

7/7/25

Washington State Department of Transportation

RE: Existing Box Culvert Evaluation

As part of the I-405, SR522 Vicinity to SR527 Express Toll Lanes Improvement Project, traffic from the I-405 will be shifted onto an existing concrete box culvert located in the median. The existing culvert was built in 1996. Since the available plans for the culvert do not match field conditions, the following information was determined based on field investigation:

- Configuration and materials: Single-cell precast concrete box culvert
- Geometry: Interior dimensions are 20' wide x 9' high, with 2' chamfer at top and bottom. Wall and slab thicknesses are 10".
- Depth of fill above culvert: Varies from 4'-6'
- Reinforcement:
 - Top Slab - Interior: #6 bars at 5" o.c. transverse and #5 bars at 12" o.c. longitudinal
 - Top Slab – Exterior: #6 bars at 5" o.c. transverse and #5 bars at 12" o.c. longitudinal
 - Wall – Interior: #5 bars at 5" o.c. vertical with #5 bars at 10" o.c. horizontal
 - Wall – Exterior: #6 bars at 5" o.c. vertical with #5 bars at 10" o.c. horizontal
- Concrete strength, $f'_c = 6500$ psi min.
- Reinforcing steel strength, $f_y = 60,000$ psi

In order to analyze the culvert, the below assumptions were made:

- Fill density above culvert: 127 pcf. This is a weighted average which includes 6" of asphalt at 140 pcf with compacted or saturated soils below at 125 pcf.
- Reinforcement:
 - Corner bars are assumed at least equivalent to vertical interior wall bars (#5 at 5" o.c.)
 - Bottom slab reinforcement is taken to be equal to the top slab reinforcement. Standard practice is equivalent or better.

The culvert parameters outlined above were analyzed in the Eriksson Culvert software, the program indicated for box culvert design and analysis per the WSDOT Bridge Design Manual (BDM). The software inputs can be viewed on Pages 5-6. Input values that were confirmed by field investigations are highlighted for reference.

To evaluate the ability of the culvert to support traffic loading, load ratings were determined for HL-93 loads and the additional rating trucks outlined in Chapter 13 of the BDM. It was determined that the culvert could support the various truck loadings with ratings greater than 1.0 for all loadings, modeling the culvert as a double box culvert with pinned connections to the lid. A double box culvert was modeled to represent the addition of post shores which will be placed at the center of the culvert, rather than a center stem. The shoring is designed to carry the Truck Live Load and Pavement Dead Load only. The corresponding load ratings can be found on Pages 9, 15&16. Minimum controlling HL-93 inventory, and operating ratings are 1.81 and 2.35 respectively, demonstrating that the culvert can safely support the worst-case traffic loadings which could occur during construction.

Field investigations did not determine if additional reinforcement was installed near the access riser openings, additional post shores will be placed to prop up the top slab adjacent to the risers.

Additionally, the concrete riser and steel plate cover strength was evaluated under HL-93 LL and soil DL and found to be acceptable (see Pages 22-25).



7-7-25

**BRIDGE RATING SUMMARY:
EXISTING CULVERT (WITH SHORING)**



7-7-25

Bridge Name: I-405 OVER DETENTION VAULT
 Bridge Number: 405/102.5DV
 SID Number:
 Span Types: N/A
 Bridge Length: 285 ft
 Design Load: HL-93
 Engineering Firm/Agency: 4M Engineering
 Rated By: Jessica Merrell
 Checked By: Forrest Megargel
 Date: 7/7/2025

Inspection Report Date:	3/13/2025	Deck Condition	N/A
Rating Method:	LRFR	Superstructure Condition	N/A
Overlay Thickness:	N/A	Substructure Condition	N/A

Truck	RF	γ	Controlling Point
AASHTO 1 (Type 3)	2.75	2.0	Shear @ top slab
AASHTO 2 (Type 3S2)	3.07	2.0	Shear @ top slab
AASHTO 3 (Type 3-3)	3.48	2.0	Shear @ top slab
Legal Lane	4.57	2.0	Shear @ top slab
NRL	2.75	2.0	Shear @ top slab
LGL-105	2.75	2.0	Shear @ top slab
OL-1	4.76	1.20	Shear @ top slab
OL-2	4.76	1.20	Shear @ top slab
EV2	3.20	1.30	Shear @ top slab
EV3	2.82	1.30	Shear @ top slab

SNBI Rating	RF	γ	Controlling Point
Inventory (HL-93)	1.81	1.75	Shear @ bottom slab
Operating (HL-93)	2.35	1.35	Shear @ bottom slab

Remarks:

Per inspection report, concrete culvert is 20'x9' in good condition.

Existing Culvert Analysis (Shored)

4MENGINEERING

Sht _____ of _____

Project : Bothell to Swamp Creek

By: _____

Task : Box Culvert Evaluation

Client: Skanska

Ck: _____

Job No. :

File: Bothell DBC pinned.etcx

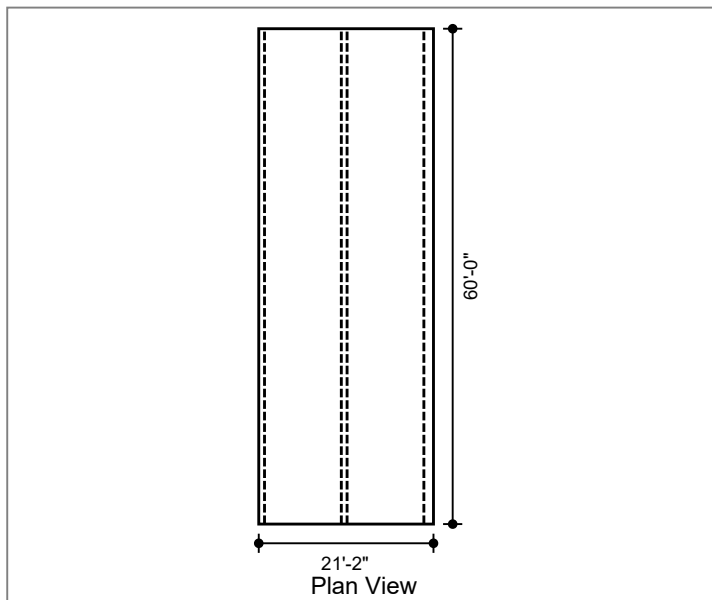
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Spec.: LRFD 9th ed.
Type of Culvert: Precast

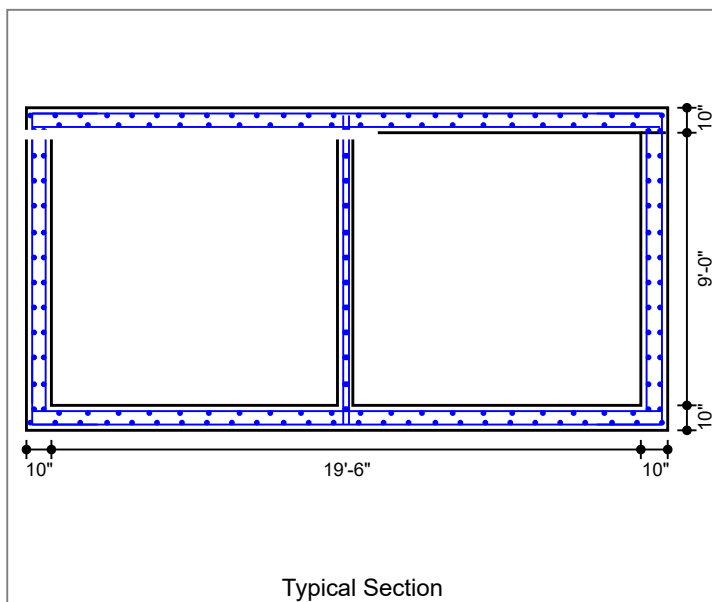
Physical Dimensions

Clear Span:	9'-6"
Clear Height:	9'-0"
Top Slab:	10"
Bottom Slab:	10"
Ext. Wall:	10"
Int. Wall:	6"
Fill Depth Range	
Maximum:	6.00 ft
Minimum:	4.00 ft
Increment:	0.50 ft
Length:	60'-0"
Skew Angle:	0.00 deg
Bottom Slab Support:	Full Slab
Top Haunch, Width:	0"
Top Haunch, Height:	0"
Bottom Haunch, Width:	0"
Bottom Haunch, Height:	0"



Material Properties

Concrete	
Strength, f _c :	6.500 ksi
Density:	0.155 kcf
Elasticity, E _c :	5347 ksi
Type:	Normal wt
Steel	
Yield, f _y :	60 ksi
Allow Stress:	36 ksi
Elasticity, E _s :	29000 ksi
Soil	
Density:	0.127 kcf
Exposure Factor	
User-Defined:	1.00
Reinforcement Covers	
Ext. Cover Top Slab:	2"
Ext. Cover Bottom Slab:	2"
Ext. Cover Walls:	2"
Int. Cover Walls:	2"
Int. Cover Top Slab:	2"
Int. Cover Bottom Slab:	2"



Controlling Ratings

Inventory Rating: 1.81
Operating Rating: 2.35

Loads

Live Load			
Vehicle Names:	HL-93 NRL - Legal Lane Overload 2 Type 3S2	EV 2 NRL Type 3-3 WA-105	EV 3 Overload 1 Type 3
Traffic Direction:	Perpendicular		
Eq. Height of Soil:	Calculated		
Max No. of Lanes:	2		
Dead Load			
Future Wearing Surface:	0.000 klf	Lateral Soil Loads	
Additional Dead Load:	0.000 klf	Eq. Fluid Press. Max:	60.00 pcf
Concentrated Loads:	none	Eq. Fluid Press. Min:	30.00 pcf
Interior Water Pressure:	no		
Exterior Water Pressure:	no		

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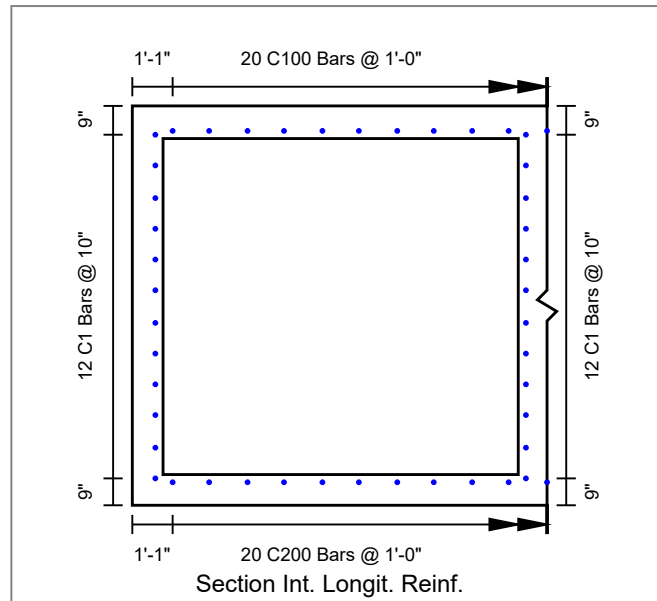
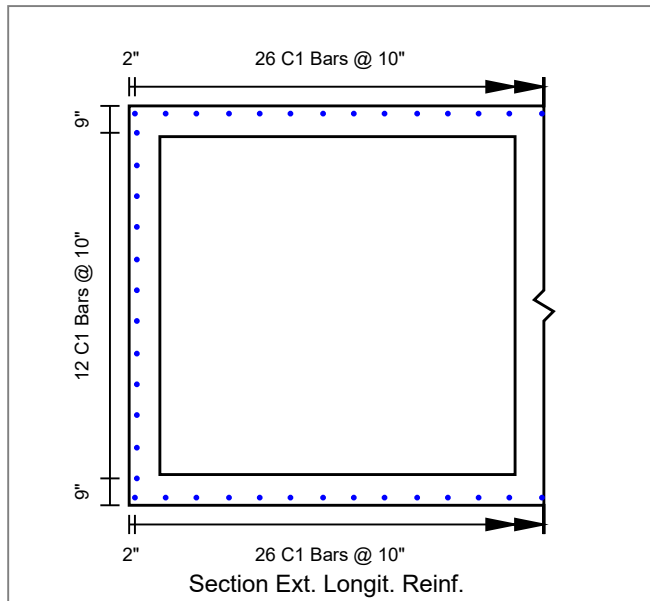
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 By: _____
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Concrete Summary

Volume of Concrete: 2.029 cy/ft Total Volume of Concrete: 121.728 cy

Reinforcing Steel Bar Schedule (lb)

Location	Mark	Qty	Size	Spacing	Type	Length	Hor.Leg	Ver.Leg	Tot.Weight
Top Slab(Int)	A100 (AS2)	1446	5"	5"	S	20'-9"	--	--	4488.0
Bot Slab(Int)	A200 (AS3)	1446	5"	5"	S	20'-9"	--	--	4488.0
Top Slab(Ext)	A300 (AS7)	1446	5"	5"	S	20'-9"	--	--	4488.0
Bot Slab(Ext)	A400 (AS8)	1446	5"	5"	S	20'-9"	--	--	4488.0
Corner(Top)	A1 (AS1)	2885	5"	5"	L	4'-4"	2'-2"	2'-2"	1302.0
Corner(Bot)	A2 (AS1)	2885	5"	5"	L	4'-4"	2'-2"	2'-2"	1302.0
Wall(Int)	B1 (AS4)	2885	5"	5"	S	9'-4"	--	--	2854.0
Wall(Ext)	B2 (AS1)	2886	5"	5"	S	8'-10"	--	--	3893.0
Int Wall	B3	1203	1'-0"	1'-0"	S	10'-3"	--	--	462.0
Longit. Top (Int)	C100 (AS5)	20	5	1'-0"	S	59'-11"	--	--	1250.0
Longit. Bot (Int)	C200	20	5	1'-0"	S	59'-11"	--	--	1250.0
Longit. Top (Ext)	C1 (AS6)	26	5	10"	S	59'-11"	--	--	1624.8
Longit. Bot (Ext)	C1 (AS6)	26	5	10"	S	59'-11"	--	--	1624.8
Longit. Wall (Ext)	C1 (AS6)	24	5	10"	S	59'-11"	--	--	1499.8
Longit. Wall (Int)	C1 (AS6)	24	5	10"	S	59'-11"	--	--	1499.8
Longit. Int	C1 (AS6)	24	5	10"	S	59'-11"	--	--	1374.8
									37889



4MENGINEERING

Sht _____ of _____

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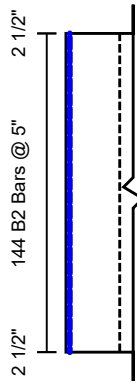
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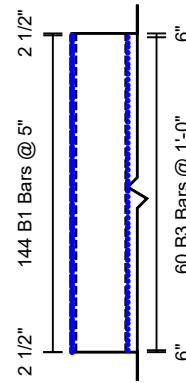
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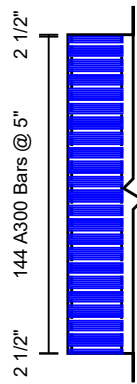
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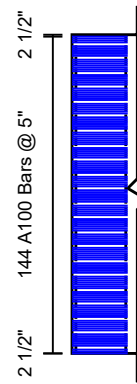
Ext. Wall Reinf.



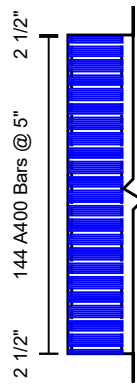
Int. Wall Reinf.



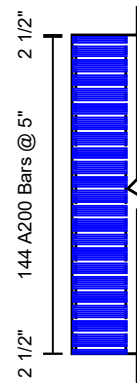
Top Slab Ext. Reinf.



Top Slab Int. Reinf.



Bottom Slab Ext. Reinf.



Bottom Slab Int. Reinf.

4MENGINEERING

Sht _____ of _____

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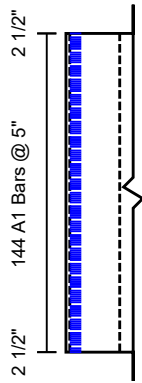
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Job No. :

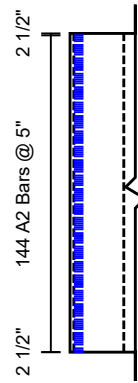
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Top Slab Corner Reinf.



Bottom Slab Corner Reinf.

RATINGS SUMMARY
 =====

Truck	Flexure			Shear		
	RF(INV)	RF(OP)	Controlling Point	RF(INV)	RF(OP)	Controlling Point
(AA) HL-93	2.59	3.36	Top Slab, RT	1.81	2.35	Top Slab, RT
(AB) EV 2	3.91	3.91	Top Slab, MID	3.20	3.20	Top Slab, RT
(AC) EV 3	3.52	3.52	Top Slab, MID	2.82	2.82	Top Slab, RT
(AD) NRL - Le	5.38	5.38	Top Slab, RT	4.57	4.57	Top Slab, RT
(AE) NRL	3.56	3.56	Top Slab, RT	2.75	2.75	Top Slab, RT
(AF) Oveload	5.51	5.51	Top Slab, MID	4.76	4.76	Top Slab, RT
(AG) Oveload	5.51	5.51	Top Slab, MID	4.76	4.76	Top Slab, RT
(AH) Type 3-3	4.32	4.32	Top Slab, RT	3.48	3.48	Top Slab, RT
(AI) Type 3	3.56	3.56	Top Slab, RT	2.75	2.75	Top Slab, RT
(AJ) Type 3S2	3.91	3.91	Top Slab, RT	3.07	3.07	Top Slab, RT
(AK) WA-105	3.56	3.56	Top Slab, RT	2.75	2.75	Top Slab, RT

REINFORCEMENT SUMMARY

M dimension = 1' 6" (method of equivalent capacity)
 = 4' 9" (method of contraflexure - ASTM)

Reinforcing steel Schedule

Location	Bar Mark	Qty	Size	Type	Spacing (in)	As,prv (in ² /ft)	Length (ft-in)	Wgt (lbs)	H Leg (ft-in)	V Leg (ft-in)
Top slab (int)	A100 (AS2)	144	6	STR	5.00	1.056	20- 9	4488		
Bot Slab (int)	A200 (AS3)	144	6	STR	5.00	1.056	20- 9	4488		
Top slab (ext)	A300 (AS7)	144	6	STR	5.00	1.056	20- 9	4488		
Bot Slab (ext)	A400 (AS8)	144	6	STR	5.00	1.056	20- 9	4488		
Corner (Top)	A1 (AS1)	288	5	L-BAR	5.00	0.744	4- 4	1302	2- 2	2- 2
Corner (Bottom)	A2 (AS1)	288	5	L-BAR	5.00	0.744	4- 4	1302	2- 2	2- 2
Ext wall (int)	B1 (AS4)	288	5	STR	5.00	0.744	9- 4	2854		
Ext wall (ext)	B2 (AS1)	288	6	STR	5.00	1.056	8-10	3893		
Int wall	B3	120	3	STR	12.00	0.110	10- 3	462		
Top slab (int- 1)	C100 (AS5)	20	5	STR	12.00	0.310	59-11	1250		
Bot Slab (int- 1)	C200	20	5	STR	12.00	0.310	59-11	1250		
Temperature (1)	C1 (AS6)	26	5	STR	10.00	0.372	59-11	1625		
Temperature (1)	C1 (AS6)	26	5	STR	10.00	0.372	59-11	1625		
Temperature (1)	C1 (AS6)	24	5	STR	10.00	0.372	59-11	1500		
Temperature (1)	C1 (AS6)	24	5	STR	10.00	0.372	59-11	1500		
Temperature (1)	C1 (AS6)	24	5	STR	10.00	0.372	59-11	1375		
Total								37889		

Note: A denotes flexural steel, B denotes vertical steel, C denotes longitudinal steel

AS Bar Marks

Location	As prv in ² /ft
Transverse Side wall - Outside Face (AS1)	1.056
Transverse Top Slab - Inside Face (AS2)	1.056
Transverse Bottom Slab - Inside Face (AS3)	1.056
Transverse Side wall - Inside Face (AS4)	0.744
Distribution Top Slab - Inside Face (AS5)	0.310
Distribution Top Slab - Outside Face (AS6)	0.372
Transverse Top Slab - Outside Face (AS7)	1.056
Transverse Bottom Slab - Outside Face (AS8)	1.056

Notes: 1.) Final areas of steel provided must be checked in analysis mode

Project: Bothell to Swamp Creek
Task : Box Culvert Evaluation
Client : Skanska
Job No.:

CULVERT PROPERTIES

=====
Type of Culvert: Precast Specification : LRFD 9th Edition
Operating Mode : Analysis

Physical Dimensions

No. of Boxes: 2 Name: BoxCulvert
Clear Span : 9.5000 ft
Clear Height: 9.0000 ft Skew Angle : 0.00 deg
Length : 60.0000 ft Bottom Slab Support: Full Slab
Fill Depth Range: Maximum : 6.00 ft Minimum : 4.00 ft Increment : 0.50 ft
Haunches: Top, Length: 0.0000 in Height: 0.0000 in
Bottom, Length: 0.0000 in Height: 0.0000 in
Member Thicknesses: Top Slab: 10.0000 in Bot Slab: 10.0000 in
Ext wall: 10.0000 in Int wall: 6.0000 in
Wall Joint: Top
Releases : Moment

Material Properties

Concrete, Bot: Strength: 6.500 ksi Density: 0.155 kcf Elasticity: 5347 ksi
Concrete, Top: Strength: 5.000 ksi Density: 0.155 kcf Elasticity: 4903 ksi
Concrete, All: Type: Normal weight Density Modification Factor : 1.00
Fr Factor : 0.24 Gamma1 : 1.60 Gamma3 : 1.00 (user defined)
Steel: Yield,fy : 60.00 ksi fss Limit : 0.60fy Elasticity,Es: 29000 ksi
Yield,fyv : 60.00 ksi Diameter : 1.000 in Type : Rebar
Soil: Density : 0.127 kcf Slope Factor: 1.150
Poisson's : 0.5
Fe Factor : 1.000 (User Defined)
Serviceability, Gamma-e: 1.00

Loads

Live Load: Vehicle: (AA) HL-93 - Design Vehicle
Axle No. weight(k) Dist. From Previous(ft)
1 8.00 0.00
2 32.00 14.00
3 32.00 14.00
Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
Include Tandem: yes
Tandem: Axle 1: 25.00 k, Axle 2: 25.00 k, Axle Spacing: 4.00 ft
Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck + Lane Or Tandem + Lane
Inventory Rating Load Factor: 1.75 Operating Rating Load Factor: 1.35
Design Load Combinations: Strength II
Override MPF: no
Override DLA: no
Vehicle: (AB) EV 2 - Permit Vehicle
Axle No. weight(k) Dist. From Previous(ft)
1 24.00 0.00
2 33.50 15.00
Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
Include Tandem: no
Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck Or Tandem Or Lane
Rating Load Factor: 1.3
Design Load Combinations: Strength II
Override MPF: no
Override DLA: no
Vehicle: (AC) EV 3 - Permit Vehicle
Axle No. weight(k) Dist. From Previous(ft)
1 24.00 0.00
2 31.00 15.00
3 31.00 4.00
Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
Include Tandem: no
Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck Or Tandem Or Lane
Rating Load Factor: 1.3
Design Load Combinations: Strength II
Override MPF: no
Override DLA: no
Vehicle: (AD) NRL - Legal Lane - Legal Vehicle
Axle No. weight(k) Dist. From Previous(ft)

1	10.50	0.00
2	10.50	4.00
3	12.00	16.00
4	9.00	15.00
5	9.00	4.00
6	9.00	15.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
 Include Tandem: no
 Lane Load: 0.20 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
 Combine: Truck + Lane Or Tandem + Lane
 Rating Load Factor: 2
 Design Load Combinations: Strength I
 Override MPF: no
 Override DLA: no

Vehicle: (AE) NRL - Legal Vehicle

Axle No.	Weight(k)	Dist. From Previous(ft)
1	8.00	0.00
2	8.00	4.00
3	8.00	4.00
4	17.00	4.00
5	17.00	4.00
6	8.00	4.00
7	8.00	4.00
8	6.00	6.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
 Include Tandem: no
 Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
 Combine: Truck + Lane Or Tandem + Lane
 Rating Load Factor: 2
 Design Load Combinations: Strength I
 Override MPF: no
 Override DLA: no

Vehicle: (AF) Oveload 1 - Permit Vehicle

Axle No.	Weight(k)	Dist. From Previous(ft)
1	21.50	0.00
2	21.50	4.00
3	21.50	12.00
4	21.50	4.00
5	10.00	10.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
 Include Tandem: no
 Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
 Combine: Truck + Lane Or Tandem + Lane
 Rating Load Factor: 1.2
 Design Load Combinations: Strength II
 Override MPF: no
 Override DLA: no

Vehicle: (AG) Oveload 2 - Permit Vehicle

Axle No.	Weight(k)	Dist. From Previous(ft)
1	22.00	0.00
2	21.50	6.00
3	21.50	4.00
4	22.00	14.00
5	21.50	6.00
6	21.50	4.00
7	22.00	16.00
8	21.50	6.00
9	21.50	4.00
10	12.00	10.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
 Include Tandem: no
 Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
 Combine: Truck + Lane Or Tandem + Lane
 Rating Load Factor: 1.2
 Design Load Combinations: Strength II
 Override MPF: no
 Override DLA: no

Vehicle: (AH) Type 3-3 - Legal Vehicle

Axle No.	Weight(k)	Dist. From Previous(ft)
1	14.00	0.00
2	14.00	4.00
3	16.00	16.00
4	12.00	15.00
5	12.00	4.00
6	12.00	15.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
 Include Tandem: no
 Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
 Combine: Truck + Lane Or Tandem + Lane
 Rating Load Factor: 2
 Design Load Combinations: Strength I
 Override MPF: no

Override DLA: no
 Vehicle: (AI) Type 3 - Legal Vehicle
 Axle No. Weight(k) Dist. From Previous(ft)
 1 17.00 0.00
 2 17.00 4.00
 3 16.00 15.00
 Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
 Include Tandem: no
 Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
 Combine: Truck + Lane Or Tandem + Lane
 Rating Load Factor: 2
 Design Load Combinations: Strength I
 Override MPF: no
 Override DLA: no

Vehicle: (AJ) Type 3S2 - Legal Vehicle
 Axle No. Weight(k) Dist. From Previous(ft)
 1 15.50 0.00
 2 15.50 4.00
 3 15.50 22.00
 4 15.50 4.00
 5 10.00 11.00
 Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
 Include Tandem: no
 Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
 Combine: Truck + Lane Or Tandem + Lane
 Rating Load Factor: 2
 Design Load Combinations: Strength I
 Override MPF: no
 Override DLA: no

Vehicle: (AK) WA-105 - Legal Vehicle
 Axle No. Weight(k) Dist. From Previous(ft)
 1 14.00 0.00
 2 14.00 4.00
 3 17.00 10.00
 4 17.00 32.00
 5 17.00 4.00
 6 7.00 4.00
 7 7.00 4.00
 8 12.50 11.00
 Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
 Include Tandem: no
 Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
 Combine: Truck + Lane Or Tandem + Lane
 Rating Load Factor: 2
 Design Load Combinations: Strength I
 Override MPF: no
 Override DLA: no

Include Lane Load : yes Max. No. of Lanes: 2
 Traffic Direction : Lanes Perpendicular to Main Reinforcement
 Neglect Live Load if: Fill > 8 ft and Fill > Clear Span
 Apply Surcharge at Fill Depths > 2 ft : yes
 Compute Surcharge Depth: yes

Dead Load: Future wearing Surface : 0.00 klf Add. Dead Load : 0.00 klf
 Concentrated Loads : none

Lateral Soil Loads: Max. Equiv. Fluid Press.: 60.00 pcf Min. Equiv. Fluid Press. : 30.00 pcf
 Include Additional Uniform Horiz. Load: no
 Include Additional Uniform Vert. Load: no
 Buoyancy Check : no
 Fluid Pressures : Apply Water Press. : no
 Foundation Model : Uniform Loads
 Seismic Analysis : Do not include

Load and Resistance Factors

DC:	Max 1.250	Min 0.900			
DW:	1.500	0.650			
EV:	1.300	0.900			
EH:	1.350	0.900			
WA:	1.000				
EQ:	1.000				
LL I	: 1.750	LL II : 1.350	LL Legal : 1.750	LL Extreme : 0.500	
Ductility:	1.000	Importance: 1.000	Redundancy, non-earth: 1.000	Redundancy, earth: 1.000	
Condition:	1.000	System : 1.000			
Phi Shear:	0.900	Phi Moment: 1.000	PM Compression: 0.750	PM Tension : 0.900	
Load Factor Multipliers, Design Mode:	1.00	Analysis Mode:	1.00		

Reinforcement

Reinforcement Covers : Exterior Interior
 Top Slab: 2.0000 in 2.0000 in
 walls : 2.0000 in 2.0000 in

Assigned reinforcement:			
Location	Mark	Size	Spacing (in)
Top Slab Inside	A100 (AS2)	6	5.0000
Bottom Slab Inside	A200 (AS3)	6	5.0000
Top Slab Outside	A300 (AS7)	6	5.0000
Bottom Slab Outside	A400 (AS8)	6	5.0000
Top Corner	A1 (AS1)	5	5.0000
Bottom Corner	A2 (AS1)	5	5.0000
Ext. Wall Inside	B1 (AS4)	5	5.0000
Ext. Wall Outside	B2 (AS1)	6	5.0000
Interior Wall	B3	3	12.0000
Longitudinal	C1 (AS6)	5	10.0000
Top Distribution	C100 (AS5)	5	12.0000
Bottom Distribution	C200	5	12.0000

Analysis Options

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-----
LL Analysis      : Automatically Set Traffic Direction to Account for Skew Effects: no
                  Limit LL Distribution Width to Culvert Length for: None
                  Combine Longitudinal Axle Distribution Overlaps: Yes, Max of 2 Axles
                  Combine Transverse Axle Distribution Overlaps: Yes, Max of 2 Axles
                  Axle Placement Increment for Moving Load Analysis: 20
                  Include Impact on Bottom Slab: yes
                  Always Distribute Wheel Load: yes
                  Deflection Criteria      : 1/800
                  Approach Slab will be Used: no
Reinforcement   : Always Include Distribution Steel: no
                  Distribution Slab Provided: no
                  User Defined Longitudinal Steel: yes
                  Max. As used in Vc Calcs: 2.00 in2/ft
                  Distribute Minimum Reinforcement per Face: yes
                  Use individual Member Thicknesses for Min Steel: no
                  Epoxy coat steel: no
                  Use M-dimension for bar length calcs.: no
Slenderness     : Checked      K Factor: 2.00
Analysis Modeling : Use Haunches in the Structural Analysis Model: yes
Critical Sections : Flexure critical section location: 1.5 member depth
                  Shear critical section location: dv beyond support
                  Use Max. Moment with Max. Shear at the Critical Section for Shear: no
                  Include depth of haunch for critical sections: no
Flexure         : Ignore Axial Thrust: no
                  Use Eq. 12.10.4.2.4a-1: yes  Nu Multiplier: 1.00
Shear           : Always Check Iterative Beta Method
Environmental   : Apply durability factors: no
Load Combinations : LRFD min/min: no
  
```

ANALYSIS RESULTS
 =====

Top Slab Thickness = 10.00 in
 Bottom Slab Thickness = 10.00 in
 Exterior Wall Thickness = 10.00 in
 Interior Wall Thickness = 6.00 in

Modular Ratio (N) = 5.42 Max. Steel Ratio = 0.030
 Design Span = 10.17 ft Design Height = 9.83 ft

Volume of Concrete: 2.029 cy/ft weight of Steel: 631 lb/ft

Note: Design and analysis results do not include force effects from stripping and handling stages

M dimension = 1' 6" (method of equivalent capacity)
 = 4' 9" (method of contraflexure - ASTM)

Reinforcing Steel Schedule

Location	Bar Mark	Qty	Size	Type	Spacing (in)	As,prv (in ² /ft)	Length (ft-in)	Wgt (lbs)	H Leg (ft-in)	V Leg (ft-in)
Top Slab (int)	A100 (AS2)	144	6	STR	5.00	1.056	20- 9	4488		
Bot Slab (int)	A200 (AS3)	144	6	STR	5.00	1.056	20- 9	4488		
Top Slab (ext)	A300 (AS7)	144	6	STR	5.00	1.056	20- 9	4488		
Bot Slab (ext)	A400 (AS8)	144	6	STR	5.00	1.056	20- 9	4488		
Corner (Top)	A1 (AS1)	288	5	L-BAR	5.00	0.744	4- 4	1302	2- 2	2- 2
Corner (Bottom)	A2 (AS1)	288	5	L-BAR	5.00	0.744	4- 4	1302	2- 2	2- 2
Ext wall (int)	B1 (AS4)	288	5	STR	5.00	0.744	9- 4	2854		
Ext wall (ext)	B2 (AS1)	288	6	STR	5.00	1.056	8-10	3893		
Int wall	B3	120	3	STR	12.00	0.110	10- 3	462		
Top Slab (int- 1)	C100 (AS5)	20	5	STR	12.00	0.310	59-11	1250		
Bot Slab (int- 1)	C200	20	5	STR	12.00	0.310	59-11	1250		
Temperature (1)	C1 (AS6)	26	5	STR	10.00	0.372	59-11	1625		
Temperature (1)	C1 (AS6)	26	5	STR	10.00	0.372	59-11	1625		
Temperature (1)	C1 (AS6)	24	5	STR	10.00	0.372	59-11	1500		
Temperature (1)	C1 (AS6)	24	5	STR	10.00	0.372	59-11	1500		
Temperature (1)	C1 (AS6)	24	5	STR	10.00	0.372	59-11	1375		
Total								37889		

Note: A denotes flexural steel, B denotes vertical steel, C denotes longitudinal steel

AS Bar Marks

Location	As prv in ² /ft
Transverse Side Wall - Outside Face (AS1)	1.056
Transverse Top Slab - Inside Face (AS2)	1.056
Transverse Bottom Slab - Inside Face (AS3)	1.056
Transverse Side Wall - Inside Face (AS4)	0.744
Distribution Top Slab - Inside Face (AS5)	0.310
Distribution Top Slab - Outside Face (AS6)	0.372
Transverse Top Slab - Outside Face (AS7)	1.056
Transverse Bottom Slab - Outside Face (AS8)	1.056

Notes: 1.) Final areas of steel provided must be checked in analysis mode

Summary of Ratings Table:

Truck	Flexure							Shear				
	ILF	OLF	Fill	Member	Location	IR	OR	Fill	Member	Location	IR	OR
(AA)HL-93	1.75	1.35	4.00	2	RT	2.59	3.36	4.00	2	RT	1.81	2.35
(AB)EV 2	1.30	1.30	4.00	2	MID	3.91	3.91	4.00	2	RT	3.20	3.20
(AC)EV 3	1.30	1.30	4.00	2	MID	3.52	3.52	4.00	2	RT	2.82	2.82
(AD)NRL -	2.00	2.00	4.00	2	RT	5.38	5.38	4.00	2	RT	4.57	4.57
(AE)NRL	2.00	2.00	4.00	2	RT	3.56	3.56	4.00	2	RT	2.75	2.75
(AF)Oveloa	1.20	1.20	4.00	2	MID	5.51	5.51	4.00	2	RT	4.76	4.76
(AG)Oveloa	1.20	1.20	4.00	2	MID	5.51	5.51	4.00	2	RT	4.76	4.76
(AH)Type 3	2.00	2.00	4.00	2	RT	4.32	4.32	4.00	2	RT	3.48	3.48
(AI)Type 3	2.00	2.00	4.00	2	RT	3.56	3.56	4.00	2	RT	2.75	2.75
(AJ)Type 3	2.00	2.00	4.00	2	RT	3.91	3.91	4.00	2	RT	3.07	3.07
(AK)WA-105	2.00	2.00	4.00	2	RT	3.56	3.56	4.00	2	RT	2.75	2.75

Critical Sections Summary: Flexure

Member 1: (Exterior wall), Thickness = 10.00 in
 Design Corr.

Loc	Dist. (in)	Moment (k-ft)	A. F. (k)	Mu (k-ft)	ds (in)	Ma (k-ft)	phi	As (in ²)	Mcr (k-ft)	IR	OR	Truck	Depth (ft)
BOT	5.00	-12.59	8.38	27.35	7.69	30.32	1.00	0.74	16.32	6.11	7.92	AA	6.00
MID	59.00	8.24	3.08	27.35	7.69	28.45	1.00	0.74	16.32	10.49	13.60	AA	6.00
MID-	59.00	-1.58	8.76	37.74	7.63	40.64	1.00	1.06	16.32	18.62	24.13	AA	4.00
TOP	5.00	0.0#	2.20	27.35	7.69	28.14	1.00	0.74	16.32	NC	NC	AA	4.00

Member 2: (Top Slab), Thickness = 10.00 in

Loc	Dist. (in)	Design Moment (k-ft)	Corr. A. F. (k)	Mu (k-ft)	ds (in)	Ma (k-ft)	phi	As (in ²)	Mcr (k-ft)	Load Ratings		Truck	Fill Depth (ft)
										IR	OR		
LT	5.00	0.0#	0.87	27.35	7.69	27.66	1.00	0.74	16.32	NC	NC	AA	4.00
MID	48.80	17.24	0.50	37.74	7.63	37.90	1.00	1.06	16.32	2.85	3.69	AA	4.00
MID-	48.80	0.0#	0.87	37.74	7.63	38.03	1.00	1.06	16.32	NC	NC	AA	4.00
RT	3.00	-20.71	1.09	38.07	7.69	38.43	1.00	1.06	16.32	3.27	4.24	AA	6.00

Member 3: (Interior wall), Thickness = 6.00 in

Loc	Dist. (in)	Design Moment (k-ft)	Corr. A. F. (k)	Mu (k-ft)	ds (in)	Ma (k-ft)	phi	As (in ²)	Mcr (k-ft)	Load Ratings		Truck	Fill Depth (ft)
										IR	OR		
BOT	5.00	0.00	7.26	2.07	3.81	3.79	1.00	0.11	5.87	NC	NC	AA	4.00
MID	59.00	0.00	12.49	2.07	3.81	4.99	1.00	0.11	5.87	NC	NC	AA	5.00
TOP	5.00	0.00	7.26	2.07	3.81	3.79	1.00	0.11	5.87	NC	NC	AA	4.00

Member 4: (Bottom Slab), Thickness = 10.00 in

Loc	Dist. (in)	Design Moment (k-ft)	Corr. A. F. (k)	Mu (k-ft)	ds (in)	Ma (k-ft)	phi	As (in ²)	Mcr (k-ft)	Load Ratings		Truck	Fill Depth (ft)
										IR	OR		
LT	5.00	-11.95	7.96	27.35	7.69	30.17	1.00	0.74	16.32	7.09	9.19	AA	6.00
MID	48.80	10.46	2.85	37.74	7.63	38.69	1.00	1.06	16.32	5.97	7.74	AA	4.00
MID-	48.80	0.0#	6.68	37.74	7.63	39.96	1.00	1.06	16.32	NC	NC	AA	4.00
RT	3.00	-18.30	3.22	38.07	7.69	39.15	1.00	1.06	16.32	3.18	4.12	AA	4.00

- A 0.0 design moment indicates no negative moments at this location. Check the 'Load Combination Results' table to determine if a positive moment exists.

Critical Sections Summary: Vertical Shear

Member 1: (Exterior wall), Thickness = 10.00 in

Loc	Dist. (in)	Design Shear (k)	Corr. Moment (k-ft)	Corr. A. F. (k)	Dv (in)	phi*Vn	Beta	Vc (k)	Vs (k)	Av (in ²)	Max. Spac (in)	Load Ratings		Truck	Fill Depth (ft)
												IR	OR		
BOT	12.20	6.41	8.4	8.38	7.35	18.15	2.838	20.17 a	0.00	0.00	0.00	9.56	12.39	AA	6.00
MID	59.00	1.26	8.2	3.08	7.35	18.76	2.932	20.84 a	0.00	0.00	0.00	43.02	55.76	AA	6.00
MID-	59.00	0.68	0.8	6.20	7.20	31.63	5.049	35.14 a	0.00	0.00	0.00	NC	NC	AD	6.00
TOP	12.20	-3.06	0.7	3.08	7.35	25.36	3.966	28.18 a	0.00	0.00	0.00	29.37	38.07	AA	6.00

Member 2: (Top Slab), Thickness = 10.00 in

Loc	Dist. (in)	Design Shear (k)	Corr. Moment (k-ft)	Corr. A. F. (k)	Dv (in)	phi*Vn	Beta	Vc (k)	Vs (k)	Av (in ²)	Max. Spac (in)	Load Ratings		Truck	Fill Depth (ft)
												IR	OR		
LT	12.20	6.71	7.8	0.87	7.69	17.78	2.658	19.76 a	0.00	0.00	0.00	3.52	4.57	AA	4.00
MID	61.00	1.00	15.1	0.84	7.63	17.46	2.631	19.40 a	0.00	0.00	0.00	82.10	99.99	AA	6.00
MID-	61.00	2.76	4.8	1.03	7.63	23.67	3.568	26.30 a	0.00	0.00	0.00	15.65	20.29	AA	5.50
RT	10.20	11.09	14.5	0.87	7.69	16.45	n/a	18.28 c	0.00	0.00	0.00	1.81	2.35	AA	4.00

Member 3: (Interior wall), Thickness = 6.00 in

Loc	Dist. (in)	Design Shear (k)	Corr. Moment (k-ft)	Corr. A. F. (k)	Dv (in)	phi*Vn	Beta	Vc (k)	Vs (k)	Av (in ²)	Max. Spac (in)	Load Ratings		Truck	Fill Depth (ft)
												IR	OR		
BOT	9.32	0.00	0.0	10.15	4.32	19.76	5.256	21.95 a	0.00	0.00	0.00	NC	NC	AA	6.00
MID	59.00	0.00	0.0	14.58	4.32	19.93	5.303	22.15 a	0.00	0.00	0.00	NC	NC	AA	6.00
TOP	9.32	0.00	0.0	19.40	4.32	20.12	5.353	22.36 a	0.00	0.00	0.00	NC	NC	AF	6.00

Member 4: (Bottom Slab), Thickness = 10.00 in

Loc	Dist. (in)	Design Shear (k)	Corr. Moment (k-ft)	Corr. A. F. (k)	Dv (in)	phi*Vn	Beta	Vc (k)	Vs (k)	Av (in ²)	Max. Spac (in)	Load Ratings		Truck	Fill Depth (ft)
												IR	OR		
LT	12.20	7.90	6.7	7.96	7.69	19.72	2.948	21.91 a	0.00	0.00	0.00	5.90	7.64	AA	6.00
MID	61.00	0.53	10.4	2.85	7.63	20.28	3.056	22.53 a	0.00	0.00	0.00	73.87	95.76	AA	4.00
MID-	61.00	1.05	0.0	6.68	7.63	26.45	5.030	29.39 a	0.00	0.00	0.00	97.02	99.99	AA	4.00
RT	10.20	9.56	12.2	3.22	7.69	17.59	2.630	19.54 a	0.00	0.00	0.00	2.65	3.43	AA	4.00

Vc Calculation By: a - Iterative Beta, b - Constant Beta, c - Box Culvert, d - Standard/Arema

Culvert Shoring Calculations

Post Shore Loading

Results Grid

Fill Depth, ft: 6 Truck: HL-93 Member: Interior wall Load Type: Unfactored Dead Load (DL)

Location (ft)	Moment (kip-ft/ft)	Shear (k/ft)	Axial Force (k/ft)
0.42	0.00	0.00	-1.63
1.40	0.00	0.00	-1.63
2.38	0.00	0.00	-1.63
3.37	0.00	0.00	-1.63
4.35	0.00	0.00	-1.63
5.33	0.00	0.00	-1.63
6.32	0.00	0.00	-1.63
7.30	0.00	0.00	-1.63
8.28	0.00	0.00	-1.63
9.27	0.00	0.00	-1.63
10.25	0.00	0.00	-1.63

Close

Results Grid

Fill Depth, ft: 4 Truck: HL-93 Member: Interior wall Load Type: Unfactored Live Load (LL)

Location (ft)	+Moment (kip-ft/ft)	-Moment (kip-ft/ft)	+Shear (k/ft)	-Shear (k/ft)	+Axial Force (k/ft)	-Axial Force (k/ft)
0.42	0.00	0.00	0.00	0.00	0.00	-7.21
1.40	0.00	0.00	0.00	0.00	0.00	-7.21
2.38	0.00	0.00	0.00	0.00	0.00	-7.21
3.37	0.00	0.00	0.00	0.00	0.00	-7.21
4.35	0.00	0.00	0.00	0.00	0.00	-7.21
5.33	0.00	0.00	0.00	0.00	0.00	-7.21
6.32	0.00	0.00	0.00	0.00	0.00	-7.21
7.30	0.00	0.00	0.00	0.00	0.00	-7.21
8.28	0.00	0.00	0.00	0.00	0.00	-7.21
9.27	0.00	0.00	0.00	0.00	0.00	-7.21
10.25	0.00	0.00	0.00	0.00	0.00	-7.21

Close

Total vertical load = $1.63 + 7.21 = 8.84$ kips/ft

Post allowable load = 8.5 kips ea.

Spacing = $8.5/8.8 * 12 = 11.6$ " o.c. – Use 12"

Check Punching Shear at Slab

f'c	6500	psi	
d	7.69	in	
Load Factor, LF	1.0		Max LF for LL
Load, P	8.8	kips	Load per shore
c1	5	in	Dimensions of Jack Bas
c2	5	in	
$b_0 = 2(c1+d)+2(c2+d)$	50.75	in	Critical Shear perimete
ϕ	0.75		
$V_u = P*LF$	8.8	kips	
$\phi V_c = \phi(4*f'c^{0.5}*b_0*d)$	94.4	kips	OK ACI Eq 11-3

Check Shear at Slab

ϕ	0.75		
b	12	in	
d	7.69	in	
f'c	6500	psi	
$\phi V_c = \phi(2*f'c^{0.5}*b*d)$	11156	lbs per ft	
$V_u = wl/2$	7215	lbs	OK

Check Longitudinal Slab Bending Between Shoring Posts

f'c	6500	psi	
f _y	60000	psi	
b	12	in	
No. Bar	5		
d _b	0.625	in	
As per bar	0.31	in ² /bar	
Spacing	10	in	
As per width "b"	0.37	in ² /ft	
Slab Thickness, t	10	in	
$d = t - 2" \text{ cover} - 0.5*d_b$	7.69	in	
$a = A_s*f_y / (0.85*f'c*b)$	0.34	in	
ϕ	0.9		
$\phi M_n = \phi A_s*f_y*(d-a/2)$	12587	lb-ft /ft	
w (Strength I, factored)	10850	plf	
Span, l	1.33	ft	
$M = wl^2/8$	2399.1	lb-ft	OK

The best possible "support" on your site – Doka floor props



- Doka floor props always have the same safe working load at any extension eliminating field calculation
- Doka floor props are light weight
- Doka floor props are galvanized – no rust
- Doka floor props come with accessories for both H20 and Alu beams

The numbered holes are a convenient feature that makes for quicker and easier height adjustments.

Eurex 30

8.5
kips
(*)

(*) over entire extension range



Eurex 30 floor props						
Type	Article Number	closed	extended	weight	Safe working load	safety factor
Eurex 30 250	586092000	5' - 0"	8' - 2"	33 lbs	8,5 kips (37,8 kN) (**)	3 : 1
Eurex 30 300	586093000	5' - 8"	9' - 10"	37 lbs		3 : 1
Eurex 30 350	586094000	6' - 6"	11' - 5"	45 lbs		3 : 1
Eurex 30 400	586095000	7' - 6"	13' - 1"	55 lbs		3 : 1

(**) according to DOKA TEST REPORT on compressions test for Doka-post-shores EUREX 30 8.5 kips. Nr. 861/01, Date: 27.09.2001 and US-Standards

doka
The Formwork Experts

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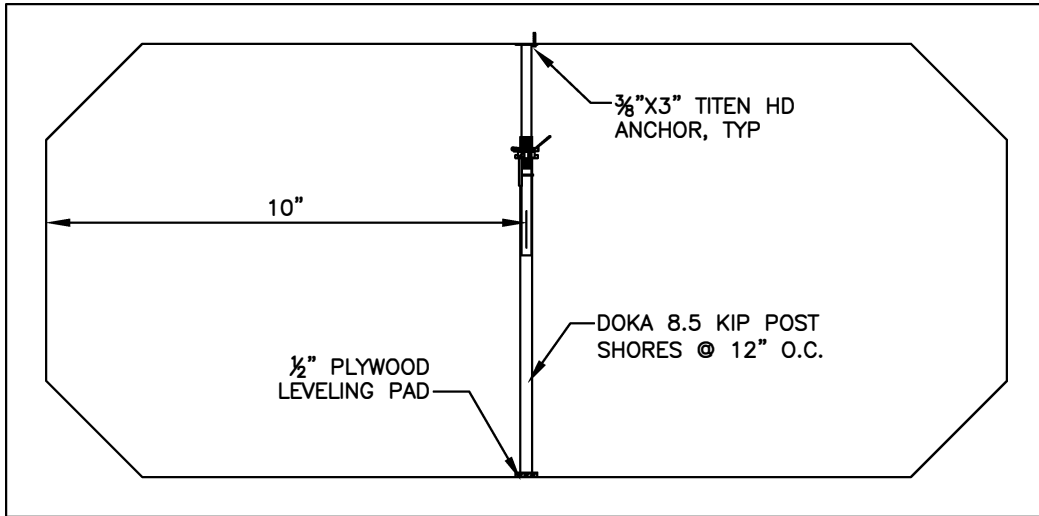
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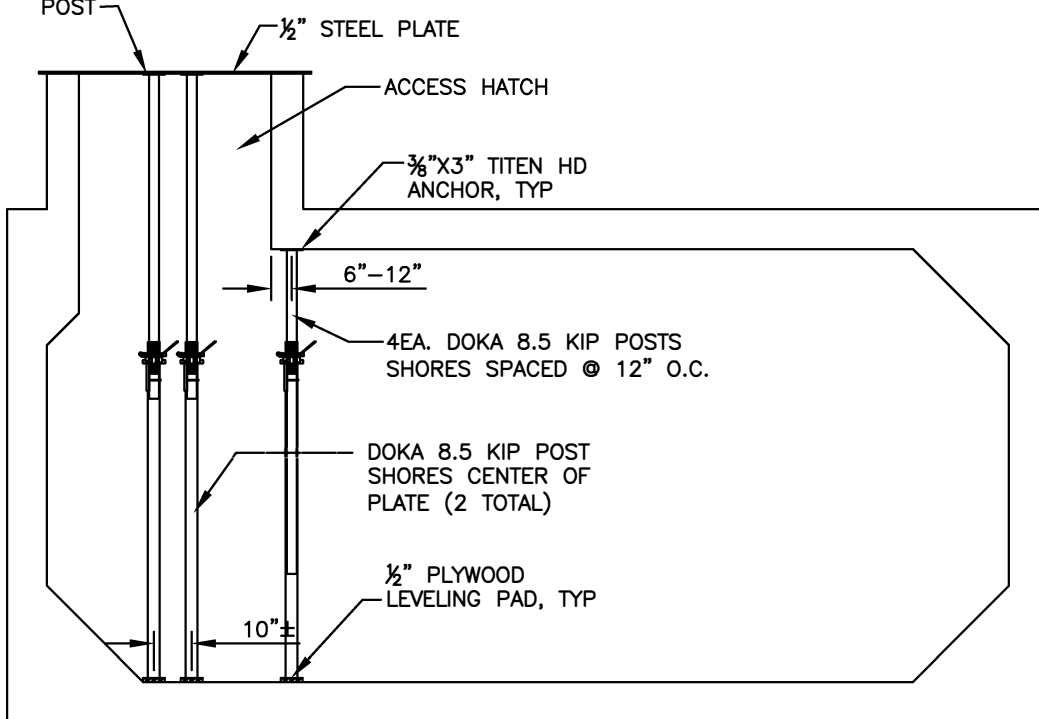
Internet: <http://www.doka.com>



BOX CULVERT TEMP SHORING

SCALE: 1:4

1EA. $\frac{3}{8}$ "X1" SELF TAPPING BOLT IN PREDRILLED HOLES PER POST



HATCH LID & ACCESS OPENING TEMP SHORING

SCALE: 1:4

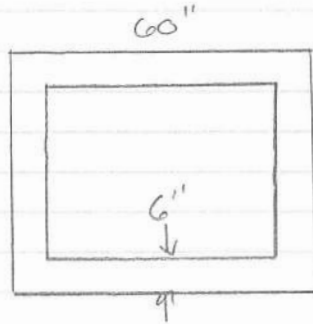


7-7-25

Access Riser Calculations



Concrete Riser



60"

$$\text{Area} = 108 \text{ in}^2$$

Assume min steel = 12 no. 3's

$$\text{Riser Load} = \text{HL-93 wheel load} + \text{Soil DL}$$

$$= 1.75 (16,000) + 1.75 (2 \cdot 127) (5^2) = 35,938 \text{ lbs}$$

$$\text{Compressive stress} = \frac{35938 \text{ lbs}}{108 \text{ in}^2} = 333 \text{ psi}$$

Check Concrete Risers as Concrete Columns

Dead Load	6.35	kips	
Live Load	16.0	kips	
Design Load (Vertical)	36	kips	1.25 DL + 1.75LL

Lateral Load	0	kips	
Divided over 4 supports (Lateral)	0	kips	

f'c	3.5	ksi	
fy	60	ksi	
ρ_{trial}	0.03		
Ag _{trial}	17.0	sq in	
	4.1	in	

Check w/ #3 bars

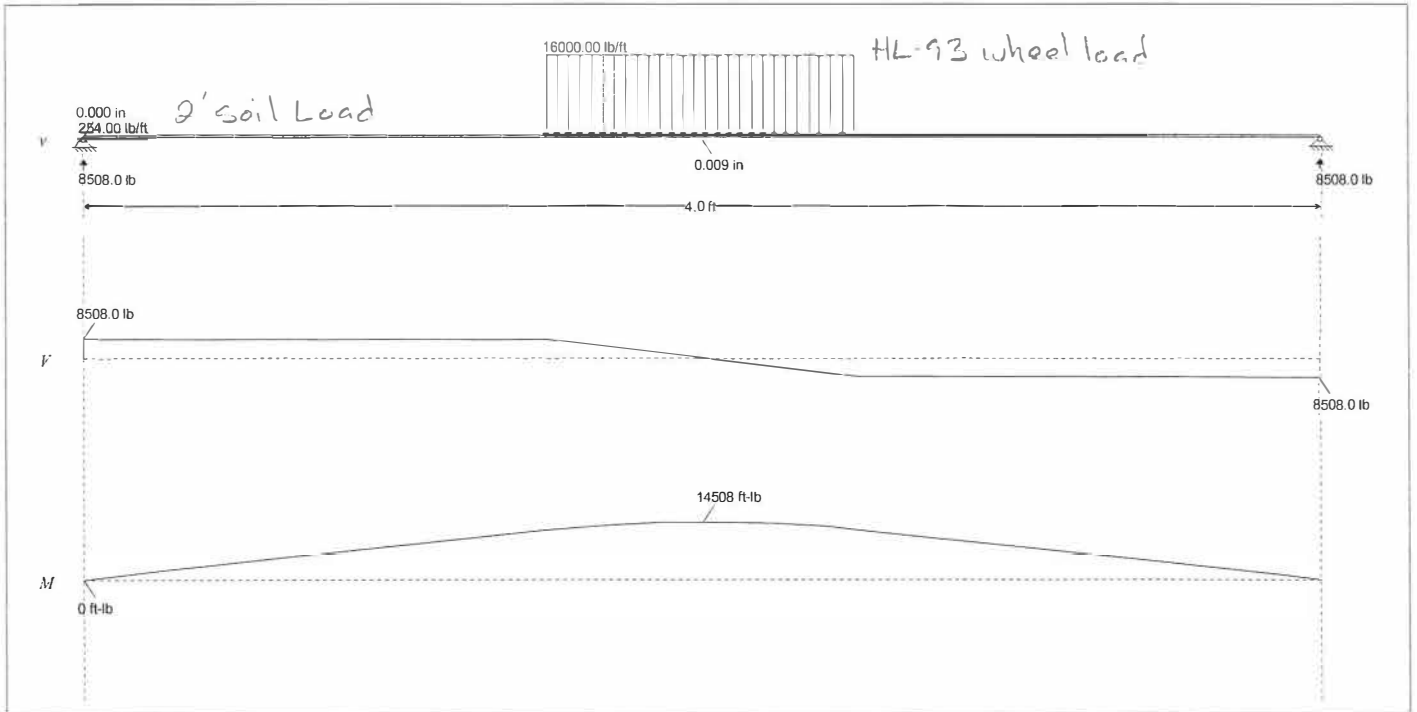
Bar Number	3		
Number of Bars	12		
db	0.375	in	
As per bar	0.11	sq in	
Ast (total)	1.32	sq in	
Length	60	in	
Width	60	in	
Int width	48	in	
Ag	108	sq in	
$\rho = Ast/Ag$	0.012		Per ACI 10.9, Must be between 0.01 to 0.08
ϕ	0.7		
$\phi * P_n = 0.8 * \phi * [0.85 * f'_c * (A_g - A_{st}) + f_y * A_{st}]$	222	kips	OK ACI-318 Eq. 10-2
Rating Factor RF	7.6		AASHTO eqn 13.1.1A-1

Check Slenderness Effects

Effective length factor, k	2		
Unsupported length, lu	4.5	ft	
Radius of gyration, r	76.8	in	Per ACI 10.10.1.2, equal to 0.3x dimension
Check $k * l_u / r < 22$	1.41		OK ACI-318 Eq. 10-6

Check Concrete for Shear

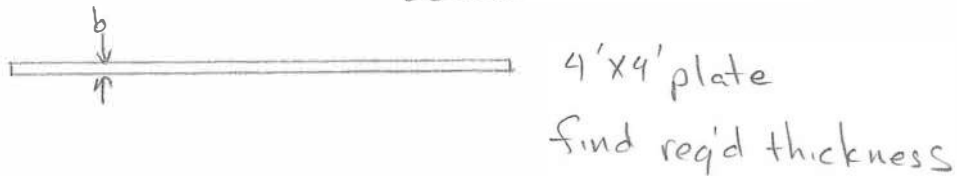
ϕ	0.75		
b	60	in	
d	57.81	in	
f'c	3500	psi	
$\phi V_c = \phi [2 * (1 + N_u / 2000 A_g) * f'_c * 0.5 * b * d]$	309	kips	OK ACI-318 Eq. 11-4



Beam Parameters: Length = 4.0 ft, E = 29000.0 ksi, I = 140.0 in⁴, A = 6.0 in²

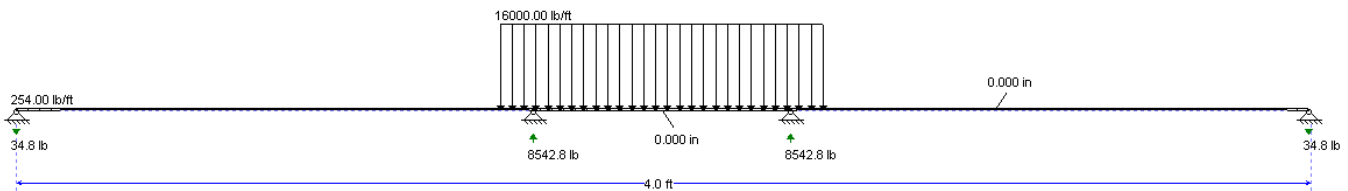
A36 plate $F_y = 36 \text{ ksi}$, $f_y = 22 \text{ ksi}$ (ASD)

$$f_b = \frac{m}{S} \quad S_{min} = \frac{m}{f_b} = \frac{14508}{22000} \cdot 12 = 7.91 \text{ in}^3$$



$$S = \frac{bh^2}{6} \quad h = \frac{7.91(6)}{48''} = .99'' \Rightarrow 1'' \text{ plate req'd}$$

Note: steel plates as-built are 1/2" thick. 2ea. 8.5 kip shoring posts will be implemented rather than replacing 1/2" plates with 1" plates.



APPENDIX

Inspection

Agency: Washington State

Program Mgr: Sonia L. Lowry

CD Status: Work

Release Date:

Structure No. V001

SID XG180500

Structure Name Drainge vault

Carrying

Route On

Mile Post

Intersecting

Route Under

Mile Post

2/9/2028

3/18/2028

Inspector's Signature JJL

Cert # G1805

Cert Exp Date

Co-Inspector's Signature

Current Inspections Performed

Report Type	Subtype	Rsk Mthd	Begin Date	Comp Date	Interval	Due Date	Hours	Inspector	Cert No	Co-Insp
Initial		1	3/13/2025	3/13/2025			1.0	JJL	G1805	
Routine Bridge		1	3/13/2025	3/13/2025			1.0	JJL	G1805	

Component Condition Ratings

Appraisal

Miscellaneous Fields

G	Overall Condition Classification (BC12)			Scour Critical (NBI Disc) (1680)	1996	Year Built (BW01)	
N	FHWA Deck Overall (BC01)	N		Scour Vulnerability (BAP03)		Asphalt Depth (WIE30)	
N	WSDOT Deck Overall (WC01)	X		Scour Plan of Action (BAP04)	0.00	Design Curb Height (WIE31)	
N	Bridge Railings (BC05)			Waterway (NBI Disc) (1662)	0.00	Bridge Rail Height (WIE32)	
N	Bridge Railing Transitions (BC06)	N		Overtopping Likelihood (BAP02)	1	Number of Utilities (WIE33)	
N	Bridge Joints (BC08)			Appr Roadway Align (BAP01)	Y	Subject to NBIS (WIE34)	
N	Superstructure Overall (BC02)			Fatigue Details (BIR02)	03/17/2025	Inspn QA Date (BIE09)	
N	NSTM Inspection (BC14)			Seismic Vulnerability (BAP05)			
N	Bridge Bearings (BC07)	Optional Condition Ratings					Inspection Flags
N	Substructure Overall (BC03)	6		Drain Condition (LP01)		Soundings (WIE20)	
N	UW Inspection (BC15)	9		Retaining Wall Condition (LP02)		Clearance (WIE21)	
8	Culvert Overall (BC04)					P	PhotosFlag (WIE23)
N	Scour Condition (BC11)					Y	Roadside Hardware Flag (WIE25)
N	Channel Condition (BC09)					Y	QA Flag (WIE24)
N	Channel Protection (BC10)						
	Chan/Prot (NBI Disc) (1677)						
	Pier/Abut/Prot (NBI Disc) (1679)						

BMS Elements

Element	Element Description	Total	Units	CS 1	CS 2	CS 3	CS 4
Culvert Elements							
241	Concrete Culvert	285	LF	285	0	0	0

Notes

Culvert Notes

241 This is a drainage detention vault running along the median area of I-405 near Exist 26, north of 228th St. SE., Bothell, WA . The actual length of culvert is approximately 285 feet, and the vault interior width and height are approximately 20 x 9 feet . The inspection was performed by entering the vault through one of the hatches at night around 11:30 pm on March 12, with one lane I-405 closure. The ground above the vault was not inspected due to the night condition. At the hatch opening, the ground is about 4 feet above the vault. The vault bottom has standing water due to rain on the inspection day. The vault is an active drainage structure with three cells, an inlet chamber, a settling chamber, and an outlet chamber connecting to outfall. the structure condition is good, with typical longitudinal hairline cracks at each expansion joint. The expansion joint spaces at 10 feet, all expansion joints and hatches leak significantly.

Agency: Washington State

Program Mgr: Sonia L. Lowry

CD Status: Work

Release Date:

Structure No. V001 **SID** XG180500 **Structure Name** Drainge vault
Carrying **Route On** **Mile Post**
Intersecting **Route Under** **Mile Post**

Repairs						
Repair No	Pr	R	Repair Descriptions	BMS	Noted	Verified
			(No repairs for this structure)			

All Inspections and Resources Required

Report Type	Subtype	Rsk Mthd	Begin Date	Comp Date	Interval	Due Date	Hours	Inspector	Cert No	Co-Insp
Initial		N	3/13/2025	3/13/2025			1.0	JJL	G1805	
Inspection Note Mid night underground inspection, rainy			Late Inspection Explanation			Late PM Resp Date	Late PM Approval	Insp QC Date	Inspn Data Update Date	

Report Type	Subtype	Rsk Mthd	Begin Date	Comp Date	Interval	Due Date	Hours	Inspector	Cert No	Co-Insp
Routine Bridge		N	3/13/2025	3/13/2025			1.0	JJL	G1805	
Inspection Note Mid night underground inspection, rainy			Late Inspection Explanation			Late PM Resp Date	Late PM Approval	Insp QC Date	Inspn Data Update Date	















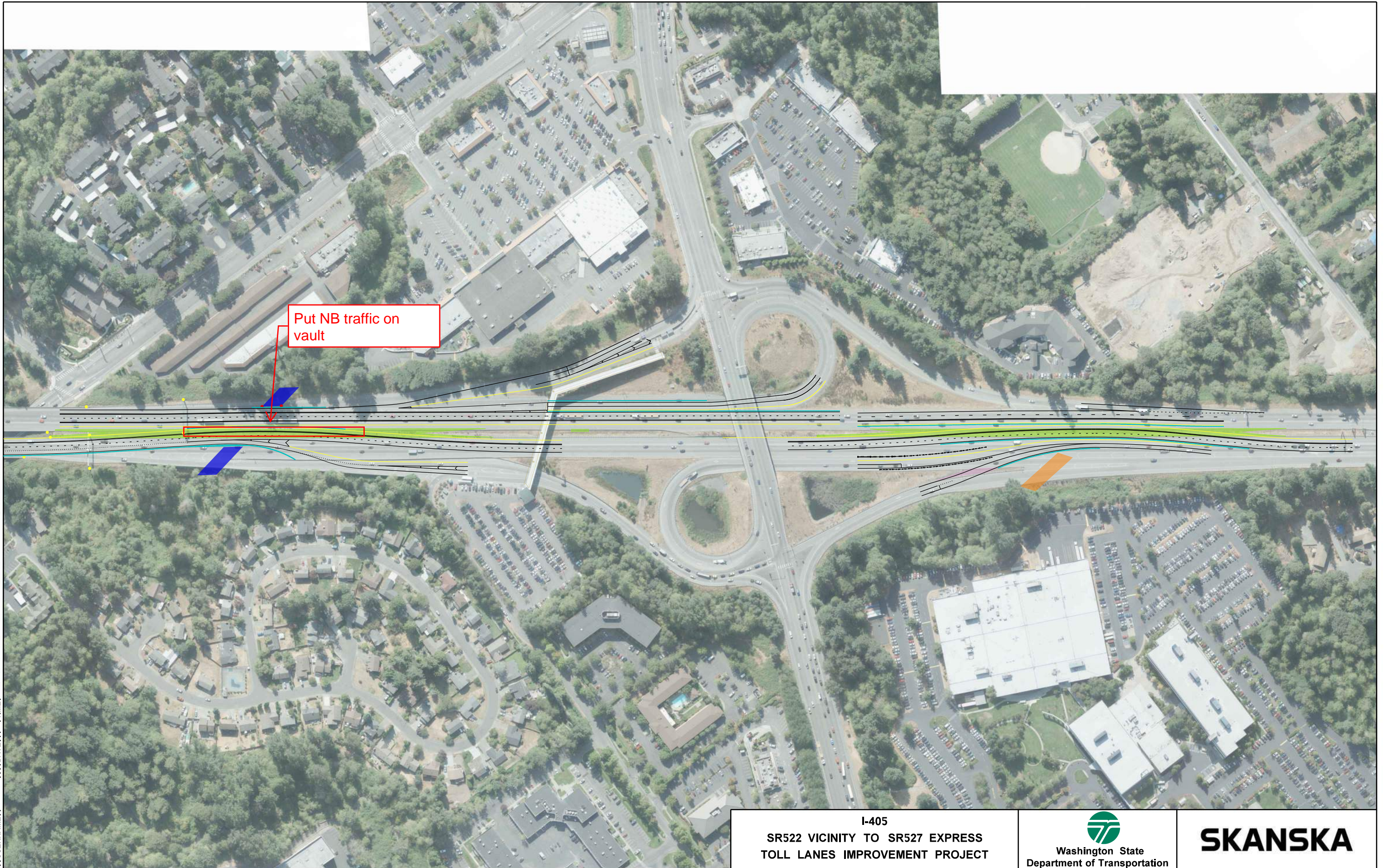






Plans

\$\$\$\$\$DESIGNFILENAME\$\$\$\$\$
\$USERNAM\$\$ \$\$\$\$DATE\$\$\$ \$TIMES



I-405
SR522 VICINITY TO SR527 EXPRESS
TOLL LANES IMPROVEMENT PROJECT



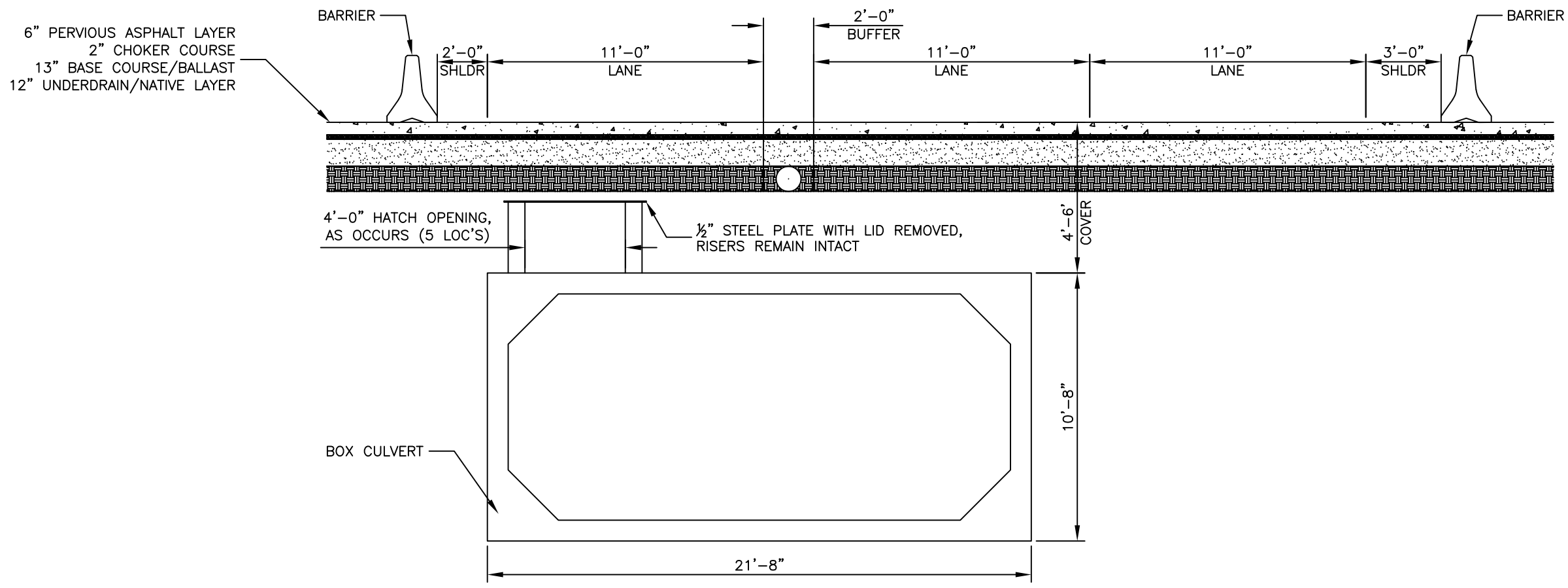
put SB traffic on vault

\$\$\$\$\$DESIGNFILENAME\$\$\$\$\$
\$\$USERNAME\$\$ \$\$\$\$DATE\$\$\$ \$TIMES

I-405
SR522 VICINITY TO SR527 EXPRESS
TOLL LANES IMPROVEMENT PROJECT

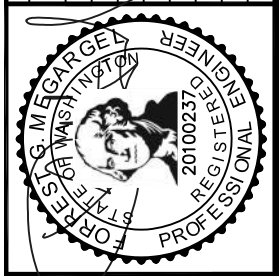


SKANSKA



TYP SECTION THROUGH VAULT NW-12
SCALE: 1:5

NO.	DATE	DESCRIPTION
0	5-16-25	ISSUED FOR CONSTRUCTION



PLANS PREPARED BY
4M ENGINEERING
CIVIL - STRUCTURAL

6675 PURPLE POPPY LN., PARK CITY, UT 84098
801-380-0562
WWW.4MENGINEERS.COM

DESIGNED BY: JESSICA MERRELL




PLANS PREPARED FOR:
SKANSKA USA CIVIL
18911 NORTH CREEK PKWY, STE 300

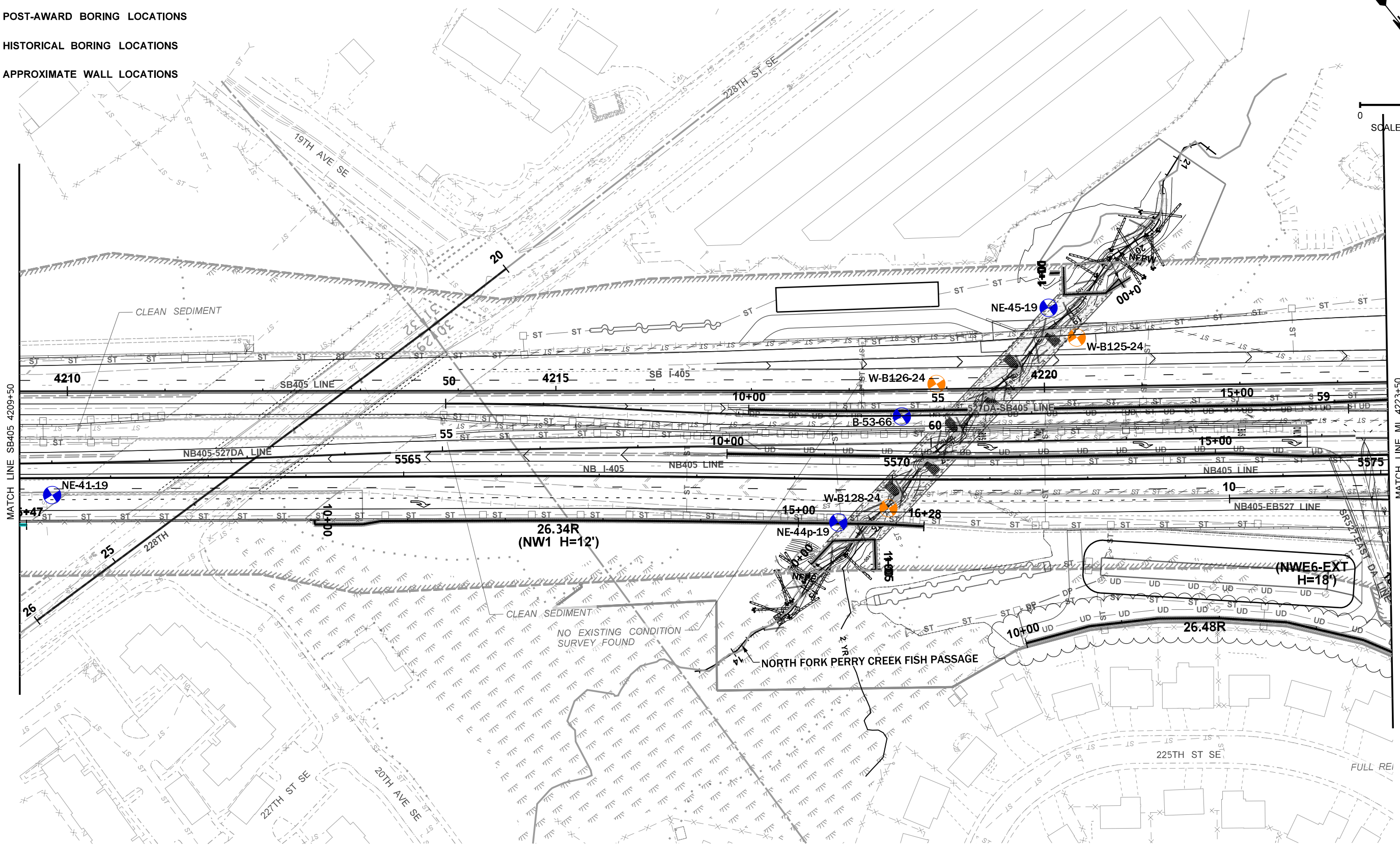
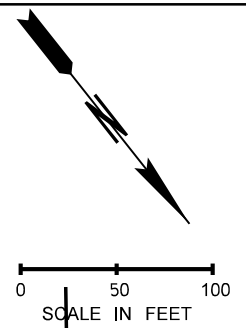
PROJECT INFORMATION			
PROJECT TITLE: I-405 BRICKYARD TO SR527			
OWNER: WASH DOT			
DIST	COUNTY	ROUTE	POST MILE
-	SNOHOMISH	405	-
CONTRACT NO.: 9727			

SHEET NAME: TYP SECTION @ VAULT NW-12	
STR NAME: VAULT NW-12	STR NO.: VAULT NW-12
SHEET 1	FILE: Bothell culvert section.dwg
OF 1	

6/3/25

LEGEND

-  POST-AWARD BORING LOCATIONS
-  HISTORICAL BORING LOCATIONS
-  APPROXIMATE WALL LOCATIONS



SR FILE NO. SHEET

FILE NAME: c:\pwork\Ingluswaldms10950\IC9727_BP_EJK-P8_04.dgn				REGION NO.:	STATE:	FED.AID PROJ.NO.:
TIME:	7:10:07 PM	10	WASH	LOCATION NO.:		
DATE:	10/4/2024	JOB NUMBER:		XL5446		
PLOTTED BY:	ejkennedy	22AB17		CONTRACT NO.:		
DESIGNED BY:				9727		
ENTERED BY:						
CHECKED BY:						
PROJ. ENGR.:	J SLAVICEK					
REGIONAL ADM.:	L HODGSON	REVISION	DATE	BY		

FINAL
NOT FOR
CONSTRUCTION

SEE SHEET CT1
DATE
P.E. STAMP BOX



AECOM



Washington State
Department of Transportation



Terracon
Consulting Engineers and Scientists



SKANSKA

<p>I-405 BRICKYARD TO SR527 IMPROVEMENT PROJECT</p> <p style="font-weight: bold;">PLAN VIEW: Package 8</p>	PLAN REF NO SHEET 3 OF 7 SHEETS
44	



Drilled	Start 4/11/2024	End 4/11/2024	Total Depth (ft)	50.25	Logged By Checked By	JSP GDT	Driller	Holocene Drilling	Drilling Method	Hollow-stem Auger
Surface Elevation (ft) Vertical Datum	116.89 NAVD88		Hammer Data	Autohammer 140 (lbs) / 30 (in) Drop		Drilling Equipment		Diedrich D70 Track Rig #137		
Easting (X) Northing (Y)	1630287.35 620145.73		System Datum	Project Datum		See "Remarks" section for groundwater observed				
Notes: Autohammer Average Transfer Efficiency = 85%										

Elevation (feet)	FIELD DATA					Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	Depth (feet)	Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing						
0						AC	Approximately 8 inches of asphalt concrete				
						RX	Approximately 16 inches of base course				
115						SP-SM	Brown poorly graded sand with silt (dense, moist)				
	13	41		1							
5						CL	Gray lean clay with sand (very stiff, moist)	15	70		AL (LL=40; PI=19)
	17	19		2	AL, HA						
110							Grades to with oxidation staining				
	13	28		3							
10						SM	Brown silty sand (loose, moist)				
	4	5		4A 4B							
105						ML	Gray silt (medium stiff, moist)				
15											
	16	7		5A							
100						SP-SM	Gray poorly graded sand with silt and gravel (loose, wet)				Driller noted groundwater seepage at approximately 16 feet at time of drilling
				5B							
20							Becomes medium dense	16	11		
	18	22		6	SA						
95											
25											

Note: See Figure A-1 for explanation of symbols.

Log of Boring W-B126-24



Project: I-405, Brickyard to SR 527 Improvement Project
 Project Location: King and Snohomish Counties, Washington
 Project Number: 0180-423-01

Date: 9/23/24 Path: C:\USERS\LUHSTON\ONE DRIVE - GEOENGINEERS, INC\WORK\0180-423-01.GPJ DBLibrary\Library\GEOENGINEERS_DF_STD_US_JUNE_2017.GLB\GEL_GEO TECH_STD_SF_NO_GW_NO_DATA_SOURCE

Date: 9/23/24 Path: C:\Users\j\houston\OneDrive - GEOENGINEERS, INC\WORK\018042301.GPJ DBLibrary\Library\GEOENGINEERS_DF_STD_US_JUNE_2017.GLB\GEL\GEO TECH STD_SF_NO GW_NO DATA SOURCE

Elevation (feet)	FIELD DATA				Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	Depth (feet)	Interval Recovered (in)	Blows/foot	Collected Sample						
25	17	39		7		Becomes dense			Corrosion test pH=8.5, Resistivity=6,700 ohm-cm	
30	13	85	SA		SM	Gray silty sand (very dense, moist)	13	43	Corrosion test pH=8.3, Chloride=trace (<30 ppm), Resistivity=6,500 ohm-cm, Sulfate=trace (<2 ppm)	
35	6	50/4"		9	CH	Gray fat clay (very hard, moist)				
40	7	50/4"		10	GP-GM	Gray poorly graded gravel with silt (very dense, wet)				
45	10	50/5"		11	CL	Gray lean clay (very hard, moist)				
50	0	50/3"		12					No recovery	

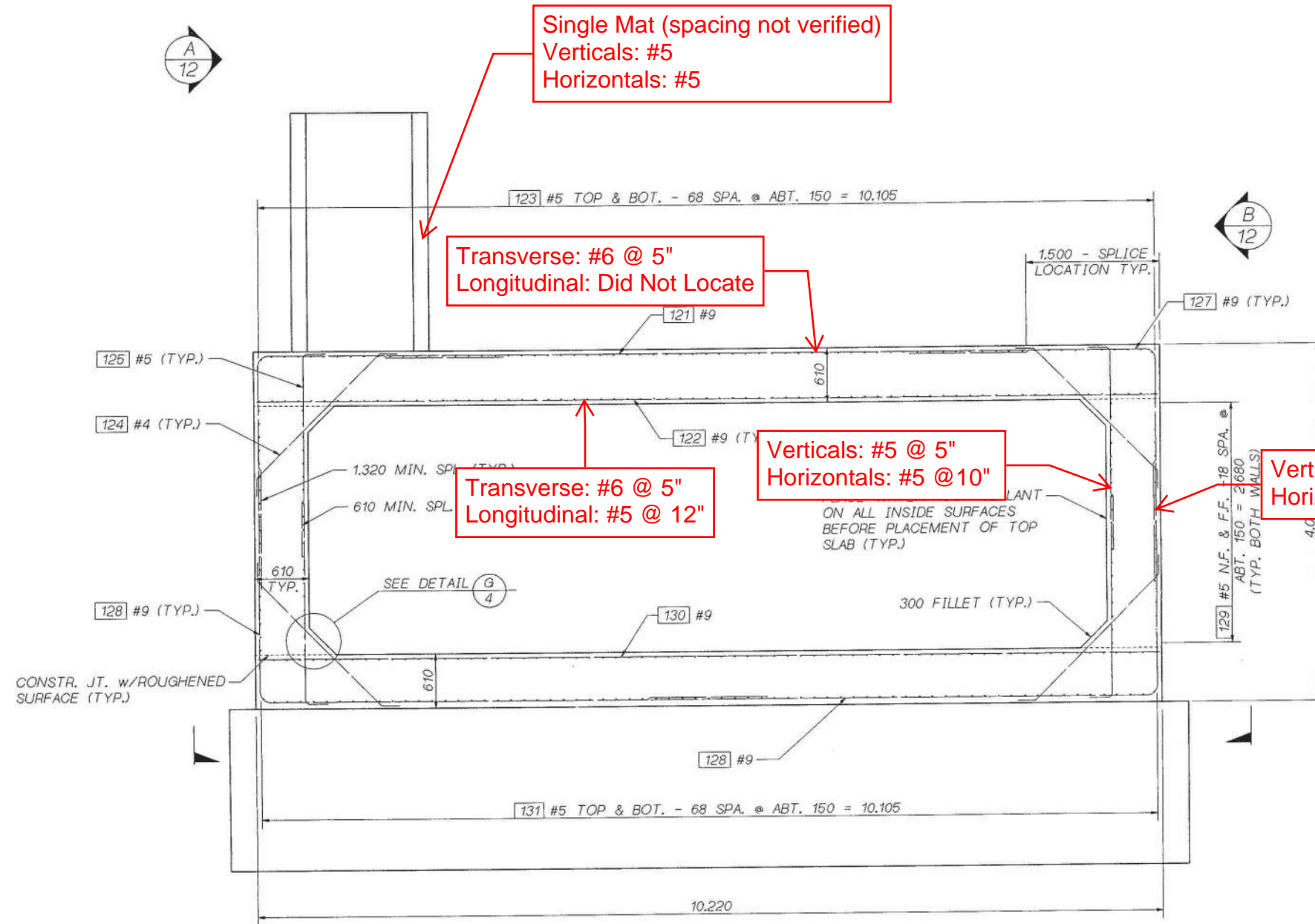
Boring terminated at 50.25 feet below ground surface

Log of Boring W-B126-24 (continued)



Project: I-405, Brickyard to SR 527 Improvement Project
 Project Location: King and Snohomish Counties, Washington
 Project Number: 0180-423-01

Field Investigations



Single Mat (spacing not verified)
 Verticals: #5
 Horizontals: #5

Transverse: #6 @ 5"
 Longitudinal: Did Not Locate

Transverse: #6 @ 5"
 Longitudinal: #5 @ 12"

Verticals: #5 @ 5"
 Horizontals: #5 @ 10"

Verticals: #6 @ 5"
 Horizontals: #5 @ 10"

Grade 60



TYPICAL TRANSVERSE SECTION

FOR "AS CONSTRUCTED
 PLANS" ONLY

Bridge Design Engr. C. C. RUTH	VAULTSROOT (FGB) VAULT9_1.FGB: 1	REGION NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS	BRIDGE AND STRUCTURES OFFICE	SR 405	BRIDGE SHEET NO.
Supervisor R. T. SHAEFER		10	WASH.						9
Designed By M. TALUKDAR 8/96									199
Checked By F. KESHAVARZI 10/96									OF
Detailed By V.B. SCHICCHI 8/96									668
Bridge Projects Engr.									SHEETS
Prelim. Plan By									
Architect/Specialist	DATE	REVISION	BY	APP'D	5054				
15-NOV-96									

REPORT OF CORED CYLINDER TEST

O'Neill Service Group

17619 NE 67th Ct Suite 100, Redmond, WA 98052

Report Date: 7/2/25

Project Number: 3181
Project: I-405 Brickyard to SR 527
Client: Skanska
Address:

Report Number: 3181-20250701MC-1

Attn:

SAMPLING INFORMATION (ASTM C 42)

Date Sampled: 7/1/2025

Time Sampled: na

Technician: Miles C

Date Placed: 7/1/2025

Location of Sample: Drainage vault N-12

Supplier: na

Mix Number: na

Design Strength:

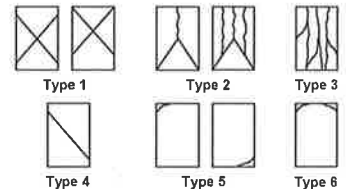
LABORATORY TEST RESULTS (ASTM C 39)

Specimen	Test Date	Age	Load	Diameter	Area	Un-capped Height	Capped Height	Strength	Percent of Design	Type of Fracture
150918	7/2/2025	1	99395	3.74	10.99		3.75	7870		1

Remarks: Specimen 150918 is core #1.

Copies to:

TYPES OF FRACTURE



Reported by:

MIke Holtz
Laboratory Manager

Ceiling Rebar



Network: Mar 13, 2025 at 1:14:08 AM PDT
Local: Mar 13, 2025 at 1:14:08 AM PDT
N 47° 47' 33.121", W 122° 12' 35.475"
I-405 S
Bothell WA 98021
United States





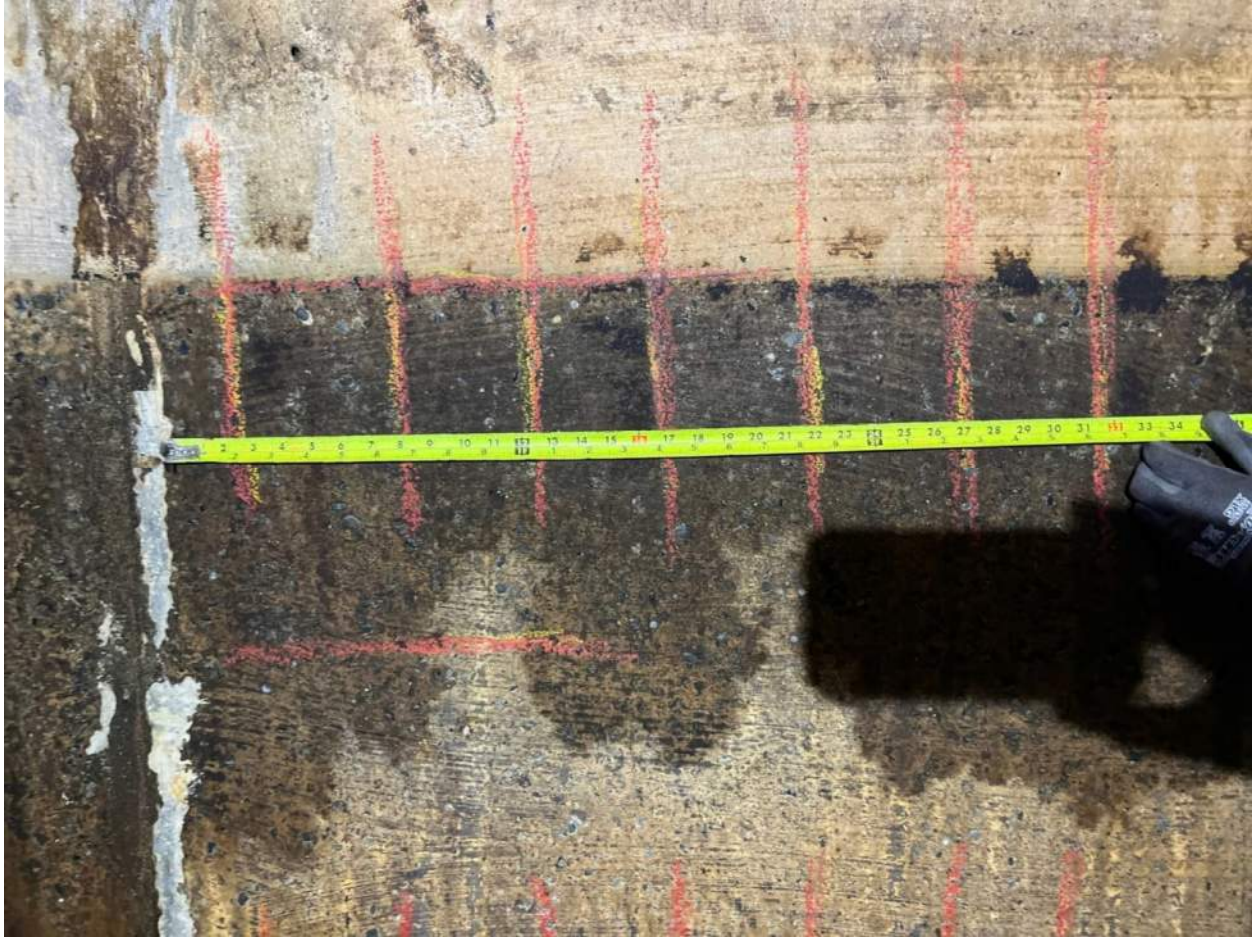


Wall Rebar

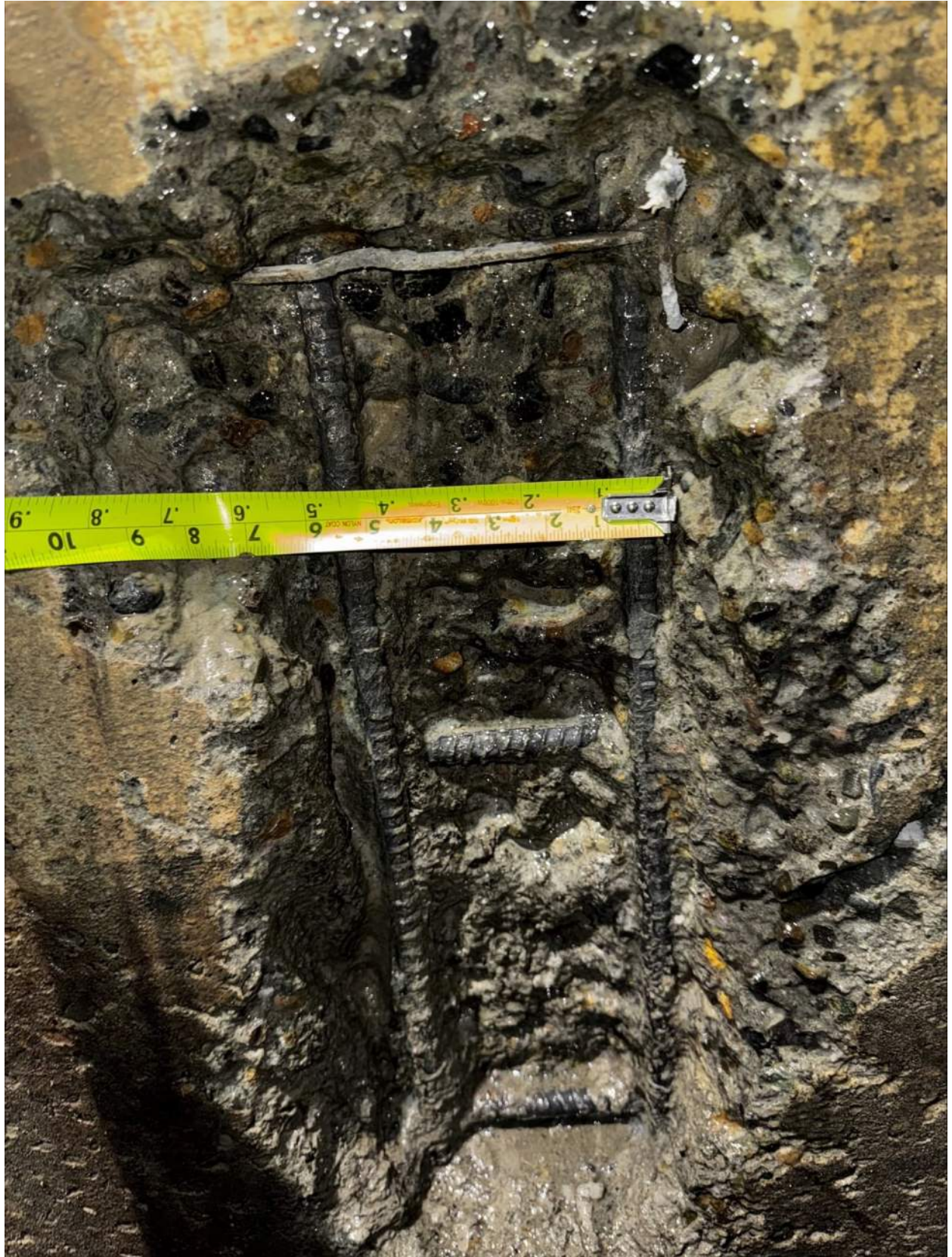














I-405 NB

ITS #103

1

2

3

4

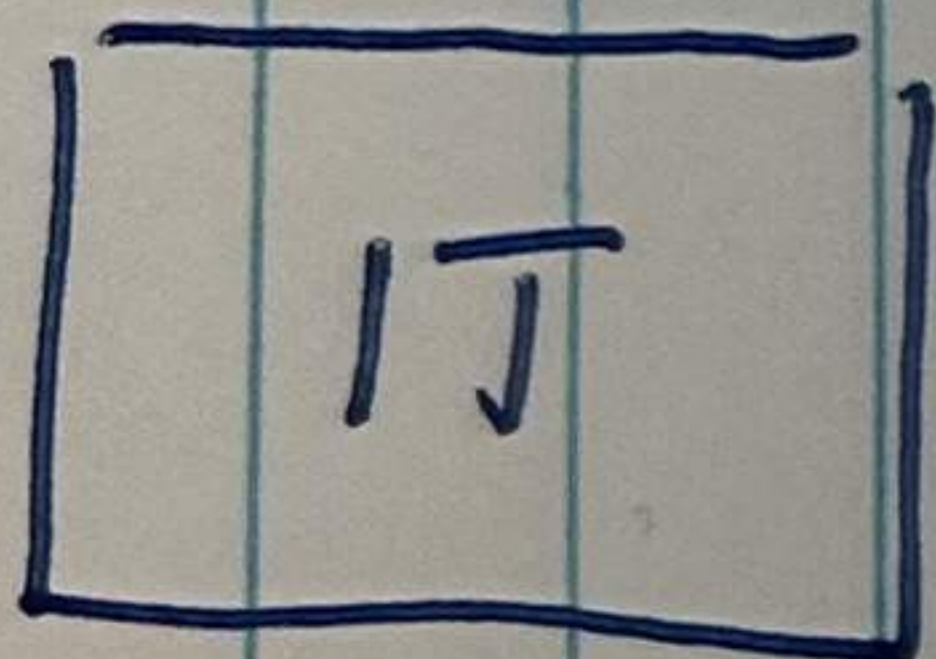
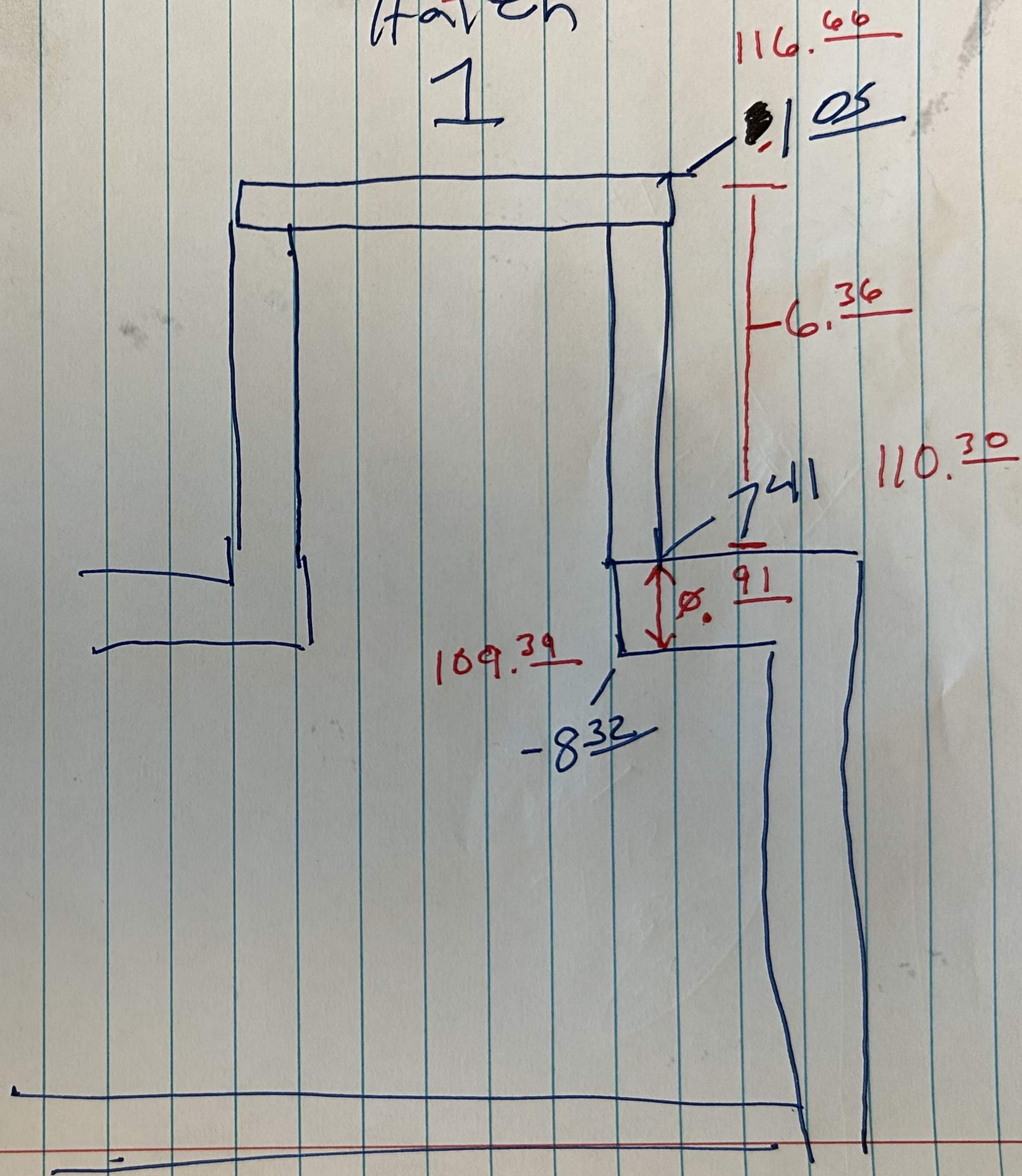
5

6

7

I-405 SB

North End
Hatch
1

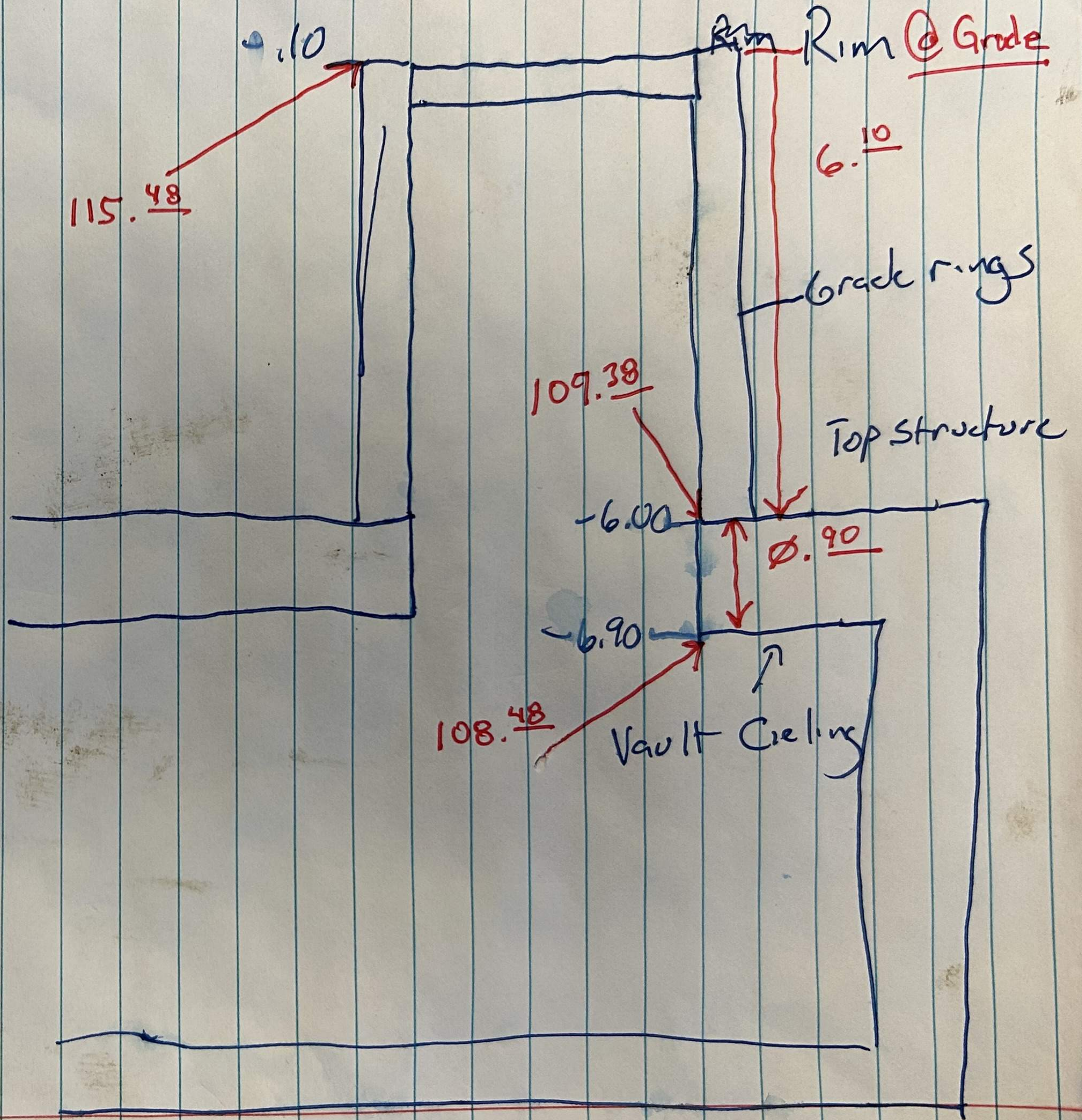


117.71

250317 PRKER 120

115.38 per survey shot
0.00
ITS
25031 7PKER 103

Hatch 6



May 15, 2025 at 2:00:35 AM
I-405 S
Bothell WA 98021
United States



Confined Space Access

(Skanska Provided)

NW 12 Access and Inspection Plan

Skanska BU	Skanska USA Civil
Project Number	90009590
Project Name	I-405/BRICKYARD TO SR527
Project State	WA
Cost Code	
CWP No.	C-90009590-0346-A
Valid Dates	06/30/2025 - 12/30/2030
Plan Creator	Barrios, Josh
Project Manager	Turner, Scott
Engineer	Barrios, Josh
Superintendent	
EHS Professional	Barrios, Josh
Foreman	

Work Area

Vault NW 12

Access to Area

Access to the work area and vault will be provided via a left lane closure on southbound I-405 or by center median.

PPE & Safety Equipment

ANSI class II high visibility Safety Vest, Confined space gear, Fall protection, Head Protection (Hard Hat or Type II Helmet where required), Safety Glasses, Safety Toe Work Boots, sniffers., Task Appropriate Cut Resistant Level 3 Gloves

Specific PPE

Full Body Harness with Retrieval Line

Site Specific Hazards & Controls

- 1) Care for Life 5: Human-Machine Interface, Energized Systems, Line of Fire, Falls, Lifting Operations
- 3) If using a forklift or excavator to hoist as a secondary function, no lift plan is needed. However, capacity for front and side, load weight, rigging, and path of travel must be included in the plan details portion of the CWP.

Revision Notes

None

Emergency Action Plans

Office
For medical attention, alert supervisor
Morgan, Johnny J 951-453-5110
Barrios, Josh 510-456-5511

Muster Point & Other Instructions: 18911 N Creek Pkwy S, Bothell, WA 98011

Muster points will be located at the foreman's truck or closest safe area.



Scope of Work

Step 1: This Construction Work Plan outlines the access procedures and safety protocols for the inspection of Vault NW12, located in the southbound median of I-405. Following the traffic switch scheduled for completion by the end of July, all inspections will require nighttime access due to mandatory lane closures, as entry will occur from the far-left lane of I-405 southbound.

Scheduling and Access Requests

All inspection requests must be submitted a minimum of two weeks in advance of the intended inspection date to allow time for CUR coordination. Requests must be made through Skanska Superintendent Danny Villalobos at danny.villalobos@skanska.com. Start times will vary depending on the approved lane closure schedule, and all access will be coordinated between Skanska and WSDOT inspectors.

All WSDOT inspectors participating in this work must be confined space trained prior to the scheduled inspection date. Inspections will occur at night due to required traffic control (MOT) closures of the left lane on I-405 southbound. Class 3 PPE is required.

Step 2: Day-of-Work Protocol

On the night of the scheduled work, inspectors will report to the Skanska/WSDOT main office at Brickyard for a Daily Hazard Analysis (DHA) meeting with the Skanska foreman. Inspectors will remain at the office until they receive confirmation from Skanska that the lane closure is in place and the vault is safe to enter. At that point, they will proceed to the vault site, either in their own or a company-issued vehicle.

Vehicles must have 360° amber construction lights when entering or exiting the lane closure.

Class 3 high-visibility PPE is required for all personnel at night.

Harnesses are required

If an inspector's vehicle does not meet lighting requirements, a Skanska vehicle and driver will be made available.

Step 3: Confined Space Entry Procedures

Vault NW12 is classified as an Alternate Entry Confined Space, due to limited means of access and the absence of other known hazards. Prior to entry, a Skanska competent person will perform an alternate entry evaluation. Entry will not begin until the evaluation is complete and approved.

Skanska will provide:

All required confined space equipment and permits
Continuous atmospheric monitoring using a bump-tested Altair 4X gas meter
Onsite oversight by a Skanska competent person throughout the inspection

Step 4: CFL5 line of fire and Safety Considerations

Although protected by the MOT lane closure, this work is still located on an active highway. Inspectors are expected to remain behind the Truck-Mounted Attenuator (TMA) protection at all times and exercise caution when entering or exiting both the closure and the vault.

Step 5: Completion and Sign-Out

Once the inspection is complete, the Skanska foreman will meet the inspectors back at the Skanska/WSDOT main office to formally sign them out of the DHA.

Scope of Work Categories

confined space, Storm Water Pollution Prevention - SWPPP, Traffic Control & Circulation, Underground

Triggers**Task Environment**

Confined Space

Equipment

Truck - Attenuator



Confined and Enclosed Spaces

Objective

The purpose of this program is to protect workers from the hazards associated with permit-required and non-permit required confined spaces on our jobsites. Projects will take the necessary steps to correctly evaluate confined spaces in order to safely enter and perform our work. All workers taking part in an entry will be trained in accordance with the requirements of this program.

Legal and Other Requirements

Federal, State, Local Regulations

- a. [OSHA 29 CFR 1926.21 Subpart C - General Safety and Health Provisions - Safety training and education](#)
- b. [OSHA 29 CFR 1926 Subpart AA - Confined Spaces in Construction - Authority for 1926 Subpart AA](#)
- c. [OSHA 29 CFR 1910.146 Subpart J - General Environmental Controls - Permit-required confined spaces](#)
- d. [WAC 296-809 - Confined Spaces](#)

Procedure

1. General Requirements

1. Evaluate the work environment using the Confined Space Evaluation Checklist to determine if it is a confined space. A confined space meets the following conditions:
 - a. Is large enough for an employee to enter fully and perform assigned work
 - b. Is not designed for continuous occupancy by the employee
 - c. Has a limited or restricted means of entry or exit
2. The Confined Space Evaluation Checklist will also determine if the space is a permit-required confined space or a non-permit-required confined space. A permit-required confined space meets one or more of the following conditions:
 - a. Contains or has the potential to contain a hazardous atmosphere
 - b. Contains a material with the potential to engulf someone who enters the space
 - c. Has an internal configuration that might cause an entrant to be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section
 - d. Contains any other recognized serious safety or health hazards
3. If work activity produces a hazardous atmosphere, the confined space will be classified as permit required. Examples:
 - Fumes from welding
 - Fumes from painting
 - Fumes from waterproofing
 - Oxygen deficiency caused from various different work activities
4. If the space is deemed a permit-required confined space, the Confined Space Entry Permit must be completed before entry.
5. Follow all procedures identified for safe entry according to this program.
6. Any project specific requirements for this section are listed here.
 - a. None

2. Non-permit required confined space.

1. Pre-Entry

1. Identify tasks to be performed in the space and their potential hazards.
2. Secure the following equipment prior to entry:
 - a. Testing and monitoring equipment.
 - b. Adequate lighting equipment.
 - c. Rescue and emergency equipment as needed.
 - d. Any other equipment necessary for safe entry into and rescue from space.
3. Isolate the space and implement measures to prevent unauthorized entry.
4. Complete the air-monitoring log on the Confined Space Evaluation and maintain at the jobsite for inspection. Properly calibrate air-monitoring equipment and maintain records of calibration.
 - a. Test the space for atmospheric hazards in this order: oxygen content, combustible gases, vapors, dusts, and toxic gases.

- b. If necessary, purge, flush or ventilate the space to eliminate or control atmospheric hazard for at least thirty (30) minutes prior to retesting air quality.
5. Implement Lockout/tagout as necessary.
 6. If necessary, select rescue and retrieval methods and/or notify proper emergency services that may be required to respond.

2. Entry

1. Only confined space trained personnel shall enter non-permit required confined spaces.
2. Follow all entry procedures including, but not limited to:
 - a. Verification of acceptable entry conditions
 - i. Perform one single monitoring event at the beginning of each shift and document on the confined space evaluation form to be approved
 - ii. The confined space evaluation should be signed off by the competent person
 - b. Implementation of forced air ventilation if necessary
 - c. Proper use of equipment required
 - d. Ensure an attendant is available if a rescue system is needed for precautionary measures
 - e. Any other procedures deemed necessary for safe operations
3. Evacuate the space if a prohibited condition is detected inside or outside the space, entrant exhibits signs of hazard exposure or evacuation orders are given.

3. Permit-required confined space

1. Pre-Entry

1. Identify tasks to be performed in the space and their potential hazards.
2. Secure the following equipment prior to entry:
 - a. Testing and monitoring equipment
 - b. Ventilation equipment needed to maintain acceptable entry conditions
 - c. Any necessary communications equipment
 - d. Personal protective equipment when feasible engineering and work practice controls do not adequately protect employees
 - e. Adequate lighting equipment
 - f. Non-sparking hand tools
 - g. Barriers and shields as required
 - h. Rescue and emergency equipment needed
 - i. Any other equipment necessary for safe entry into and rescue
 - j. In an explosive environment, use explosion-proof mechanical equipment and lighting (Class one (1) Div one (1))
3. Isolate the space and implement measures to prevent unauthorized entry.
4. Complete the air-monitoring log on the Confined Space Entry Permit and maintain at the jobsite for inspection. Properly calibrate air monitoring equipment and maintain records of calibration.
 - a. Test the space for atmospheric hazards in this order: oxygen content, combustible gases, vapors, dusts and toxic gases.
 - b. Purge, flush or ventilate the space to eliminate or control atmospheric hazard for at least thirty (30) minutes prior to retesting air quality.
 - c. No employee will be allowed to enter an oxygen-deficient or potentially toxic/explosive confined space until project management approves the Construction Work Plan.
5. Implement Lockout/tagout as necessary.
6. Identify appropriate controls if hot work is to be performed in the space.
7. Select rescue and retrieval methods and/or notify proper emergency services that may be required to respond. In addition:
 - a. Evaluate a prospective rescuer's ability to respond to a rescue summons in a timely manner.
 - b. To facilitate non-entry rescue, use retrieval systems or methods whenever an authorized entrant enters a confined space. Retrieval equipment is not required when its use would increase the overall risk of entry or would not contribute to rescue such as with confined spaces with side openings. Side openings in a confined space are those within three and a half (3½) feet off the bottom. Retrieval systems must meet the following requirements:
 - i. Each authorized entrant must use a chest or full body harness with the retrieval line attached at the center of the entrant's back near shoulder level, or above the entrant's head. Wristlets may be used in lieu of the chest or full body harness if the use of a full body harness is infeasible or creates a greater hazard. The wristlets must be the safest and most effective alternative in this case.

- ii. The other end of the retrieval line must be attached to a mechanical device or fixed point outside the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device must be available to retrieve personnel from vertical-type permit spaces more than five (5) feet deep.
- 8. Select a communication method based on configuration of space and work task.
- 9. Before entry is authorized, the entry supervisor must complete and sign the entry permit. The permit must be posted for attendants and entrants to review. The duration of the permit may not exceed the time required to complete the work, or eight hours.
- 10. During pre-entry, the entry supervisor must:
 - a. Evaluate the confined space to determine known and potential hazards.
 - b. Identify acceptable entry conditions.
 - c. Verify appropriate equipment (retrieval, personal protective equipment, air monitors, etc.) based on hazards in the confined space.
 - d. Verify that rescue services are available and the means for summoning them are operable.
 - e. Assign qualified and trained individuals as authorized entrants and attendants.
 - f. Keep all Safety Data Sheets (SDS) for hazardous chemicals involved with entry available for emergency personnel if an employee is overexposed to a substance.
 - g. Provide pedestrian, vehicle or other barriers as necessary to protect entrants from external hazards.
 - h. Provide adequate lighting equipment.
 - i. Provide equipment needed for safe access.
 - j. Before signing the permit allowing entry to begin, verify the following:
 - i. The permit has been completed.
 - ii. All tests specified by the permit have been conducted.
 - iii. All procedures and equipment specified by the permit are in place.
 - k. For confined space work extending beyond eight (8) hours, determine when responsibility for a confined space entry operation is transferred, at intervals dictated by the hazards and operations performed within the space, to maintain safe confined space operations.
- 11. During pre-entry the attendant must:
 - a. Verify acceptable entry conditions.
 - b. Monitor air continuously.
 - c. Implement forced air ventilation if necessary.
 - d. Communicate with entrants.
 - e. Ensure rescue controls are in place.
 - f. Comply with any other procedures deemed necessary for safe operations.
- 12. Only authorized personnel shall enter confined spaces. Authorized entrants must review posted permit and verify the following before entry:
 - a. Acceptable entry conditions
 - b. Continuous air monitoring
 - c. Implementation of forced air ventilation if necessary
 - d. Proper use of equipment required
 - e. Communication with attendant and other entrants
 - f. Any other procedures deemed necessary for safe operations

2. Entry

- 1. During entry, the entry supervisor must:
 - a. Remove unauthorized persons who enter or who attempt to enter the confined space during entry operations.
 - b. Terminate the entry and cancel the permit when a prohibited condition is detected, or a condition that is not allowed under the entry permit criteria arises inside or near the confined space.
 - c. Verify that operations covered by the entry permit have been completed.
- 2. During entry, the attendant must:
 - a. Remain outside the confined space during entry operations until relieved by another approved attendant.
 - b. Continuously maintain an accurate count of authorized entrants in the confined space and note time of entry and exit.
 - c. Test or monitor the space continuously to determine if acceptable entry conditions are being maintained. Document readings every fifteen (15) minutes on the air monitoring log.
 - d. Monitor activities inside and outside the space to determine if it is safe for entrants to remain in the space.

- e. Ensure continuous communication between themselves and the entrants in order to monitor their status.
 - f. If unauthorized persons approach or enter a confined space while entry is in progress, take the following actions:
 - i. Warn the unauthorized person(s) that they must stay away from the confined space.
 - ii. Advise the unauthorized persons that they must exit immediately if they have entered the confined space.
 - iii. Inform the authorized entrants and the entry supervisor if an unauthorized person(s) has entered the confined space.
 - g. Order evacuation if any of the following conditions occur:
 - i. A prohibited condition is detected.
 - ii. The behavioral effects of hazard exposure are detected in an authorized entrant.
 - iii. A situation outside the space could endanger the authorized entrants.
 - iv. He/she cannot effectively and safely perform all the required duties of an attendant.
 - v. Summon rescue and other emergency services as soon as it is determined that authorized entrants may need assistance to escape from space hazards.
 - vi. Perform non-entry rescues with retrieval equipment.
3. During entry, entrants must:
- a. Alert attendant when:
 - i. Any warning sign or symptom of exposure to a hazard is recognized.
 - ii. A prohibited condition is detected.
 - b. Evacuate the permit space immediately when:
 - i. An order to evacuate is given by the attendant or the entry supervisor.
 - ii. Any warning sign or symptom of exposure to a hazard is recognized.
 - iii. A prohibited condition is recognized.
 - iv. An evacuation alarm is sounded.

3. Post-Entry

- 1. The entry supervisor must cancel the permit and file it with the safety department for one year to facilitate a review of the confined space program. Document any problems during entry operations, in order to make continuous improvements to the confined space program.
- 2. Remove all entrants and equipment from space.
- 3. Replace the cover, hatch, door, etc., in space to prevent unauthorized entry.

4. Emergency

- 1. In the event of an emergency, the following emergency procedure will be followed:
 - 1. The Attendant will notify all Entrants to evacuate and immediately notify the Supervisor and the project EAP Director. Specific information related to the emergency should be conveyed, including, the nature of the emergency, hazards associated with the space, and approximate number of affected employees.
 - 2. The EAP Director will ensure notification is made for internal and external emergency services to respond.
 - 3. The Entry Supervisor will immediately cancel the Entry Permit.
 - 4. The EAP Director, Entry Supervisor, and Attendant will provide emergency services with any observations or information about the emergency.
 - 5. Unauthorized personnel will evacuate the area and await further instruction from the EAP Director or designee.

EHS Forms and Documents

- a. [Confined Space Evaluation Checklist - Confined Space Evaluation Checklist](#)
- b. [Confined Space Entry Permit - Confined Space Entry Permit](#)

Applicable Training

Training Links

- a. [Confined Space Entry--Permit-Required \[Competent Person\] - Confined Space Entry--Permit-Required \[Competent Person\]](#)

Skanska USA
 , New York

Confined Space Evaluation

TYPE: EH&S Optional

TRADE:

DESCRIPTION:

This checklist is optional - can be required if determined by the project team. It can be completed prior to work inside a confined space to evaluate the space to determine if it fits the definition of a permit-required confined space. If the space is determined to not require a permit (non-PRCS), the checklist on this form shall be completed prior to entry in this non-PRCS. Acceptable Air Monitoring Levels Oxygen: 19.5% - 23.5% Explosive (Gas/Vapor): < 10% LEL Carbon Monoxide: < 35 ppm Hydrogen Sulfide: < 10 ppm

ATTACHMENTS:

[Confined Space Evaluation Checklist.pdf](#)

General Information

1.1	Confined Space Name and Location
1.2	Purpose for Entry
1.3	Date of Entry

Does the space meet the criteria for a confined space? If all three boxes are checked, this space is a CONFINED SPACE.

2.1	Does it have limited means of access and egress?
2.2	Is it not designed for continuous occupancy?
2.3	Is the space large enough to enter to perform work?

Does the space meet the criteria for a PERMIT REQUIRED confined space? If any of the below items are not met, this space is a PERMIT REQUIRED confined space. A CONFINED SPACE ENTRY PERMIT must be used in order to conduct work in this space. If all of the below items are met, this space is a NON PERMIT REQUIRED confined space.

3.1	The space does not contain or have the potential to contain a hazardous atmosphere
3.2	The space does not contain material that has the potential to engulf an entrant
3.3	The space does not have walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant
3.4	The space does not contain any other recognized safety or health hazard (unguarded machinery, exposed live wires, etc.)

A NON PERMIT REQUIRED confined space must have the following

4.1	Employees have confined space training and are trained in the use of a retrieval system, if needed
4.2	Air monitoring has been conducted to ensure there is no risk of a hazardous atmosphere. See description for acceptable levels.
4.3	Air monitoring is being conducted for the duration of the work in the space
4.4	Ventilation is installed and properly functioning, if needed. It has been inspected prior to use.
4.5	A retrieval system (tripod, davit arm, winch, harness, SRL, etc.) is installed and properly functioning, if needed. It has been inspected prior to use.
4.6	Proper access is installed for safe entry into the space. It has been inspected prior to use.

Entry Authorization	
5.1	Name
5.2	Title
5.3	Time
5.4	Date

Skanska USA
 , New York

Confined Space Entry Permit

TYPE: EH&S

TRADE:

DESCRIPTION:

This permit is required to be completed (following the review of the attached Confined Space Evaluation Checklist) if the space is determined to fit the definition of a permit-required confined space (PRCS). This permit is to be completed prior to entry into the PRCS and acts as a checklist to confirm the space is safe for employee entry - through confirmation of proper LOTO, purging, training, setup of emergency provisions, etc. This permit requires signature by the Entry Supervisor. Create a separate entry if more entrants are involved in permit required confined space activity than allowed for on this form.

ATTACHMENTS:

[Confined Space Evaluation Checklist.pdf](#)

Description - Required for All Entries	
1.1	Permit #
1.2	Supervisor
1.3	Type (Permit or Non-Permit)
1.4	Date
1.5	Time of Entry
1.6	Location of Confined Space
1.7	Type of Confined Space (Tank, Pipe, Manhole, Tunnel, Vault, or Other)
1.8	Work Description/Purpose of Entry
1.9	Hazards

Pre-Entry Preparation (Select N/A if not required)	
2.1	EHS Notified
2.2	Training
2.3	Lockout/Tagout (Electrical, Mechanical, Hydraulic, etc.)
2.4	Purged, Cleaned, Drained, and Ventilated
2.5	Adequate Access
2.6	Adequate Lighting (low voltage)
2.7	Harness/Lifelines
2.8	Ventilation Adequacy

2.9	Communications Equipment
2.10	Continuous Air Monitoring

Additional Permit Controls (Select N/A if not required)

3.1	Authorized Entry Log at Access
3.2	Fire Extinguisher Available (Do not use O2 displacing fire extinguishers in confined space)
3.3	Attendant (if needed, add name in Comments)
3.4	Warning Signs Posted at Access
3.5	Respirators (if needed, add respirator type in Comments)
3.6	Protective Clothing Required (if needed, add type in Comments)
3.7	Rescue Equipment/Service Available (if needed, add equipment/service in Comments)
3.8	Hot Work Permit

Names

4.1	Attendant(s) Name(s):
4.2	Entrant(s) Name(s):

Air Monitoring - Required for All entries

5.1	Make
5.2	Model
5.3	ID #
5.4	Field Calibration Date
5.5	Calibrated By
5.6	Atmosphere Checked By

Substance Monitored - % Oxygen (O2) - Permissible Level: 19.5% to 23.5%

6.1	1st Check Reading
6.2	1st Check Time
6.3	2nd Check Reading

6.4	2nd Check Time
6.5	3rd Check Reading
6.6	3rd Check Time

Substance Monitored - % LEL - Permissible Level: Less than 10%

7.1	1st Check Reading
7.2	1st Check Time
7.3	2nd Check Reading
7.4	2nd Check Time
7.5	3rd Check Reading
7.6	3rd Check Time

Substance Monitored - Carbon Monoxide (CO) - Permissible Level: Less than 35 ppm

8.1	1st Check Reading
8.2	1st Check Time
8.3	2nd Check Reading
8.4	2nd Check Time
8.5	3rd Check Reading
8.6	3rd Check Time

Substance Monitored - Hydrogen Sulfide (H2S) - Permissible Level: Less than 10 ppm

9.1	1st Check Reading
9.2	1st Check Time
9.3	2nd Check Reading
9.4	2nd Check Time
9.5	3rd Check Reading
9.6	3rd Check Time

Substance Monitored - Other

10.1	1st Check Reading
10.2	1st Check Time
10.3	2nd Check Reading
10.4	2nd Check Time
10.5	3rd Check Reading
10.6	3rd Check Time

Emergency Information

11.1	IN CASE OF EMERGENCY CALL
11.2	SECONDARY CALL
11.3	Entry Supervisor Name (Permit to be emailed to this contact)
11.4	Entry Supervisor Phone Number

Supervisor Authorization (This section to be completed by Entry Supervisor)

12.1	Authorization
12.2	Entry Supervisor
12.3	Date

Post Shore
Inspection Template
(Skanska Provided)

Inspection Checklist for NW-12 Vault Shoring

(Doka 8.5 Kip Screw Jack Post Shores Under Live Load Conditions)

Inspection Information

1.1	Date:
1.2	Inspector:

General Site Conditions

2.1	Vault access is clear and safe.	Y	N	N/A
2.2	Barricades and signage in place.	Y	N	N/A
2.3	Vault access is clear and safe.	Y	N	N/A
2.4	Emergency egress routes clearly marked and unobstructed.	Y	N	N/A
2.5	Confined Space Checklists have been completed.	Y	N	N/A

Shoring Equipment Inspection

3.1	Doka 8.5 Kip post shores installed according to manufacturer specifications.	Y	N	N/A
3.2	Post shores are vertical and plumb without leaning or shifting.	Y	N	N/A
3.3	Post shores are installed at the location and spacing as per the approved load rating report.	Y	N	N/A
3.4	Shore base plates properly seated firmly on leveling pad.	Y	N	N/A
3.5	Shore heads properly adjusted to bear against structure without gaps.	Y	N	N/A
3.6	All locking pins, collars, and adjustment mechanisms secured and functional.	Y	N	N/A
3.7	No visible damage, deformation, corrosion, or cracks on posts and components.	Y	N	N/A
3.8	Locking devices or safety collars on screw jacks are fully engaged to prevent unintended adjustment or loosening.	Y	N	N/A
3.9	Were any adjustments made to screw jacks during this inspection? If Yes, also document at the end of this document.	Y	N	N/A


Documentation and Compliance			
4.1	Shoring installation was inspected and approved by qualified engineers or designee prior to load application.	Y	N N/A
4.2	This document, along with all other inspections, is electronically stored for compliance with project requirements.	Y	N N/A

Additional Checks			
5.1	No debris or materials compromising shore stability or access inside the vault.	Y	N N/A
5.2	No signs of concrete cracking, debris, or structural failure on vault interior surfaces.	Y	N N/A

Notes			

SLE Review

(Skanska/AECOM Provided)


	Washington State Department of Transportation	Doc Type: SUB
	I-405, Brickyard to SR 527 Improvement Project Contract No. 009727	REV#: 0
		SPEC SECTION: 2.13
		DATE: 06/04/2025
		CRD #: BY-CRD-01249

To: AECOM 1111 3 rd Ave Suite 1600 Seattle, WA 98101	From: Skanska USA Civil West 1995 Agua Mansa Road Riverside, CA 92509
Submittal: BY-CRD-01249_009727_SUB_18.05_Load Rating Report - Existing Vault NW-12	

SKA REFERENCE DOCUMENTS

Subcontractor/Supplier: Skanska
SKA Title and Description: Load Rating Report - Existing Vault NW-12
Due Date: 06/18/2025

ADDITIONAL REMARKS

	<p style="text-align: center;">AECOM TECHNICAL SERVICES</p> <table style="width: 100%;"> <tr> <td><input type="checkbox"/> NO EXCEPTIONS TAKEN</td> <td><input type="checkbox"/> REJECTED</td> </tr> <tr> <td><input checked="" type="checkbox"/> FURNISH AS NOTED RESUBMITTAL NOT REQ'D</td> <td><input type="checkbox"/> REVISE AND RESUBMIT</td> </tr> </table> <p style="font-size: small; color: red;"> AECOM HAS REVIEWED THIS SUBMITTAL AND VERIFIES IT'S GENERAL CONFORMANCE WITH THE CONTRACT DOCUMENTS. THIS REVIEW DOES NOT RELIEVE THE SUBCONTRACTOR OR SUPPLIER FROM RESPONSIBILITY FOR ACCURACY, COMPLETENESS, QUALITY DIMENSIONS OR COMPLIANCE WITH THE CONTRACT DOCUMENTS. ANY DEVIATION FROM THE CONTRACT DOCUMENTS MUST BE EXPRESSLY STATED. THE SUBCONTRACTOR OR MATERIAL SUPPLIER IS RESPONSIBLE FOR CONFIRMING DIMENSIONS WITH ACTUAL JOBSITE CONDITIONS. SUBCONTRACTOR IS RESPONSIBLE FOR COORDINATION WITH OTHER TRADES AND THE GENERAL CONTRACTOR. </p> <p> PROJECT NAME: I-405 Brickyard DB SUBMITTAL: SUB_18.05 Load Rating Report REVIEWED BY: Hamid Khoshnoud, P.Eng. 6/21/25 </p> <p style="font-size: x-small;"> AECOM Technical Services, Inc. 13355 Noel Road, Suite 400 Dallas, TX 75240 </p> <div style="text-align: right;">  </div>	<input type="checkbox"/> NO EXCEPTIONS TAKEN	<input type="checkbox"/> REJECTED	<input checked="" type="checkbox"/> FURNISH AS NOTED RESUBMITTAL NOT REQ'D	<input type="checkbox"/> REVISE AND RESUBMIT
<input type="checkbox"/> NO EXCEPTIONS TAKEN	<input type="checkbox"/> REJECTED				
<input checked="" type="checkbox"/> FURNISH AS NOTED RESUBMITTAL NOT REQ'D	<input type="checkbox"/> REVISE AND RESUBMIT				



6/3/25

Washington State Department of Transportation

RE: Existing Box Culvert Evaluation

Please indicate if it is for temporary or permanent service, If permanent open to traffic, then check if seismic evaluation is needed

As part of the I-405, SR522 Vicinity to SR527 Express Toll Lanes Improvement Project, traffic from the I-405 will be shifted onto an existing concrete box culvert located in the median. The existing culvert was built in 1996. Since the available plans for the culvert do not match field conditions, the following information was determined based on field investigation:

- Configuration and materials: Single-cell precast concrete box culvert
- Geometry: Interior dimensions are 20' wide x 9' high, with 2' chamfer at top and bottom. Wall and slab thicknesses are 10".
- Depth of fill above culvert: Varies from 4'-6'
- Reinforcement:
 - Top Slab - Interior: #7 bars at 5" o.c. transverse and #5 bars at 10" o.c. longitudinal
 - Wall - Interior: #5 bars at 5" o.c. vertical with #5 bars at 10" o.c. horizontal
 - Wall - Exterior: #7 bars at 5" o.c. vertical with #5 bars at 10" o.c. horizontal

In order to analyze the culvert, the below assumptions were made:

- Concrete strength, $f'_c = 5000$ psi. Typical for precast concrete.
- Reinforcing steel strength, $f_y = 60,000$ psi
- Fill density above culvert: 127 pcf. This is a weighted average which includes 6" of asphalt at 140 pcf with compacted or saturated soils below at 125 pcf.
- Reinforcement:
 - Corner bars are assumed equivalent to vertical exterior wall bars (#7 at 5" o.c.) as is standard practice. These bars are often combined into one single U-shaped bar.
 - Bottom slab reinforcement is taken to be equal to the top slab reinforcement. Standard practice is equivalent or better.
 - Top and bottom slab exterior reinforcement is taken to be #5 bars at 10" o.c. in both directions, matching the top slab longitudinal rebar and the horizontal wall rebar. Standard practice is equivalent or better.
 - Additional bars were added around the riser/access openings, to account for the opening, which provide the same level of strength as uninterrupted bars. This assumption is based on typical details for openings in similar box culverts (provided on Page 75).

The culvert parameters outlined above were analyzed in the Eriksson Culvert software, the program indicated for box culvert design and analysis per the WSDOT Bridge Design Manual (BDM). The software inputs can be viewed on Pages 5-6. Input values that were confirmed by field investigations are highlighted for reference.

To evaluate the ability of the culvert to support traffic loading, load ratings were determined for HL-93 loads and the additional rating trucks outlined in Chapter 13 of the BDM. It was determined that the culvert



could support the various truck loadings with ratings greater than 1.0 for all loadings except HL-93 (see Page 9). Although there are two lanes of traffic above the culvert running parallel to the centerline of the culvert, one of these lanes is an express lane and not likely to be subject to truck loadings. However, to ensure HL-93 truck loadings could be supported in both lanes simultaneously, temporary shoring has been conservatively added to the center of the culvert. The shoring is designed to carry the HL-93 Live Load only. To approximate load ratings for this condition, the culvert was modeled as a double box culvert with a center stem. The corresponding load ratings can be found on Pages 3 and 22. Minimum controlling HL-93 inventory and operating ratings are 1.26 and 1.63 respectively, demonstrating that the culvert can safely support the worst-case traffic loadings which could occur during construction.

Additionally, the concrete riser and steel plate cover strength was evaluated under HL-93 LL and soil DL and found to be acceptable (see Pages 36-39).



Check: how many years will the construction be? if more than 5 years, then treat it a permanent structure.

6-3-25

**BRIDGE RATING SUMMARY:
EXISTING CULVERT (WITH SHORING)**



6-3-25

Bridge Name: Drainage Vault
 Bridge Number: V001
 SID Number: XG180500
 Span Types: N/A
 Bridge Length: 285 ft
 Design Load: HL-93
 Engineering Firm/Agency: 4M Engineering
 Rated By: Jessica Merrell
 Checked By: Forrest Megargel
 Date: 6/3/2025

Inspection Report Date:	3/13/2025	Deck Condition	N/A
Rating Method:	LRFR	Superstructure Condition	N/A
Overlay Thickness:	N/A	Substructure Condition	N/A

Truck	RF	γ	Controlling Point
AASHTO 1 (Type 3)	2.08	2.0	Shear @ bottom slab
AASHTO 2 (Type 3S2)	2.28	2.0	Shear @ bottom slab
AASHTO 3 (Type 3-3)	2.21	2.0	Shear @ bottom slab
Legal Lane	2.73	2.0	Shear @ bottom slab
NRL	2.08	2.0	Shear @ bottom slab
LGL-105	2.08	2.0	Shear @ bottom slab
OL-1	3.44	1.20	Shear @ top slab
OL-2	3.36	1.20	Shear @ top slab
EV2	2.04	1.30	Shear @ top slab
EV3	2.20	1.30	Shear @ top slab

SNBI Rating	RF	γ	Controlling Point
Inventory (HL-93)	1.26	1.75	Shear @ bottom slab
Operating (HL-93)	1.63	1.35	Shear @ bottom slab

Remarks:

Per inspection report, concrete culvert is 20'x9' in good condition.

*Existing Culvert Analysis
(Unshored)*

Project : Bothell to Swamp Creek
 Task : Box Culvert Evaluation
 Job No. : _____

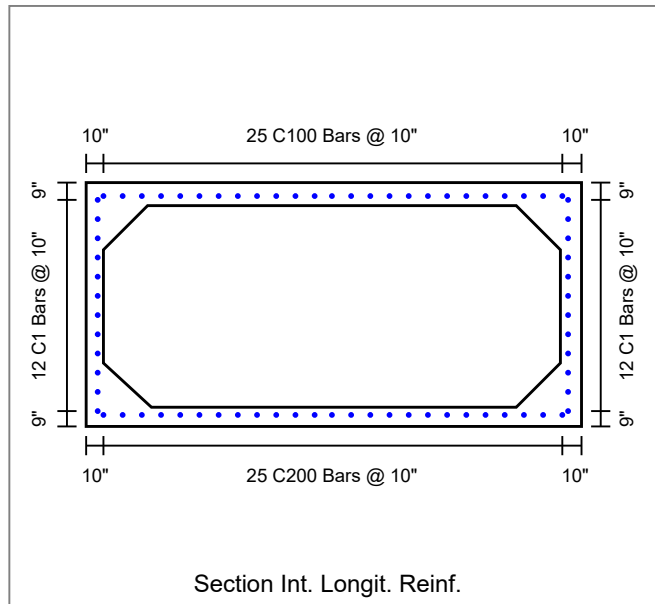
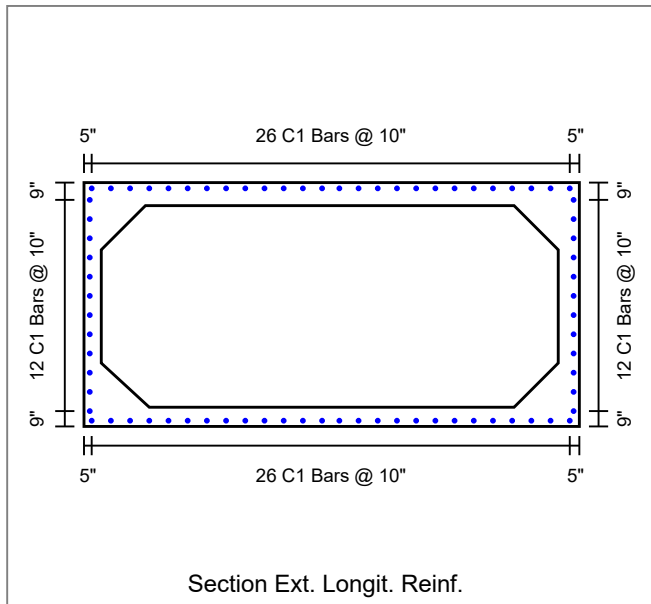
Client: Skanska
 File: Bothell Culvert Analysis 522.etcx

Concrete Summary

Volume of Concrete: 2.189 cy/ft Total Volume of Concrete: 131.358 cy

Reinforcing Steel Bar Schedule (lb)

Location	Mark	Qty	Size	Spacing	Type	Length	Hor.Leg	Ver.Leg	Tot.Weight
Top Slab(Int)	A100 (AS2)	144	7	5"	S	21'-3"	--	--	6255.0
Bot Slab(Int)	A200 (AS3)	144	7	5"	S	21'-3"	--	--	6255.0
Top Slab(Ext)	A300 (AS7)	72	5	10"	S	21'-3"	--	--	1596.0
Bot Slab(Ext)	A400 (AS8)	72	5	10"	S	21'-3"	--	--	1596.0
Corner(Top)	A1 (AS1)	288	7	5"	L	9'-5"	6'-4"	3'-1"	5543.0
Corner(Bot)	A2 (AS1)	288	7	5"	L	9'-0"	5'-11"	3'-1"	5298.0
Wall(Int)	B1 (AS4)	288	5	5"	S	9'-6"	--	--	2854.0
Wall(Ext)	B2 (AS1)	288	7	5"	S	9'-0"	--	--	5298.0
Longit. Top (Int)	C100 (AS5)	25	5	10"	S	59'-11"	--	--	1562.0
Longit. Bot (Int)	C200	25	5	10"	S	59'-11"	--	--	1562.0
Longit. Top (Ext)	C1 (AS6)	26	5	10"	S	59'-11"	--	--	1624.7
Longit. Bot (Ext)	C1 (AS6)	26	5	10"	S	59'-11"	--	--	1624.7
Longit. Wall (Ext)	C1 (AS6)	24	5	10"	S	59'-11"	--	--	1499.8
Longit. Wall (Int)	C1 (AS6)	24	5	10"	S	59'-11"	--	--	1499.8
									44068



Notes:

- Field verified values are highlighted.
- A1, A2, and B2 are often combined into one U-bar, or same sizes used. A1 and A2 are assumed to match B2.
- Bottom slab interior rebar typically matches or exceeds top slab interior rebar (assumed to match top slab rebar)
- Other bars are conservatively assumed to be #5 @ 10" o.c.

Project : Bothell to Swamp Creek

Task : Box Culvert Evaluation

Job No. :

Client: Skanska

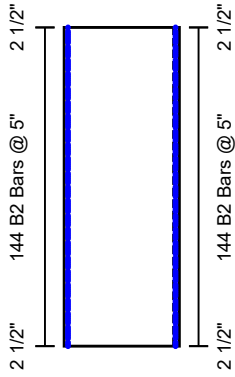
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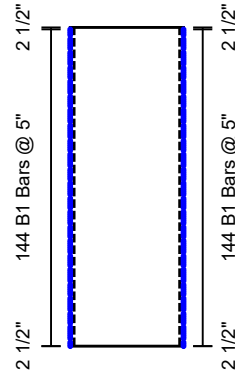
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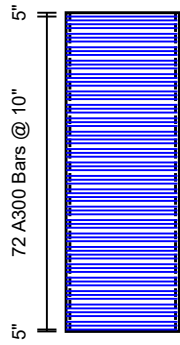
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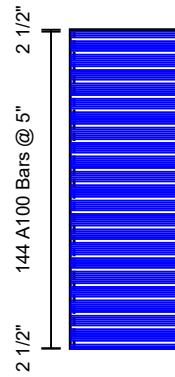
Ext. Wall Reinf.



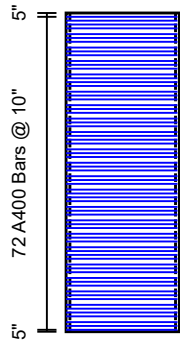
Int. Wall Reinf.



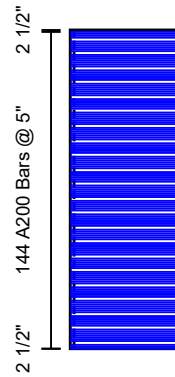
Top Slab Ext. Reinf.



Top Slab Int. Reinf.



Bottom Slab Ext. Reinf.



Bottom Slab Int. Reinf.

Project : Bothell to Swamp Creek

Task : Box Culvert Evaluation

Job No. :

Client: Skanska

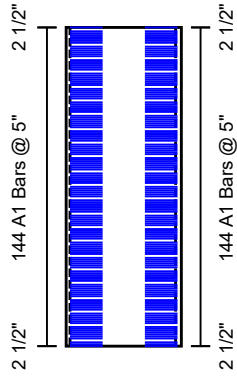
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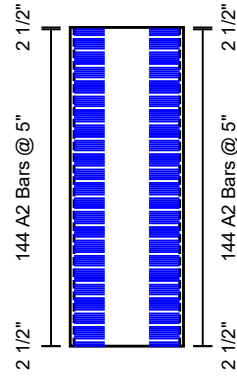
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Top Slab Corner Reinf.



Bottom Slab Corner Reinf.

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RATINGS SUMMARY
 =====

Truck	Flexure			Shear		
	RF(INV)	RF(OP)	Controlling Point	RF(INV)	RF(OP)	Controlling Point
(AA) HL-93	0.75	0.97	Ext wall, BOT	0.83	1.08	Bottom Slab, RT
(AB) NRL	1.17	1.17	Ext wall, BOT	1.37	1.37	Bottom Slab, LT
(AC) Type 3	1.17	1.17	Ext wall, BOT	1.37	1.37	Bottom Slab, LT
(AD) Type 3S2	1.27	1.27	Ext wall, BOT	1.50	1.50	Bottom Slab, LT
(AE) Type 3-3	1.24	1.24	Ext wall, BOT	1.45	1.45	Bottom Slab, LT
(AF) Overload	2.11	2.11	Ext wall, BOT	2.56	2.56	Top Slab, LT
(AG) Overload	2.06	2.06	Ext wall, BOT	2.50	2.50	Top Slab, LT
(AH) EV 2	1.29	1.29	Ext wall, BOT	1.54	1.54	Top Slab, RT
(AI) EV 3	1.38	1.38	Ext wall, BOT	1.64	1.64	Top Slab, LT
(AJ) NRL - Le	1.47	1.47	Ext wall, BOT	1.74	1.74	Bottom Slab, LT
(AK) WA-105	1.17	1.17	Ext wall, BOT	1.37	1.37	Bottom Slab, LT

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REINFORCEMENT SUMMARY

M dimension = 5' 3" (method of equivalent capacity)
 = 6' 12" (method of contraflexure - ASTM)

Reinforcing steel Schedule

Location	Bar Mark	Qty	Size	Type	Spacing (in)	As,prv (in2/ft)	Length (ft-in)	Wgt (lbs)	H Leg (ft-in)	V Leg (ft-in)
Top slab (int)	A100 (AS2)	144	7	STR	5.00	1.440	21- 3	6255		
Bot slab (int)	A200 (AS3)	144	7	STR	5.00	1.440	21- 3	6255		
Top slab (ext)	A300 (AS7)	72	5	STR	10.00	0.372	21- 3	1596		
Bot slab (ext)	A400 (AS8)	72	5	STR	10.00	0.372	21- 3	1596		
Corner (Top)	A1 (AS1)	288	7	L-BAR	5.00	1.440	9- 5	5543	6- 4	3- 1
Corner (Bottom)	A2 (AS1)	288	7	L-BAR	5.00	1.440	9- 0	5298	5-11	3- 1
Ext wall (int)	B1 (AS4)	288	5	STR	5.00	0.744	9- 6	2854		
Ext wall (ext)	B2 (AS1)	288	7	STR	5.00	1.440	9- 0	5298		
Top slab (int- 1)	C100 (AS5)	25	5	STR	10.00	0.372	59-11	1562		
Bot slab (int- 1)	C200	25	5	STR	10.00	0.372	59-11	1562		
Temperature (1)	C1 (AS6)	26	5	STR	10.00	0.372	59-11	1625		
Temperature (1)	C1 (AS6)	26	5	STR	10.00	0.372	59-11	1625		
Temperature (1)	C1 (AS6)	24	5	STR	10.00	0.372	59-11	1500		
Temperature (1)	C1 (AS6)	24	5	STR	10.00	0.372	59-11	1500		
Total								44068		

Note: A denotes flexural steel, B denotes vertical steel, C denotes longitudinal steel

AS Bar Marks

Location	As prv in2/ft
Transverse Side Wall - Outside Face (AS1)	1.440
Transverse Top Slab - Inside Face (AS2)	1.440
Transverse Bottom Slab - Inside Face (AS3)	1.440
Transverse Side Wall - Inside Face (AS4)	0.744
Distribution Top Slab - Inside Face (AS5)	0.372
Distribution Top Slab - Outside Face (AS6)	0.372
Transverse Top Slab - Outside Face (AS7)	0.372
Transverse Bottom Slab - Outside Face (AS8)	0.372

Notes: 1.) Final areas of steel provided must be checked in analysis mode

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Project: Bothell to Swamp Creek
Task : Box Culvert Evaluation
Client : Skanska
Job No.:

CULVERT PROPERTIES

Type of Culvert: Precast Specification : LRFD 9th Edition
Operating Mode : Analysis

Physical Dimensions

No. of Boxes: 1 Name: BoxCulvert
Clear Span : 20.0000 ft
Clear Height: 9.0000 ft Skew Angle : 0.00 deg
Length : 60.0000 ft Bottom Slab Support: Full Slab
Fill Depth Range: Maximum : 6.00 ft Minimum : 4.00 ft Increment : 0.50 ft
Haunches: Top, Length: 24.0000 in Height: 24.0000 in
Bottom, Length: 24.0000 in Height: 24.0000 in
Member Thicknesses: Top Slab: 10.0000 in Bot Slab: 10.0000 in
Ext wall: 10.0000 in

Wall Joint: None

Material Properties

Concrete: Strength, f'c : 5.000 ksi Density : 0.155 kcf Elasticity, Ec: 4903 ksi
Type : Normal weight Density Modification Factor : 1.00
Fr Factor : 0.24 Gamma1 : 1.60 Gamma3 : 1.00 (user defined)
Steel: Yield, fy : 60.00 ksi fss Limit : 0.60fy Elasticity, Es: 29000 ksi
Yield, fyv : 60.00 ksi Diameter : 1.000 in Type : Rebar
Soil: Density : 0.127 kcf Slope Factor: 1.150
Poisson's : 0.5
Fe Factor : 1.000 (User Defined)
Serviceability, Gamma-e: 1.00

Loads

Live Load: Vehicle: (AA) HL-93 - Design Vehicle
Axle No. weight(k) Dist. From Previous(ft)
1 8.00 0.00
2 32.00 14.00
3 32.00 14.00
Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
Include Tandem: yes
Tandem: Axle 1: 25.00 k, Axle 2: 25.00 k, Axle Spacing: 4.00 ft
Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck + Lane Or Tandem + Lane
Inventory Rating Load Factor: 1.75 Operating Rating Load Factor: 1.35
Design Load Combinations: Strength I
Override MPF: no
Override DLA: no
Vehicle: (AB) NRL - Legal Vehicle
Axle No. weight(k) Dist. From Previous(ft)
1 8.00 0.00
2 8.00 4.00
3 8.00 4.00
4 17.00 4.00
5 17.00 4.00
6 8.00 4.00
7 8.00 4.00
8 6.00 6.00
Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
Include Tandem: no
Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck + Lane Or Tandem + Lane
Rating Load Factor: 2
Design Load Combinations: Strength I
Override MPF: no
Override DLA: no
Vehicle: (AC) Type 3 - Legal Vehicle
Axle No. weight(k) Dist. From Previous(ft)
1 17.00 0.00
2 17.00 4.00
3 16.00 15.00
Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
Include Tandem: no
Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck + Lane Or Tandem + Lane
Rating Load Factor: 2
Design Load Combinations: Strength I

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Vehicle: (AD) Type 3S2 - Legal Vehicle

Axle No.	Weight(k)	Dist. From Previous(ft)
1	15.50	0.00
2	15.50	4.00
3	15.50	22.00
4	15.50	4.00
5	10.00	11.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in

Include Tandem: no

Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k

Combine: Truck + Lane Or Tandem + Lane

Rating Load Factor: 2

Design Load Combinations: Strength I

Override MPF: no

Override DLA: no

Vehicle: (AE) Type 3-3 - Legal Vehicle

Axle No.	Weight(k)	Dist. From Previous(ft)
1	14.00	0.00
2	14.00	4.00
3	16.00	16.00
4	12.00	15.00
5	12.00	4.00
6	12.00	15.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in

Include Tandem: no

Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k

Combine: Truck + Lane Or Tandem + Lane

Rating Load Factor: 2

Design Load Combinations: Strength I

Override MPF: no

Override DLA: no

Vehicle: (AF) Overload 1 - Permit Vehicle

Axle No.	Weight(k)	Dist. From Previous(ft)
1	21.50	0.00
2	21.50	4.00
3	21.50	12.00
4	21.50	4.00
5	10.00	10.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in

Include Tandem: no

Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k

Combine: Truck + Lane Or Tandem + Lane

Rating Load Factor: 1.2

Design Load Combinations: Strength II

Override MPF: no

Override DLA: no

Vehicle: (AG) Overload 2 - Permit Vehicle

Axle No.	Weight(k)	Dist. From Previous(ft)
1	22.00	0.00
2	21.50	6.00
3	21.50	4.00
4	22.00	14.00
5	21.50	6.00
6	21.50	4.00
7	22.00	16.00
8	21.50	6.00
9	21.50	4.00
10	12.00	10.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in

Include Tandem: no

Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k

Combine: Truck + Lane Or Tandem + Lane

Rating Load Factor: 1.2

Design Load Combinations: Strength II

Override MPF: no

Override DLA: no

Vehicle: (AH) EV 2 - Permit Vehicle

Axle No.	Weight(k)	Dist. From Previous(ft)
1	24.00	0.00
2	33.50	15.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in

Include Tandem: no

Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k

Combine: Truck Or Tandem Or Lane

Rating Load Factor: 1.3

Design Load Combinations: Strength II

Override MPF: no

Override DLA: no

Vehicle: (AI) EV 3 - Permit Vehicle

Axle No.	Weight(k)	Dist. From Previous(ft)
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1 24.00 0.00
2 31.00 15.00
3 31.00 4.00
Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
Include Tandem: no
Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck Or Tandem Or Lane
Rating Load Factor: 1.3
Design Load Combinations: Strength II
Override MPF: no
Override DLA: no

Vehicle: (AJ) NRL - Legal Lane - Legal Vehicle
Axle No. Weight(k) Dist. From Previous(ft)
1 10.50 0.00
2 10.50 4.00
3 12.00 16.00
4 9.00 15.00
5 9.00 4.00
6 9.00 15.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
Include Tandem: no
Lane Load: 0.20 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck + Lane Or Tandem + Lane
Rating Load Factor: 2
Design Load Combinations: Strength I
Override MPF: no
Override DLA: no

Vehicle: (AK) WA-105 - Legal Vehicle
Axle No. Weight(k) Dist. From Previous(ft)
1 14.00 0.00
2 14.00 4.00
3 17.00 10.00
4 17.00 32.00
5 17.00 4.00
6 7.00 4.00
7 7.00 4.00
8 12.50 11.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
Include Tandem: no
Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck + Lane Or Tandem + Lane
Rating Load Factor: 2
Design Load Combinations: Strength I
Override MPF: no
Override DLA: no

Include Lane Load : yes Max. No. of Lanes: 2
Traffic Direction : Lanes Perpendicular to Main Reinforcement
Neglect Live Load if: Fill > 8 ft and Fill > Clear Span
Apply Surcharge at Fill Depths > 2 ft : yes
Compute Surcharge Depth: yes

Dead Load: Future wearing Surface : 0.00 klf Add. Dead Load : 0.00 klf
Concentrated Loads : none

Lateral Soil Loads: Max. Equiv. Fluid Press.: 60.00 pcf Min. Equiv. Fluid Press. : 30.00 pcf
Include Additional Uniform Horiz. Load: no
Include Additional Uniform Vert. Load: no
Buoyancy Check : no
Fluid Pressures : Apply Water Press. : no
Foundation Model : Uniform Loads
Seismic Analysis : Do not include

Load and Resistance Factors

Max Min
DC: 1.250 0.900
DW: 1.500 0.650
EV: 1.300 0.900
EH: 1.350 0.900
WA: 1.000
EQ: 1.000
LL I : 1.750 LL II : 1.350 LL Legal : 2.000 LL Extreme : 0.500
Ductility: 1.000 Importance: 1.000 Redundancy, non-earth: 1.000 Redundancy, earth: 1.000
Condition: 1.000 System : 1.000
Phi Shear: 0.900 Phi Moment: 1.000 PM Compression: 0.750 PM Tension : 0.900
Load Factor Multipliers, Design Mode: 1.00 Analysis Mode: 1.00

Reinforcement

Reinforcement Covers : Exterior Interior
Top Slab: 2.0000 in 2.0000 in
walls : 2.0000 in 2.0000 in
Bot Slab: 2.0000 in 2.0000 in

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Assigned reinforcement:			
Location	Mark	Size	Spacing (in)
Top Slab Inside	A100 (AS2)	7	5.0000
Bottom Slab Inside	A200 (AS3)	7	5.0000
Top Slab Outside	A300 (AS7)	5	10.0000
Bottom Slab Outside	A400 (AS8)	5	10.0000
Top Corner	A1 (AS1)	7	5.0000
Bottom Corner	A2 (AS1)	7	5.0000
Ext. Wall Inside	B1 (AS4)	5	5.0000
Ext. wall Outside	B2 (AS1)	7	5.0000
Longitudinal	C1 (AS6)	5	10.0000
Top Distribution	C100 (AS5)	5	10.0000
Bottom Distribution	C200	5	10.0000

Analysis Options

```

-----
LL Analysis      : Automatically Set Traffic Direction to Account for Skew Effects: no
                  Limit LL Distribution Width to Culvert Length for: None
                  Combine Longitudinal Axle Distribution Overlaps: No
                  Combine Transverse Axle Distribution Overlaps: No
                  Axle Placement Increment for Moving Load Analysis: 20
                  Include Impact on Bottom Slab: yes
                  Always Distribute wheel Load: yes
                  Deflection Criteria      : 1/800
                  Approach Slab will be Used: no
Reinforcement    : Always Include Distribution Steel: no
                  Distribution Slab Provided: no
                  User Defined Longitudinal Steel: yes
                  Max. As used in Vc Calcs: 2.00 in2/ft
                  Distribute Minimum Reinforcement per Face: yes
                  Use individual Member Thicknesses for Min Steel: no
                  Epoxy coat steel: no
                  Use M-dimension for bar length calcs.: no
Slenderness      : Checked      K Factor: 2.00
Analysis Modeling : Use Haunches in the Structural Analysis Model: yes
Critical Sections : Flexure critical section location: 1.5 member depth
                  Shear critical section location: dv beyond support
                  Use Max. Moment with Max. Shear at the Critical section for Shear: no
                  Include depth of haunch for critical sections: no
Flexure          : Ignore Axial Thrust: no
                  Use Eq. 12.10.4.2.4a-1: yes  Nu Multiplier: 1.00
Shear            : Always Check Iterative Beta Method
Environmental    : Apply durability factors: no
Load Combinations : LRFD min/min: no

```

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ANALYSIS RESULTS

Top Slab Thickness = 10.00 in
 Bottom Slab Thickness = 10.00 in
 Exterior Wall Thickness = 10.00 in

Modular Ratio (N) = 5.91 Max. Steel Ratio = 0.025
 Design Span = 20.83 ft Design Height = 9.83 ft

Volume of Concrete: 2.189 cy/ft weight of Steel: 734 lb/ft

Note: Design and analysis results do not include force effects from stripping and handling stages

M dimension = 5' 3" (method of equivalent capacity)
 = 6' 12" (method of contraflexure - ASTM)

Reinforcing Steel Schedule

Location	Bar Mark	Qty	Size	Type	Spacing (in)	As,prv (in2/ft)	Length (ft-in)	Wgt (lbs)	H Leg (ft-in)	V Leg (ft-in)
Top Slab (int)	A100 (AS2)	144	7	STR	5.00	1.440	21- 3	6255		
Bot Slab (int)	A200 (AS3)	144	7	STR	5.00	1.440	21- 3	6255		
Top Slab (ext)	A300 (AS7)	72	5	STR	10.00	0.372	21- 3	1596		
Bot Slab (ext)	A400 (AS8)	72	5	STR	10.00	0.372	21- 3	1596		
Corner (Top)	A1 (AS1)	288	7	L-BAR	5.00	1.440	9- 5	5543	6- 4	3- 1
Corner (Bottom)	A2 (AS1)	288	7	L-BAR	5.00	1.440	9- 0	5298	5-11	3- 1
Ext wall (int)	B1 (AS4)	288	5	STR	5.00	0.744	9- 6	2854		
Ext wall (ext)	B2 (AS1)	288	7	STR	5.00	1.440	9- 0	5298		
Top slab (int- 1)	C100 (AS5)	25	5	STR	10.00	0.372	59-11	1562		
Bot slab (int- 1)	C200	25	5	STR	10.00	0.372	59-11	1562		
Temperature (1)	C1 (AS6)	26	5	STR	10.00	0.372	59-11	1625		
Temperature (1)	C1 (AS6)	26	5	STR	10.00	0.372	59-11	1625		
Temperature (1)	C1 (AS6)	24	5	STR	10.00	0.372	59-11	1500		
Temperature (1)	C1 (AS6)	24	5	STR	10.00	0.372	59-11	1500		
Total								44068		

Note: A denotes flexural steel, B denotes vertical steel, C denotes longitudinal steel

AS Bar Marks

Location	As prv in2/ft
Transverse Side Wall - Outside Face (AS1)	1.440
Transverse Top Slab - Inside Face (AS2)	1.440
Transverse Bottom Slab - Inside Face (AS3)	1.440
Transverse Side Wall - Inside Face (AS4)	0.744
Distribution Top Slab - Inside Face (AS5)	0.372
Distribution Top Slab - Outside Face (AS6)	0.372
Transverse Top Slab - Outside Face (AS7)	0.372
Transverse Bottom Slab - Outside Face (AS8)	0.372

Notes: 1.) Final areas of steel provided must be checked in analysis mode

Summary of Ratings Table:

Truck	Flexure								Shear				
	ILF	OLF	Fill	Member	Location	IR	OR	Fill	Member	Location	IR	OR	
(AA)HL-93	1.75	1.35	6.00	1	BOT	0.75	0.97	6.00	4	RT	0.83	1.08	
(AB)NRL	2.00	2.00	6.00	1	BOT	1.17	1.17	6.00	4	LT	1.37	1.37	
(AC)Type 3	2.00	2.00	6.00	1	BOT	1.17	1.17	6.00	4	LT	1.37	1.37	
(AD)Type 3	2.00	2.00	6.00	1	BOT	1.27	1.27	6.00	4	LT	1.50	1.50	
(AE)Type 3	2.00	2.00	6.00	1	BOT	1.24	1.24	6.00	4	LT	1.45	1.45	
(AF)overlo	1.20	1.20	6.00	1	BOT	2.11	2.11	4.00	2	LT	2.56	2.56	
(AG)overlo	1.20	1.20	6.00	1	BOT	2.06	2.06	4.00	2	LT	2.50	2.50	
(AH)EV 2	1.30	1.30	6.00	1	BOT	1.29	1.29	4.00	2	RT	1.54	1.54	
(AI)EV 3	1.30	1.30	6.00	1	BOT	1.38	1.38	4.00	2	LT	1.64	1.64	
(AJ)NRL -	2.00	2.00	6.00	1	BOT	1.47	1.47	6.00	4	LT	1.74	1.74	
(AK)WA-105	2.00	2.00	6.00	1	BOT	1.17	1.17	6.00	4	LT	1.37	1.37	

Critical Sections Summary: Flexure

Member 1: (Exterior wall), Thickness = 10.00 in

Loc	Dist. (in)	Design Moment (k-ft)	Corr. A. F. (k)	Mu (k-ft)	ds (in)	Ma (k-ft)*	phi	As (in2)	Mcr (k-ft)	Load Ratings		Truck	Fill Depth (ft)
										IR	OR		
BOT	24.00	-58.07	19.07	48.35	7.56	53.31*	1.00	1.44	14.31	0.75	0.97	15AA	6.00

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Eriksson Culvert v6.3.4

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Filename: Bothell Culvert Analysis 522.etcx

Sht: ___ of ___

By: Chk: ___

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Culvert p. 6 of 181

MID	59.00	0.00	6.37	26.97	7.69	29.13	1.00	0.74	14.31	NC	NC	AA	4.00
MID-	59.00	-55.33	19.07	48.35	7.56	53.31*	1.00	1.44	14.31	0.89	1.15	AA	6.00
TOP	24.00	-55.25	19.07	48.35	7.56	53.31*	1.00	1.44	14.31	0.90	1.17	AA	6.00

Member 2: (Top Slab), Thickness = 10.00 in

Loc	Dist. (in)	Design Moment (k-ft)	Corr. A. F. (k)	Mu (k-ft)	ds (in)	Ma (k-ft)	phi	As (in2)	Mcr (k-ft)	Load Ratings		Truck	Fill Depth (ft)
										IR	OR		
LT	24.00	-25.93	4.75	48.35	7.56	49.64	1.00	1.44	14.31	3.40	4.40	AA	6.00
MID	125.00	39.58	0.88	48.35	7.56	48.59	1.00	1.44	14.31	1.67	2.16	AA	6.00
MID-	125.00	0.37	4.49	13.89	7.69	15.58	1.00	0.37	14.31	NC	NC	AA	6.00
RT	24.00	-25.93	4.75	48.35	7.56	49.64	1.00	1.44	14.31	3.40	4.40	AA	6.00

Member 4: (Bottom Slab), Thickness = 10.00 in

Loc	Dist. (in)	Design Moment (k-ft)	Corr. A. F. (k)	Mu (k-ft)	ds (in)	Ma (k-ft)	phi	As (in2)	Mcr (k-ft)	Load Ratings		Truck	Fill Depth (ft)
										IR	OR		
LT	24.00	-28.60	7.42	48.35	7.56	50.35	1.00	1.44	14.31	3.70	4.79	AA	6.00
MID	125.00	41.27	2.89	48.35	7.56	49.14	1.00	1.44	14.31	1.63	2.12	AA	6.00
MID-	125.00	0.58	6.95	13.89	7.69	16.49	1.00	0.37	14.31	NC	NC	AA	6.00
RT	24.00	-28.60	7.42	48.35	7.56	50.35	1.00	1.44	14.31	3.70	4.79	AA	6.00

Critical Sections Summary: Vertical Shear

Member 1: (Exterior wall), Thickness = 10.00 in

Loc	Dist. (in)	Design Shear (k)	Corr. Moment (k-ft)	Corr. A. F. (k)	Dv (in)	phi*Vn	Beta	Vc (k)	Vs (k)	Av (in2)	Max. Spac (in)	Load Ratings		Truck	Fill Depth (ft)
												IR	OR		
BOT	12.20	5.88	60.3	19.07	7.20	10.99	2.000	12.21 b	0.00	0.00	0.00	5.23	6.78	AA	6.00
MID	59.00	0.93	15.2	8.15	7.25	13.39	2.420	14.88 a	0.00	0.00	0.00	41.52	53.83	AA	5.50
MID-	59.00	0.29	51.0	16.59	7.20	10.99	2.000	12.21 b	0.00	0.00	0.00	13.61	17.64	AA	4.00
TOP	12.20	-3.93	56.1	19.07	7.20	10.99	2.000	12.21 b	0.00	0.00	0.00	4.80	6.22	AA	6.00

Member 2: (Top Slab), Thickness = 10.00 in

Loc	Dist. (in)	Design Shear (k)	Corr. Moment (k-ft)	Corr. A. F. (k)	Dv (in)	phi*Vn	Beta	Vc (k)	Vs (k)	Av (in2)	Max. Spac (in)	Load Ratings		Truck	Fill Depth (ft)
												IR	OR		
LT	12.20	17.13	42.3	4.75	7.56	17.31	n/a	19.24 c	0.00	0.00	0.00	1.03	1.34	AA	6.00
MID	125.00	2.03	36.5	0.35	7.56	17.31	n/a	19.24 c	0.00	0.00	0.00	8.52	11.04	AA	4.00
MID-	125.00	2.32	11.2	3.80	7.69	17.60	n/a	19.56 c	0.00	0.00	0.00	7.60	9.85	AA	4.00
RT	12.20	17.35	42.3	4.75	7.56	17.31*	n/a	19.24 c	0.00	0.00	0.00	0.99	1.29	AA	6.00

Member 4: (Bottom Slab), Thickness = 10.00 in

Loc	Dist. (in)	Design Shear (k)	Corr. Moment (k-ft)	Corr. A. F. (k)	Dv (in)	phi*Vn	Beta	Vc (k)	Vs (k)	Av (in2)	Max. Spac (in)	Load Ratings		Truck	Fill Depth (ft)
												IR	OR		
LT	12.20	17.86	46.5	7.42	7.56	17.31*	n/a	19.24 c	0.00	0.00	0.00	0.89	1.16	AA	6.00
MID	125.00	0.15	37.5	2.35	7.56	17.31	n/a	19.24 c	0.00	0.00	0.00	NC	NC	AA	4.00
MID-	125.00	0.17	0.0	6.25	7.69	23.39	5.052	25.99 a	0.00	0.00	0.00	NC	NC	AA	4.00
RT	12.20	18.24	46.5	7.42	7.56	17.31*	n/a	19.24 c	0.00	0.00	0.00	0.83	1.08	AA	6.00

Vc Calculation By: a - Iterative Beta, b - Constant Beta, c - Box Culvert, d - Standard/Arema

Existing Culvert Analysis (Shored)

Project : Bothell to Swamp Creek
 Task : Box Culvert Evaluation
 Job No. : _____
 Client: Skanska
 File: Bothell DBC.etcx

Spec.: LRFD 9th ed.
 Type of Culvert: Precast

Physical Dimensions

Clear Span: 9'-6"
 Clear Height: 9'-0"
 Top Slab: 10"
 Bottom Slab: 10"
 Ext. Wall: 10"
 Int. Wall: 1'-0"
 Fill Depth Range
 Maximum: 6.00 ft
 Minimum: 4.00 ft
 Increment: 0.50 ft
 Length: 60'-0"
 Skew Angle: 0.00 deg
 Bottom Slab Support: Full Slab
 Top Haunch, Width: 2'-0"
 Top Haunch, Height: 2'-0"
 Bottom Haunch, Width: 2'-0"
 Bottom Haunch, Height: 2'-0"

Material Properties

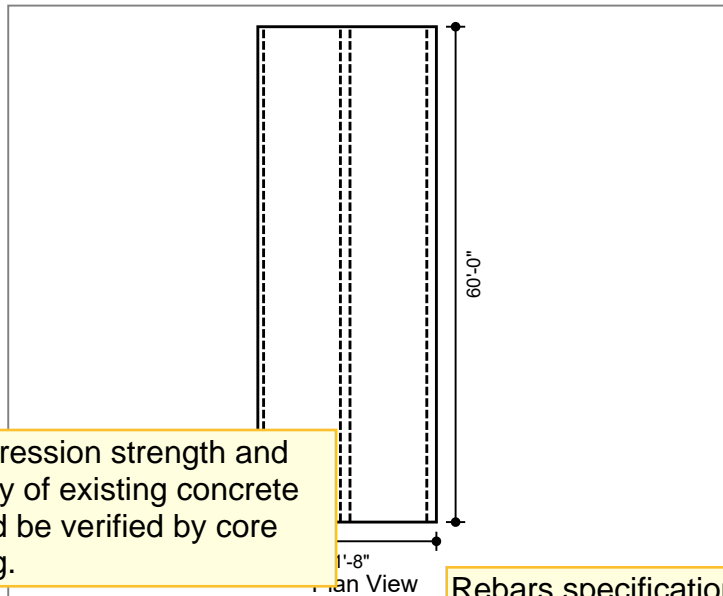
Concrete
 Strength, f_c: 5.000 ksi
 Density: 0.155 kcf
 Elasticity, E_c: 4903 ksi
 Type: Normal wt
 Steel
 Yield, f_y: 60 ksi
 Allow Stress: 36 ksi
 Elasticity, E_s: 29000 ksi
 Soil
 Density: 0.127 kcf
 Exposure Factor
 User-Defined: 1.00
 Reinforcement Covers
 Ext. Cover Top Slab: 2"
 Ext. Cover Bottom Slab: 2"
 Ext. Cover Walls: 2"
 Int. Cover Top Slab: 2"
 Int. Cover Bottom Slab: 2"

Controlling Ratings

Inventory Rating: 1.26
 Operating Rating: 1.63

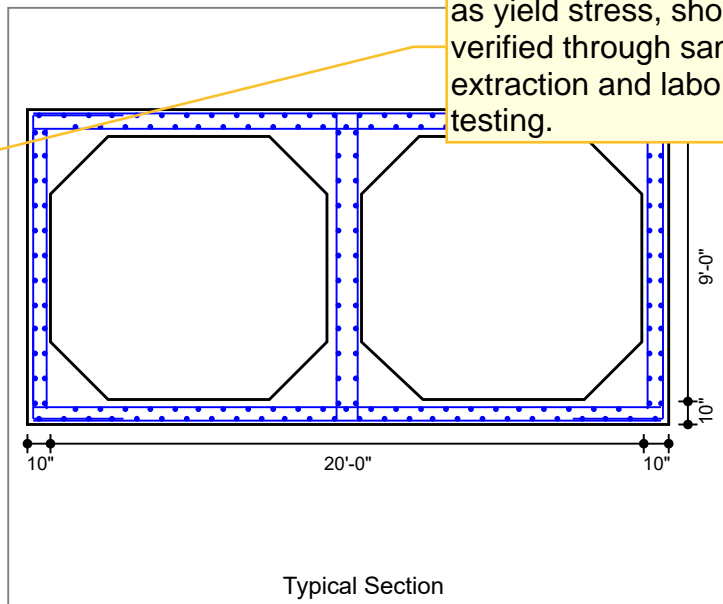
Loads

Live Load
 Vehicle Names: HL-93 EV 2 EV 3
 NRL - Legal Lane NRL Oveload 1
 Oveload 2 Type 3-3 Type 3
 Type 3S2 WA-105
 Traffic Direction: Perpendicular
 Eq. Height of Soil: Calculated
 Max No. of Lanes: 2
 Dead Load
 Future Wearing Surface: 0.000 klf Lateral Soil Loads
 Additional Dead Load: 0.000 klf Eq. Fluid Press. Max: 60.00 pcf
 Concentrated Loads: none Eq. Fluid Press. Min: 30.00 pcf
 Interior Water Pressure: no
 Exterior Water Pressure: no



Compression strength and density of existing concrete should be verified by core testing.

Rebars specifications, such as yield stress, should be verified through sample extraction and laboratory testing.



5.000 ksi
 0.155 kcf
 4903 ksi
 Normal wt
 60 ksi
 36 ksi
 29000 ksi

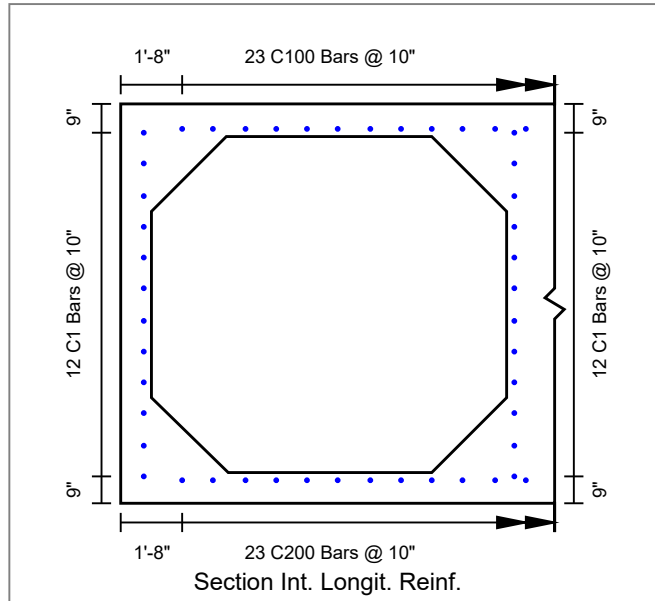
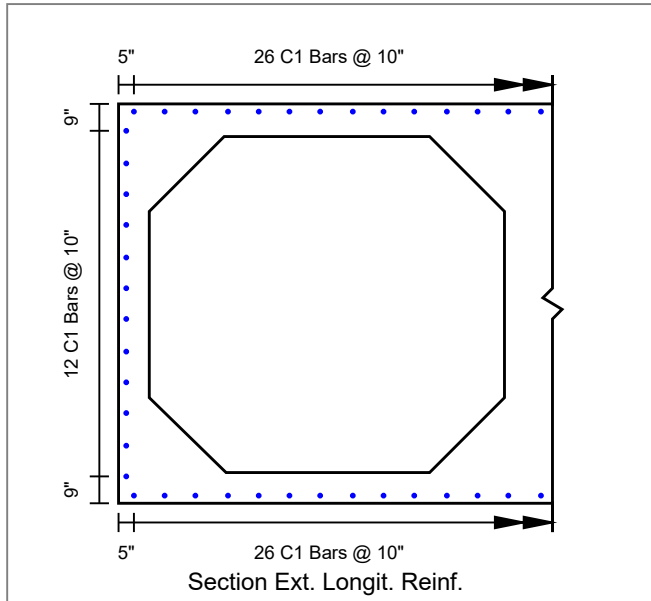
Project : Bothell to Swamp Creek
 Task : Box Culvert Evaluation
 Job No. : _____
 Client: Skanska
 File: Bothell DBC.etcx

Concrete Summary

Volume of Concrete: 2.819 cy/ft Total Volume of Concrete: 169.136 cy

Reinforcing Steel Bar Schedule (lb)

Location	Mark	Qty	Size	Spacing	Type	Length	Hor.Leg	Ver.Leg	Tot.Weight
Top Slab(Int)	A100 (AS2)	144	7	5"	S	21'-3"	--	--	6255.0
Bot Slab(Int)	A200 (AS3)	144	7	5"	S	21'-3"	--	--	6255.0
Top Slab(Ext)	A300 (AS7)	72	5	10"	S	21'-3"	--	--	1596.0
Bot Slab(Ext)	A400 (AS8)	72	5	10"	S	21'-3"	--	--	1596.0
Corner(Top)	A1 (AS1)	288	7	5"	L	6'-2"	3'-1"	3'-1"	3630.0
Corner(Bot)	A2 (AS1)	288	7	5"	L	6'-2"	3'-1"	3'-1"	3630.0
Wall(Int)	B1 (AS4)	288	5	5"	S	9'-6"	--	--	2854.0
Wall(Ext)	B2 (AS1)	288	7	5"	S	9'-0"	--	--	5298.0
Int Wall	B3	288	5	5"	S	10'-3"	--	--	3079.0
Longit. Top (Int)	C100 (AS5)	23	5	10"	S	59'-11"	--	--	1437.0
Longit. Bot (Int)	C200	23	5	10"	S	59'-11"	--	--	1437.0
Longit. Top (Ext)	C1 (AS6)	26	5	10"	S	59'-11"	--	--	1624.8
Longit. Bot (Ext)	C1 (AS6)	26	5	10"	S	59'-11"	--	--	1624.8
Longit. Wall (Ext)	C1 (AS6)	24	5	10"	S	59'-11"	--	--	1499.8
Longit. Wall (Int)	C1 (AS6)	24	5	10"	S	59'-11"	--	--	1499.8
Longit. Int	C1 (AS6)	24	5	10"	S	59'-11"	--	--	1374.8
									44691



Project : Bothell to Swamp Creek

Task : Box Culvert Evaluation

Job No. :

Client: Skanska

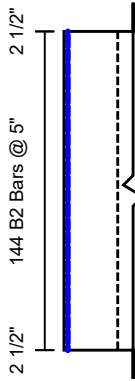
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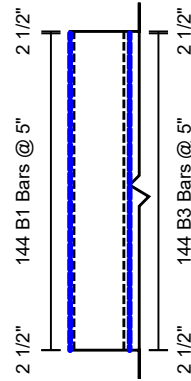
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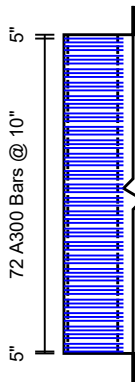
p. 3 of 4



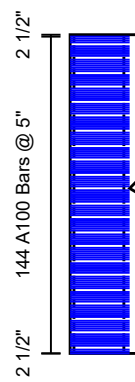
Ext. Wall Reinf.



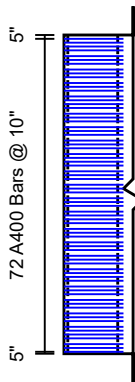
Int. Wall Reinf.



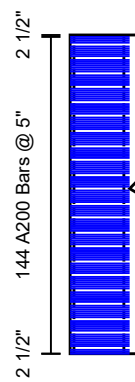
Top Slab Ext. Reinf.



Top Slab Int. Reinf.



Bottom Slab Ext. Reinf.



Bottom Slab Int. Reinf.

Project : Bothell to Swamp Creek

Task : Box Culvert Evaluation

Job No. :

Client: Skanska

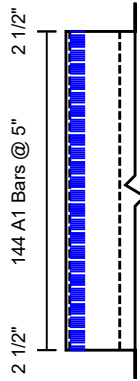
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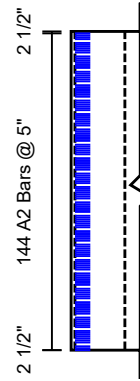
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Top Slab Corner Reinf.



Bottom Slab Corner Reinf.

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 Filename: Bothell DBC.etcx

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 By: Chk: ___
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 Culvert p. 1 of 1

RATINGS SUMMARY
 =====

Truck	Flexure			Shear		
	RF(INV)	RF(OP)	Controlling Point	RF(INV)	RF(OP)	Controlling Point
(AA) HL-93	1.45	1.88	Bottom Slab, RT	1.26	1.63	Bottom Slab, RT
(AB) EV 2	2.31	2.31	Bottom Slab, RT	2.04	2.04	Top Slab, RT
(AC) EV 3	2.49	2.49	Bottom Slab, RT	2.20	2.20	Top Slab, RT
(AD) NRL - Le	3.10	3.10	Bottom Slab, RT	2.73	2.73	Bottom Slab, RT
(AE) NRL	2.36	2.36	Bottom Slab, RT	2.08	2.08	Bottom Slab, RT
(AF) Oveload	3.86	3.86	Bottom Slab, RT	3.44	3.44	Top Slab, RT
(AG) Oveload	3.78	3.78	Bottom Slab, RT	3.36	3.36	Top Slab, RT
(AH) Type 3-3	2.51	2.51	Bottom Slab, RT	2.21	2.21	Bottom Slab, RT
(AI) Type 3	2.36	2.36	Bottom Slab, RT	2.08	2.08	Bottom Slab, RT
(AJ) Type 3S2	2.59	2.59	Bottom Slab, RT	2.28	2.28	Bottom Slab, RT
(AK) WA-105	2.36	2.36	Bottom Slab, RT	2.08	2.08	Bottom Slab, RT

REINFORCEMENT SUMMARY

M dimension = 2' 5" (method of equivalent capacity)
 = 6' 1" (method of contraflexure - ASTM)

Reinforcing steel Schedule

Location	Bar Mark	Qty	Size	Type	Spacing (in)	As,prv (in ² /ft)	Length (ft-in)	Wgt (lbs)	H Leg (ft-in)	V Leg (ft-in)
Top slab (int)	A100 (AS2)	144	7	STR	5.00	1.440	21- 3	6255		
Bot Slab (int)	A200 (AS3)	144	7	STR	5.00	1.440	21- 3	6255		
Top slab (ext)	A300 (AS7)	72	5	STR	10.00	0.372	21- 3	1596		
Bot Slab (ext)	A400 (AS8)	72	5	STR	10.00	0.372	21- 3	1596		
Corner (Top)	A1 (AS1)	288	7	L-BAR	5.00	1.440	6- 2	3630	3- 1	3- 1
Corner (Bottom)	A2 (AS1)	288	7	L-BAR	5.00	1.440	6- 2	3630	3- 1	3- 1
Ext wall (int)	B1 (AS4)	288	5	STR	5.00	0.744	9- 6	2854		
Ext wall (ext)	B2 (AS1)	288	7	STR	5.00	1.440	9- 0	5298		
Int wall	B3	288	5	STR	5.00	0.744	10- 3	3079		
Top slab (int- 1)	C100 (AS5)	23	5	STR	10.00	0.372	59-11	1437		
Bot Slab (int- 1)	C200	23	5	STR	10.00	0.372	59-11	1437		
Temperature (1)	C1 (AS6)	26	5	STR	10.00	0.372	59-11	1625		
Temperature (1)	C1 (AS6)	26	5	STR	10.00	0.372	59-11	1625		
Temperature (1)	C1 (AS6)	24	5	STR	10.00	0.372	59-11	1500		
Temperature (1)	C1 (AS6)	24	5	STR	10.00	0.372	59-11	1500		
Temperature (1)	C1 (AS6)	24	5	STR	10.00	0.372	59-11	1375		
Total								44691		

Note: A denotes flexural steel, B denotes vertical steel, C denotes longitudinal steel

AS Bar Marks

Location	As prv in ² /ft
Transverse Side wall - Outside Face (AS1)	1.440
Transverse Top Slab - Inside Face (AS2)	1.440
Transverse Bottom Slab - Inside Face (AS3)	1.440
Transverse Side wall - Inside Face (AS4)	0.744
Distribution Top Slab - Inside Face (AS5)	0.372
Distribution Top Slab - Outside Face (AS6)	0.372
Transverse Top Slab - Outside Face (AS7)	0.372
Transverse Bottom Slab - Outside Face (AS8)	0.372

Notes: 1.) Final areas of steel provided must be checked in analysis mode

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By: Chk: ___
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Culvert p. 1 of 286

Project: Bothell to Swamp Creek
Task : Box Culvert Evaluation
Client : Skanska
Job No.:

CULVERT PROPERTIES

Type of Culvert: Precast Specification : LRFD 9th Edition
Operating Mode : Analysis

Physical Dimensions

No. of Boxes: 2 Name: BoxCulvert
Clear Span : 9.5000 ft
Clear Height: 9.0000 ft Skew Angle : 0.00 deg
Length : 60.0000 ft Bottom Slab Support: Full Slab
Fill Depth Range: Maximum : 6.00 ft Minimum : 4.00 ft Increment : 0.50 ft
Haunches: Top, Length: 24.0000 in Height: 24.0000 in
Bottom, Length: 24.0000 in Height: 24.0000 in
Member Thicknesses: Top Slab: 10.0000 in Bot Slab: 10.0000 in
Ext wall: 10.0000 in Int wall: 12.0000 in
Wall Joint: None

Material Properties

Concrete: Strength, f'c : 5.000 ksi Density : 0.155 kcf Elasticity, Ec: 4903 ksi
Type : Normal weight Density Modification Factor : 1.00
Fr Factor : 0.24 Gamma1 : 1.60 Gamma3 : 1.00 (user defined)
Steel: Yield, fy : 60.00 ksi fss Limit : 0.60fy Elasticity, Es: 29000 ksi
Yield, fyv : 60.00 ksi Diameter : 1.000 in Type : Rebar
Soil: Density : 0.127 kcf Slope Factor: 1.150
Poisson's : 0.5
Fe Factor : 1.000 (User Defined)
Serviceability, Gamma-e: 1.00

Loads

Live Load: Vehicle: (AA) HL-93 - Design Vehicle
Axle No. weight(k) Dist. From Previous(ft)
1 8.00 0.00
2 32.00 14.00
3 32.00 14.00
Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
Include Tandem: yes
Tandem: Axle 1: 25.00 k, Axle 2: 25.00 k, Axle Spacing: 4.00 ft
Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck + Lane Or Tandem + Lane
Inventory Rating Load Factor: 1.75 Operating Rating Load Factor: 1.35
Design Load Combinations: Strength I
Override MPF: no
Override DLA: no
Vehicle: (AB) EV 2 - Permit Vehicle
Axle No. weight(k) Dist. From Previous(ft)
1 24.00 0.00
2 33.50 15.00
Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
Include Tandem: no
Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck Or Tandem Or Lane
Rating Load Factor: 1.3
Design Load Combinations: Strength II
Override MPF: no
Override DLA: no
Vehicle: (AC) EV 3 - Permit Vehicle
Axle No. weight(k) Dist. From Previous(ft)
1 24.00 0.00
2 31.00 15.00
3 31.00 4.00
Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
Include Tandem: no
Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck Or Tandem Or Lane
Rating Load Factor: 1.3
Design Load Combinations: Strength II
Override MPF: no
Override DLA: no
Vehicle: (AD) NRL - Legal Lane - Legal Vehicle
Axle No. weight(k) Dist. From Previous(ft)
1 10.50 0.00
2 10.50 4.00

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3 12.00 16.00
4 9.00 15.00
5 9.00 4.00
6 9.00 15.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in

Include Tandem: no
Lane Load: 0.20 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck + Lane Or Tandem + Lane
Rating Load Factor: 2
Design Load Combinations: Strength I

Override MPF: no
Override DLA: no

Vehicle: (AE) NRL - Legal Vehicle

Axle No.	weight(k)	Dist. From Previous(ft)
1	8.00	0.00
2	8.00	4.00
3	8.00	4.00
4	17.00	4.00
5	17.00	4.00
6	8.00	4.00
7	8.00	4.00
8	6.00	6.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in

Include Tandem: no
Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck + Lane Or Tandem + Lane
Rating Load Factor: 2
Design Load Combinations: Strength I

Override MPF: no
Override DLA: no

Vehicle: (AF) Oveload 1 - Permit Vehicle

Axle No.	weight(k)	Dist. From Previous(ft)
1	21.50	0.00
2	21.50	4.00
3	21.50	12.00
4	21.50	4.00
5	10.00	10.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in

Include Tandem: no
Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck + Lane Or Tandem + Lane
Rating Load Factor: 1.2
Design Load Combinations: Strength II

Override MPF: no
Override DLA: no

Vehicle: (AG) Oveload 2 - Permit Vehicle

Axle No.	weight(k)	Dist. From Previous(ft)
1	22.00	0.00
2	21.50	6.00
3	21.50	4.00
4	22.00	14.00
5	21.50	6.00
6	21.50	4.00
7	22.00	16.00
8	21.50	6.00
9	21.50	4.00
10	12.00	10.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in

Include Tandem: no
Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck + Lane Or Tandem + Lane
Rating Load Factor: 1.2
Design Load Combinations: Strength II

Override MPF: no
Override DLA: no

Vehicle: (AH) Type 3-3 - Legal Vehicle

Axle No.	weight(k)	Dist. From Previous(ft)
1	14.00	0.00
2	14.00	4.00
3	16.00	16.00
4	12.00	15.00
5	12.00	4.00
6	12.00	15.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in

Include Tandem: no
Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck + Lane Or Tandem + Lane
Rating Load Factor: 2
Design Load Combinations: Strength I

Override MPF: no
Override DLA: no

Vehicle: (AI) Type 3 - Legal Vehicle

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Axle No. Weight(k) Dist. From Previous(ft)
1 17.00 0.00
2 17.00 4.00
3 16.00 15.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
Include Tandem: no

Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck + Lane Or Tandem + Lane

Rating Load Factor: 2
Design Load Combinations: Strength I

Override MPF: no
Override DLA: no

Vehicle: (AJ) Type 3S2 - Legal Vehicle

Axle No. Weight(k) Dist. From Previous(ft)
1 15.50 0.00
2 15.50 4.00
3 15.50 22.00
4 15.50 4.00
5 10.00 11.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
Include Tandem: no

Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck + Lane Or Tandem + Lane

Rating Load Factor: 2
Design Load Combinations: Strength I

Override MPF: no
Override DLA: no

Vehicle: (AK) WA-105 - Legal Vehicle

Axle No. Weight(k) Dist. From Previous(ft)
1 14.00 0.00
2 14.00 4.00
3 17.00 10.00
4 17.00 32.00
5 17.00 4.00
6 7.00 4.00
7 7.00 4.00
8 12.50 11.00

Gage width: 6.00 ft, Tread width: 20.00 in, Tread Length: 10.00 in
Include Tandem: no

Lane Load: 0.00 klf, P-Moment: 0.00 k, P-Shear: 0.00 k
Combine: Truck + Lane Or Tandem + Lane

Rating Load Factor: 2
Design Load Combinations: Strength I

Override MPF: no
Override DLA: no

Include Lane Load : yes Max. No. of Lanes: 2
Traffic Direction : Lanes Perpendicular to Main Reinforcement
Neglect Live Load if: Fill > 8 ft and Fill > Clear Span
Apply Surcharge at Fill Depths > 2 ft : yes
Compute Surcharge Depth: yes

Dead Load: Future wearing Surface : 0.00 klf Add. Dead Load : 0.00 klf
Concentrated Loads : none

Lateral Soil Loads: Max. Equiv. Fluid Press.: 60.00 pcf Min. Equiv. Fluid Press. : 30.00 pcf

Include Additional Uniform Horiz. Load: no
Include Additional Uniform Vert. Load: no

Buoyancy Check : no
Fluid Pressures : Apply Water Press. : no
Foundation Model : Uniform Loads
Seismic Analysis : Do not include

Load and Resistance Factors

Max Min
DC: 1.250 0.900
DW: 1.500 0.650
EV: 1.300 0.900
EH: 1.350 0.900
WA: 1.000
EQ: 1.000
LL I : 1.750 LL II : 1.350 LL Legal : 1.750 LL Extreme : 0.500
Ductility: 1.000 Importance: 1.000 Redundancy, non-earth: 1.000 Redundancy, earth: 1.000
Condition: 1.000 System : 1.000
Phi Shear: 0.900 Phi Moment: 1.000 PM Compression: 0.750 PM Tension : 0.900
Load Factor Multipliers, Design Mode: 1.00 Analysis Mode: 1.00

Reinforcement

Reinforcement Covers : Exterior Interior
Top Slab: 2.0000 in 2.0000 in
walls : 2.0000 in 2.0000 in
Bot Slab: 2.0000 in 2.0000 in

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Assigned reinforcement:			
Location	Mark	Size	Spacing (in)
Top Slab Inside	A100 (AS2)	7	5.0000
Bottom Slab Inside	A200 (AS3)	7	5.0000
Top Slab Outside	A300 (AS7)	5	10.0000
Bottom Slab Outside	A400 (AS8)	5	10.0000
Top Corner	A1 (AS1)	7	5.0000
Bottom Corner	A2 (AS1)	7	5.0000
Ext. Wall Inside	B1 (AS4)	5	5.0000
Ext. wall Outside	B2 (AS1)	7	5.0000
Interior wall	B3	5	5.0000
Longitudinal	C1 (AS6)	5	10.0000
Top Distribution	C100 (AS5)	5	10.0000
Bottom Distribution	C200	5	10.0000

Analysis Options

- LL Analysis : Automatically Set Traffic Direction to Account for Skew Effects: no
Limit LL Distribution width to Culvert Length for: None
Combine Longitudinal Axle Distribution Overlaps: No
Combine Transverse Axle Distribution Overlaps: No
Axle Placement Increment for Moving Load Analysis: 20
Include Impact on Bottom Slab: yes
Always distribute wheel Load: yes
Deflection Criteria : 1/800
Approach Slab will be Used: no
- Reinforcement : Always Include Distribution Steel: no
Distribution Slab Provided: no
User Defined Longitudinal Steel: yes
Max. As used in Vc Calcs: 2.00 in²/ft
Distribute Minimum Reinforcement per Face: yes
Use individual Member Thicknesses for Min Steel: no
Epoxy coat steel: no
Use M-dimension for bar length calcs.: no
- Slenderness : Checked K Factor: 2.00
- Analysis Modeling : Use Haunches in the Structural Analysis Model: yes
- Critical Sections : Flexure critical section location: 1.5 member depth
Shear critical section location: dv beyond support
Use Max. Moment with Max. Shear at the Critical Section for Shear: no
Include depth of haunch for critical sections: no
- Flexure : Ignore Axial Thrust: no
Use Eq. 12.10.4.2.4a-1: yes Nu Multiplier: 1.00
- Shear : Always Check Iterative Beta Method
- Environmental : Apply durability factors: no
- Load Combinations : LRFD min/min: no

ANALYSIS RESULTS

Top Slab Thickness = 10.00 in
 Bottom Slab Thickness = 10.00 in
 Exterior Wall Thickness = 10.00 in
 Interior Wall Thickness = 12.00 in

Modular Ratio (N) = 5.91 Max. Steel Ratio = 0.025
 Design Span = 10.42 ft Design Height = 9.83 ft

Volume of Concrete: 2.819 cy/ft weight of Steel: 745 lb/ft

Note: Design and analysis results do not include force effects from stripping and handling stages

M dimension = 2' 5" (method of equivalent capacity)
 = 6' 1" (method of contraflexure - ASTM)

Reinforcing Steel Schedule

Location	Bar Mark	Qty	Size	Type	Spacing (in)	As,prv (in2/ft)	Length (ft-in)	Wgt (lbs)	H Leg (ft-in)	V Leg (ft-in)
Top Slab (int)	A100 (AS2)	144	7	STR	5.00	1.440	21- 3	6255		
Bot Slab (int)	A200 (AS3)	144	7	STR	5.00	1.440	21- 3	6255		
Top Slab (ext)	A300 (AS7)	72	5	STR	10.00	0.372	21- 3	1596		
Bot Slab (ext)	A400 (AS8)	72	5	STR	10.00	0.372	21- 3	1596		
Corner (Top)	A1 (AS1)	288	7	L-BAR	5.00	1.440	6- 2	3630	3- 1	3- 1
Corner (Bottom)	A2 (AS1)	288	7	L-BAR	5.00	1.440	6- 2	3630	3- 1	3- 1
Ext wall (int)	B1 (AS4)	288	5	STR	5.00	0.744	9- 6	2854		
Ext wall (ext)	B2 (AS1)	288	7	STR	5.00	1.440	9- 0	5298		
Int wall	B3	288	5	STR	5.00	0.744	10- 3	3079		
Top Slab (int- 1)	C100 (AS5)	23	5	STR	10.00	0.372	59-11	1437		
Bot Slab (int- 1)	C200	23	5	STR	10.00	0.372	59-11	1437		
Temperature (1)	C1 (AS6)	26	5	STR	10.00	0.372	59-11	1625		
Temperature (1)	C1 (AS6)	26	5	STR	10.00	0.372	59-11	1625		
Temperature (1)	C1 (AS6)	24	5	STR	10.00	0.372	59-11	1500		
Temperature (1)	C1 (AS6)	24	5	STR	10.00	0.372	59-11	1500		
Temperature (1)	C1 (AS6)	24	5	STR	10.00	0.372	59-11	1375		
Total								44691		

Note: A denotes flexural steel, B denotes vertical steel, C denotes longitudinal steel

AS Bar Marks

Location	As prv in2/ft
Transverse Side Wall - Outside Face (AS1)	1.440
Transverse Top Slab - Inside Face (AS2)	1.440
Transverse Bottom Slab - Inside Face (AS3)	1.440
Transverse Side Wall - Inside Face (AS4)	0.744
Distribution Top Slab - Inside Face (AS5)	0.372
Distribution Top Slab - Outside Face (AS6)	0.372
Transverse Top Slab - Outside Face (AS7)	0.372
Transverse Bottom Slab - Outside Face (AS8)	0.372

Notes: 1.) Final areas of steel provided must be checked in analysis mode

Summary of Ratings Table:

Truck	Flexure							Shear				
	ILF	OLF	Fill	Member	Location	IR	OR	Fill	Member	Location	IR	OR
(AA)HL-93	1.75	1.35	4.00	4	RT	1.45	1.88	4.00	4	RT	1.26	1.63
(AB)EV 2	1.30	1.30	4.00	4	RT	2.31	2.31	4.00	2	RT	2.04	2.04
(AC)EV 3	1.30	1.30	4.00	4	RT	2.49	2.49	4.00	2	RT	2.20	2.20
(AD)NRL -	2.00	2.00	4.00	4	RT	3.10	3.10	4.00	4	RT	2.73	2.73
(AE)NRL	2.00	2.00	4.00	4	RT	2.36	2.36	4.00	4	RT	2.08	2.08
(AF)Oveloa	1.20	1.20	4.00	4	RT	3.86	3.86	4.00	2	RT	3.44	3.44
(AG)Oveloa	1.20	1.20	4.00	4	RT	3.78	3.78	4.00	2	RT	3.36	3.36
(AH)Type 3	2.00	2.00	4.00	4	RT	2.51	2.51	4.00	4	RT	2.21	2.21
(AI)Type 3	2.00	2.00	4.00	4	RT	2.36	2.36	4.00	4	RT	2.08	2.08
(AJ)Type 3	2.00	2.00	4.00	4	RT	2.59	2.59	4.00	4	RT	2.28	2.28
(AK)WA-105	2.00	2.00	4.00	4	RT	2.36	2.36	4.00	4	RT	2.08	2.08

Critical Sections Summary: Flexure

Member 1: (Exterior wall), Thickness = 10.00 in
 Design Corr.

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Loc	Dist. (in)	Moment (k-ft)	A. F. (k)	Mu (k-ft)	ds (in)	Ma (k-ft)	phi	As (in2)	Mcr (k-ft)	IR	OR	Truck	Depth (ft)
BOT	24.00	-5.65	10.35	48.35	7.56	51.12	1.00	1.44	14.31	18.53	24.02	AA	4.00
MID	59.00	2.50	3.71	26.97	7.69	28.23	1.00	0.74	14.31	19.94	25.85	AA	4.00
MID-	59.00	-4.32	9.55	48.35	7.56	50.91	1.00	1.44	14.31	15.25	19.77	AA	4.00
TOP	24.00	-7.28	10.35	48.35	7.56	51.12	1.00	1.44	14.31	10.26	13.30	AA	4.00

Member 2: (Top Slab), Thickness = 10.00 in

Loc	Dist. (in)	Moment (k-ft)	A. F. (k)	Mu (k-ft)	ds (in)	Ma (k-ft)	phi	As (in2)	Mcr (k-ft)	IR	OR	Truck	Depth (ft)
LT	24.00	-3.20	5.20	48.35	7.56	49.76	1.00	1.44	14.31	36.28	47.03	AA	6.00
MID	50.00	8.90	0.75	48.35	7.56	48.56	1.00	1.44	14.31	7.72	10.00	AA	4.00
MID-	50.00	0.40	4.86	13.89	7.69	15.72	1.00	0.37	14.31	NC	NC	AA	6.00
RT	25.00	-10.13	1.90	13.66	7.56	14.38	1.00	0.37	14.31	1.72	2.23	AA	4.00

Member 3: (Interior wall), Thickness = 12.00 in

Loc	Dist. (in)	Moment (k-ft)	A. F. (k)	Mu (k-ft)	ds (in)	Ma (k-ft)	phi	As (in2)	Mcr (k-ft)	IR	OR	Truck	Depth (ft)
BOT	23.00	-2.33	23.26	34.41	9.69	43.90	1.00	0.74	20.61	NC	NC	AA	4.50
MID	59.00	3.04	11.48	34.41	9.69	39.20	1.00	0.74	20.61	12.88	16.69	AA	4.00
TOP	23.00	-6.35	24.55	34.41	9.69	44.40	1.00	0.74	20.61	6.99	9.06	AA	4.00

Member 4: (Bottom Slab), Thickness = 10.00 in

Loc	Dist. (in)	Moment (k-ft)	A. F. (k)	Mu (k-ft)	ds (in)	Ma (k-ft)	phi	As (in2)	Mcr (k-ft)	IR	OR	Truck	Depth (ft)
LT	24.00	-3.60	6.96	48.35	7.56	50.23	1.00	1.44	14.31	37.19	48.21	AA	6.00
MID	50.00	8.05	1.82	48.35	7.56	48.85	1.00	1.44	14.31	10.76	13.95	AA	4.00
MID-	50.00	0.55	6.58	13.89	7.69	16.36	1.00	0.37	14.31	NC	NC	AA	6.00
RT	25.00	-12.01	2.96	13.66	7.56	14.78	1.00	0.37	14.31	1.45	1.88	AA	4.00

Critical Sections Summary: Vertical Shear

Member 1: (Exterior wall), Thickness = 10.00 in

Loc	Dist. (in)	Shear (k)	Moment (k-ft)	A. F. (k)	Dv (in)	phi*Vn	Beta	Vc (k)	Vs (k)	Av (in2)	Max. Spac (in)	IR	OR	Truck	Depth (ft)
BOT	12.20	5.42	9.7	9.61	7.20	18.77	3.416	20.85 a	0.00	0.00	0.00	11.34	14.70	AA	6.00
MID	59.00	0.62	2.5	3.71	7.25	23.36	4.223	25.96 a	0.00	0.00	0.00	41.25	53.48	AA	4.00
MID-	59.00	0.66	4.3	9.55	7.20	25.17	4.581	27.97 a	0.00	0.00	0.00	41.98	54.41	AA	4.00
TOP	12.20	-4.38	10.4	9.61	7.20	18.64	3.393	20.71 a	0.00	0.00	0.00	11.26	14.59	AA	6.00

Member 2: (Top Slab), Thickness = 10.00 in

Loc	Dist. (in)	Shear (k)	Moment (k-ft)	A. F. (k)	Dv (in)	phi*Vn	Beta	Vc (k)	Vs (k)	Av (in2)	Max. Spac (in)	IR	OR	Truck	Depth (ft)
LT	12.20	7.98	6.7	4.70	7.56	19.92	3.451	22.13 a	0.00	0.00	0.00	3.51	4.55	AA	4.00
MID	62.50	0.33	7.6	0.75	7.56	20.87	3.616	23.19 a	0.00	0.00	0.00	38.12	49.41	AA	4.00
MID-	62.50	2.72	0.6	4.70	7.69	21.88	3.730	24.32 a	0.00	0.00	0.00	11.39	14.76	AA	4.00
RT	13.20	11.06	19.5	1.90	7.56	12.89	n/a	14.33 c	0.00	0.00	0.00	1.28	1.66	AA	4.00

Member 3: (Interior wall), Thickness = 12.00 in

Loc	Dist. (in)	Shear (k)	Moment (k-ft)	A. F. (k)	Dv (in)	phi*Vn	Beta	Vc (k)	Vs (k)	Av (in2)	Max. Spac (in)	IR	OR	Truck	Depth (ft)
BOT	13.64	1.10	1.2	22.94	9.25	35.60	5.043	39.56 a	0.00	0.00	0.00	32.29	41.86	AA	4.00
MID	59.00	1.10	3.0	11.48	9.25	34.86	4.939	38.74 a	0.00	0.00	0.00	31.63	41.00	AA	4.00
TOP	13.64	1.10	7.2	24.55	9.25	34.97	4.953	38.85 a	0.00	0.00	0.00	31.72	41.12	AA	4.00

Member 4: (Bottom Slab), Thickness = 10.00 in

Loc	Dist. (in)	Shear (k)	Moment (k-ft)	A. F. (k)	Dv (in)	phi*Vn	Beta	Vc (k)	Vs (k)	Av (in2)	Max. Spac (in)	IR	OR	Truck	Depth (ft)
LT	12.20	7.46	7.7	6.96	7.56	19.90	3.448	22.11 a	0.00	0.00	0.00	7.15	9.27	AA	6.00
MID	62.50	0.24	6.6	1.82	7.56	21.78	3.774	24.20 a	0.00	0.00	0.00	60.23	78.08	AA	4.00
MID-	62.50	2.56	0.0	5.89	7.69	23.39	4.042	25.99 a	0.00	0.00	0.00	64.83	84.04	AA	4.00
RT	13.20	11.42	22.3	2.96	7.56	12.84	n/a	14.27 c	0.00	0.00	0.00	1.26	1.63	AA	4.00

Vc Calculation By: a - Iterative Beta, b - Constant Beta, c - Box Culvert, d - Standard/Arema

Culvert Shoring Calculations

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Unfactored Thrusts due to All Loads: (k) (Fill Depth = 4.00 ft)

Member	Pdc	Pev	Pdw	Peh	Pls	Pwa
1	0.79	1.92	0.00	0.69	0.19	0.00
2	-0.18	0.02	0.00	2.22	0.74	0.00
3	2.92	6.74	0.00	-1.37	-0.39	0.00
4	0.18	-0.02	0.00	3.28	0.75	0.00

Analysis Truck, HL-93

HL-93 load
 distribution on box
 culvert

vehicle	Axle No.	weight (k/ft)	Length (ft)	Dist. From Previous (ft)
Truck	1	0.495	6.27	
	2	0.495	6.27	6.00
	3	0.495	6.27	4.00
	4	0.495	6.27	6.00
Tandem	1	0.387	6.27	
	2	0.387	6.27	6.00
	3	0.387	6.27	4.00
	4	0.387	6.27	6.00

Live Load Parameters:

Traffic Direction is Perpendicular to Main Reinforcement
 Distribution width : 6.00 ft
 Impact Factor : 1.17
 Truck MPF : 1.20 Tandem MPF : 1.20
 Lane Load Distribution Width : 15.17 ft
 Lane Load: 0.000 k/ft

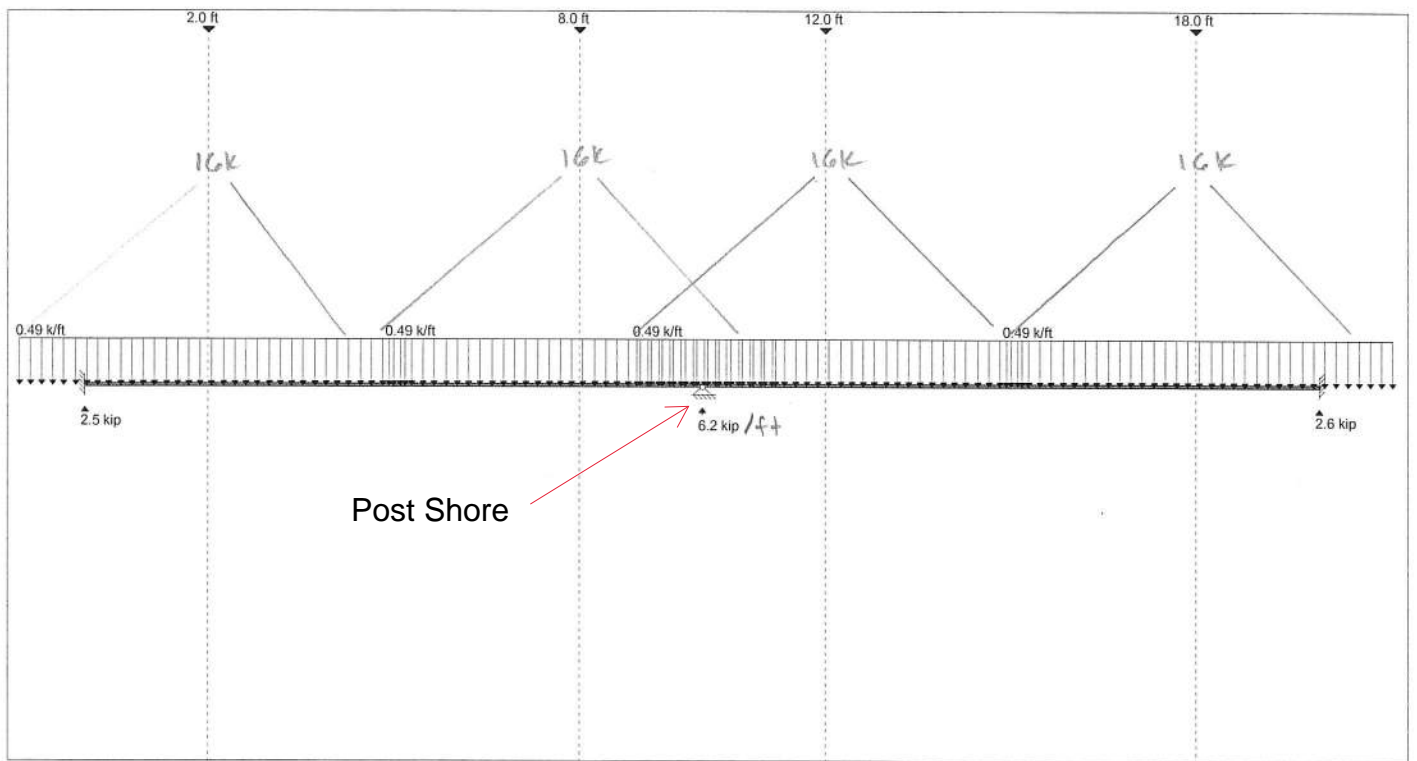
Truck Positions That Cause Maximum Results:

Maximum +Moment in Top Slab					Maximum -Moment in Top Slab				
Vehicle	Axle No.	Weight (klf)	Length (ft)	Dist. From Left End (ft)	Vehicle	Axle No.	Weight (klf)	Length (ft)	Dist. From Left End (ft)
Truck	1	0.495	6.27	11.97	Truck	1	0.495	6.27	14.95
	2	0.495	6.27	5.97		2	0.495	6.27	8.95
	3	0.495	6.27	1.97		3	0.495	6.27	4.95
	4	0.495	6.27	-4.03		4	0.495	6.27	-1.05
Maximum +Moment : 3.37 k-ft					Maximum -Moment : -10.73 k-ft				
Corresponding Moment at End : -3.02 k-ft					Corresponding Moment at Mid : 2.30 k-ft				
Coincident Bottom Slab Load : 0.42 k/ft					Coincident Bottom Slab Load : 0.50 k/ft				
Maximum +Shear in Top Slab					Maximum -Shear in Top Slab				
Truck	1	0.495	6.27	9.13	Truck	1	0.495	6.27	17.28
	2	0.495	6.27	3.13		2	0.495	6.27	11.28
	3	0.495	6.27	-0.87		3	0.495	6.27	7.28
	4	0.495	6.27	-6.87		4	0.495	6.27	1.28
Maximum +Shear : 3.20 k					Maximum -Shear : -4.43 k				
Corresponding Shear at Mid : -0.50 k					Corresponding Shear at Mid : -0.72 k				
Coincident Bottom Slab Load : 0.35 k/ft					Coincident Bottom Slab Load : 0.55 k/ft				
Maximum +Moment in Top Slab					Maximum -Moment in Top Slab				
Tandem	1	0.387	6.27	11.97	Tandem	1	0.387	6.27	14.95
	2	0.387	6.27	5.97		2	0.387	6.27	8.95
	3	0.387	6.27	1.97		3	0.387	6.27	4.95
	4	0.387	6.27	-4.03		4	0.387	6.27	-1.05
Maximum +Moment : 2.64 k-ft					Maximum -Moment : -8.39 k-ft				
Corresponding Moment at End : -2.36 k-ft					Corresponding Moment at Mid : 1.79 k-ft				
Coincident Bottom Slab Load : 0.33 k/ft					Coincident Bottom Slab Load : 0.39 k/ft				
Maximum +Shear in Top Slab					Maximum -Shear in Top Slab				
Tandem	1	0.387	6.27	9.13	Tandem	1	0.387	6.27	17.28
	2	0.387	6.27	3.13		2	0.387	6.27	11.28
	3	0.387	6.27	-0.87		3	0.387	6.27	7.28
	4	0.387	6.27	-6.87		4	0.387	6.27	1.28
Maximum +Shear : 2.50 k					Maximum -Shear : -3.46 k				
Corresponding Shear at Mid : -0.39 k					Corresponding Shear at Mid : -0.56 k				
Coincident Bottom Slab Load : 0.27 k/ft					Coincident Bottom Slab Load : 0.43 k/ft				

Unfactored Moments and Shears due to Truck Loads: (k-ft, k)

M-PT	Truck				Tandem				Lane			
	M11+	M11-	V11+	V11-	M11+	M11-	V11+	V11-	M11+	M11-	V11+	V11-
Member 1: (Exterior wall)												

HL-93 Wheel Load on Box Culvert



Beam Parameters: Length = 20.0 ft, [REDACTED]

Shore capacity = 8.5 kips

Shore max spacing = $8.5/6.2 = 1.37' = 16''$



Project Name: Bothell Culvert
 Calculated By: FM
 Date: 6-2-25

Compression strength of existing concrete should be verified by core testing.

Check Punching Shear at Slab

f'_c	5000	psi	
d	7.69	in	
Load Factor, LF	1.0		Max LF for LL
Load, P	8.5	kips	Load per shore
c_1	5	in	Dimensions of Jack Base Bracket
c_2	5	in	
$b_0 = 2(c_1+d)+2(c_2+d)$	50.75	in	Critical Shear perimeter
ϕ	0.75		
$V_u = P*LF$	9	kips	
$\phi V_c = \phi(4*f'_c^{0.5}*b_0*d)$	83	kips	OK ACI Eq 11-33

Check Shear at Slab

ϕ	0.75		
b	12	in	
d	7.69	in	
f'_c	5000	psi	
$\phi V_c = \phi(2*f'_c^{0.5}*b*d)$	9785	lbs per ft	
$V_u = wl/2$	7215	lbs	OK

Rebars specifications, such as yield stress, should be verified through sample extraction and laboratory testing.

Check Longitudinal Slab Bending Between Shoring Posts

f'_c	5000	psi	
f_y	60000	psi	
b	12	in	
No. Bar	5		
db	0.625	in	
As per bar	0.31	in ² /bar	
Spacing	10	in	
As per width "b"	0.37	in ² /ft	
Slab Thickness, t	10	in	
$d = t - 2" \text{ cover} - 0.5*db$	7.69	in	
$a = A_s*f_y / (0.85*f'_c*b)$	0.44	in	
ϕ	0.9		
$\phi M_n = \phi A_s*f_y*(d-a/2)$	12503	lb-ft /ft	
w (Strength I, factored)	10850	plf	
Span, l	1.33	ft	
$M = wl^2/8$	2399.1	lb-ft	OK

The best possible "support" on your site – Doka floor props



Eurex 30

8.5 kips
(*)

(*) over entire extension range



- Doka floor props always have the same safe working load at any extension eliminating field calculation
- Doka floor props are light weight
- Doka floor props are galvanized – no rust
- Doka floor props come with accessories for both H20 and Alu beams

The numbered holes are a convenient feature that makes for quicker and easier height adjustments.

Eurex 30 floor props						
Type	Article Number	closed	extended	weight	Safe working load	safety factor
Eurex 30 250	586092000	5' - 0"	8' - 2"	33 lbs	8,5 kips (37,8 kN) (**)	3 : 1
Eurex 30 300	586093000	5' - 8"	9' - 10"	37 lbs		3 : 1
Eurex 30 350	586094000	6' - 6"	11' - 5"	45 lbs		3 : 1
Eurex 30 400	586095000	7' - 6"	13' - 1"	55 lbs		3 : 1

(**) according to DOKA TEST REPORT on compressions test for Doka-post-shores EUREX 30 8.5 kips. Nr. 861/01, Date: 27.09.2001 and US-Standards



Osterreichische Doka
Schalungstechnik GmbH
Reichsstrasse 23
A-3350 Amstetten / Austria
Tel. +43 7472 505-0
Fax +43 7472 605 54430
E-Mail: Oest.Doka@doka.com

Northeast Office
Corporate Headquarters:
Conesco Industries, Ltd.
214 Gates Road
Little Ferry, NJ 07642
Tel. 201-641-6500
Fax 201-641-6254

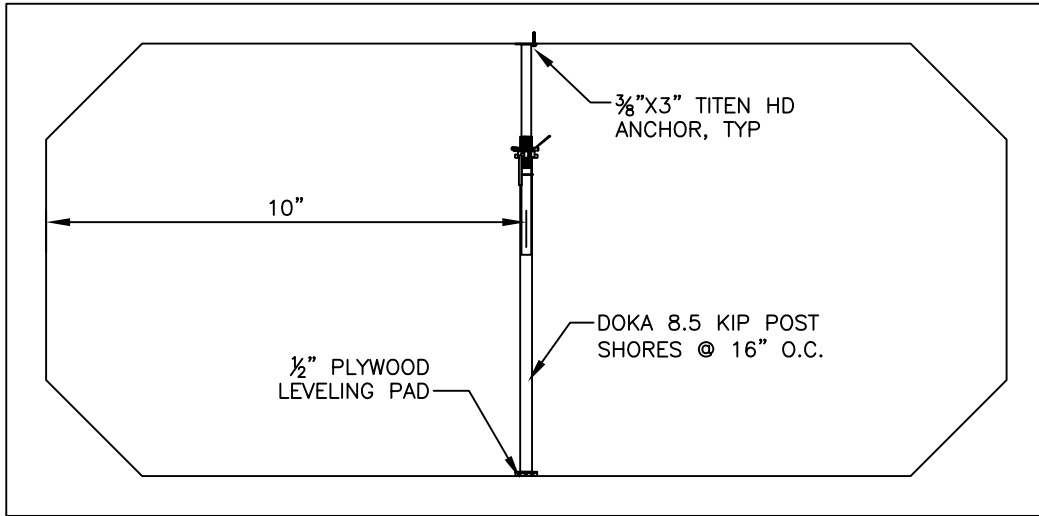
Florida Office
Conesco Industries, Ltd.
838 Midham St.
Banco De Desaro
LLO Economico Bldg
Suite 110-79
San Juan, PR 00929
Tel 787-277-3560
Fax 787-783-9011

Texas Office:
Conesco Industries, Ltd.
1840 Highway Way
Suite 204 & 208
Carrington, TX 75607
Tel 972-446-1662/1663
Fax 972-446-1772

Mid-Atlantic Office:
Conesco Industries, Ltd.
6537 Mid Cities Avenue
Beltsville, MD 20705
Tel 301-295-1900
Fax 301-566-7305

Southeast Office
Conesco Industries, Ltd.
195A Boulderbrook Circle
Lawrenceville, GA 30045
Tel 770-962-7914
Tel 855-615-4700
Fax 770-962-9228

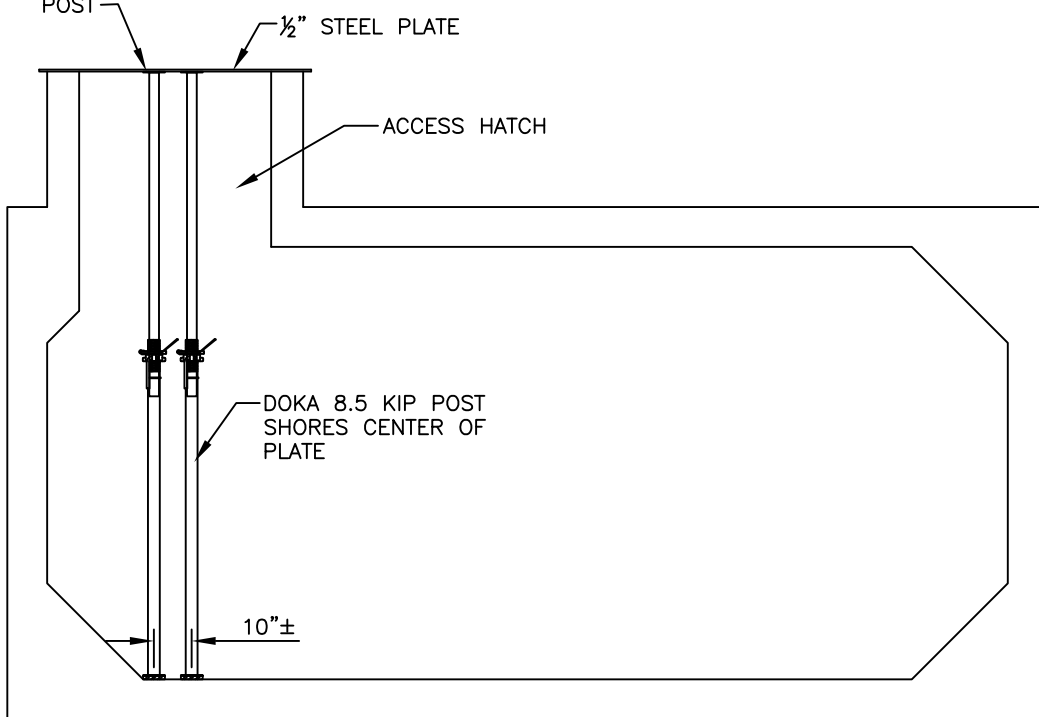
Midwest Office:
Conesco Industries, Ltd.
1032 Mason Avenue
Rockdale, IL 60430
Tel 815-730-8700
Fax 815-730-4770



BOX CULVERT TEMP SHORING

SCALE: 1:4

1EA. $\frac{3}{8}$ "X1" SELF TAPPING BOLT IN PREDRILLED HOLES PER POST



HATCH LID TEMP SHORING

SCALE: 1:4

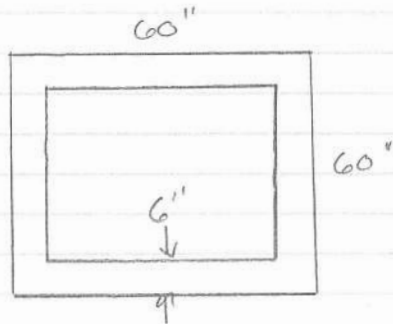


6-3-25

Access Riser Calculations



Concrete Riser



$$\text{Area} = 108 \text{ in}^2$$

Assume min steel = 12 no. 3's

$$\text{Riser Load} = \text{HL-93 wheel load} + \text{Soil DL}$$

$$= 1.75 (16,000) + 1.75 (2 \cdot 127) (5^2) = 35,938 \text{ lbs}$$

$$\text{Compressive stress} = \frac{35938 \text{ lbs}}{108 \text{ in}^2} = 333 \text{ psi}$$



Check Concrete Risers as Concrete Columns

Dead Load	6.35	kips	
Live Load	16.0	kips	
Design Load (Vertical)	36	kips	1.25 DL + 1.75LL

Lateral Load	0	kips	
Divided over 4 supports (Lateral)	0	kips	

f'c	3.5	ksi	
fy	60	ksi	
ρ _{trial}	0.03		
Ag _{trial}	17.0	sq in	
	4.1	in	

Check w/ #3 bars

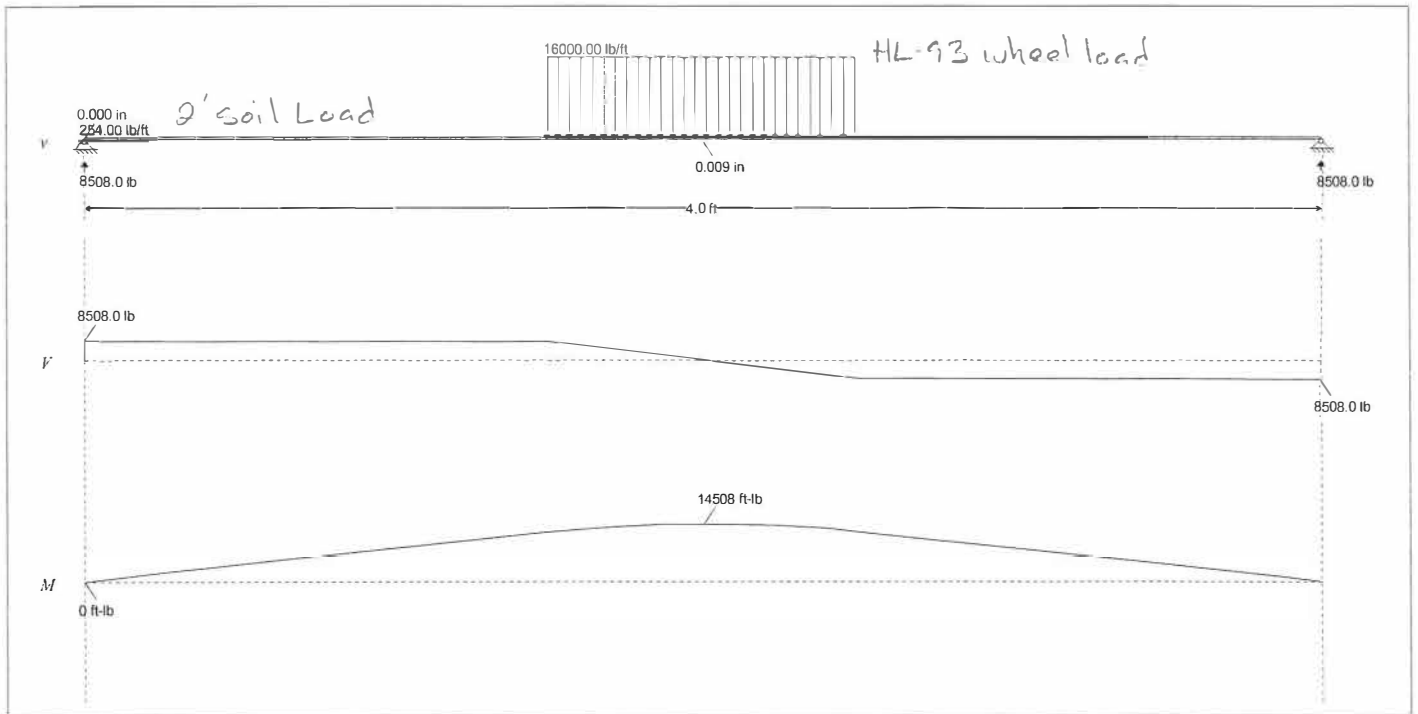
Bar Number	3		
Number of Bars	12		
db	0.375	in	
As per bar	0.11	sq in	
Ast (total)	1.32	sq in	
Length	60	in	
Width	60	in	
Int width	48	in	
Ag	108	sq in	
ρ = Ast/Ag	0.012		Per ACI 10.9, Must be between 0.01 to 0.08
φ	0.7		
φ*Pn = 0.8*φ*[0.85*f'c*(Ag-Ast)+fy*Ast]	222	kips	OK ACI-318 Eq. 10-2
Rating Factor RF	7.6		AASHTO eqn 13.1.1A-1

Check Slenderness Effects

Effective length factor, k	2		
Unsupported length, lu	4.5	ft	
Radius of gyration, r	76.8	in	Per ACI 10.10.1.2, equal to 0.3x dimension
Check k*lu/r < 22	1.41		OK ACI-318 Eq. 10-6

Check Concrete for Shear

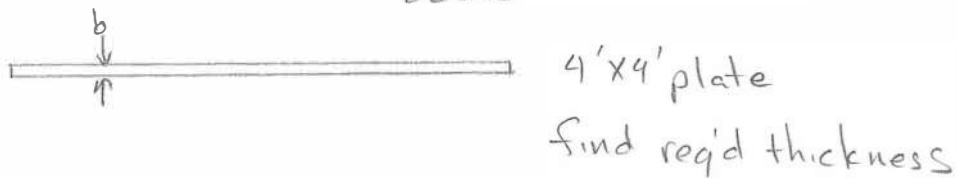
φ	0.75		
b	60	in	
d	57.81	in	
f'c	3500	psi	
φVc = φ[2*(1+N _u /2000Ag)*f'c ^{0.5} *b*d]	309	kips	OK ACI-318 Eq. 11-4



Beam Parameters: Length = 4.0 ft, E = 29000.0 ksi, I = 140.0 in⁴, A = 6.0 in²

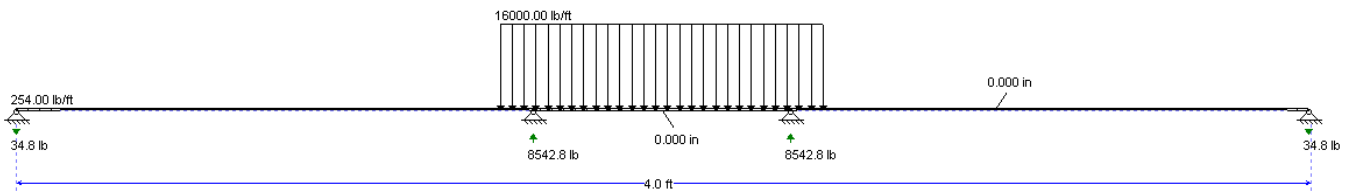
A36 plate $F_y = 36 \text{ ksi}$, $f_y = 22 \text{ ksi}$ (ASD)

$$f_b = \frac{m}{S} \quad S_{min} = \frac{m}{f_b} = \frac{14508}{22000} \cdot 12 = 7.91 \text{ in}^3$$



$$S = \frac{bh^2}{6} \quad h = \frac{7.91(6)}{48''} = .99'' \Rightarrow 1'' \text{ plate req'd}$$

Note: steel plates as-built are 1/2" thick. 2ea. 8.5 kip shoring posts will be implemented rather than replacing 1/2" plates with 1" plates.



APPENDIX

Inspection

Agency: Washington State

Program Mgr: Sonia L. Lowry

CD Status: Work

Release Date:

Structure No. V001

SID XG180500

Structure Name Drainage vault

Carrying

Route On

Mile Post

Intersecting

Route Under

Mile Post

2/9/2028

Genlher

3/18/2028

Inspector's Signature JLL

Cert # G1805

Cert Exp Date

Co-Inspector's Signature

Current Inspections Performed

Report Type	Subtype	Rsk Mthd	Begin Date	Comp Date	Interval	Due Date	Hours	Inspector	Cert No	Co-Insp
Initial		1	3/13/2025	3/13/2025			1.0	JLL	G1805	
Routine Bridge		1	3/13/2025	3/13/2025			1.0	JLL	G1805	

Component Condition Ratings

Appraisal

Miscellaneous Fields

G	Overall Condition Classification (BC12)			Scour Critical (NBI Disc) (1680)	1996	Year Built (BW01)	
N	FHWA Deck Overall (BC01)	N		Scour Vulnerability (BAP03)		Asphalt Depth (WIE30)	
N	WSDOT Deck Overall (WC01)	X		Scour Plan of Action (BAP04)	0.00	Design Curb Height (WIE31)	
N	Bridge Railings (BC05)			Waterway (NBI Disc) (1662)	0.00	Bridge Rail Height (WIE32)	
N	Bridge Railing Transitions (BC06)	N		Overtopping Likelihood (BAP02)	1	Number of Utilities (WIE33)	
N	Bridge Joints (BC08)			Appr Roadway Align (BAP01)	Y	Subject to NBIS (WIE34)	
N	Superstructure Overall (BC02)			Fatigue Details (BIR02)	03/17/2025	Inspn QA Date (BIE09)	
N	NSTM Inspection (BC14)			Seismic Vulnerability (BAP05)			
N	Bridge Bearings (BC07)	Optional Condition Ratings					Inspection Flags
N	Substructure Overall (BC03)	6		Drain Condition (LP01)		Soundings (WIE20)	
N	UW Inspection (BC15)	9		Retaining Wall Condition (LP02)		Clearance (WIE21)	
8	Culvert Overall (BC04)				P	Revise Rating (WIE22)	
N	Scour Condition (BC11)				Y	PhotosFlag (WIE23)	
N	Channel Condition (BC09)				Y	Roadside Hardware Flag (WIE25)	
N	Channel Protection (BC10)				Y	QA Flag (WIE24)	
	Chan/Prot (NBI Disc) (1677)						
	Pier/Abut/Prot (NBI Disc) (1679)						

BMS Elements

Element	Element Description	Total	Units	CS 1	CS 2	CS 3	CS 4
Culvert Elements							
241	Concrete Culvert	285	LF	285	0	0	0

Notes

Culvert Notes

241 This is a drainage detention vault running along the median area of I-405 near Exist 26, north of 228th St. SE., Bothell, WA . The actual length of culvert is approximately 285 feet, and the vault interior width and height are approximately 20 x 9 feet . The inspection was performed by entering the vault through one of the hatches at night around 11:30 pm on March 12, with one lane I-405 closure. The ground above the vault was not inspected due to the night condition. At the hatch opening, the ground is about 4 feet above the vault. The vault bottom has standing water due to rain on the inspection day. The vault is an active drainage structure with three cells, an inlet chamber, a settling chamber, and an outlet chamber connecting to outfall. the structure condition is good, with typical longitudinal hairline cracks at each expansion joint. The expansion joint spaces at 10 feet, all expansion joints and hatches leak significantly.

Agency: Washington State

Program Mgr: Sonia L. Lowry

CD Status: Work

Release Date:

Structure No. V001 **SID** XG180500 **Structure Name** Drainge vault
Carrying **Route On** **Mile Post**
Intersecting **Route Under** **Mile Post**

Repairs						
Repair No	Pr	R	Repair Descriptions	BMS	Noted	Verified
			(No repairs for this structure)			

All Inspections and Resources Required

Report Type	Subtype	Rsk Mthd	Begin Date	Comp Date	Interval	Due Date	Hours	Inspector	Cert No	Co-Insp
Initial		N	3/13/2025	3/13/2025			1.0	JJL	G1805	
Inspection Note Mid night underground inspection, rainy			Late Inspection Explanation			Late PM Resp Date	Late PM Approval	Insp QC Date	Inspn Data Update Date	

Report Type	Subtype	Rsk Mthd	Begin Date	Comp Date	Interval	Due Date	Hours	Inspector	Cert No	Co-Insp
Routine Bridge		N	3/13/2025	3/13/2025			1.0	JJL	G1805	
Inspection Note Mid night underground inspection, rainy			Late Inspection Explanation			Late PM Resp Date	Late PM Approval	Insp QC Date	Inspn Data Update Date	













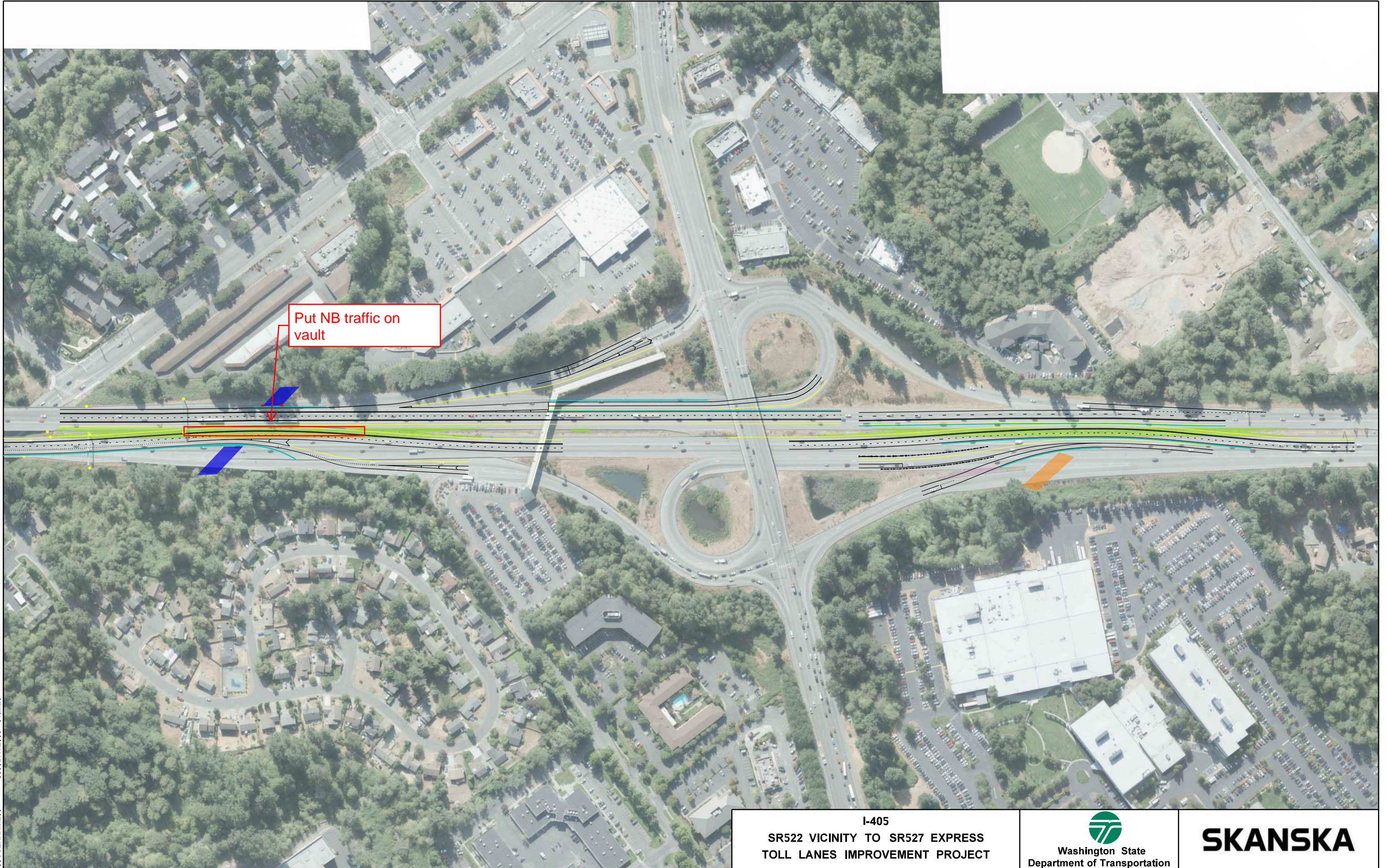




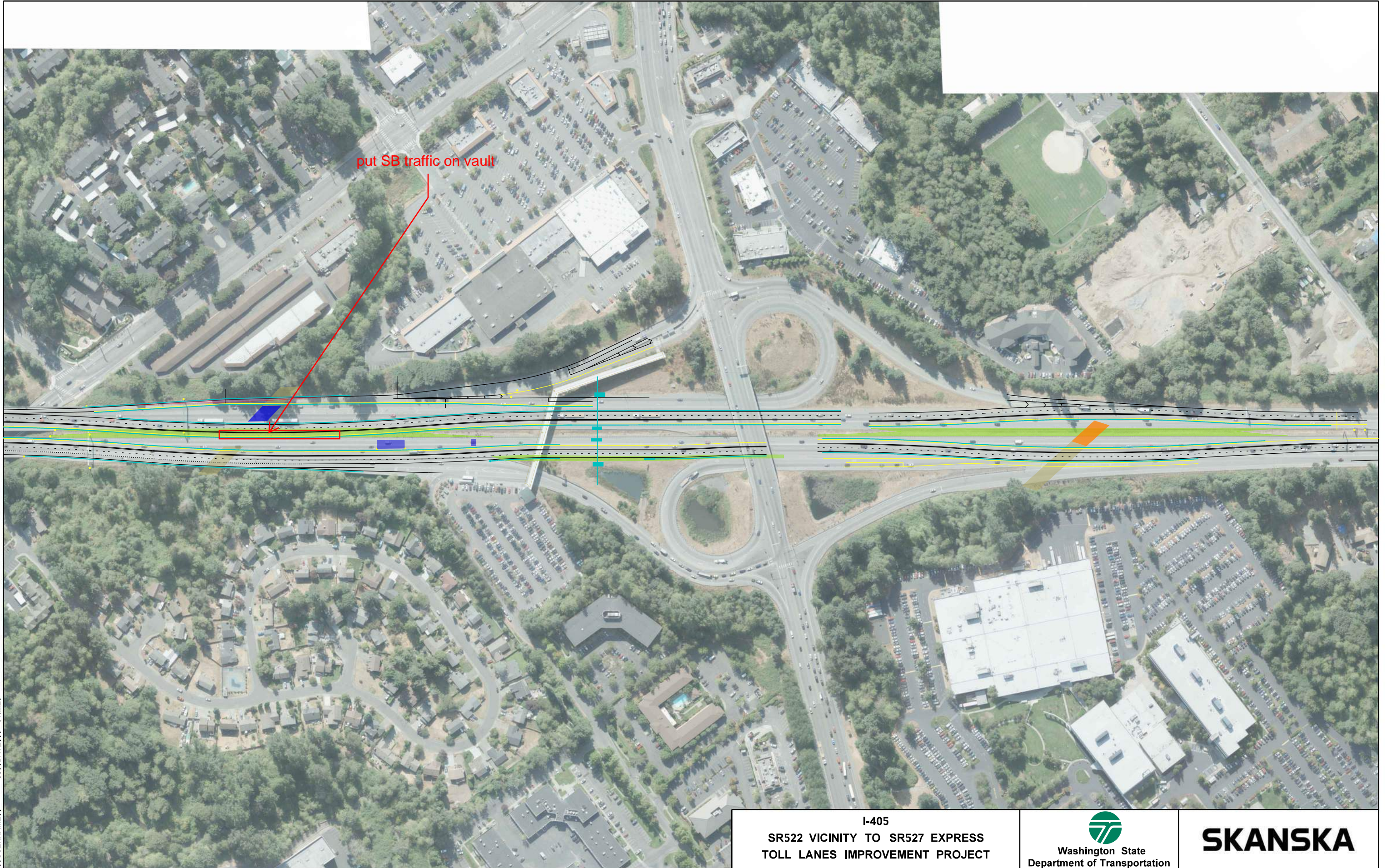




Plans



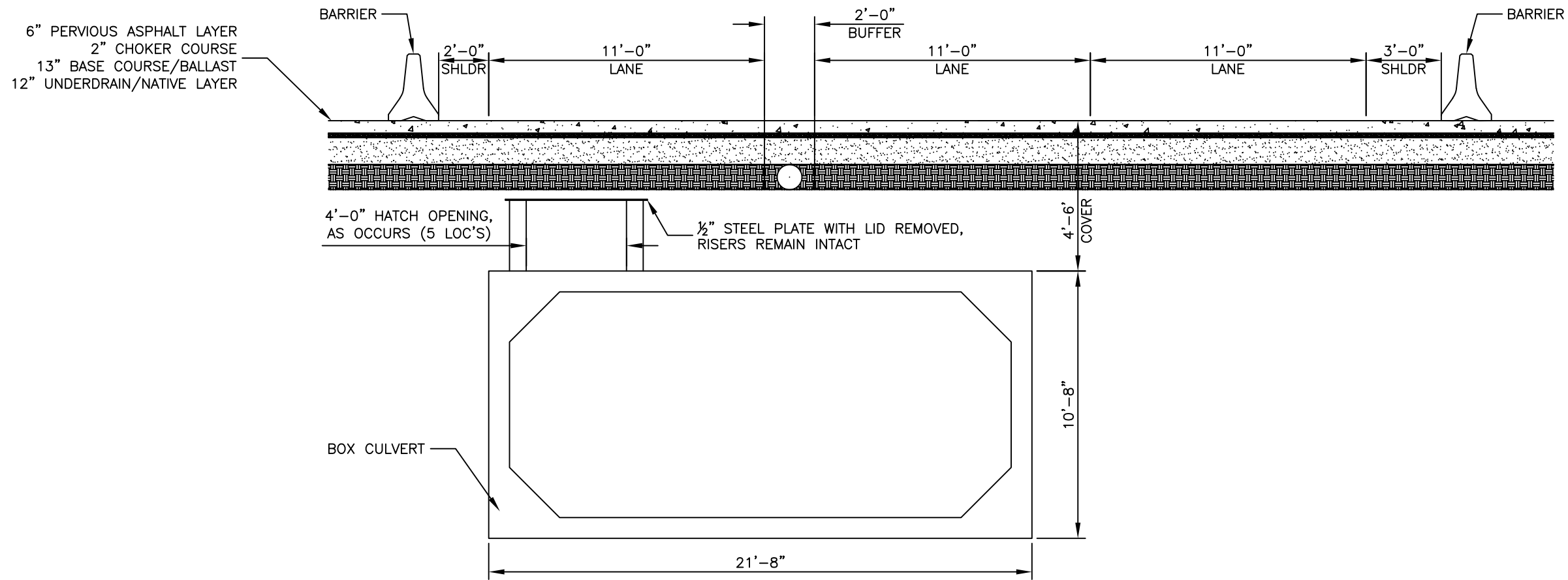
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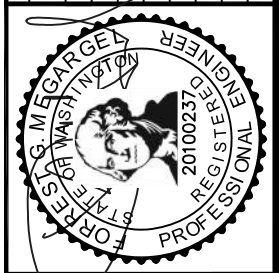
I-405
SR522 VICINITY TO SR527 EXPRESS
TOLL LANES IMPROVEMENT PROJECT





TYP SECTION THROUGH VAULT NW-12
SCALE: 1:5

REVISIONS	
DATE	DESCRIPTION
0	5-16-25 ISSUED FOR CONSTRUCTION
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-



PLANS PREPARED BY
4M ENGINEERING
CIVIL - STRUCTURAL

6675 PURPLE POPPY LN., PARK CITY, UT 84098
801-380-0562
WWW.4MENGINEERS.COM

DESIGNED BY: JESSICA MERRELL

PLANS PREPARED FOR:
SKANSKA USA CIVIL
18911 NORTH CREEK PKWY, STE 300

PROJECT INFORMATION			
PROJECT TITLE: I-405 BRICKYARD TO SR527			
OWNER: WASH DOT	ROUTE	POST MILE	
DIST COUNTY	ROUTE	POST MILE	
- SNOHOMISH	405	-	
CONTRACT NO.: 9727			

SHEET NAME: TYP SECTION @ VAULT NW-12	
STR NAME: VAULT NW-12	
SHEET 1	STR NO.: VAULT NW-12
OF 1	FILE: Bothell culvert section.dwg

Field Investigations



Re: Box Culvert Findings

From Lucarelli, Zachary <Zachary.Lucarelli@skanska.com>

Date Tue 4/15/2025 2:50 PM

To Forrest Megargel <forrestm@4mengineers.com>

Cc Jessica Merrell <jessicam@4mengineers.com>

Forrest,

Our superintendent verified the following today:

"The wall portion is #5 bar 5" OC vertical and #5 bar 10" OC horizontal. The lid portion looks to be #7 bar transverse at 5" OC, and #5 bar longitudinal at 10" OC."

Thanks!

Zach

From: Lucarelli, Zachary

Sent: Monday, April 14, 2025 1:47 PM

To: Forrest Megargel

Cc: Jessica Merrell

Subject: Re: Box Culvert Findings

Forrest,

Some photos attached.

Thanks,

Zach

From: Forrest Megargel <forrestm@4mengineers.com>

Sent: Wednesday, April 2, 2025 6:24 AM

To: Lucarelli, Zachary <Zachary.Lucarelli@skanska.com>

Cc: Jessica Merrell <jessicam@4mengineers.com>

Subject: Box Culvert Findings



Re: Box Culvert

From Lucarelli, Zachary <Zachary.Lucarelli@skanska.com>
Date Thu 4/24/2025 9:49 AM
To Forrest Megargel <forrestm@4mengineers.com>
Cc Jessica Merrell <jessicam@4mengineers.com>

Forrest,

The exterior mat of the walls is #7 verticals at 5" OC, and #5 horizontals at 10" OC.

Thanks,

Zach

From: Forrest Megargel <forrestm@4mengineers.com>
Sent: Thursday, April 17, 2025 7:49 AM
To: Lucarelli, Zachary <Zachary.Lucarelli@skanska.com>
Cc: Jessica Merrell <jessicam@4mengineers.com>
Subject: Box Culvert

Zach,

Based on as-built the bar information we recommend adding shoring to the box culvert, unless the exterior bars in the walls can be verified as #7's or larger. I don't know how practical getting that information would be.

Forrest Megargel, P.E.



6675 Purple Poppy Ln
Park City, Utah, 84098
801-380-0562

Ceiling Rebar







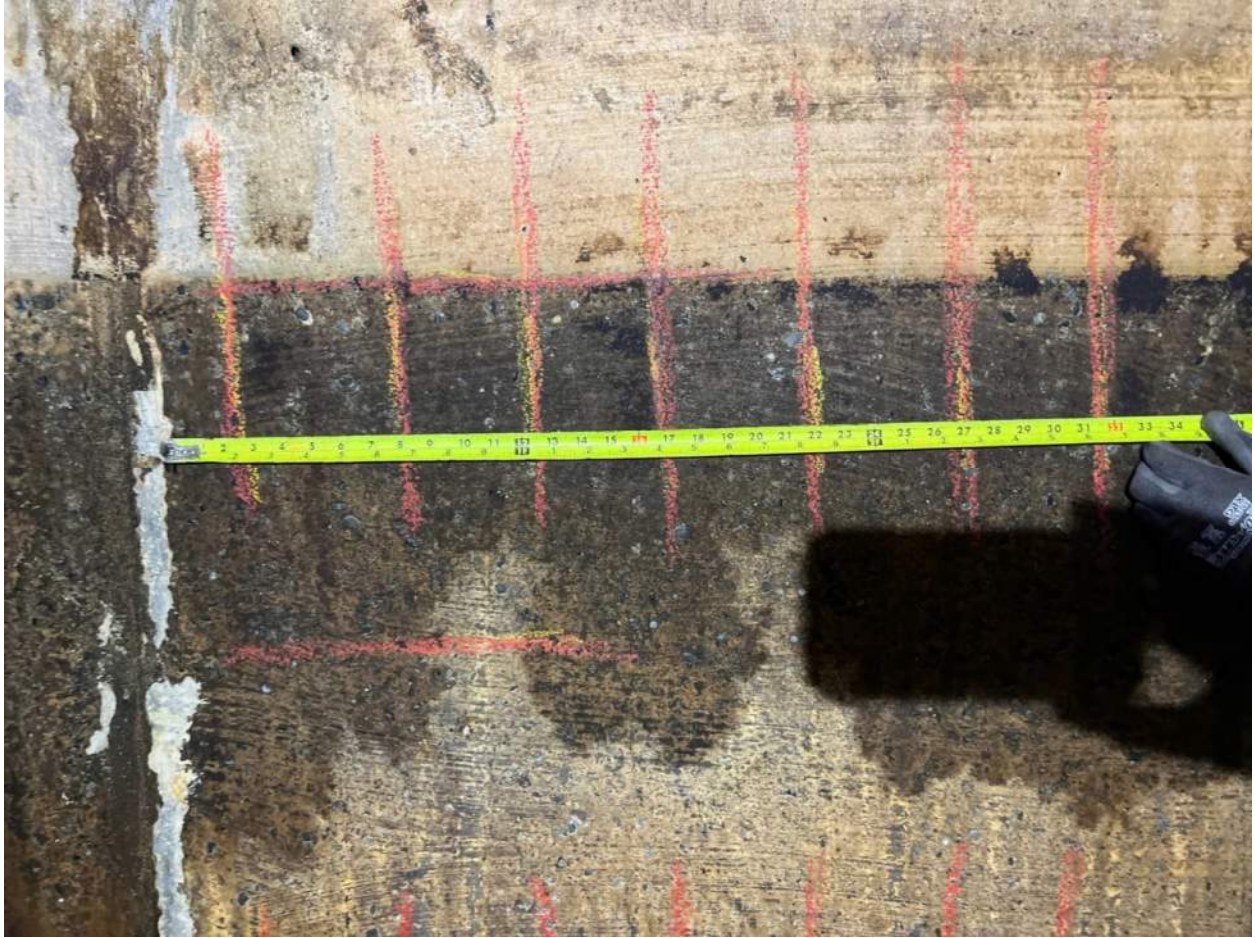


Wall Rebar

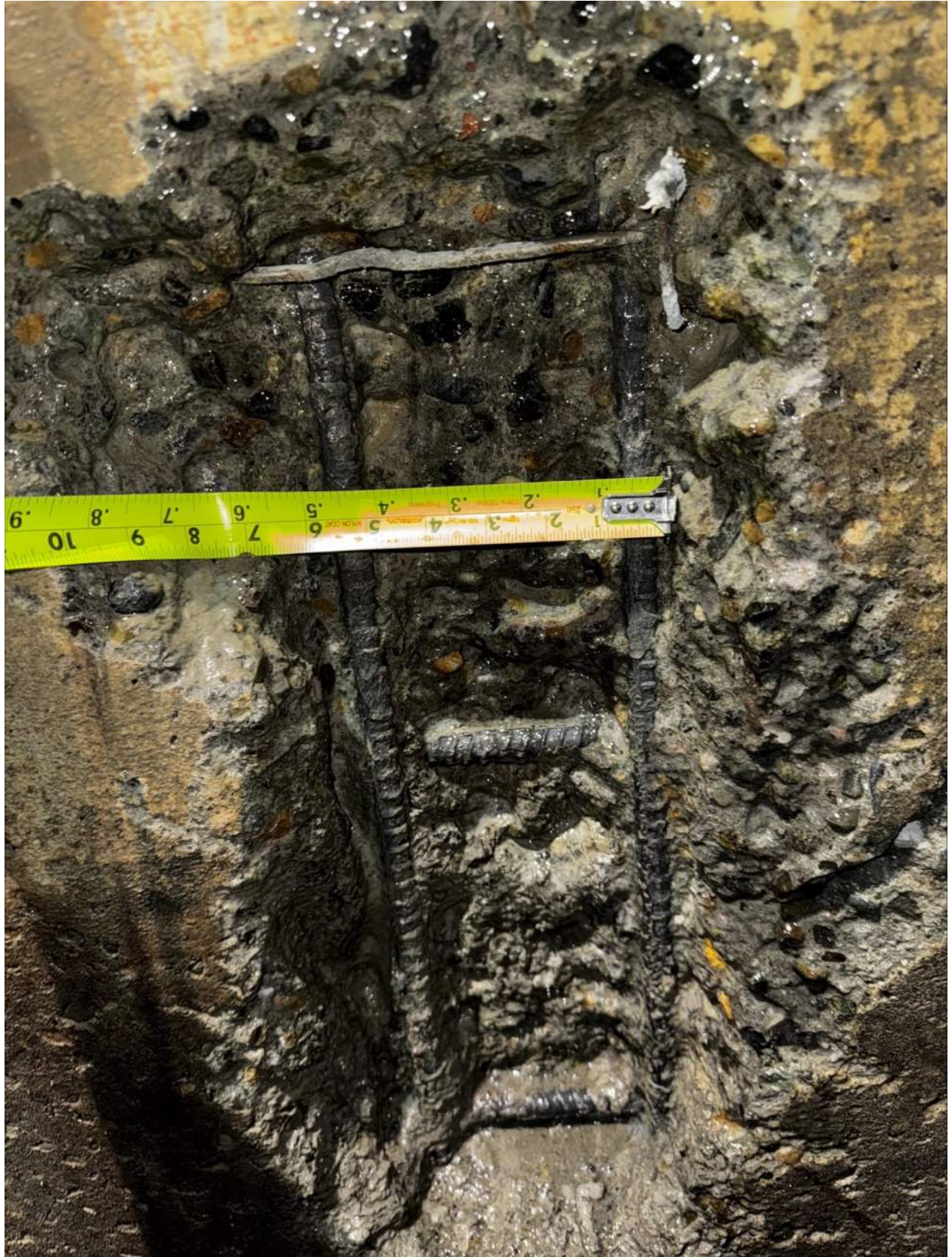












Sample Plans

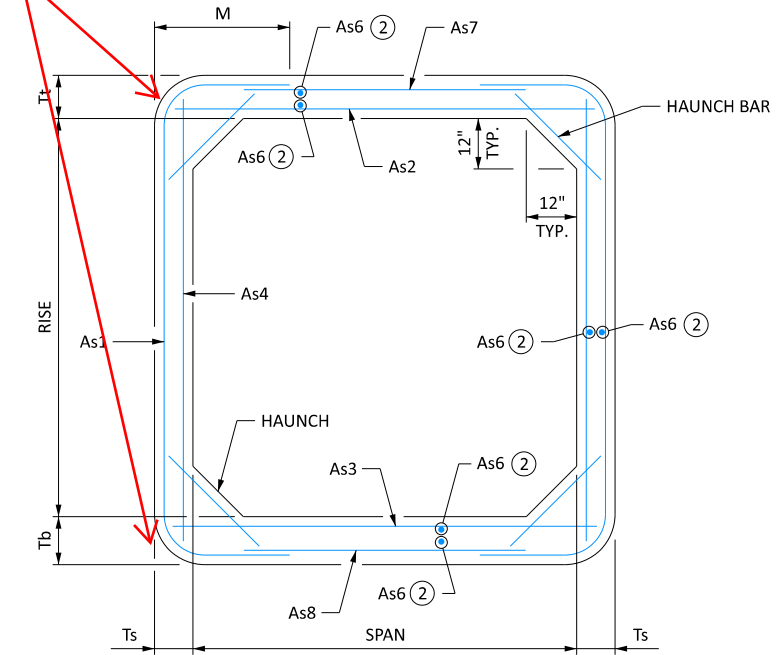
As3 exceeds As2

As7 and As8 bars exceed longitudinal bars

Corner bars match exterior wall rebar (one bar used)

Note: all longitudinal bars are equivalent

SIZE	CLASS	f'c (psi)	FILL HEIGHT RANGE (ft.)	Tt (in.)	Tb (in.)	Ts (in.)	WEIGHT (lbs./ft.)	REINFORCEMENT REQUIREMENTS ①										
								As1			As2		As3		As4		As7/As8	
								As	LENGTH	M	As	LENGTH	As	LENGTH	As	LENGTH	As	LENGTH
16x4	1	5000	<3	10	11	9	5800	1.33	16'-11"	5'-10"	0.87	16'-6"	0.81	16'-6"	0.22	4'-6"	0.27	10'-5"
	2	5000	3 - 6	10	11	9	5800	1.24	15'-7"	5'-2"	0.83	16'-6"	0.81	16'-6"	0.22	4'-6"	0.27	11'-5"
	3	5000	6 - 10	10	11	10	5950	1.48	17'-4"	6'-1"	1.01	16'-6"	1.00	16'-6"	0.24	4'-6"	0.27	10'-5"
	4	6000	10 - 16	12	12	11	6750	1.85	16'-8"	5'-7"	1.30	16'-6"	1.32	16'-6"	0.27	4'-6"	0.29	11'-1"
16x5	1	5000	<3	10	11	9	6025	1.23	17'-7"	5'-8"	0.95	16'-6"	0.90	16'-6"	0.22	5'-6"	0.27	10'-5"
	2	5000	3 - 6	10	11	9	6025	1.14	16'-3"	5'-0"	0.91	16'-6"	0.90	16'-6"	0.22	5'-6"	0.27	11'-5"
	3	5000	6 - 10	10	11	10	6200	1.36	17'-4"	5'-7"	1.09	16'-6"	1.11	16'-6"	0.24	5'-6"	0.27	11'-3"
16x6	1	5000	<3	10	11	9	6250	1.15	17'-3"	5'-0"	1.01	16'-6"	0.98	16'-6"	0.22	6'-6"	0.27	11'-5"
	2	5000	3 - 6	10	11	9	6250	1.06	17'-0"	4'-11"	0.98	16'-6"	0.98	16'-6"	0.22	6'-6"	0.27	11'-5"
	3	5000	6 - 10	10	11	9	6250	1.38	18'-1"	5'-5"	1.27	16'-6"	1.32	16'-6"	0.22	6'-6"	0.27	11'-5"
	4	6000	10 - 16	12	12	10	7100	1.69	16'-10"	4'-8"	1.66	16'-6"	1.69	16'-6"	0.24	6'-6"	0.29	12'-9"
16x7	1	5000	<3	10	11	8	6250	1.13	16'-10"	4'-4"	1.17	16'-6"	1.16	16'-6"	0.20	7'-6"	0.27	12'-9"
	2	5000	3 - 6	10	11	8	6250	1.05	16'-6"	4'-2"	1.14	16'-6"	1.16	16'-6"	0.20	7'-6"	0.27	12'-10"
	3	5000	6 - 10	10	11	9	6475	1.29	17'-5"	4'-7"	1.34	16'-6"	1.41	16'-6"	0.22	7'-6"	0.27	12'-10"
	4	6000	10 - 16	12	12	10	7350	1.57	17'-10"	4'-8"	1.76	16'-6"	1.80	16'-6"	0.24	7'-6"	0.29	12'-9"
16x8	1	5000	<3	10	11	8	6450	1.05	17'-6"	4'-2"	1.23	16'-6"	1.23	16'-6"	0.20	8'-6"	0.27	12'-9"
	2	5000	3 - 6	10	11	8	6450	0.97	17'-2"	4'-0"	1.20	16'-6"	1.23	16'-6"	0.20	8'-6"	0.27	12'-9"
	3	5000	6 - 10	10	11	9	6700	1.20	18'-2"	4'-6"	1.41	16'-6"	1.50	16'-6"	0.22	8'-6"	0.27	12'-10"
	4	6000	10 - 16	12	12	10	7600	1.47	18'-10"	4'-8"	1.84	16'-6"	1.89	16'-6"	0.24	8'-6"	0.29	12'-9"
16x9	1	5000	<3	10	11	8	6650	0.98	18'-4"	4'-1"	1.29	16'-6"	1.28	16'-6"	0.20	9'-6"	0.27	12'-9"
	2	5000	3 - 6	10	11	8	6650	0.90	17'-11"	3'-10"	1.24	16'-6"	1.28	16'-6"	0.20	9'-6"	0.27	12'-9"
	3	5000	6 - 10	10	11	9	6925	1.13	18'-11"	4'-4"	1.53	16'-6"	1.57	16'-6"	0.22	9'-6"	0.27	12'-9"
	4	6000	10 - 16	12	12	10	7850	1.36	19'-8"	4'-7"	1.90	16'-6"	1.97	16'-6"	0.24	9'-6"	0.29	12'-9"
16x10	1	5000	<3	10	11	8	6850	0.93	19'-1"	3'-11"	1.34	16'-6"	1.34	16'-6"	0.20	10'-6"	0.27	12'-9"
	2	5000	3 - 6	10	11	8	6850	0.84	18'-9"	3'-9"	1.29	16'-6"	1.34	16'-6"	0.20	10'-6"	0.27	12'-9"
	3	5000	6 - 10	10	11	9	7150	1.07	19'-8"	4'-3"	1.58	16'-6"	1.64	16'-6"	0.22	10'-6"	0.27	12'-10"
	4	6000	10 - 16	12	12	10	8100	1.29	20'-6"	4'-6"	1.96	16'-6"	2.06	16'-6"	0.24	10'-6"	0.29	12'-9"
16x11	1	5000	<3	10	11	8	7050	0.91	20'-0"	3'-11"	1.39	16'-6"	1.39	16'-6"	0.20	11'-6"	0.27	12'-9"
	2	5000	3 - 6	10	11	8	7050	0.83	19'-8"	3'-9"	1.33	16'-6"	1.39	16'-6"	0.20	11'-6"	0.27	12'-9"
	3	5000	6 - 10	10	11	9	7375	1.02	20'-6"	4'-2"	1.63	16'-6"	1.70	16'-6"	0.22	11'-6"	0.27	12'-9"
	4	6000	10 - 16	12	12	10	8350	1.23	21'-3"	4'-5"	2.03	16'-6"	2.12	16'-6"	0.24	11'-6"	0.29	12'-9"
16x12	1	5000	<3	10	11	8	7250	0.90	21'-1"	3'-11"	1.43	16'-6"	1.44	16'-6"	0.24	12'-6"	0.27	12'-7"
	2	5000	3 - 6	10	11	8	7250	0.83	20'-9"	3'-9"	1.37	16'-6"	1.44	16'-6"	0.24	12'-6"	0.27	12'-9"
	3	5000	6 - 10	10	11	9	7600	0.99	22'-7"	4'-8"	1.67	16'-6"	1.75	16'-6"	0.24	12'-6"	0.27	11'-7"
	4	6000	10 - 16	12	12	11	8950	1.20	22'-2"	4'-4"	1.92	16'-6"	2.02	16'-6"	0.24	12'-6"	0.29	12'-11"



GENERAL NOTES

SEE STANDARD FIG. 5-395.100(A) FOR BASIS OF DESIGN. FILL HEIGHT IS DEFINED AS THE DISTANCE FROM THE TOP OF THE CULVERT TO THE TOP OF THE PAVEMENT OR TO TOP OF FILL IF THERE IS NO PAVEMENT.

DESIGNS FOR FILL HEIGHTS GREATER THAN SHOWN IN THE TABLES ARE AVAILABLE FROM THE MnDOT BRIDGE OFFICE.

SEE STANDARD FIG. 5-395.101(A) AND FIG. 5-397.101(B) FOR ADDITIONAL INFORMATION. TRANSVERSE REINFORCEMENT IS PARALLEL TO THE CULVERT SPAN. LONGITUDINAL REINFORCEMENT IS PERPENDICULAR TO THE CULVERT SPAN.

IF THE FILL HEIGHT RANGE EXTENDS INTO MORE THAN ONE CLASS, USE THE CLASS WITH THE LARGEST REINFORCEMENT AREAS. CHECK MAXIMUM AND MINIMUM FILL HEIGHTS OVER THE FULL AREA OF ROADWAY AND SHOULDERS.

ROADWAY OR SHOULDER FILL HEIGHTS OF LESS THAN 2'-0" REQUIRE A DISTRIBUTION SLAB. EXTEND THE WIDTH OF THE DISTRIBUTION SLAB TO THE OUTSIDE EDGES OF THE ROADWAY SHOULDERS UNLESS DIRECTED BY THE ENGINEER.

USE CONCRETE MIX 3552 FOR THE DISTRIBUTION SLAB.

PLACE 6" THICK CAST-IN-PLACE DISTRIBUTION SLAB WITH NO. 5 BARS AT 1'-0" TRANSVERSELY AND NO. 5 BARS AT 1'-0" LONGITUDINALLY. EPOXY COAT ALL DISTRIBUTION SLAB REINFORCEMENT. CENTER DISTRIBUTION SLAB JOINTS OVER BARREL SEGMENTS. PROVIDE 3" MINIMUM GRANULAR MATERIAL IN ACCORDANCE WITH SPEC. 3149.2B BETWEEN BARREL AND DISTRIBUTION SLAB.

PRECAST DISTRIBUTION SLABS WITH THE SAME REINFORCEMENT MAY BE USED FOR FILL HEIGHTS OVER 1'-0". CENTER DISTRIBUTION SLAB JOINTS OVER BARREL SEGMENTS. PROVIDE 6" MIN GRANULAR MATERIAL IN ACCORDANCE WITH SPEC. 3149.2B BETWEEN BARREL AND DISTRIBUTION SLAB.

REDESIGN DISTRIBUTION SLAB PER THE MnDOT PAVEMENT DESIGN MANUAL IF IT IS USED AS PAVEMENT SURFACE.

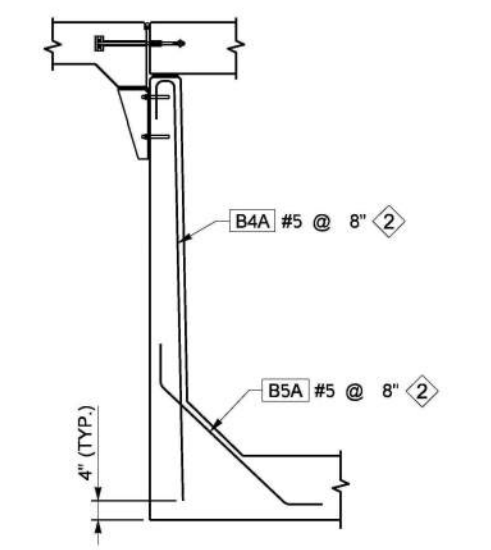
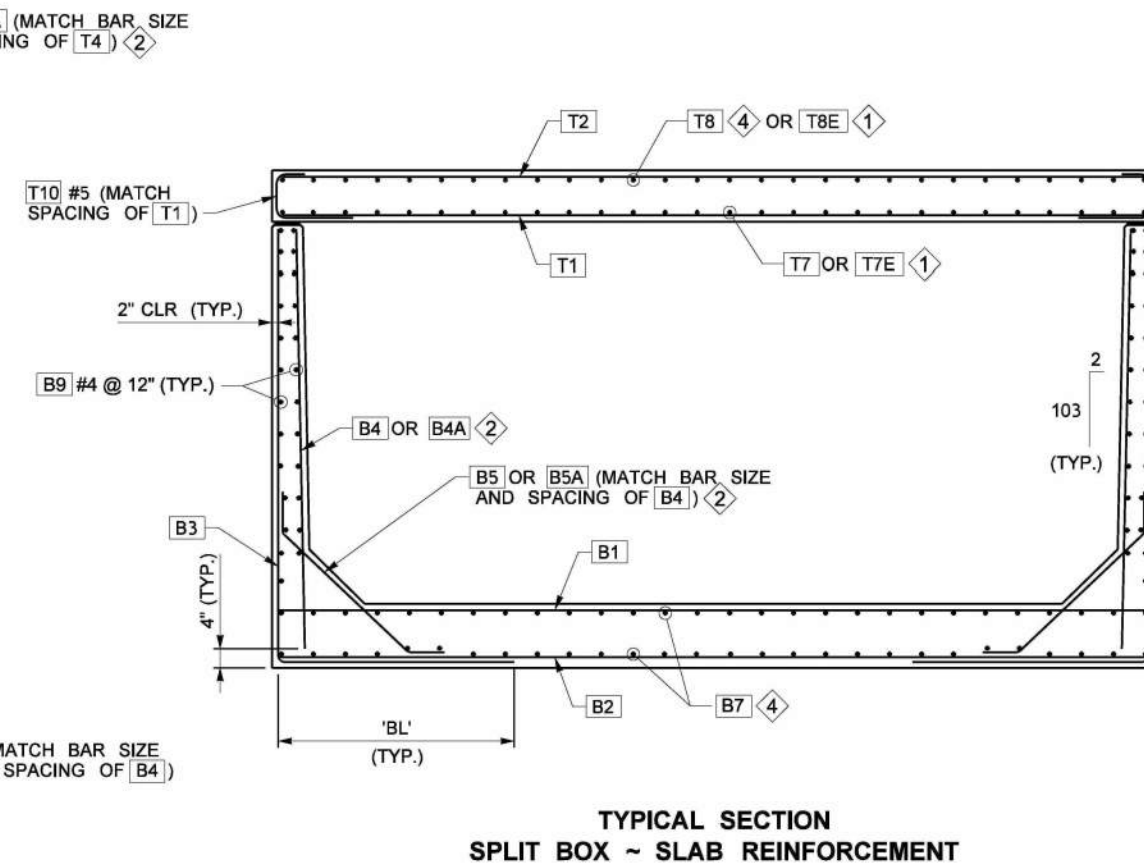
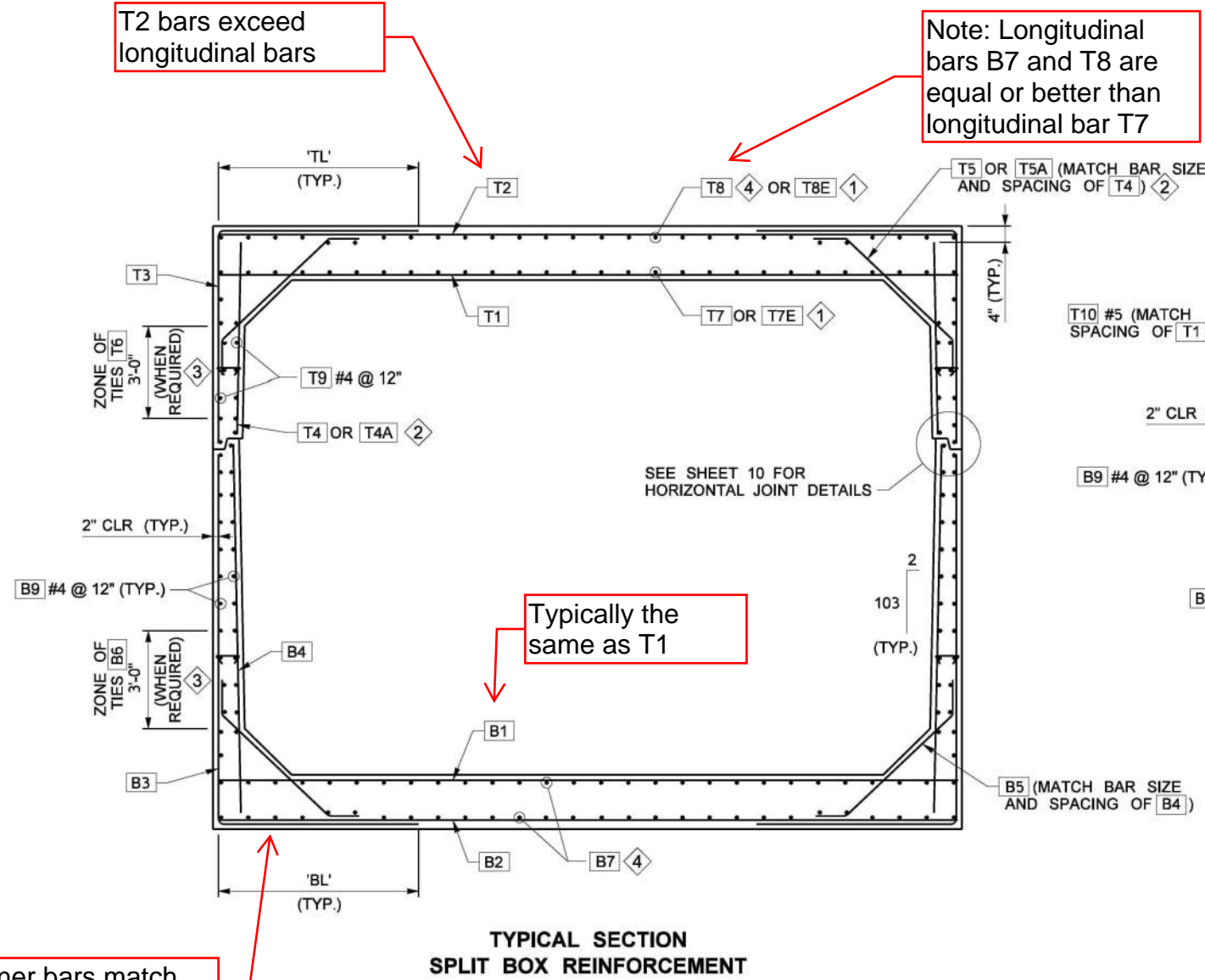
CULVERT WEIGHT IS BASED ON 150 P.C.F. WITH A HAUNCH SIZE OF 12 INCHES.

① REINFORCEMENT AREAS ARE IN SQUARE INCHES PER LINEAL FOOT OF BARREL. ALL REINFORCEMENT LENGTHS AND AREAS ARE MINIMUM REQUIREMENTS. REINFORCEMENT REQUIREMENTS ARE FOR WELDED WIRE REINFORCEMENT WITH MINIMUM SPECIFIED YIELD STRESS OF 65 ksi. IF BAR REINFORCEMENT IS SUBSTITUTED FOR WELDED WIRE REINFORCEMENT, INCREASE THE AREA OF REINFORCEMENT BY 8%, AND SUBMIT DESIGN CALCULATIONS VERIFYING COMPLIANCE WITH AASHTO 5.7.3.4 "CONTROL OF CRACKING BY DISTRIBUTION OF REINFORCEMENT".

② PLACE LONGITUDINAL REINFORCEMENT DENOTED AS As6 IN ALL SLABS AND WALLS WITH A MINIMUM OF 0.06 IN²/FT.

MnDOT
 REVISION: AUGUST 21, 2024
 APPROVED: MARCH 24, 2011

FIG. 5-395.100(E)
 TITLE: PRECAST CONCRETE BOX CULVERT TABLES
 DO NOT INCLUDE TABLES WITH PLAN

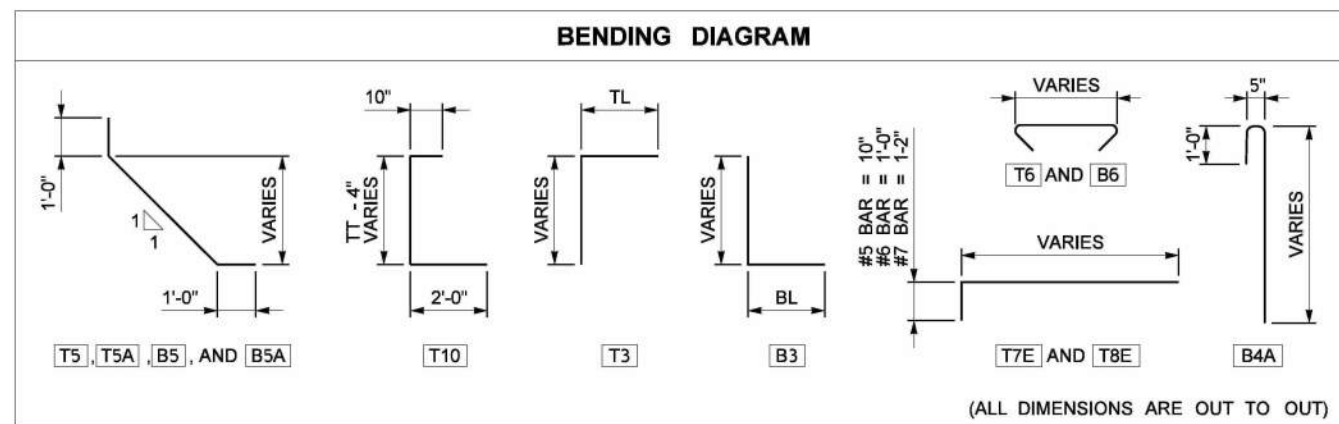


SPLIT BOX ~ SLAB ADDITIONAL REINFORCEMENT WHEN APPROACH SLAB SEAT IS PRESENT

TYPICAL SECTION SPLIT BOX REINFORCEMENT

TYPICAL SECTION SPLIT BOX ~ SLAB REINFORCEMENT

Corner bars match exterior wall rebar (one bar used)



KEY NOTES

- 1 BARS T7E AND T8E SHALL BE INSTALLED IN THE END SEGMENTS. ROTATE 90° HOOK AS NECESSARY TO PROVIDE THE SPECIFIED CLEARANCE.
 SIZE AND SPACING OF BARS T7E SHALL MATCH T7.
 BARS T8E SHALL BE AS FOLLOWS:
 END SEGMENT WITHOUT HEADWALL OR TRAFFIC BARRIER: #5 @ 12"
 END SEGMENT WITH UP TO 2'-0" HEADWALL: #6 @ 12"
 END SEGMENT WITH UP TO 4'-0" HEADWALL: #6 @ 6"
 END SEGMENT WITH TRAFFIC BARRIER: #7 @ 6"
 FOR ADDITIONAL END SEGMENT DETAILS SEE SHEET 11.
- 2 WHEN AN APPROACH SLAB SEAT IS PRESENT, ADDITIONAL REINFORCEMENT IS REQUIRED AS FOLLOWS:
 FOR SPLIT BOX ~ SLAB STRUCTURES:
 ADD B4A #5 @ 8" AND B5A #5 @ 8". BUNDLE WITH TYPICAL B4 AND B5 RESPECTIVELY.
 FOR SPLIT BOX STRUCTURES:
 ADD T4A #5 @ 8" AND T5A #5 @ 8". BUNDLE WITH TYPICAL T4 AND T5 RESPECTIVELY.
- 3 TIES T6 #4 AND B6 #4 SHALL BE SPACED AT 6" MAX. VERTICALLY AND AT 2'-0" MAX. HORIZONTALLY. EACH TIE SHALL BE HOOKED AROUND LONGITUDINAL BARS T9 OR B9. ADDITIONAL BARS T9 AND B9 MAY BE ADDED TO FACILITATE PLACEMENT OF TIES AS REQUIRED.
- 4 BARS B7 AND T8 SHALL BE #4 @ 12" WHEN CORRESPONDING SLAB THICKNESS ≤ 20 INCHES, AND #4 @ 9" FOR THICKER SLABS.



Sep 12, 2023

BURIED STRUCTURE SPLIT BOX
STANDARD PLAN E-20.10-00
 SHEET 4 OF 17 SHEETS

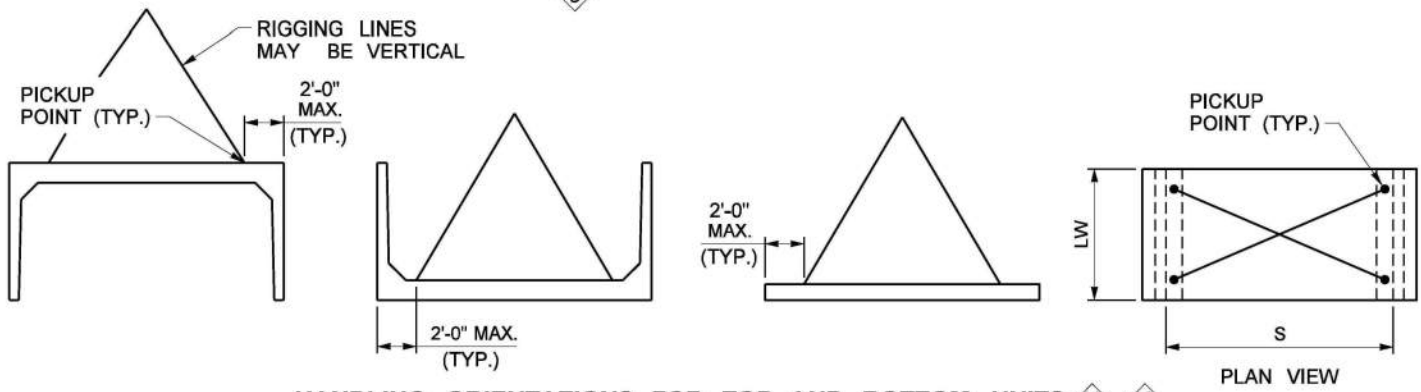
APPROVED FOR PUBLICATION
Mark A. Poirier Sep 12, 2023
 STATE DESIGN ENGINEER
 Washington State Department of Transportation

DESIGN TABLE ~ CLASS I STRUCTURES ~ SPANS 12', 15' AND 18'

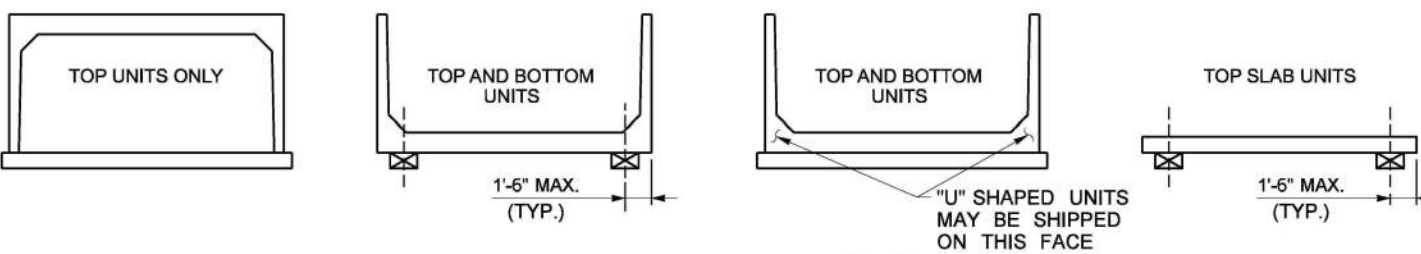
DESIGN SPAN S	DESIGN HEIGHT			FILL DEPTH FD	MEMBER THICKNESS			TOP UNIT REINFORCEMENT										BOTTOM UNIT REINFORCEMENT										MATERIAL QUANTITIES				STR. I BEARING DEMAND (PSF)	REQ'D HORIZ JOINT TYPE				
	TOTAL H	TOP UNIT WALL HT	BOT. UNIT WALL HB		WALLS TW	TOP SLAB TT	BOT. SLAB TB	T1 (SLAB INTERIOR)		T2 (SLAB EXTERIOR)		T3 (CORNER)			T4 (WALL INTERIOR)		T6 (TIES)	T7 (BOT.)		B1 (SLAB INTERIOR)		B2 (SLAB EXTERIOR)		B3 (CORNER)			B4 (WALL INTERIOR)		B6 (TIES)	TOP UNIT				BOTTOM UNIT			
								SIZE	SPA.	SIZE	SPA.	SIZE	SPA.	TL	SIZE	SPA.		SIZE	SPA.	SIZE	SPA.	BL	SIZE	SPA.	CONC. (CY/FT)	STEEL (LBS/FT)	CONC. (CY/FT)	STEEL (LBS/FT)									
12'	10'	N/A	10'	0' ≤ FD < 2'	10"	12"	10"	#7	6"	#5	12"	N/A			#4	8"	N/A	#5	10"	#6	6"	#7	5"	#7	5"	3'-2"	#4	8"	N/A	0.58	106.1	1.06	322.5	2397	2		
				2' ≤ FD ≤ 4'	10"	12"	10"	#7	6"	#5	12"	#4	8"	#4	12"	#6		6"	#7	5"	#7	5"	3'-2"	#4	8"	0.58	98.4	1.06		322.5	2490	2					
				4' < FD ≤ 6'	12"	12"	12"	#8	6"	#5	12"	#4	8"	#4	12"	#6		6"	#7	5"	#7	5"	4'-3"	#4	8"	0.59	112.8	1.28		318.9	2901	2					
				6' < FD ≤ 8'	12"	12"	12"	#8	6"	#5	12"	#4	8"	#4	12"	#6		6"	#7	5"	#7	5"	3'-4"	#4	8"	0.59	112.8	1.28		327.7	3255	2					
				8' < FD ≤ 10'	12"	12"	12"	#9	6"	#5	12"	#4	8"	#6	10"	#7		6"	#7	5"	#8	5"	3'-8"	#4	8"	0.59	150.3	1.28		382.2	3631	2					
15'	10'	N/A	10'	0' ≤ FD < 2'	10"	12"	10"	#9	6"	#5	12"	N/A			#4	8"	N/A	#4	12"	#8	6"	#6	5"	#7	5"	3'-11"	#4	8"	N/A	0.69	157.2	1.15	361.0	2269	2		
				2' ≤ FD ≤ 4'	10"	12"	10"	#8	6"	#5	12"	#4	8"	#4	12"	#8		6"	#6	5"	#7	5"	5'-1"	#4	8"	0.69	138.3	1.15		378.8	2313	2					
				4' < FD ≤ 8'	12"	14"	12"	#9	6"	#5	10"	#4	8"	#4	12"	#9		6"	#6	5"	#7	5"	4'-1"	#4	8"	0.81	163.6	1.39		399.5	3147	2					
				8' < FD ≤ 10'	12"	16"	14"	#9	6"	#6	12"	#4	8"	#5	10"	#8		6"	#6	5"	#8	5"	3'-7"	#4	8"	0.91	183.0	1.50		422.7	3625	2					
	12' TO 15'	5'	7' TO 10'	0' ≤ FD < 2'	10"	12"	10"	#9	6"	#6	7"	#6	7"	3'-0"	#4	8"	N/A	#5	9"	#8	6"	#5	10"	#6	5"	4'-4"	#4	8"	N/A	0.99	272.1	1.15	301.1	2030	1		
				2' ≤ FD ≤ 4'	10"	12"	10"	#9	6"	#6	7"	#6	7"	3'-0"	#4	8"		#4	12"	#8	6"	#5	12"	#6	6"	4'-9"	#4	8"		0.99	260.1	1.15	282.2	1992	1		
				4' < FD ≤ 8'	10"	14"	12"	#9	6"	#5	10"	#5	5"	5'-2"	#4	8"		#4	12"	#9	6"	#5	10"	#6	5"	3'-9"	#4	8"		1.09	244.9	1.26	315.9	2792	1		
				8' < FD ≤ 12'	12"	16"	14"	#10	6"	#6	12"	#5	6"	3'-10"	#4	8"		#4	12"	#9	6"	#6	12"	#7	6"	3'-5"	#4	8"		1.27	273.3	1.50	342.9	3739	1		
				12' < FD ≤ 16'	12"	18"	16"	#10	6"	#6	12"	#6	6"	3'-9"	#4	8"		#4	12"	#9	6"	#6	10"	#7	5"	3'-7"	#4	8"		1.38	292.3	1.60	375.3	4436	1		
				16' < FD ≤ 20'	12"	20"	18"	#10	6"	#5	6"	#6	6"	3'-9"	#4	8"		#4	12"	#10	6"	#6	12"	#8	6"	3'-9"	#4	8"		1.48	303.5	1.71	417.2	5372	1		
				20' < FD ≤ 24'	12"	22"	22"	#10	6"	#6	10"	#6	5"	3'-11"	#4	8"		Y	#4	12"	#10	6"	#6	9"	#8	6"	3'-11"	#4		8"	Y	1.59	327.1	1.92	443.4	6342	1
				24' < FD ≤ 28'	12"	22"	22"	#11	6"	#6	10"	#7	5"	3'-11"	#4	8"		Y	#4	12"	#10	6"	#6	10"	#8	5"	3'-11"	#4		8"	Y	1.59	387.9	1.92	473.0	7209	1
				28' < FD ≤ 32'	12"	24"	24"	#11	6"	#7	10"	#7	5"	4'-1"	#4	8"		Y	#4	12"	#11	6"	#7	10"	#8	5"	4'-1"	#4		8"	Y	1.69	402.5	2.02	522.3	8145	1
32' < FD ≤ 38'	12"	24"	24"	#11	5"	#7	10"	#8	5"	4'-1"	#4	8"	Y	#4	12"	#11	6"	#7	10"	#8	5"	4'-1"	#4	8"	Y	1.69	470.2	2.02	522.3	9445	1						
18'	10'	N/A	10'	0' ≤ FD < 2'	10"	16"	12"	#8	6"	#6	12"	N/A			#4	8"	N/A	#4	12"	#9	6"	#6	5"	#7	5"	3'-2"	#4	8"	N/A	1.04	164.2	1.37	422.3	2259	2		
				2' ≤ FD ≤ 4'	10"	14"	12"	#9	6"	#5	10"	#4	8"	#4	12"	#9		6"	#6	5"	#7	5"	3'-2"	#4	8"	0.92	188.0	1.37		420.7	2348	2					
				4' < FD ≤ 6'	12"	16"	14"	#9	6"	#6	12"	#4	8"	#4	12"	#10		6"	#7	10"	#7	5"	4'-3"	#4	8"	1.06	195.9	1.63		449.0	2731	2					
				6' < FD ≤ 8'	12"	18"	16"	#9	6"	#6	12"	#4	8"	#4	12"	#9		6"	#7	10"	#7	5"	3'-10"	#4	8"	1.18	196.3	1.75		412.6	3165	2					
				8' < FD ≤ 10'	12"	18"	16"	#10	6"	#6	12"	#4	8"	#4	12"	#9		6"	#6	5"	#8	5"	3'-6"	#4	8"	1.18	196.3	1.75		483.8	3576	2					
	12' TO 15'	5'	7' TO 10'	0' ≤ FD < 2'	10"	14"	12"	#9	6"	#6	9"	#6	9"	3'-1"	#4	8"	N/A	#5	8"	#8	6"	#6	10"	#6	5"	3'-1"	#4	8"	N/A	1.22	290.0	1.37	328.2	1877	1		
				2' ≤ FD ≤ 4'	10"	14"	12"	#9	6"	#5	8"	#6	8"	4'-0"	#4	8"		#4	12"	#9	6"	#6	10"	#6	5"	3'-1"	#4	8"		1.22	272.9	1.37	356.4	2001	1		
				4' < FD ≤ 6'	10"	16"	14"	#9	6"	#5	9"	#5	6"	3'-8"	#4	8"		#4	12"	#9	6"	#5	10"	#7	5"	3'-6"	#4	8"		1.34	261.4	1.49	381.6	2349	1		
				6' < FD ≤ 10'	10"	18"	16"	#10	6"	#6	12"	#6	6"	3'-5"	#4	8"		#4	12"	#10	6"	#6	10"	#7	5"	3'-5"	#4	8"		1.47	316.1	1.61	428.4	3198	1		
				10' < FD ≤ 14'	12"	20"	18"	#11	6"	#5	6"	#5	6"	3'-9"	#4	8"		#4	12"	#10	6"	#6	10"	#7	5"	3'-9"	#4	8"		1.67	360.8	1.87	444.3	3984	1		
				14' < FD ≤ 18'	12"	22"	22"	#11	6"	#5	7"	#6	7"	3'-11"	#4	8"		Y	#4	12"	#10	6"	#6	10"	#7	5"	3'-11"	#4		8"	Y	1.79	380.4	2.12	461.9	4973	1
				18' < FD ≤ 22'	12"	22"	22"	#11	5"	#6	10"	#6	5"	3'-11"	#4	8"		Y	#4	12"	#11	6"	#6	10"	#8	5"	3'-11"	#4		8"	Y	1.79	443.9	2.12	548.0	5841	1
				22' < FD ≤ 30'	12"	24"	24"	#10	4"	#7	10"	#6	5"	4'-1"	#4	8"		Y	#4	12"	#10	4"	#7	10"	#8	5"	4'-1"	#4		8"	Y	1.92	462.7	2.24	610.4	7643	1

KEY NOTES

- DESIGN SPAN 'S', SHALL BE TAKEN EQUAL TO THE HORIZONTAL DISTANCE BETWEEN INSIDE FACE OF WALLS AT THE CORNER BETWEEN THE FILLET AND THE WALL AS SHOWN ON SHEET 1. FOR SEGMENTS WITH A SKEW SEE GRAPHICAL CLARIFICATION OF DESIGN SPAN ON SHEET 3. IF THE DESIGN SPAN FALLS IN BETWEEN A DESIGN SPAN VALUE IN THE TABLES, USE REINFORCEMENT FOR THE LONGER SPAN. CLASS 1 STRUCTURES WITH SPANS GREATER THAN 18 FEET AND LESS THAN 20 FEET SHALL USE GEOMETRY AND REINFORCEMENT FOR 21 FOOT SPAN CLASS 2 STRUCTURES WITH A PGA = 0.32G.
- THE MAXIMUM FILL DEPTH OVER THE ENTIRE BURIED STRUCTURE SHALL BE USED WHEN SELECTING DESIGN FILL DEPTH.
- FOR REINFORCING DETAILS SEE SHEET 4.
- MAXIMUM REQUIRED BEARING RESISTANCE FOR STRENGTH LIMIT STATE.
- THESE STRUCTURES HAVE BEEN DESIGNED FOR A TRAVERSE DIFFERENTIAL SETTLEMENT DISPLACEMENT EQUAL TO 2 INCHES PER 100 FEET OF STRUCTURAL SPAN (DESIGN SPAN + 1.0 FOOT).
- FOR HORIZONTAL JOINT TYPE DETAILS SEE SHEET 10.
- WALL TIES T6 AND B6 ARE REQUIRED WHEN INDICATED BY LETTER 'Y'.
- MATERIAL QUANTITIES ARE FOR A TYPICAL INTERIOR SEGMENT. STEEL WEIGHT DOES NOT INCLUDE ADDITIONAL REINFORCING REQUIRED FOR APPROACH SLAB SEAT.
- SINGLE BARS SPACED AT 4 INCHES MAY BE SUBSTITUTED BY TWO-BAR BUNDLES SPACED AT 8".
- QUANTITIES OF BOTTOM UNIT CORRESPOND TO 'HB' = 10'-0".
- REINFORCING OF PRECAST UNITS HAVE BEEN DESIGNED FOR HANDLING AND SHIPPING ORIENTATIONS PRESENTED ON THIS SHEET. ALTERNATE SHIPPING OR HANDLING ORIENTATIONS SHALL BE ANALYZED BY THE CONTRACTOR.
- CONCRETE COMPRESSIVE STRENGTH SHALL BE AT LEAST FCI = 3.5 KSI FOR HANDLING AND FC = 7.0 KSI FOR SHIPPING.



HANDLING ORIENTATIONS FOR TOP AND BOTTOM UNITS



SHIPPING ORIENTATIONS



Sep 12, 2023

BURIED STRUCTURE SPLIT BOX

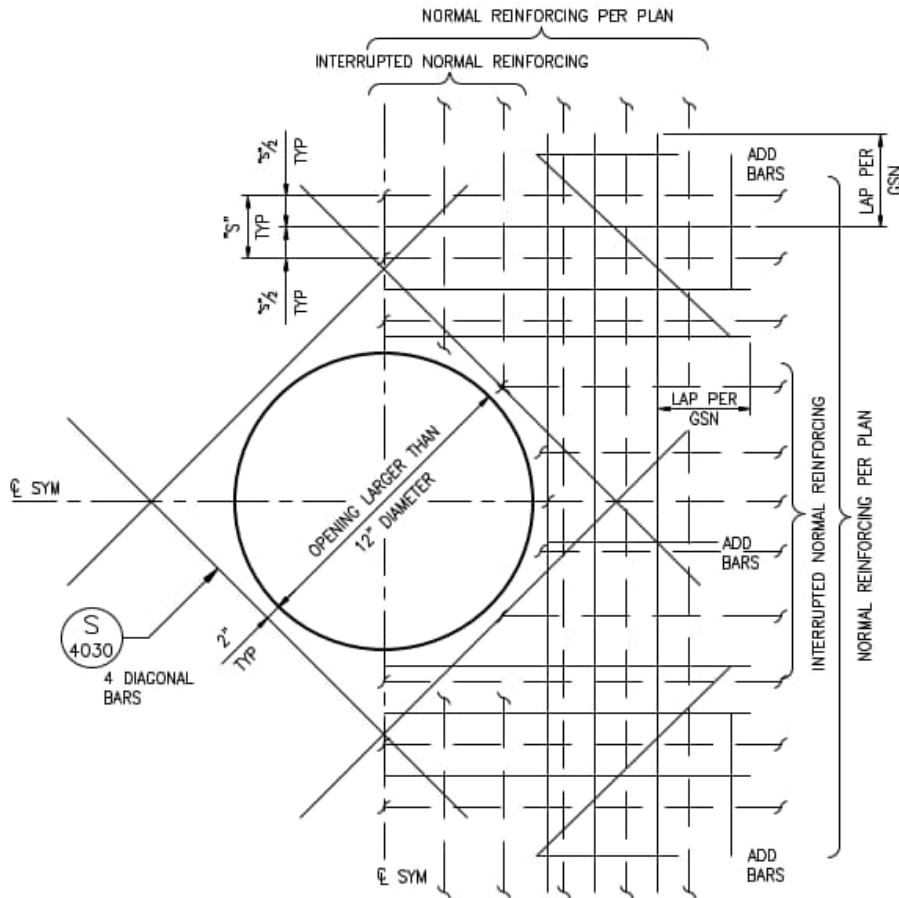
STANDARD PLAN E-20.10-00
SHEET 5 OF 17 SHEETS

APPROVED FOR PUBLICATION

Mark A. Davis Sep 12, 2023

STATE DESIGN ENGINEER

Washington State Department of Transportation



NOTES:

1. THIS DETAIL TO BE USED FOR OPENINGS LARGER THAN 12"Ø AND WHEN CALLED FOR ON THE DRAWINGS OR WHEN NO OTHER ADDITIONAL REINFORCING IS SPECIFIED. FOR OPENINGS SMALLER THAN 12"Ø, USE DETAIL S/4030.
2. FOR OPENINGS LESS THAN 60": AREA OF ADD BARS AT EACH EDGE OF OPENING IN EACH DIRECTION SHALL MATCH ½ THE CROSS SECTIONAL AREA OF THE INTERRUPTED BARS. BARS UP TO TWO BAR SIZES LARGER THAN NORMAL REINFORCING MAY BE USED. FIT ADD BARS WITHIN A DISTANCE OF 2X WALL/SLAB THICKNESS FROM EDGE OF OPENING.

FOR OPENINGS 60" AND LARGER: OMIT VERTICAL AND HORIZONTAL ADD BARS AND USE (4) #6 BARS FOR DIAGONAL BARS SIMILAR TO DETAIL S/4030.
3. CUT NORMAL REINFORCING 2" CLEAR OF OPENING.
4. PROVIDE STANDARD ACI HOOKS ON BARS/DOWELS IF STRAIGHT EXTENSION PAST THE OPENING CANNOT BE ACHIEVED.
5. PLACE ADD BARS IN SAME PLANES AS NORMAL REINFORCING INDICATED.
6. PLACE #5 ADD DIAGONAL CORNER BARS UNDER NORMAL REINFORCING INDICATED.
7. WHEN AN INTERSECTING SLAB OR WALL OCCURS WITHIN ONE WALL/SLAB THICKNESS OF THE EDGE OF OPENING, NO ADD BARS ARE REQUIRED ON THAT SIDE.

ADDITIONAL REINFORCING AT CIRCULAR OPENINGS IN WALLS/SLABS

NOT TO SCALE

S
4036



I-405 NB

ITS #103

1

2

3

4

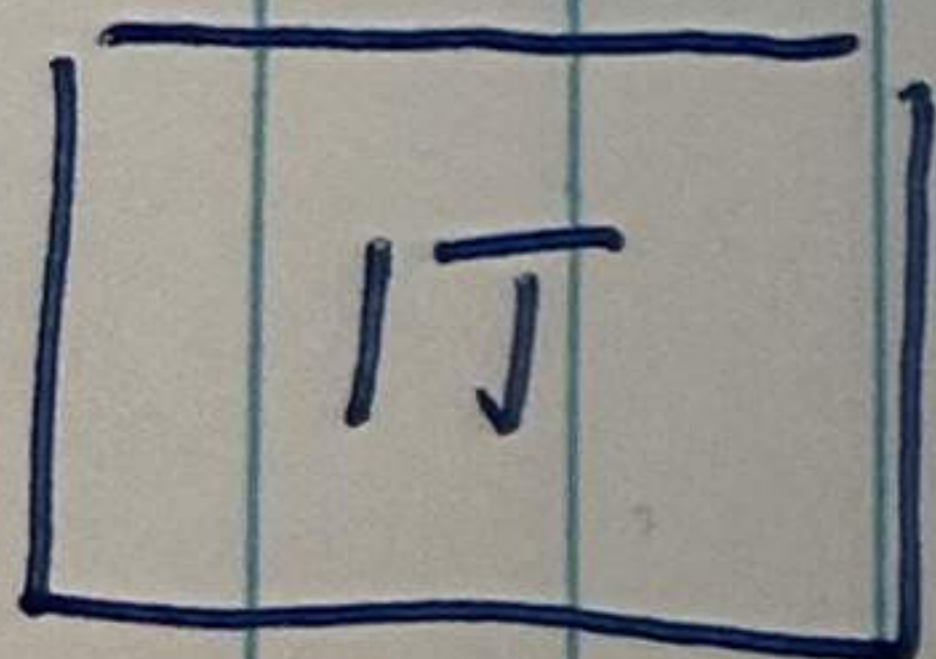
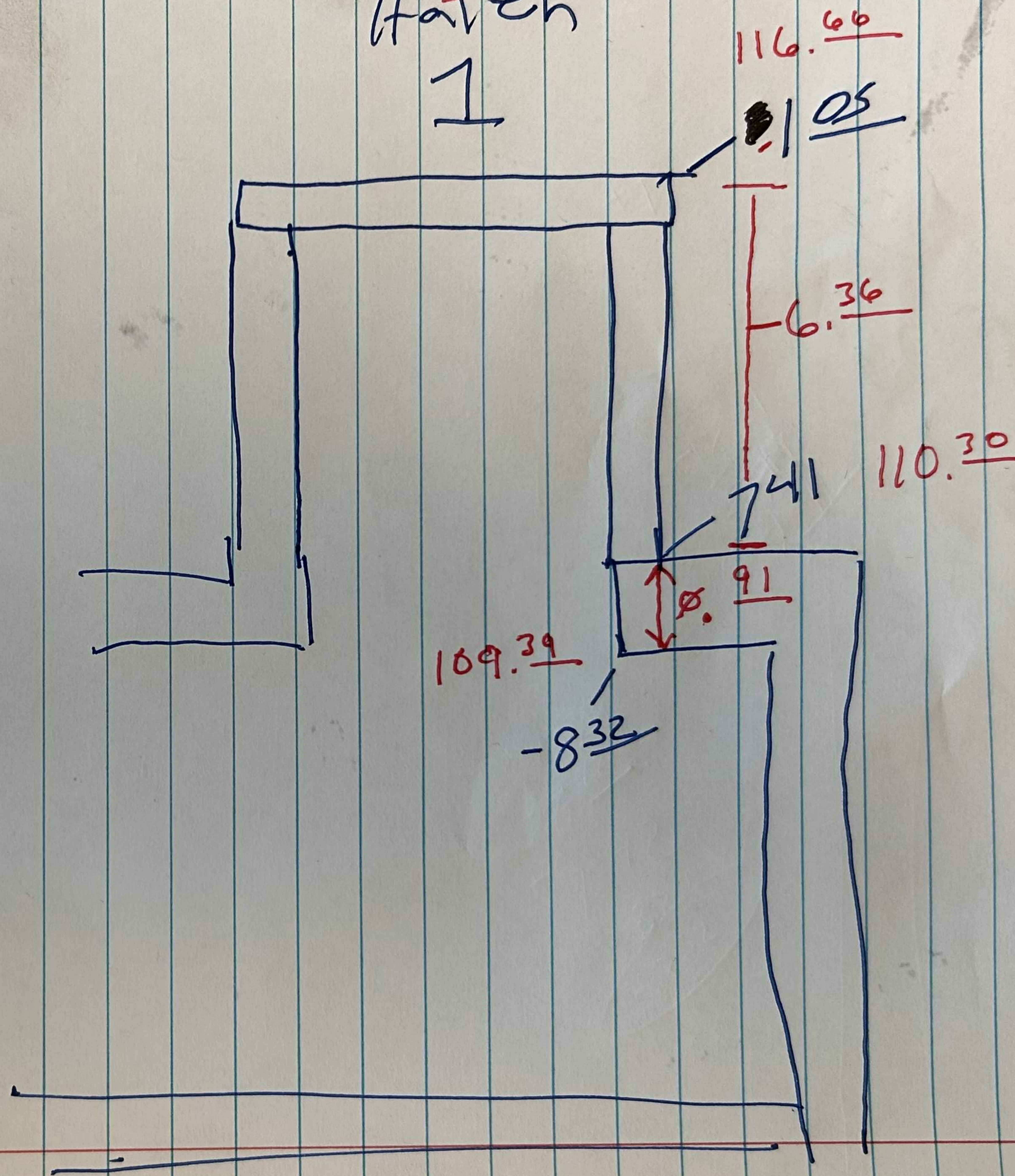
5

6

7

I-405 SB

North End
Hatch
1

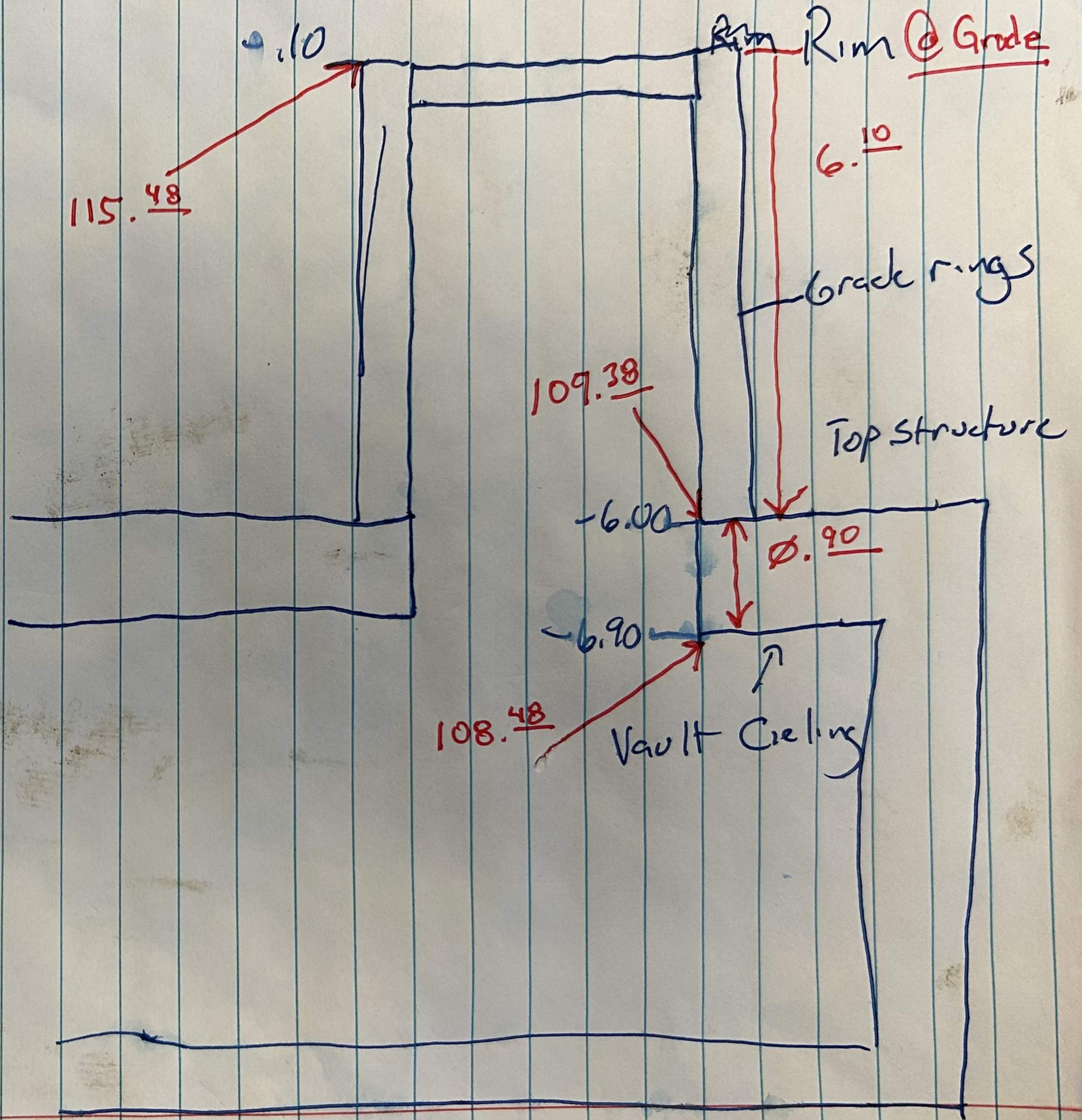


117.71

250317 PRKER 120

115.38 per survey shot
0.00
ITS
25031 7PKER 103

Hatch 6



May 15, 2025 at 2:00:35 AM
I-405 S
Bothell WA 98021
United States

