All Precast Concrete Structures - Meets ASTM C-990

Chemical Composition
Description

	Spec	Required	CS-102
Hydrocarbon plastic content % by weight	ASTM D297	50% min.	51%
Inert mineral filler % by weight	AASHTO T111	30% min.	35%
Volatile Mater % by weight	ASTM D6	2% max.	1.2%
Non-extractable, carbon-based material			12.8%
Recycled Content, % by weight			
Post Consumer:			8.41%
Post Industrial:			10.85%

Immersion Testing

30-Day Immersion Testing: No visible deterioration when tested in 5% Caustic Potash, 5% Hydrochloric Acid, 5% Sulfuric Acid, and 5% saturated Hydrogen Sulfide.

One Year Immersion Testing: No visible deterioration when tested in 5% Formaldehyde, 5% Formic Acid, 5% Sulfuric Acid, 5% Hydrochloric Acid, 5% Sodium Hydroxide, 5% Hydrogen Sulfide, and 5% Potassium Hydroxide.

Limited Warranty

This information is presented in good faith, but we cannot anticipate all conditions under which this information and our products, or the products of other manufactures in combination with our products, may be used. We accept no responsibility for results obtained by the application of this information or the safety and suitability of our products, either alone or in combination with other products. Users are advised to make their own tests to determine the safety and suitability of each such product or product combinations for their own purposes. It is the **users' responsibility** to satisfy himself as to the suitability and completeness of such information for this own particular use. We sell this product without warranty, and buyers and users assume all responsibility and liability for loss or damage arising from the handling and use of this product, whether used alone or in combination with other products.

Don't Just Seal It, ConSeal It!

ISO 9001 Registered

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P. 937.845.8776 **F.** 937.845.3587 **Toll Free** 800.332.7325 ▪ **www.conseal.com**

This is to certify that the quality control procedures of

Mack Industries Inc.

201 Columbia Road
Valley City, OH 44280

were audited during an on-site plant inspection on November 28, 2017 and have met the

Precast Concrete Requirements

stated in the 12th Edition of the NPCA Quality Control Manual for Precast Concrete Plants

Renewal Granted on December 1, 2017

Participation in the NPCA Plant Certification program affirms an ongoing commitment to producing quality precast concrete products to recognized standards of the *American Association of State Highway and Transportation Officials* (AASHTO), the American Concrete Institute (ACI), the ASTM International (ASTM), the American Welding Society (AWS), the Precast Prestressed Concrete Institute (PCI), and the Concrete Reinforcing Steel Institute (CRSI).

This renewal certificate is valid through December 31, 2018.

Ashley S. Smith

Ashley Smith, Chairman of the Board

Ty E. Gable, NPCA President

Phillip B. Cutler, P.E., Director of Quality Assurance Programs

NPCA CERTIFIED PLANT

ANSI ACCREDITED
ISO/IEC 17065
Product Certification Body
#1018

ID 1248

RENEWAL CERTIFICATE