4M ENGINEERING
CIVIL – STRUCTURAL
6675 Purple Poppy Ln., Park City, UT 84098 801-380-0562

7/23/25

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, fy = 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 Erikkson 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.

4M ENGINEERING
CIVIL – STRUCTURAL
6675 Purple Poppy Ln., Park City, UT 84098 801-380-0562

Post shore calculations and Load Rating can be found on sheets 17-22.

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 24-26).

7-23-25

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:

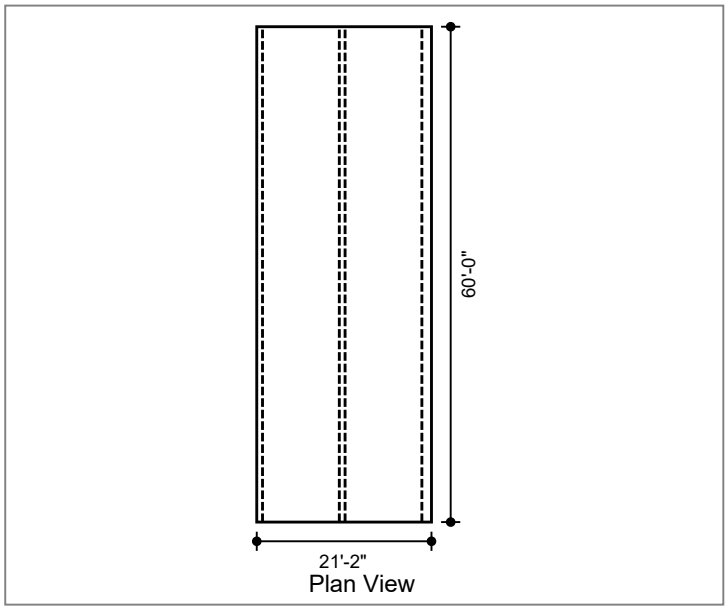
Per inspection report, concrete culvert is 20'x9' in good condition.

Existing Culvert Analysis (Shored)

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

Physical Dimensions

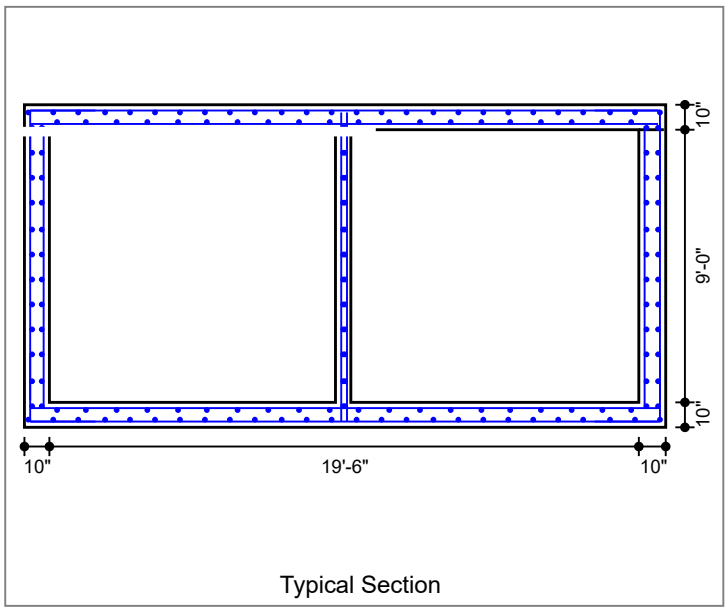
Clear Span:	9'-6"
Clear Height:	9'-0"
Top Slab:	10"
Bottom Slab:	10"
Ext. Wall:	10"
Int. Wall:	6"
Fill Depth Range	
Maximum:	6.00 ft
Minimum:	4.00 ft
Increment:	0.50 ft
Length:	60'-0"
Skew Angle:	0.00 deg
Bottom Slab Support:	Full Slab
Top Haunch, Width:	0"
Top Haunch, Height:	0"
Bottom Haunch, Width: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



Plan View

Material Properties

Concrete	
Strength, f'c:	6.500 ksi
Density:	0.155 kcf
Elasticity, Ec:	5347 ksi
Type:	Normal wt
Steel	
Yield, fy:	60 ksi
Allow Stress:	36 ksi
Elasticity, Es:	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"



Typical Section

Controlling Ratings

Inventory Rating: 1.81
Operating Rating: 2.35

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
Additional Dead Load:	0.000 klf
Concentrated Loads:	none

Lateral Soil Loads

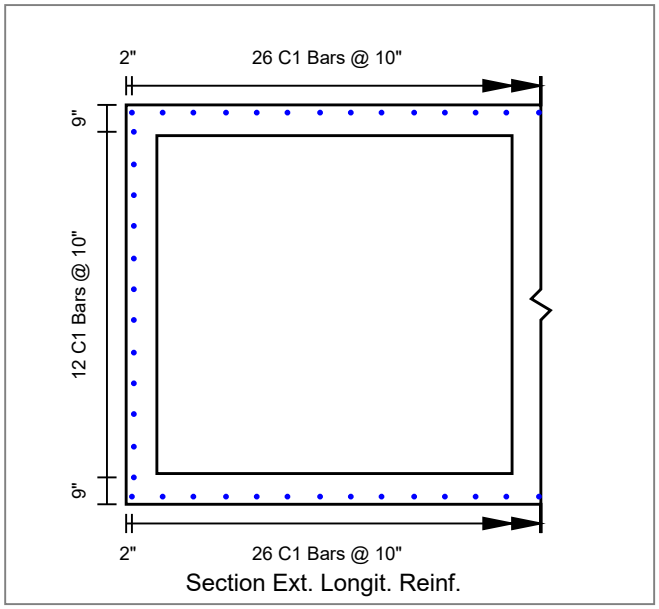
Eq. Fluid Press. Max:	60.00 pcf
Eq. Fluid Press. Min:	30.00 pcf

Interior Water Pressure:	no
Exterior Water Pressure:	no

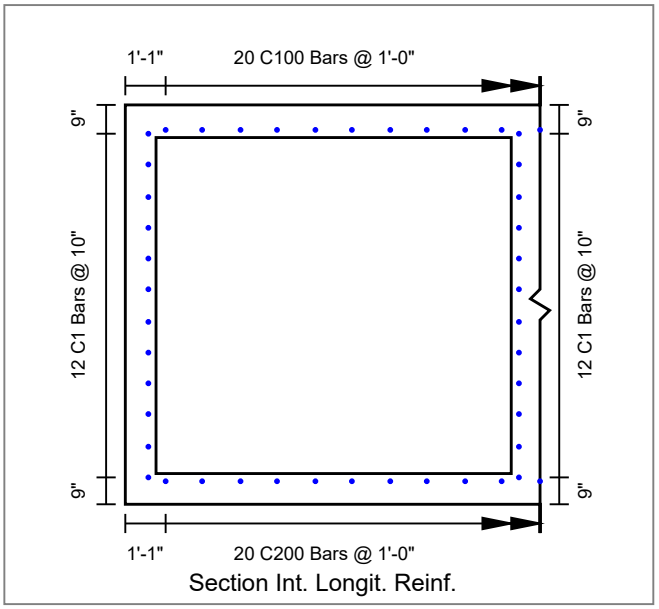
Concrete Summary
Volume of Concrete: 2.029 cy/ft Total Volume of Concrete: 121.728 cy

Reinforcing Steel Bar Schedule (lb)

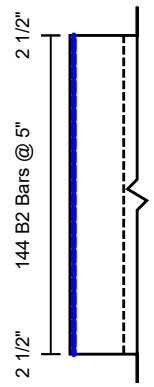
Location	Mark	Qty	Size	Spacing	Type	Length	Hor.Leg	Ver.Leg	Tot.Weight
Top Slab(Int)	A100 (AS2)	144	6	5"	S	20'-9"	--	--	4488.0
Bot Slab(Int)	A200 (AS3)	144	6	5"	S	20'-9"	--	--	4488.0
Top Slab(Ext)	A300 (AS7)	144	6	5"	S	20'-9"	--	--	4488.0
Bot Slab(Ext)	A400 (AS8)	144	6	5"	S	20'-9"	--	--	4488.0
Corner(Top)	A1 (AS1)	288	5	5"	L	4'-4"	2'-2"	2'-2"	1302.0
Corner(Bot)	A2 (AS1)	288	5	5"	L	4'-4"	2'-2"	2'-2"	1302.0
Wall(Int)	B1 (AS4)	288	5	5"	S	9'-4"	--	--	2854.0
Wall(Ext)	B2 (AS1)	288	6	5"	S	8'-10"	--	--	3893.0
Int Wall	B3	120	3	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



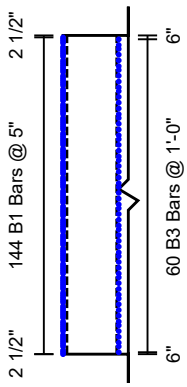
Section Ext. Longit. Reinf.



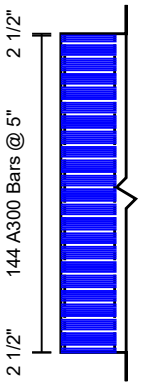
Section Int. Longit. Reinf.



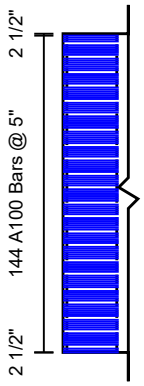
Ext. Wall Reinf.



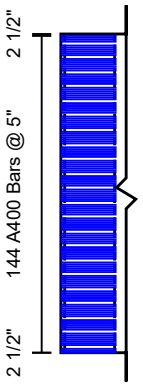
Int. Wall Reinf.



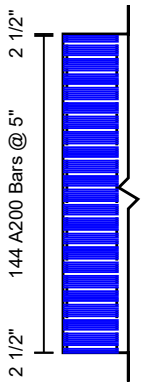
Top Slab Ext. Reinf.



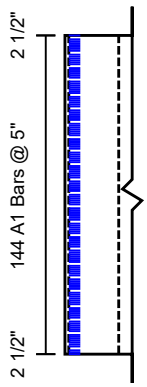
Top Slab Int. Reinf.



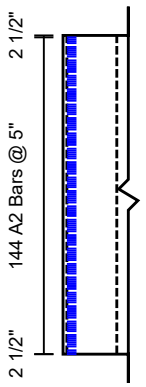
Bottom Slab Ext. Reinf.



Bottom Slab Int. Reinf.



Top Slab Corner Reinf.



Bottom Slab Corner Reinf.

RATINGS SUMMARY
==========

	Flexure			Shear		
Truck	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 (in2/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 in2/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
---------------------------
     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

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

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 duribility 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 stipping 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 (in2/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 in2/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	ILF	OLF	Flexure Fill	Flexure Member	Flexure Location	Flexure IR	Flexure OR	Shear Fill	Shear Member	Shear Location	Shear IR	Shear 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.	Load Ratings	15	Fill

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	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 (in2)	Mcr (k-ft)	Load Ratings IR	OR	Truck	Fill Depth (ft)
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 (in2)	Mcr (k-ft)	Load Ratings IR	OR	Truck	Fill Depth (ft)
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 (in2)	Mcr (k-ft)	Load Ratings IR	OR	Truck	Fill Depth (ft)
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 (in2)	Max. Spac (in)	Load Ratings IR	OR	Truck	Fill Depth (ft)
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 (in2)	Max. Spac (in)	Load Ratings IR	OR	Truck	Fill Depth (ft)
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 (in2)	Max. Spac (in)	Load Ratings IR	OR	Truck	Fill Depth (ft)
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 (in2)	Max. Spac (in)	Load Ratings IR	OR	Truck	Fill Depth (ft)
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”

4M ENGINEERING
CIVIL – STRUCTURAL

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

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			
Vu = P*LF	8.8	kips		
ϕVc ϕ(4*f'c^0.5*b_0*d)	94.4	kips	OK	ACI Eq 11-3

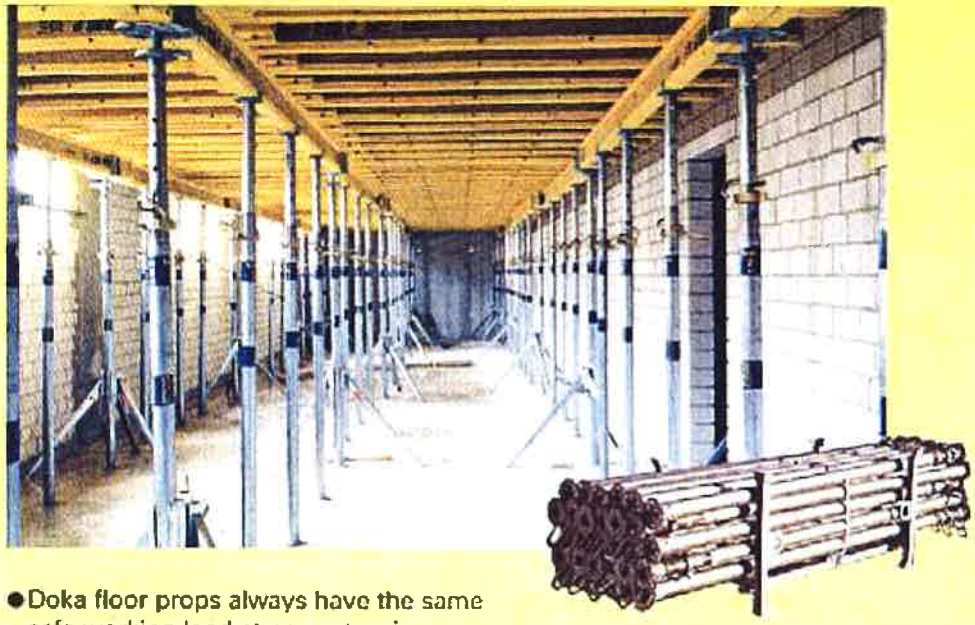
Check Shear at Slab

ϕ	0.75		
b	12	in	
d	7.69	in	
f'c	6500	psi	
ϕVc = ϕ(2*f'c^0.5*b*d)	11156	lbs per ft	
Vu = wl/2	7215	lbs	OK

Check Longitudinal Slab Bending Between Shoring Posts

f'c	6500	psi	
fy	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" cover - 0.5*db	7.69	in	
a = As*fy / (0.85*f'c*b)	0.34	in	
ϕ	0.9		
ϕMn = ϕAs*fy*(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	safetey 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

Österreichische Doka Schalungstechnik GmbH
Reichsstraße 23
A 3300 Amstetten / Austria
Tel. +43 7472 605-0
Fax +43 7472 605 54430
E-Mail: Oest.Doka@doka.com
Internet: http:// www.doka.com

Northeast Office
Corporate Headquarters:
Conesco Industries, Ltd.
214 Gates Road
Little Ferry, NJ 07643
Tel. 201-641-6500
Fax 201-641-6254

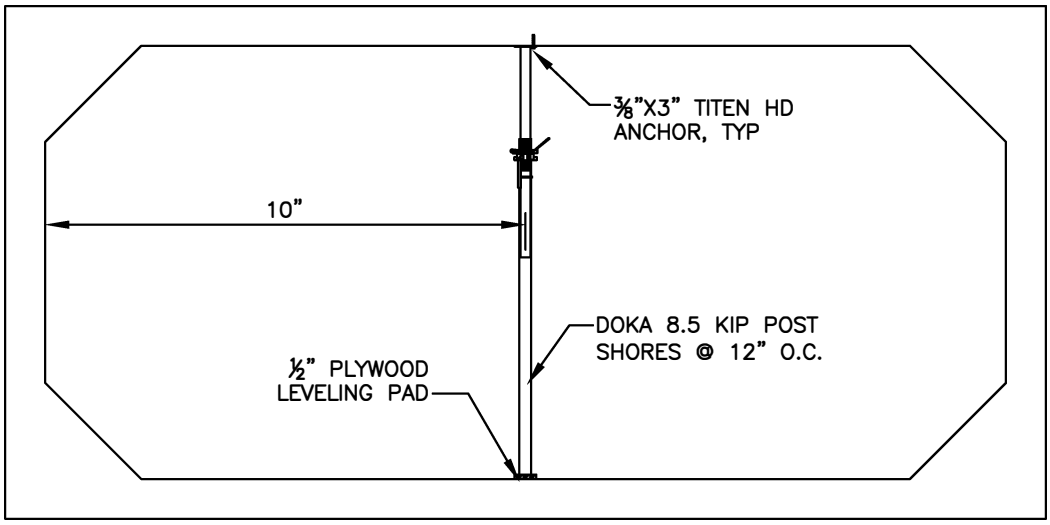
Puerto Rico Office:
Conesco Industries, Ltd.
822 Aldebaran St.
Banco De Desaro
LLO Economico Bldg.
Suite 110-19
San Juan, PR 00920
Tel 787-277-9560
Fax 787 783 9011

Texas Office:
Conesco Industries, Ltd.
1440 Halsey Way
Suites 204 & 206
Carrollton, TX 75007
Tel 972-446-1662/1663
Fax 972-446-1772

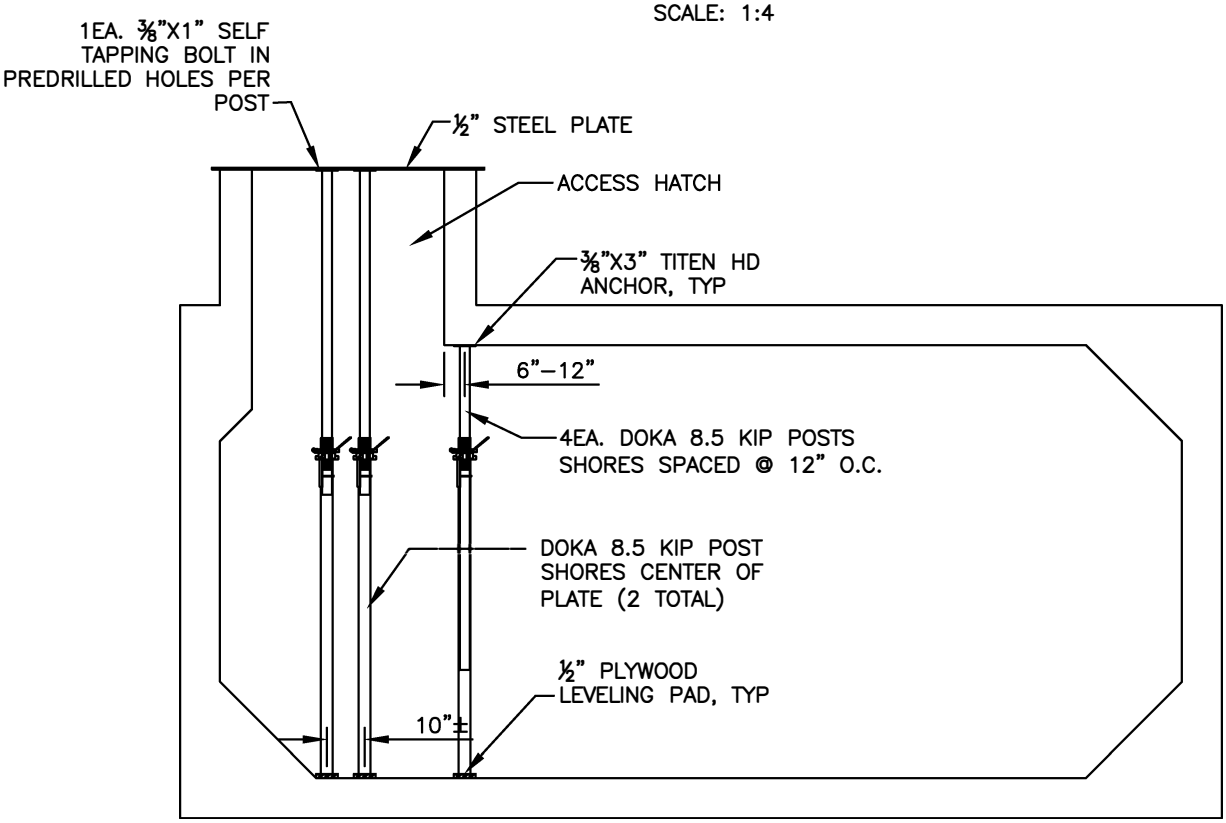
Mid-Atlantic Office
Conesco Industries, Ltd.
6537 Mid Cities Avenue
Beltsville, MD 20705
Tel 301-595-1900
Fax 301 595 7305

Southeast Office:
Conesco Industries, Ltd.
105A Boulderbrook Circle
Lawrenceville, GA 30045
Tel 770-962-7914
Tel 888 615-4700
Fax 770-962-5228

Midwest Office:
Conesco Industries, Ltd.
1032 Moon Avenue
Rockdale, IL 60436
Tel 815-730-6700
Fax 815-730-0170



BOX CULVERT TEMP SHORING
SCALE: 1:4



HATCH LID & ACCESS OPENING
TEMP SHORING
SCALE: 1:4

7-7-25

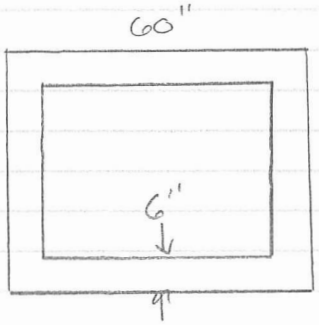
Rating Factor for Temporary Shoring

$$RF = \frac{(C - \gamma_{DC}\, DC - \gamma_{DW}\, DW \pm \gamma_p\, P)}{\gamma_{LL}\, LL\, (1+IM)}$$ eqn 13.1.1A-1

Pipe Shore ult capacity	=	25.5 kips	Rn	(8.5 allowable w/ FS = 3)
Unfactored DL	=	1.63 k/ft	Dw	
Unfactored LL	=	7.21 k/ft	LL	
ɣDW	=	1.75	table 13.1.1.D (HL-93 inventory rating)	
ɣLL	=	1.45	table 13.1-1	
∅s, c, n	=	1	tables 13.1.1B, C, 13.1.2.C	
IM	=	0	no impact on structure	
C	=	25.5		
Dc	=	0	no structural load	
P	=	0	no addt'l permanent loads	
RF, IR	=	2.2		

Access Riser Calculations

Concrete Riser



Area = 108 in²

Assume min steel = 12 no. 3's

Riser Load = HL-93 wheel load + Soil DL

= 1.75 (16,000) + 1.25 (2'·127)(5²) = 35,938 lbs

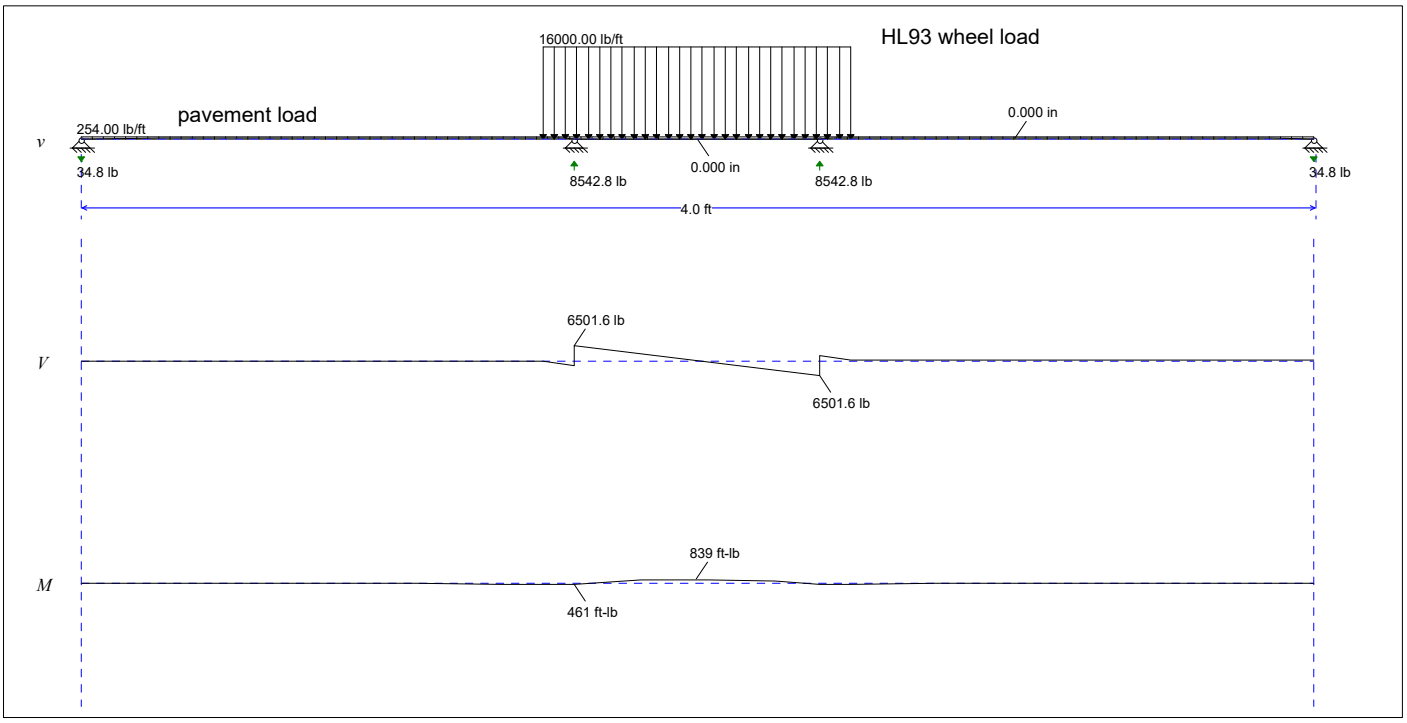
Compressive stress = $\frac{35938 \text{ lbs}}{108 \text{ in}^2}$ = 333 psi

4M ENGINEERING
CIVIL – STRUCTURAL

Project Name: Box Culvert
Date: 5-28-25

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+Nu/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 in^4, A = 6.0 in^2

Rating Factor for Temporary Shoring

$$RF = \frac{(C - \gamma_{DC}\,DC - \gamma_{DW}\,DW \pm \gamma_p\,P)}{\gamma_{LL}\,LL\,(1+IM)}$$ eqn 13.1.1A-1

Pipe Shore ult capacity	=	25.5	kips	Rn	(8.5 allowable w/ FS = 3)
Unfactored DL	=	0.34	kip	Dw	
Unfactored LL	=	8.2	kip	LL	
ɣDW	=	1.75	table 13.1.1.D (HL-93 inventory rating)		
ɣLL	=	1.45		table 13.1-1	
Ø s, Øc, Øn	=	1		tables 13.1.1B, C, 13.1.2.C	
IM	=	0.33			
C	=	25.5			
Dc	=	0		no structural load	
P	=	0		no addt'l permanent loads	
RF, IR	=	1.6			

APPENDIX

Inspection

Printed On: 3/18/2025

CD Guid: 119f214d-5bdd-451a-87b6-c08671b799fb

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 — Inspector's Signature JJL Cert # G1805 Cert Exp Date

3/18/2028 — 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

	G	Overall Condition Classification	(BC12)
	N	FHWA Deck Overall	(BC01)
	N	WSDOT Deck Overall	(WC01)
	N	Bridge Railings	(BC05)
	N	Bridge Railing Transitions	(BC06)
	N	Bridge Joints	(BC08)
	N	Superstructure Overall	(BC02)
	N	NSTM Inspection	(BC14)
	N	Bridge Bearings	(BC07)
	N	Substructure Overall	(BC03)
	N	UW Inspection	(BC15)
	8	Culvert Overall	(BC04)
	N	Scour Condition	(BC11)
	N	Channel Condition	(BC09)
	N	Channel Protection	(BC10)
		Chan/Prot (NBI Disc)	(1677)
		Pier/Abut/Prot (NBI Disc)	(1679)

Appraisal

		Scour Critical (NBI Disc)	(1680)
	N	Scour Vulnerability	(BAP03)
	X	Scour Plan of Action	(BAP04)
		Waterway (NBI Disc)	(1662)
	N	Overtopping Likelihood	(BAP02)
		Appr Roadway Align	(BAP01)
		Fatigue Details	(BIR02)
		Seismic Vulnerability	(BAP05)

Optional Condition Ratings

	6	Drain Condition	(LP01)
	9	Retaining Wall Condition	(LP02)

Miscellaneous Fields

	1996	Year Built	(BW01)
		Asphalt Depth	(WIE30)
	0.00	Design Curb Height	(WIE31)
	0.00	Bridge Rail Height	(WIE32)
	1	Number of Utilities	(WIE33)
	Y	Subject to NBIS	(WIE34)
	03/17/2025	Inspn QA Date	(BIE09)

Inspection Flags

		Soundings	(WIE20)
		Clearance	(WIE21)
		Revise Rating	(WIE22)
	P	PhotosFlag	(WIE23)
	Y	Roadside Hardware Flag	(WIE25)
	Y	QA Flag	(WIE24)

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.

CD Guid: 119f214d-5bdd-451a-87b6-c08671b799fb

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	Maint	Verified
			(No repairs for this structure)				

All Inspections and Resources Required

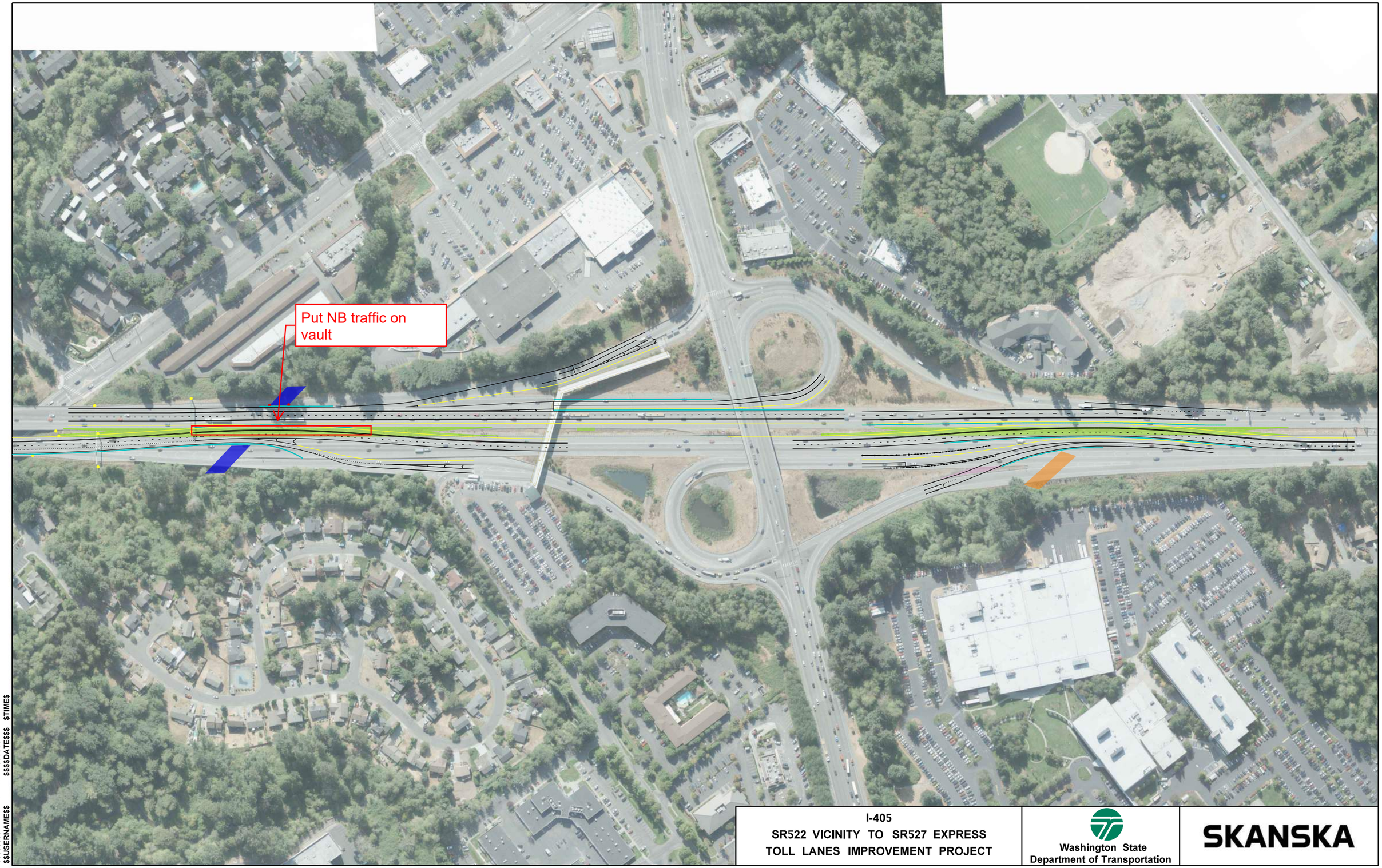
Report Type	Subtype	Rsk Mthd	Begin Date	Comp Date	Interval	Due Date	Hours	Inspector	Cert No	Co-Insp
Initial		N	3/13/2025	3/13/2025			1.0	JJL	G1805	

Inspection Note	Late Inspection Explanation	Late PM Resp Date	Late PM Approval	Insp QC Date	Inspn Data Update Date
Mid night underground inspection, rainy					

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	Late Inspection Explanation	Late PM Resp Date	Late PM Approval	Insp QC Date	Inspn Data Update Date
Mid night underground inspection, rainy					

Plans

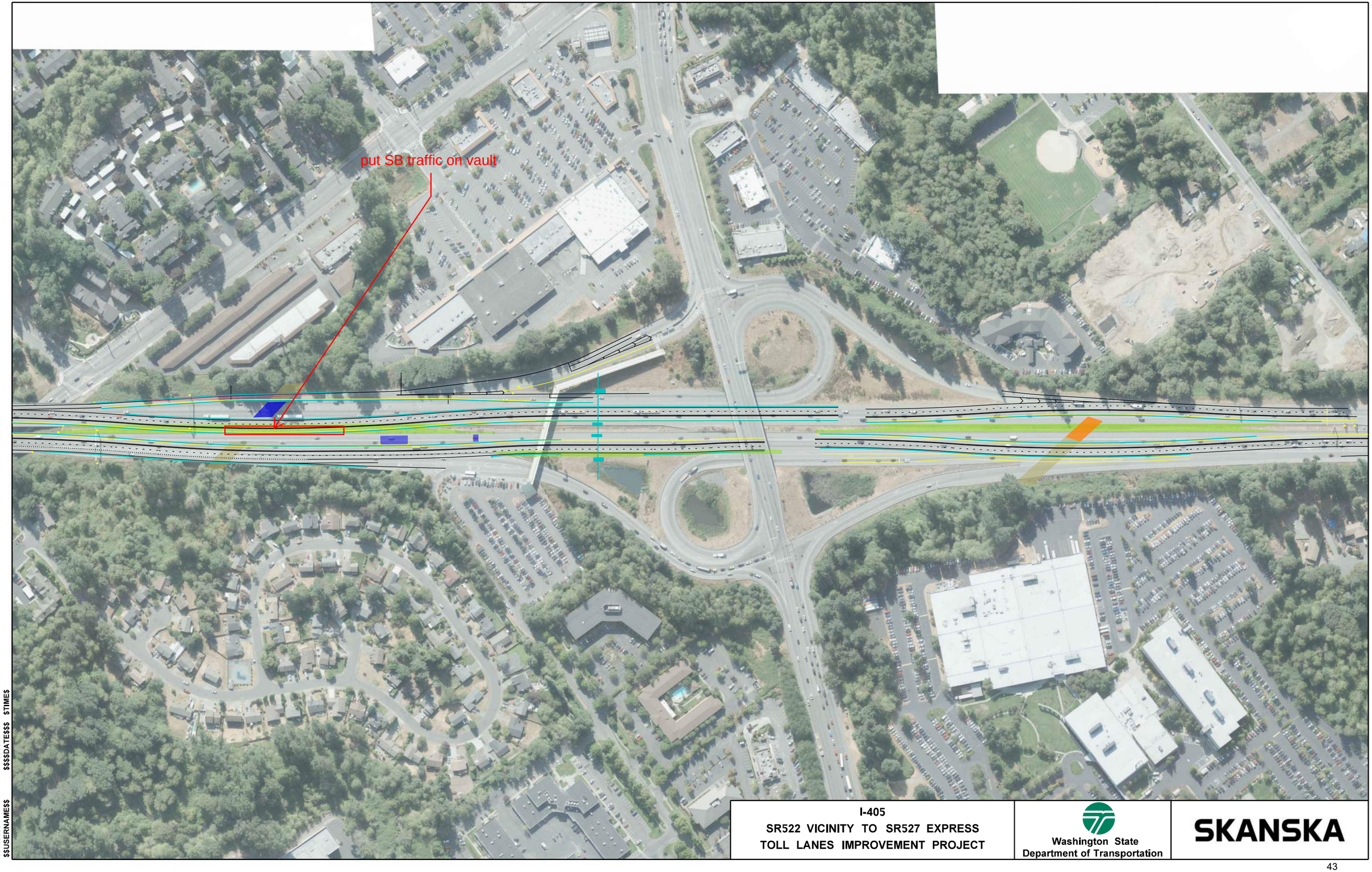


$$$$$$$$DESIGNFILENAME$$$$$$
$$USERNAME$$ $$$$DATE$$$ $TIME$

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

Washington State
Department of Transportation

SKANSKA

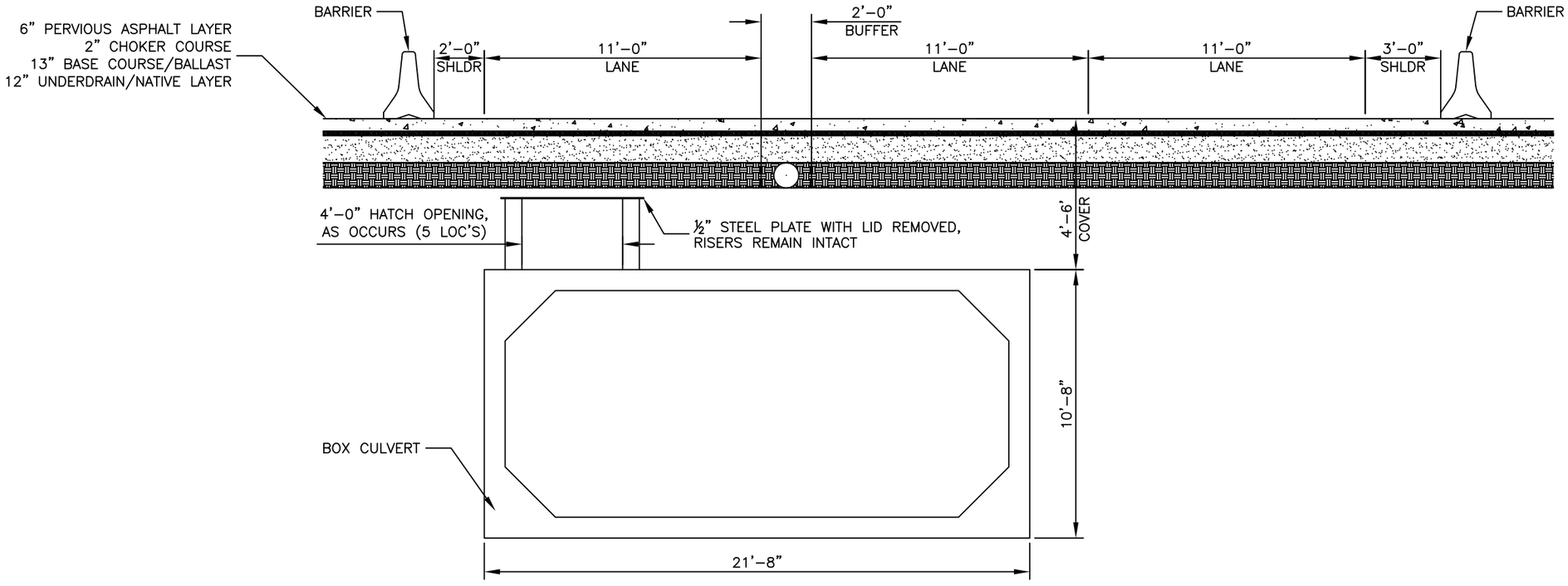


$$$$$$$$DESIGNFILENAME$$$$$$
$$USERNAME$$ $$$$DATE$$$$ $TIME$

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

Washington State Department of Transportation

SKANSKA



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

#	DATE	DESCRIPTION
0	5–16–25	ISSUED FOR CONSTRUCTION

REVISIONS

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF WASHINGTON
G. MEGARGEL
20100237
REGISTERED PROFESSIONAL ENGINEER
6/3/25

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

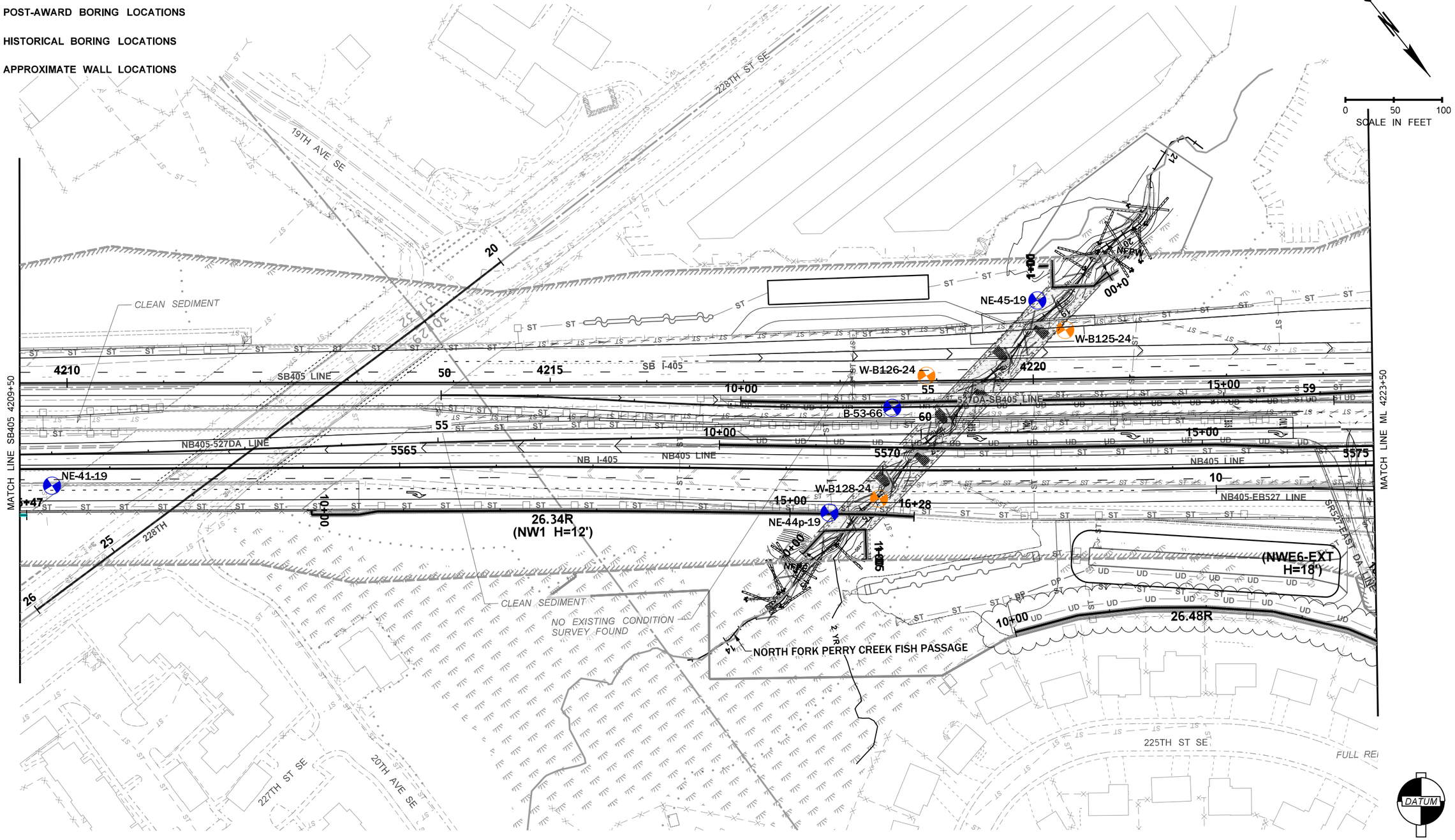
DIST	COUNTY	ROUTE	POST MILE
–	SNOHOMISH	405	–

CONTRACT NO.: 9727

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

LEGEND

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



FILE NAME	c:\pwworking\uswa\dms10950\C9727_BP_EJK-P8_04.dgn				REGION NO.	STATE	FED.AID PROJ.NO.
TIME	7:10:07 PM				10	WASH	
DATE	10/4/2024				JOB NUMBER		
PLOTTED BY	ejkennedy				22AB17		
DESIGNED BY					CONTRACT NO.		LOCATION NO.
ENTERED BY					9727		XL5446
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
Terracon Consulting Engineers and Scientists

Washington State Department of Transportation
SKANSKA

I-405
BRICKYARD TO SR527
IMPROVEMENT PROJECT

PLAN VIEW: Package 8

PLAN REF NO

SHEET 3 OF 7 SHEETS

SR ___ FILE NO. ___ SHEET ___

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

Notes: Autohammer Average Transfer Efficiency = 85%

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

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

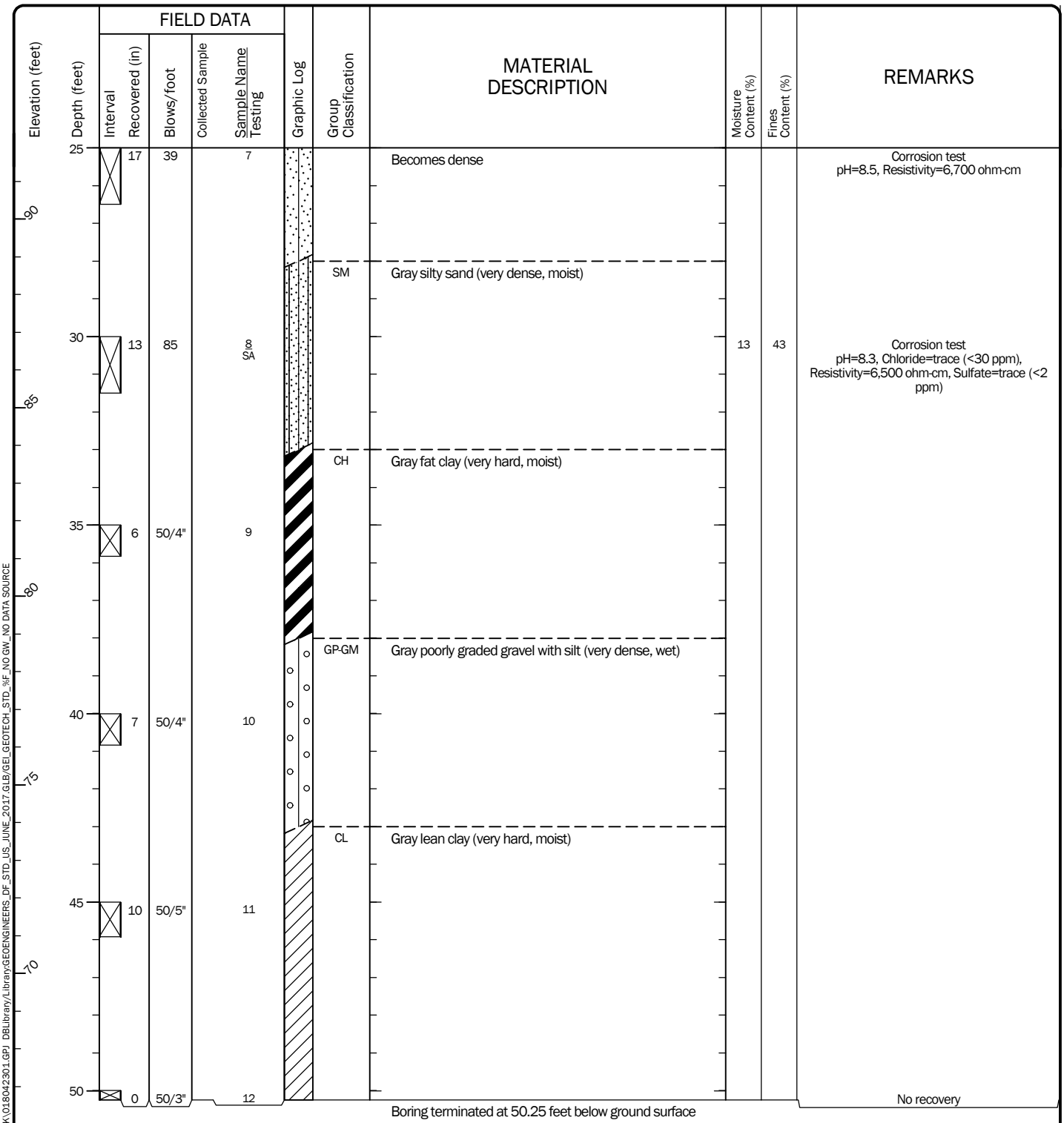
Date:9/23/24 Path:C:\USERS\LHUSTON\ONEDRIVE - GEOENGINEERS, INC\WORK\0180423O1.GPJ DBLibrary:Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEL_GEOTECH_STD_%F_NO GW_NO DATA SOURCE

Log of Boring W-B126-24

GeoEngineers

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

Figure A-46
Sheet 1 of 2



Date:9/23/24 Path:C:\USERS\LHUSTON\ONEDRIVE - GEOENGINEERS, INC\WORK\0180423001.GPJ DBLibrary:LLibrary:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEL_GEOTECH_STD_%F_NO GW_NO DATA SOURCE

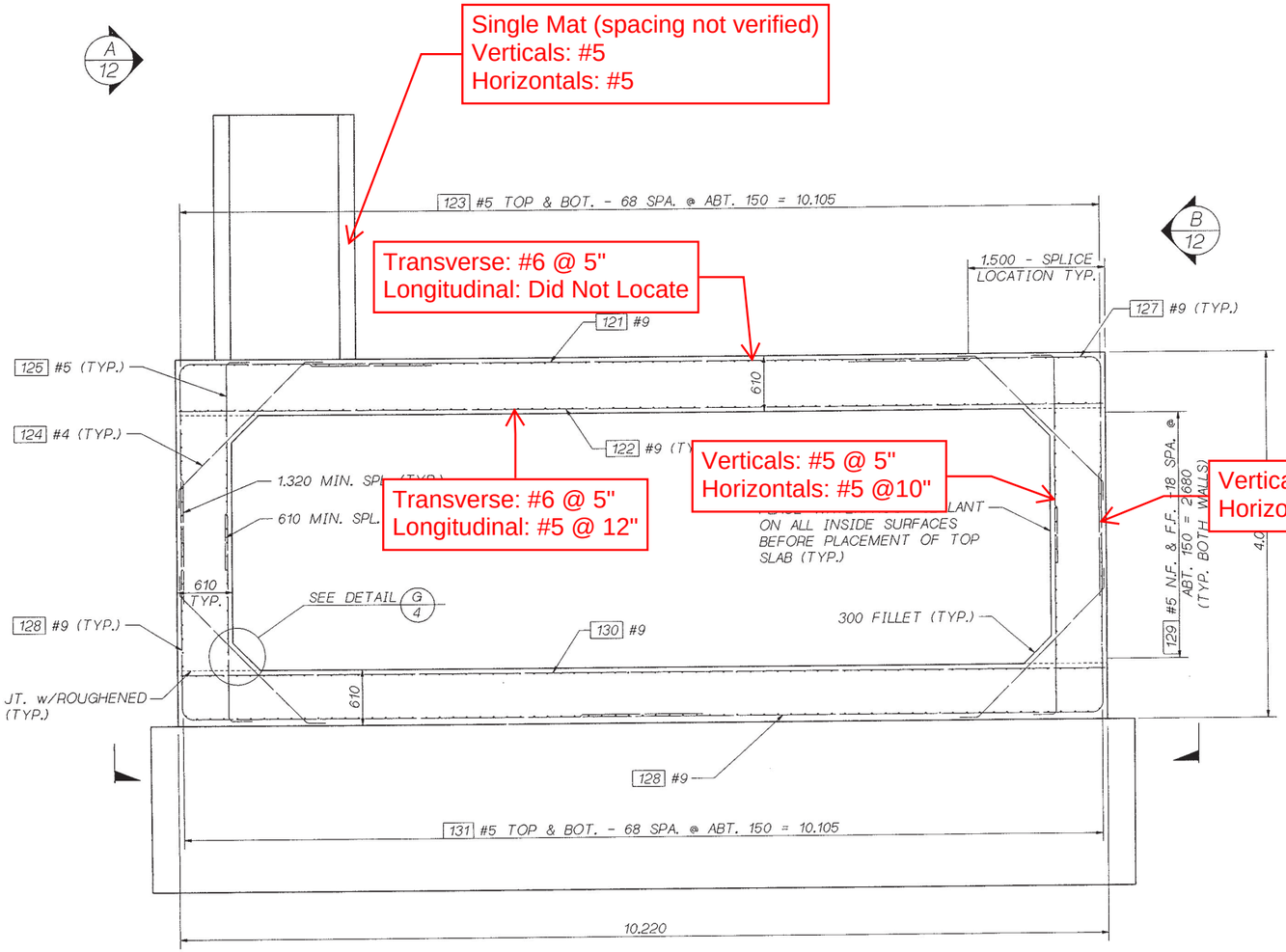
Log of Boring W-B126-24 (continued)

GeoEngineers

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

Figure A-47
Sheet 2 of 2

Field Investigations



TYPICAL TRANSVERSE SECTION

FOR "AS CONSTRUCTED PLANS" ONLY

SR 405 JOB NO. 7082 SHEET 9

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
Supervisor R. T. SHAEFER					10	WASH.				RAYMOND T. SHAEFER, STATE OF WASHINGTON, 14378, REGISTERED PROFESSIONAL ENGINEER, EXPIRES 4/23/98 — 11-15-96 — SUPERVISING BRIDGE ENGINEER
Designed By M.TALUKDAR 8/96										CHARLES C. RUTH, STATE OF WASHINGTON, 13622, REGISTERED PROFESSIONAL ENGINEER, EXPIRES 5/3/98 — 11-15-96 — BRIDGE DESIGN ENGINEER
Checked By F. KESHAVARZI 10/96					JOB NUMBER 96W035					Washington State Department of Transportation
Detailed By V.B. SCHICCHI 8/96										SR 405 BOTHELL TO SWAMP CREEK I/C HOV LANES - STAGE 1 TANKS AND VAULTS
Bridge Projects Engr.										NW-12 VAULT SECTIONS
Prelim. Plan By					5054					BRIDGE SHEET NO. 9
Architect/Specialist	DATE	REVISION	BY	APP'D						SHEET 199 OF 663 SHEETS

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

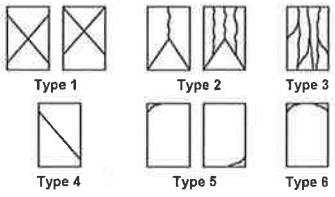
Design Strength:

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.

TYPES OF FRACTURE



Copies to:

Reported by:

MIke Holtz
Laboratory Manager

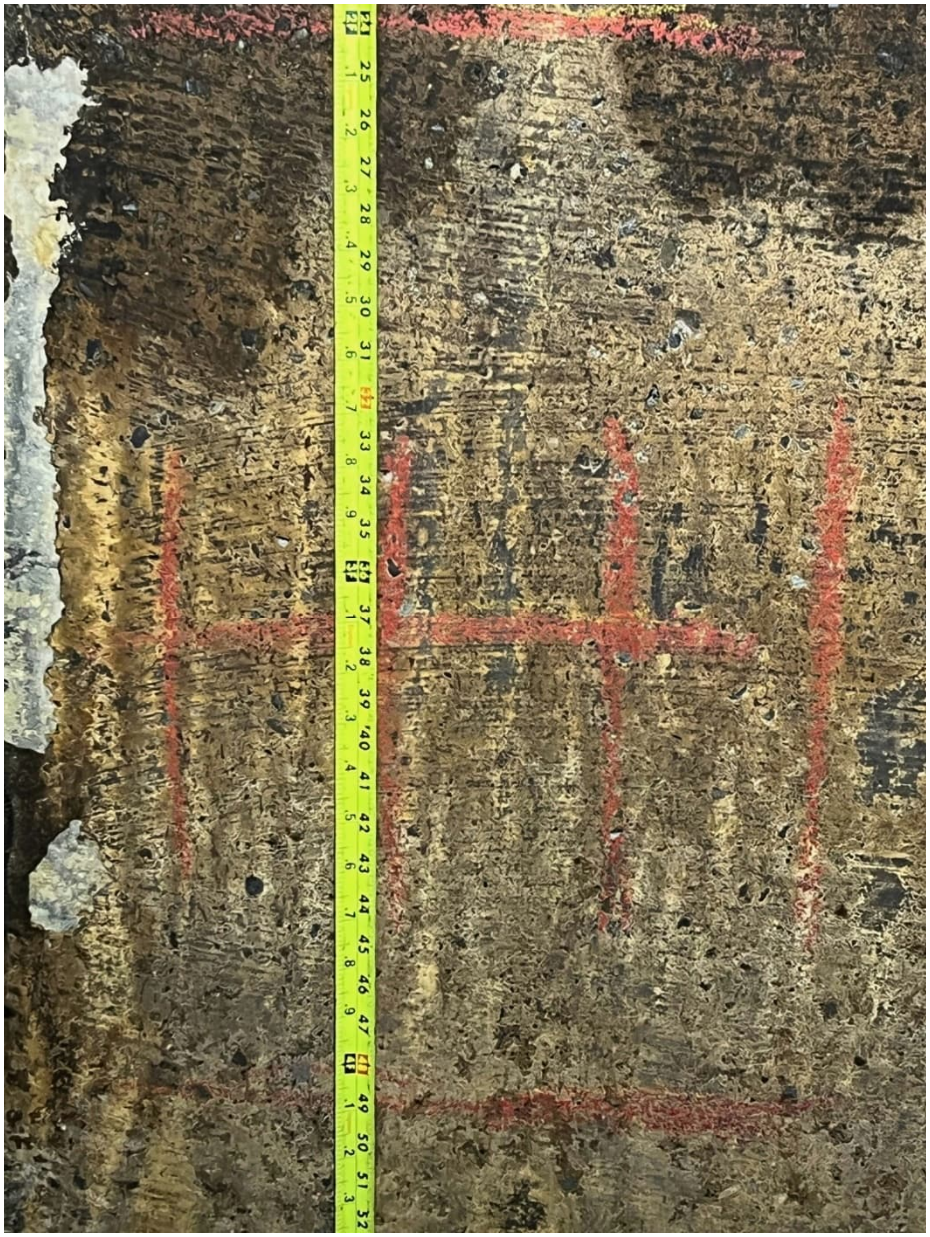
Ceiling Rebar

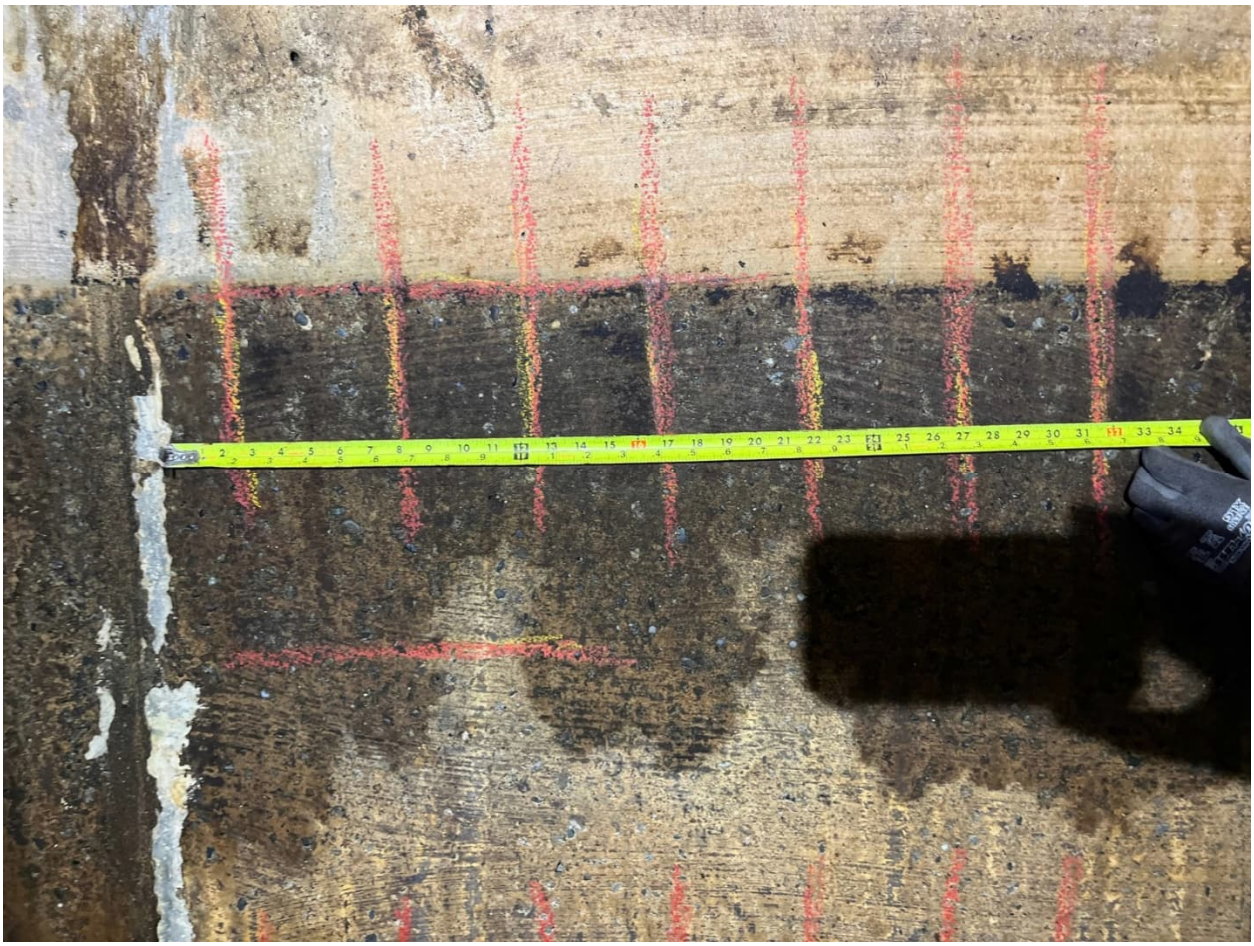

Network:Mar 13, 2025 at 1:14:08 AM PDT
Local:Mar 13, 2025 at 1:14:08 AM PDT
N 47° 47' 33.121", W 122° 12' 35.475"
I-405 S
Bothell WA 98021
United States


DEWALT

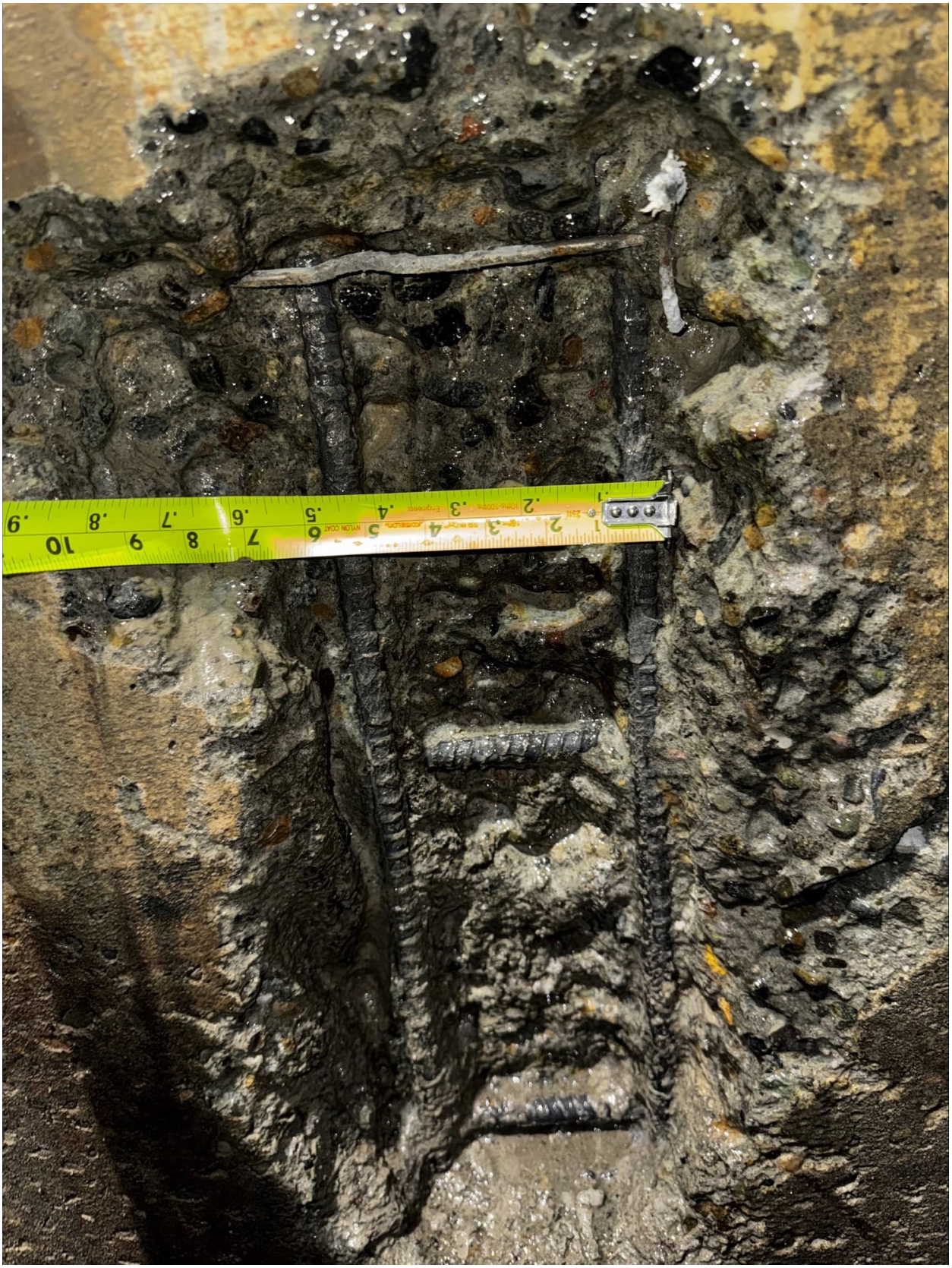

DEWALT

Wall Rebar



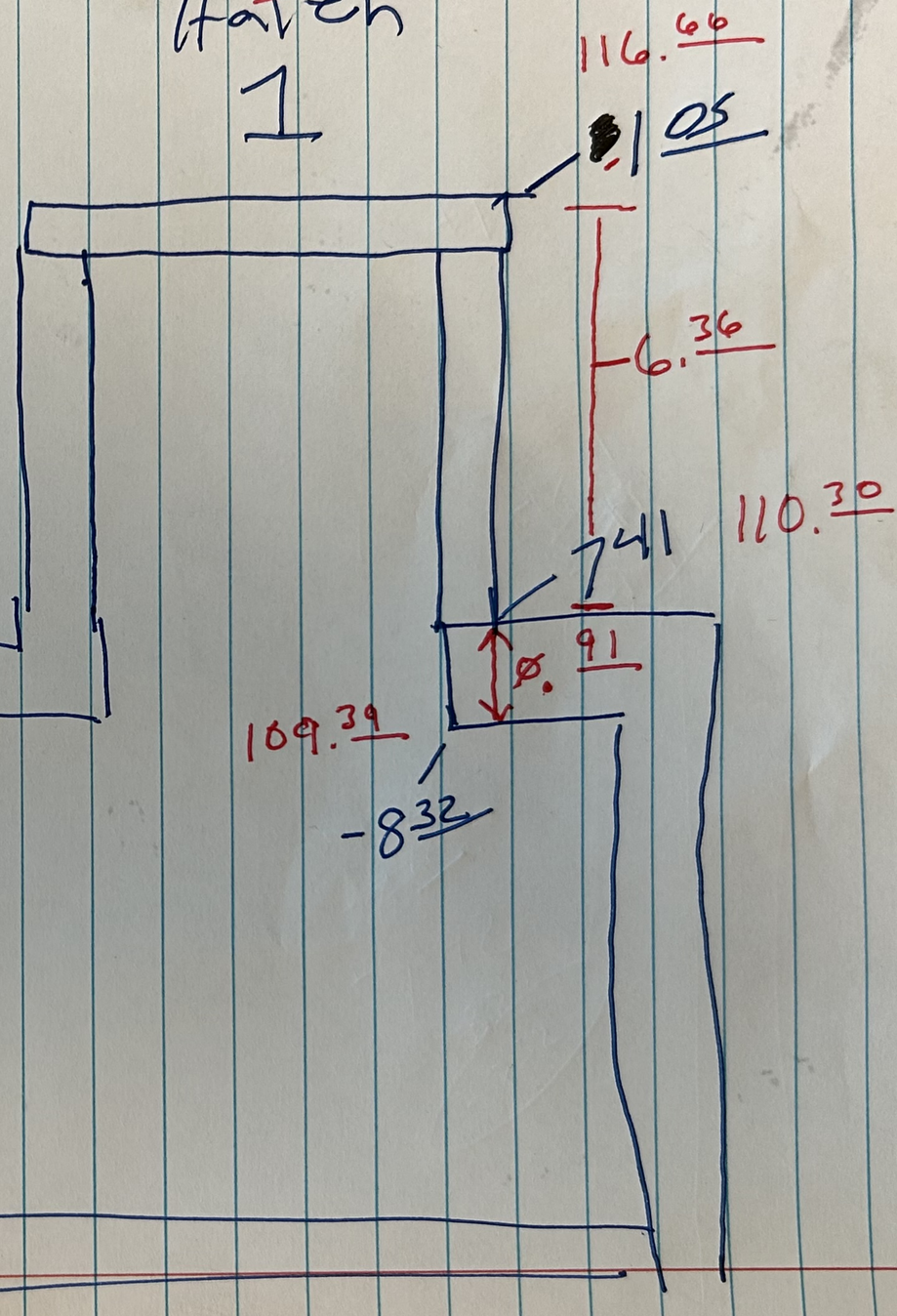



Engineers




I-405 NB
ITS #103
1
2
3
4
5
6
7
I-405 SB

North End
Hatch
1



IJ

117.71

250317 PRKER 120

Hatch 6

115.38 per survey shot

0.00

ITS

25031 7PRKER_103

.10

115.48

Rim @ Grade

6.10

Grade rings

109.38

Top structure

-6.00

Ø.90

-6.90

108.48

Vault Ceiling

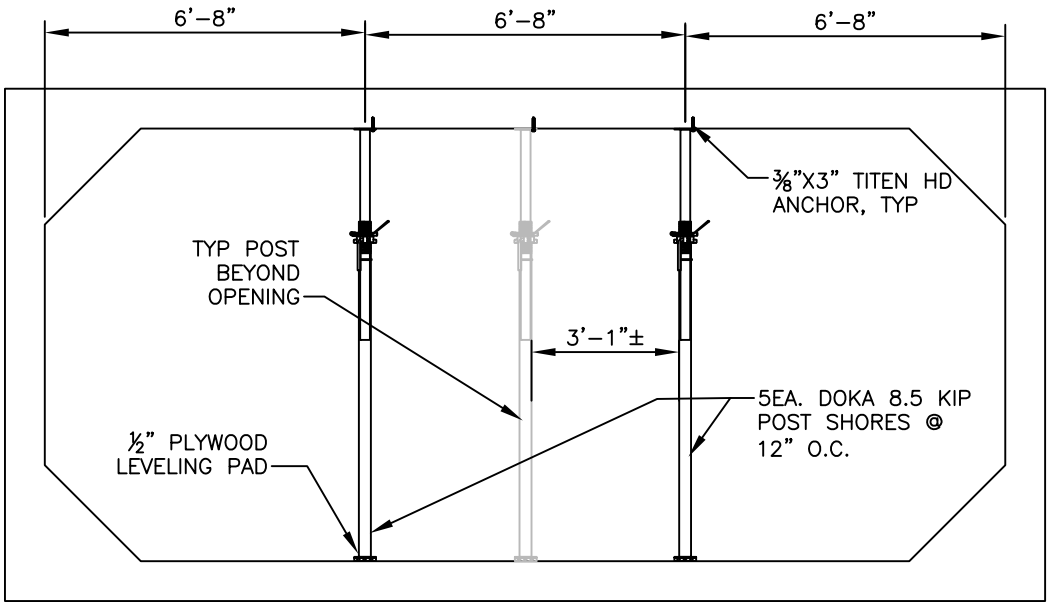
May 15, 2025 at 2:00:35 AM
I-405 S
Bothell WA 98021
United States

SUPPLEMENTARY CALCULATIONS

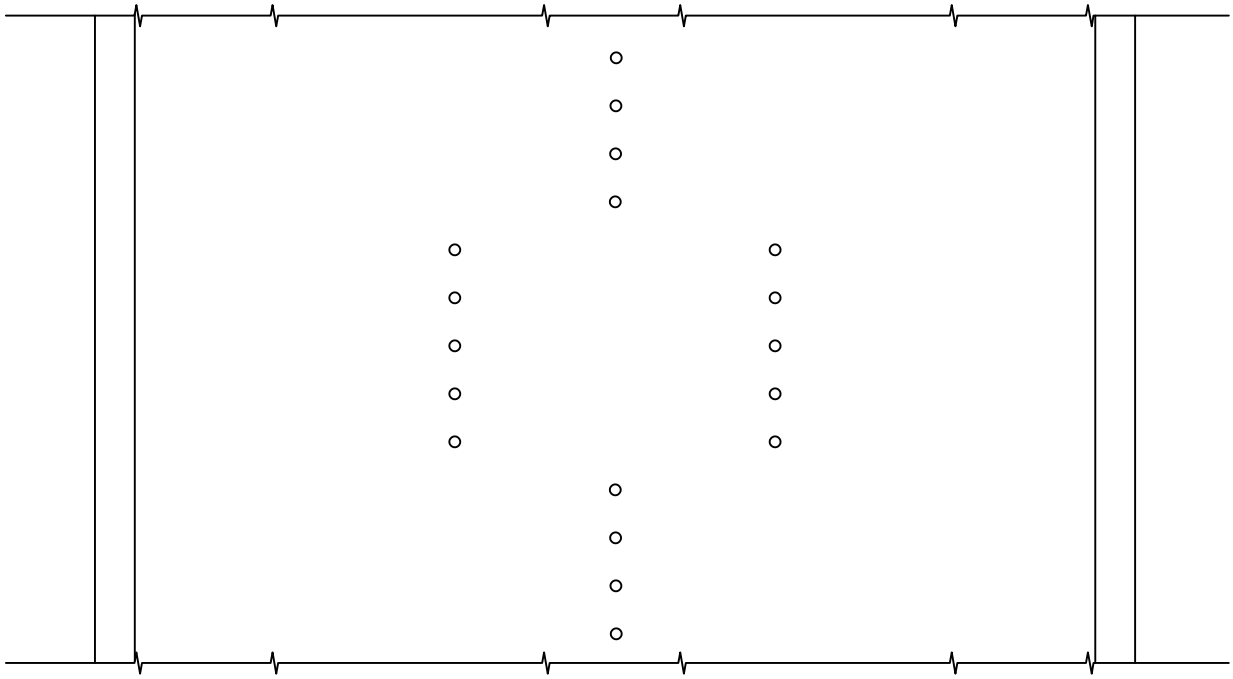
DATE:	7-17-2025
CLIENT:	SKANSKA USA CIVIL
PROJECT:	I -405 BRICKYARD
SUB-PROJECT:	BOX CULVERT TRAFFIC SHIFT
TYPE:	ACCESS POINT TEMP SHORING
REVISION:	0
PREPARED BY:	FORREST MEGARGEL

These supplementary calculations are for a revised shoring configuration to enable workers and emergency personnel to access each side of the box culvert. All external loads have remained unchanged. The bridge rating summary will not change from the original submittal which is based on a single center post configuration. That design is less conservative than this design. Load ratings are considerably higher with the 2 post configuration.

4M ENGINEERING
CIVIL – STRUCTURAL
6675 Purple Poppy Ln., Park City, UT 84098 801-380-0562



BOX CULVERT TEMP SHORING @
INTERIOR ACCESS POINTS
SCALE: 1:4



PLAN LAYOUT
INTERIOR ACCESS POINT
SCALE: 1:4

Results Grid

Fill Depth, ft: 4 | Truck: HL-93 | Member: Interior walls | Load Type: Unfactored Dead Load (DL)

Location (ft)	Moment (kip-ft/ft)	Shear (k/ft)	Axial Force (k/ft)
0.42	0.04	0.00	-0.97
1.40	0.03	0.00	-0.97
2.38	0.03	0.00	-0.97
3.37	0.03	0.00	-0.97
4.35	0.02	0.00	-0.97
5.33	0.02	0.00	-0.97
6.32	0.01	0.00	-0.97
7.30	0.01	0.00	-0.97
8.28	0.01	0.00	-0.97
9.27	0.00	0.00	-0.97
10.25	0.00	0.00	-0.97

Close

Results Grid

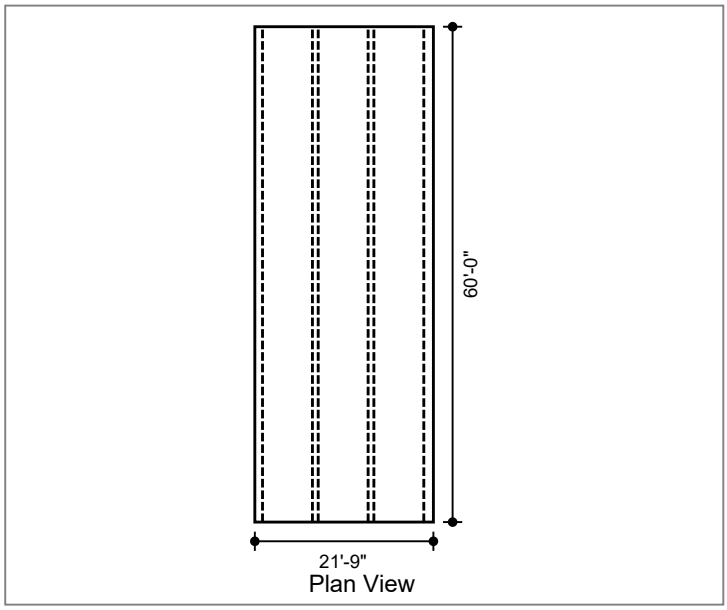
Fill Depth, ft: 4 | Truck: HL-93 | Member: Interior walls | Load Type: Unfactored Live Load (LL)

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	0.06	0.00	0.00	-0.01	0.39	-5.25
1.40	0.05	0.00	0.00	-0.01	0.39	-5.25
2.38	0.05	0.00	0.00	-0.01	0.39	-5.25
3.37	0.04	0.00	0.00	-0.01	0.39	-5.25
4.35	0.04	0.00	0.00	-0.01	0.39	-5.25
5.33	0.03	0.00	0.00	-0.01	0.39	-5.25
6.32	0.02	0.00	0.00	-0.01	0.39	-5.25
7.30	0.02	0.00	0.00	-0.01	0.39	-5.25
8.28	0.01	0.00	0.00	-0.01	0.39	-5.25
9.27	0.01	0.00	0.00	-0.01	0.39	-5.25
10.25	0.00	0.00	0.00	-0.01	0.39	-5.25

Close

Total vertical load = .97 + 5.25 = 6.22 kips/ft
Post allowable load = 8.5 kips ea.
Spacing = 12" O.C, OK

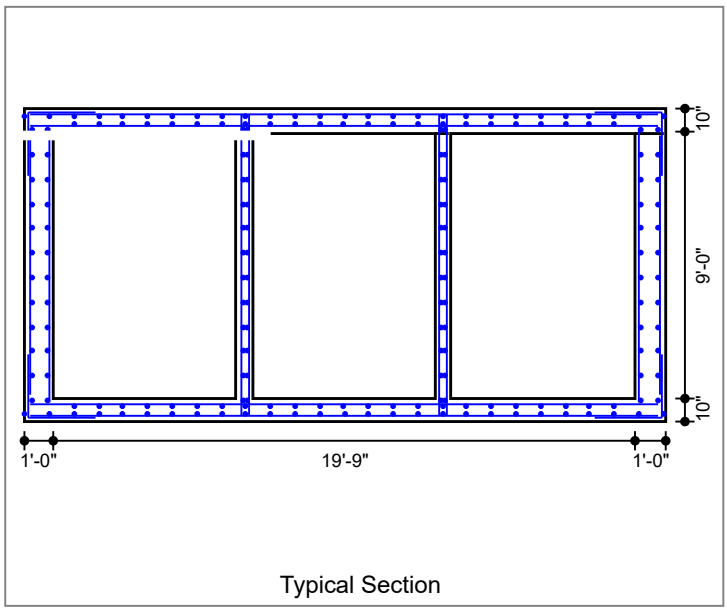
Spec.: LRFD 9th ed.
Type of Culvert: Precast



Plan View

Physical Dimensions

Clear Span:	6'-3"
Clear Height:	9'-0"
Top Slab:	10"
Bottom Slab:	10"
Ext. Wall:	1'-0"
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"



Typical Section

Material Properties

Concrete	
Strength, f'c:	6.500 ksi
Density:	0.155 kcf
Elasticity, Ec:	5347 ksi
Type:	Normal wt
Steel	
Yield, fy:	60 ksi
Allow Stress:	36 ksi
Elasticity, Es:	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: 4.05
Operating Rating: 5.24

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		

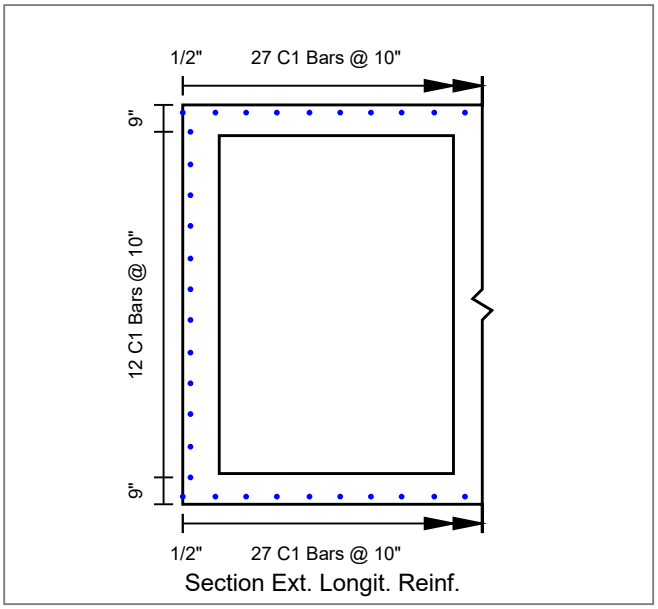
Dead Load

Future Wearing Surface:	0.000 klf	Lateral Soil Loads	
Additional Dead Load:	0.000 klf	Active, Ka:	0.33
Concentrated Loads:	none		
Interior Water Pressure:	no		
Exterior Water Pressure:	no		

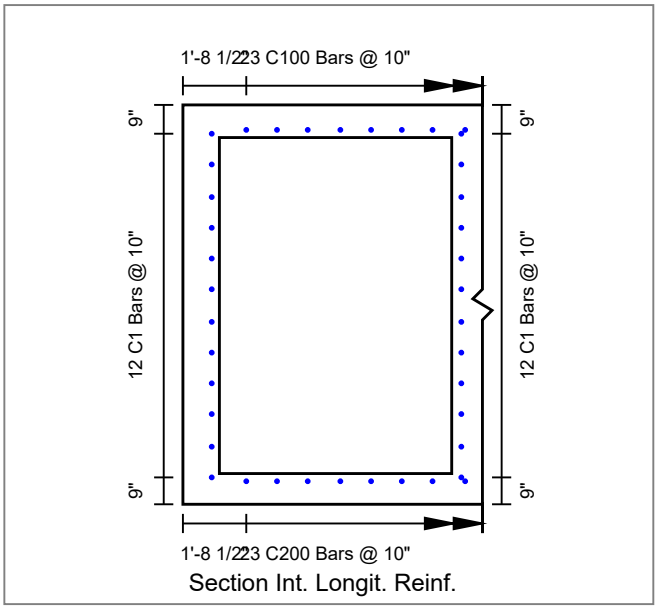
Concrete Summary
Volume of Concrete: 2.343 cy/ft Total Volume of Concrete: 140.556 cy

Reinforcing Steel Bar Schedule (lb)

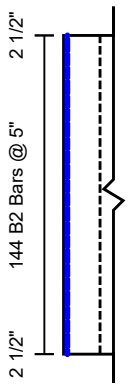
Location	Mark	Qty	Size	Spacing	Type	Length	Hor.Leg	Ver.Leg	Tot.Weight
Top Slab(Int)	A100 (AS2)	144	6	5"	S	21'-4"	--	--	4614.0
Bot Slab(Int)	A200 (AS3)	144	6	5"	S	21'-4"	--	--	4614.0
Top Slab(Ext)	A300 (AS7)	144	6	5"	S	21'-4"	--	--	4614.0
Bot Slab(Ext)	A400 (AS8)	144	6	5"	S	21'-4"	--	--	4614.0
Corner(Top)	A1 (AS1)	288	5	5"	L	4'-6"	2'-4"	2'-2"	1352.0
Corner(Bot)	A2 (AS1)	288	5	5"	L	4'-6"	2'-4"	2'-2"	1352.0
Wall(Int)	B1 (AS4)	288	5	5"	S	9'-4"	--	--	2854.0
Wall(Ext)	B2 (AS1)	288	6	5"	S	8'-10"	--	--	3893.0
Int Wall	B3	240	3	1'-0"	S	10'-3"	--	--	925.0
Longit. Top (Int)	C100 (AS5)	23	3	10"	S	59'-11"	--	--	518.0
Longit. Bot (Int)	C200	23	3	10"	S	59'-11"	--	--	518.0
Longit. Top (Ext)	C1 (AS6)	27	3	10"	S	59'-11"	--	--	608.2
Longit. Bot (Ext)	C1 (AS6)	27	3	10"	S	59'-11"	--	--	608.2
Longit. Wall (Ext)	C1 (AS6)	24	3	10"	S	59'-11"	--	--	540.7
Longit. Wall (Int)	C1 (AS6)	24	3	10"	S	59'-11"	--	--	540.7
Longit. Int	C1 (AS6)	48	3	10"	S	59'-11"	--	--	991.2
									33157



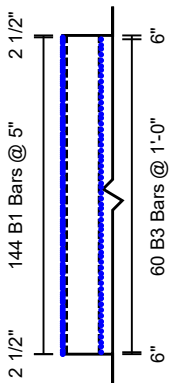
Section Ext. Longit. Reinf.



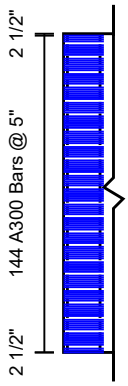
Section Int. Longit. Reinf.



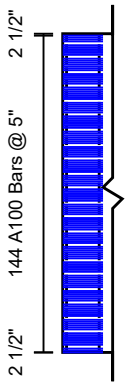
Ext. Wall Reinf.



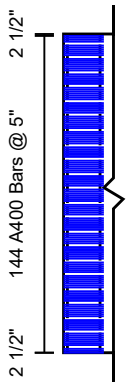
Int. Wall Reinf.



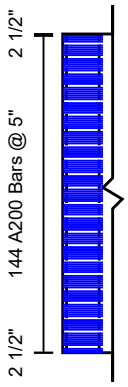
Top Slab Ext. Reinf.



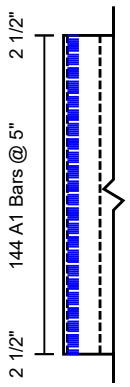
Top Slab Int. Reinf.



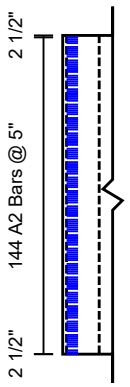
Bottom Slab Ext. Reinf.



Bottom Slab Int. Reinf.



Top Slab Corner Reinf.



Bottom Slab Corner Reinf.

RATINGS SUMMARY
==========

	Flexure			Shear		
Truck	RF(INV)	RF(OP)	Controlling Point	RF(INV)	RF(OP)	Controlling Point
(AA) HL-93	5.88	7.62	Top Slab, MID	4.05	5.24	Top Slab, RT
(AB) EV 2	8.71	8.71	Top Slab, MID	7.25	7.25	Top Slab, RT
(AC) EV 3	7.94	7.94	Top Slab, MID	6.52	6.52	Top Slab, RT
(AD) NRL - Le	12.50	12.50	Top Slab, MID	9.86	9.86	Top Slab, RT
(AE) NRL	8.18	8.18	Top Slab, MID	6.11	6.11	Top Slab, RT
(AF) Oveload	12.41	12.41	Top Slab, MID	10.67	10.67	Top Slab, RT
(AG) Oveload	12.41	12.41	Top Slab, MID	10.67	10.67	Top Slab, RT
(AH) Type 3-3	9.94	9.94	Top Slab, MID	7.61	7.61	Top Slab, RT
(AI) Type 3	8.18	8.18	Top Slab, MID	6.11	6.11	Top Slab, RT
(AJ) Type 3S2	8.97	8.97	Top Slab, MID	6.79	6.79	Top Slab, RT
(AK) WA-105	8.18	8.18	Top Slab, MID	6.11	6.11	Top Slab, RT

REINFORCEMENT SUMMARY
=====================

M dimension = 1' 7" (method of equivalent capacity)
= 4' 6" (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	6	STR	5.00	1.056	21- 4	4614		
Bot Slab (int)	A200 (AS3)	144	6	STR	5.00	1.056	21- 4	4614		
Top Slab (ext)	A300 (AS7)	144	6	STR	5.00	1.056	21- 4	4614		
Bot Slab (ext)	A400 (AS8)	144	6	STR	5.00	1.056	21- 4	4614		
Corner (Top)	A1 (AS1)	288	5	L-BAR	5.00	0.744	4- 6	1352	2- 4	2- 2
Corner (Bottom)	A2 (AS1)	288	5	L-BAR	5.00	0.744	4- 6	1352	2- 4	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	240	3	STR	12.00	0.110	10- 3	925		
Top Slab (int- 1)	C100 (AS5)	23	3	STR	10.00	0.132	59-11	518		
Bot Slab (int- 1)	C200	23	3	STR	10.00	0.132	59-11	518		
Temperature (1)	C1 (AS6)	27	3	STR	10.00	0.132	59-11	608		
Temperature (1)	C1 (AS6)	27	3	STR	10.00	0.132	59-11	608		
Temperature (1)	C1 (AS6)	24	3	STR	10.00	0.132	59-11	541		
Temperature (1)	C1 (AS6)	24	3	STR	10.00	0.132	59-11	541		
Temperature (1)	C1 (AS6)	48	3	STR	10.00	0.132	59-11	991		
							Total	33157		

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)	1.056
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)	0.132
Distribution Top Slab - OutSide Face (AS6)	0.132
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

Filename: Bothell DBC pinned revise.etcx

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: 3 Name: BoxCulvert
Clear Span : 6.2500 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: 12.0000 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: Active, Ka:  0.33
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: 1.500    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   12
```

Bot Slab: 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)	3	10.0000
Top Distribution	C100 (AS5)	3	10.0000
Bottom Distribution	C200	3	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: 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: no, Follow Specification
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 duribility 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 = 12.00 in
Interior Wall Thickness = 6.00 in

Modular Ratio (N) = 5.42 Max. Steel Ratio = 0.030
Design Span = 7.00 ft Design Height = 9.83 ft

Volume of Concrete: 2.343 cy/ft Weight of Steel: 553 lb/ft

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

M dimension = 1' 7" (method of equivalent capacity)
= 4' 6" (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	6	STR	5.00	1.056	21- 4	4614		
Bot Slab (int)	A200 (AS3)	144	6	STR	5.00	1.056	21- 4	4614		
Top Slab (ext)	A300 (AS7)	144	6	STR	5.00	1.056	21- 4	4614		
Bot Slab (ext)	A400 (AS8)	144	6	STR	5.00	1.056	21- 4	4614		
Corner (Top)	A1 (AS1)	288	5	L-BAR	5.00	0.744	4- 6	1352	2- 4	2- 2
Corner (Bottom)	A2 (AS1)	288	5	L-BAR	5.00	0.744	4- 6	1352	2- 4	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	240	3	STR	12.00	0.110	10- 3	925		
Top Slab (int- 1)	C100 (AS5)	23	3	STR	10.00	0.132	59-11	518		
Bot Slab (int- 1)	C200	23	3	STR	10.00	0.132	59-11	518		
Temperature (1)	C1 (AS6)	27	3	STR	10.00	0.132	59-11	608		
Temperature (1)	C1 (AS6)	27	3	STR	10.00	0.132	59-11	608		
Temperature (1)	C1 (AS6)	24	3	STR	10.00	0.132	59-11	541		
Temperature (1)	C1 (AS6)	24	3	STR	10.00	0.132	59-11	541		
Temperature (1)	C1 (AS6)	48	3	STR	10.00	0.132	59-11	991		
							Total	33157		

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)	1.056
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)	0.132
Distribution Top Slab - OutSide Face (AS6)	0.132
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	ILF	OLF	Flexure Fill	Flexure Member	Flexure Location	Flexure IR	Flexure OR	Shear Fill	Shear Member	Shear Location	Shear IR	Shear OR
(AA)HL-93	1.75	1.35	4.00	2	MID	5.88	7.62	4.00	2	RT	4.05	5.24
(AB)EV 2	1.30	1.30	4.00	2	MID	8.71	8.71	4.00	2	RT	7.25	7.25
(AC)EV 3	1.30	1.30	4.00	2	MID	7.94	7.94	4.00	2	RT	6.52	6.52
(AD)NRL -	2.00	2.00	4.00	2	MID	12.50	12.50	4.00	2	RT	9.86	9.86
(AE)NRL	2.00	2.00	4.00	2	MID	8.18	8.18	4.00	2	RT	6.11	6.11
(AF)Oveloa	1.20	1.20	4.00	2	MID	12.41	12.41	4.00	2	RT	10.67	10.67
(AG)Oveloa	1.20	1.20	4.00	2	MID	12.41	12.41	4.00	2	RT	10.67	10.67
(AH)Type 3	2.00	2.00	4.00	2	MID	9.94	9.94	4.00	2	RT	7.61	7.61
(AI)Type 3	2.00	2.00	4.00	2	MID	8.18	8.18	4.00	2	RT	6.11	6.11
(AJ)Type 3	2.00	2.00	4.00	2	MID	8.97	8.97	4.00	2	RT	6.79	6.79
(AK)WA-105	2.00	2.00	4.00	2	MID	8.18	8.18	4.00	2	RT	6.11	6.11

Critical Sections Summary: Flexure

Member 1: (Exterior Wall), Thickness = 12.00 in

Design	Corr.	Load Ratings	Fill

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	5.00	-7.50	6.24	34.79	9.69	37.53	1.00	0.74	23.50	16.21	21.01	AA	6.00
MID	59.00	7.00	2.28	34.79	9.69	35.79	1.00	0.74	23.50	19.29	25.01	AA	6.00
MID-	59.00	1.35	4.58	48.30	9.63	50.21	1.00	1.06	23.50	NC	NC	AF	6.00
TOP	5.00	0.0#	1.63	34.79	9.69	35.51	1.00	0.74	23.50	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 (in2)	Mcr (k-ft)	Load Ratings IR	OR	Truck	Fill Depth (ft)
LT	6.00	0.0#	0.97	27.35	7.69	27.70	1.00	0.74	16.32	NC	NC	AA	4.00
MID	33.60	9.22	0.75	37.74	7.63	37.99	1.00	1.06	16.32	5.88	7.62	AA	4.00
MID-	33.60	0.0#	2.66	37.74	7.63	38.63	1.00	1.06	16.32	NC	NC	AA	4.00
RT	3.00	-7.92	0.97	38.07	7.69	38.39	1.00	1.06	16.32	7.21	9.35	AA	4.00

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 (in2)	Mcr (k-ft)	Load Ratings IR	OR	Truck	Fill Depth (ft)
BOT	5.00	-0.10	4.32	2.07	3.81	3.10	1.00	0.11	5.87	71.36	92.51	AA	4.00
MID	47.20	0.08	5.51	2.07	3.81	3.38	1.00	0.11	5.87	53.66	69.56	AA	4.00
TOP	5.00	0.00	9.99	2.07	3.81	4.42	1.00	0.11	5.87	NC	NC	AD	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 (in2)	Mcr (k-ft)	Load Ratings IR	OR	Truck	Fill Depth (ft)
LT	6.00	-6.30	5.84	27.35	7.69	29.43	1.00	0.74	16.32	17.68	22.92	AA	6.00
MID	42.00	5.19	2.49	37.74	7.63	38.57	1.00	1.06	16.32	12.64	16.39	AA	4.00
MID-	42.00	0.0#	4.94	37.74	7.63	39.39	1.00	1.06	16.32	NC	NC	AA	4.00
RT	3.00	-6.96	2.71	38.07	7.69	38.98	1.00	1.06	16.32	10.11	13.11	AA	4.00

Member 5: (Top Slab - Interior Cell), 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 IR	OR	Truck	Fill Depth (ft)
LT	3.00	-8.44	0.98	37.74	7.63	38.07	1.00	1.06	16.32	6.64	8.61	AA	4.00
MID	42.00	3.82	0.77	37.74	7.63	37.99	1.00	1.06	16.32	12.65	16.40	AA	4.00
RT	3.00	-8.44	0.98	37.74	7.63	38.07	1.00	1.06	16.32	6.64	8.61	AA	4.00

Member 7: (Bottom Slab - Interior Cell), 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 IR	OR	Truck	Fill Depth (ft)
LT	3.00	-7.01	2.70	37.74	7.63	38.64	1.00	1.06	16.32	9.93	12.87	AA	4.00
MID	42.00	3.94	5.70	37.74	7.63	39.64	1.00	1.06	16.32	33.09	42.89	AA	6.00
RT	3.00	-7.01	2.70	37.74	7.63	38.64	1.00	1.06	16.32	9.93	12.87	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 = 12.00 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 IR	OR	Truck	Fill Depth (ft)
BOT	13.64	4.53	4.1	6.24	9.35	28.79	3.538	31.99 a	0.00	0.00	0.00	28.26	36.64	AA	6.00
MID	59.00	0.73	7.0	2.28	9.35	26.17	3.216	29.08 a	0.00	0.00	0.00	NC	NC	AA	6.00
MID-	59.00	0.42	2.0	4.58	9.15	37.98	4.772	42.20 a	0.00	0.00	0.00	NC	NC	AF	6.00
TOP	13.64	-2.39	1.0	2.28	9.35	32.52	3.997	36.13 a	0.00	0.00	0.00	56.14	72.77	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 IR	OR	Truck	Fill Depth (ft)
LT	13.20	4.22	5.6	0.97	7.69	20.12	3.009	22.36 a	0.00	0.00	0.00	6.71	8.69	AA	4.00
MID	42.00	0.51	8.5	1.08	7.63	21.46	3.234	23.84 a	0.00	0.00	0.00	82.13	99.99	AA	6.00
MID-	42.00	2.08	2.2	2.66	7.63	26.45	4.207	29.39 a	0.00	0.00	0.00	16.89	21.89	AA	4.00
RT	10.20	7.46	3.7	0.97	7.69	21.89	3.273	24.33 a	0.00	0.00	0.00	4.05	5.24	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 (in2)	Max. Spac (in)	Load Ratings IR	OR	Truck	Fill Depth (ft)
BOT	9.32	0.01	0.1	6.04	4.32	19.57	5.207	21.75 a	0.00	0.00	0.00	NC	NC	AA	6.00
MID	59.00	0.01	0.1	8.28	4.32	19.67	5.233	21.86 a	0.00	0.00	0.00	NC	NC	AA	6.00
TOP	9.32	0.01	0.0	15.37	4.32	19.96	5.310	22.18 a	0.00	0.00	0.00	99.99	99.99	AA	4.00

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 IR	OR	Truck	Fill Depth (ft)
LT	13.20	5.23	3.6	5.84	7.69	23.54	3.520	26.16 a	0.00	0.00	0.00	13.02	16.87	AA	6.00
MID	42.00	0.60	4.9	2.98	7.63	25.35	3.822	28.17 a	0.00	0.00	0.00	NC	NC	AA	6.00
MID-	42.00	0.29	0.0	4.94	7.63	26.45	5.038	29.39 a	0.00	0.00	0.00	NC	NC	AA	4.00
RT	10.20	5.85	3.0	2.71	7.69	23.88	3.570	26.53 a	0.00	0.00	0.00	7.06	9.15	AA	4.00

Member 5: (Top Slab - Interior Cell), 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 IR	OR	Truck	Fill Depth (ft)
LT	10.20	5.96	5.3	0.98	7.63	21.88	3.298	24.31 a	0.00	0.00	0.00	5.13	6.65	AA	4.00
MID	42.00	0.72	3.8	0.77	7.63	25.86	3.897	28.73 a	0.00	0.00	0.00	36.14	46.85	AA	4.00
RT	10.20	5.94	5.3	0.98	7.63	21.89	3.299	24.32 a	0.00	0.00	0.00	5.15	6.68	AA	4.00

Member 7: (Bottom Slab - Interior Cell), 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 IR	OR	Truck	Fill Depth (ft)
LT	10.20	3.94	0.2	2.70	7.63	26.12	3.938	29.03 a	0.00	0.00	0.00	12.75	16.53	AA	4.00
MID	42.00	0.00	3.9	5.70	7.63	26.45	4.319	29.39 a	0.00	0.00	0.00	NC	NC	AA	6.00
RT	10.20	5.36	3.5	2.70	7.63	24.07	3.628	26.75 a	0.00	0.00	0.00	8.30	10.76	AA	4.00

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

Confined Space Access
(Skanska Provided)

SKANSKA

Construction Work Plan

Overall Risk Level: Moderate

Editing

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

Revision Notes

None

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.

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

Inspection Template

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

Inspection Template

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 Enry
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
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)

SKANSKA

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

SKANSKA

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