WSDOT's Development of **Standard Plans** for **Buried Structures** in Support of Fish Passage

WILLIAM J. MILLER III

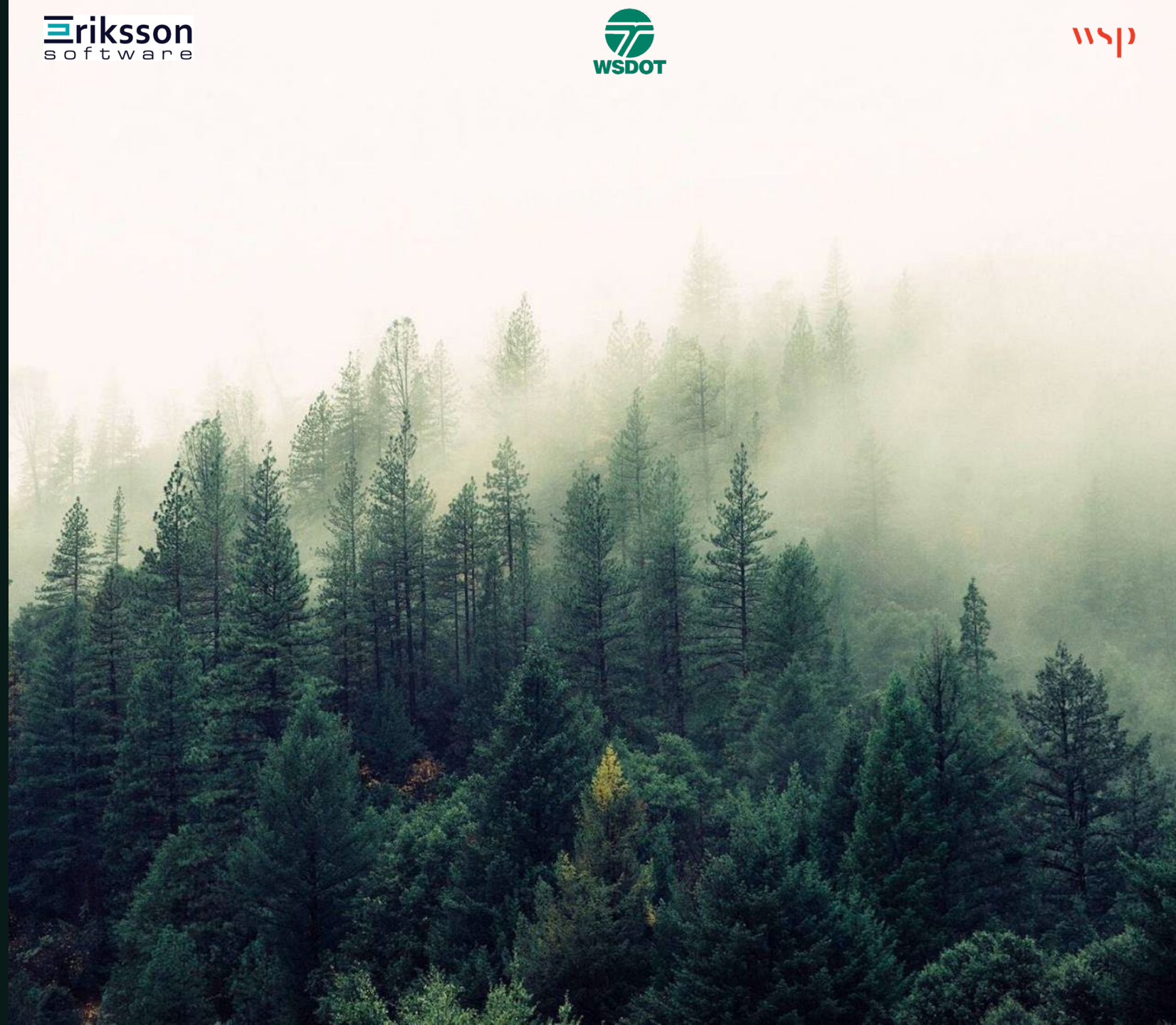


Photo Credit: scenicwa.com/ road-trips

Photo Credit: Meegan M. Reid / Kitsap Sun, File

Problem Statement

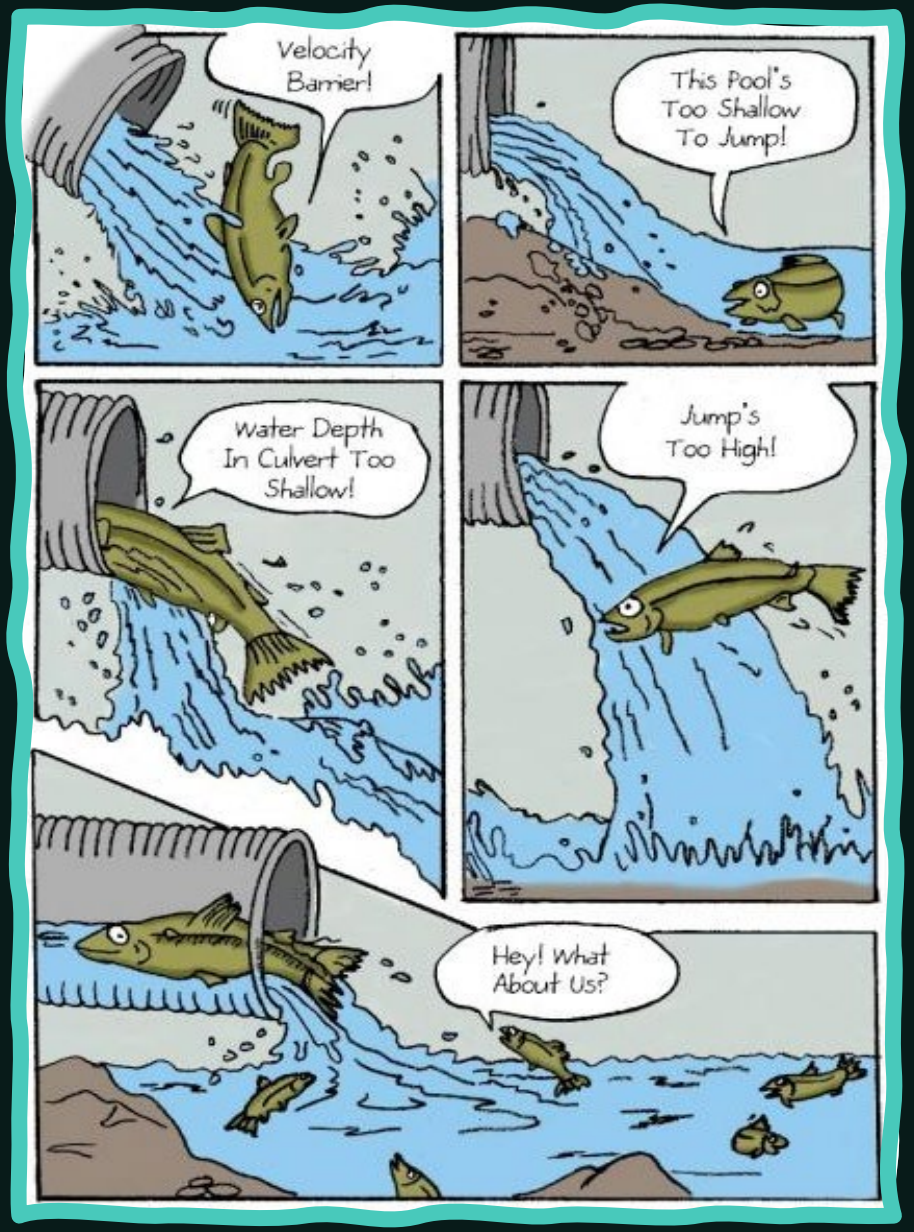
- State highways cross streams & rivers throughout Washington State.
- Substandard pipes & **Culverts** impede fish migration.
- Fish barriers block access to important spawning & rearing habitat.

Problem Statement

Fish Passage Barriers (Culverts):

- Hinder fish from moving upstream or downstream.
- Allow water flow, but don't always allow fish to swim through.
- The flow is too swift, too shallow, or has a waterfall at the inlet or outlet.

Photo Credit: WSDOT



Problem Statement

- In 1991, WSDOT created a dedicated fish passage program.
- Correcting hundreds of barriers, restoring miles of habitat.
- Fish barrier correction has created an opportunity to employ **Buried Structures**.

Photo Credit: wildsalmoncenter.org

Photo Credit: Washington Dept. of Fish & Wildlfe

Photo Credit: www.jvib.com.au

Photo Credit: WSDOT

Problem Statement

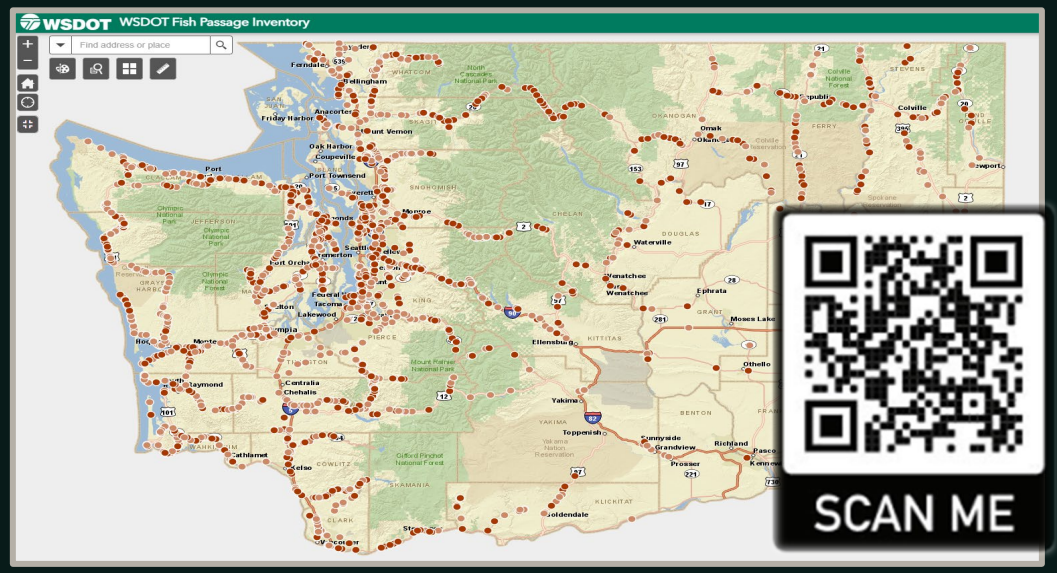
March 2013's Federal Court Injunction:

- Tribes reserved "the right of taking fish" under the Stevens Treaties.
- Requires increased efforts for removing barrier **Culverts** by 2030.
- Concentrated most of WSDOT's fish passage work within western WA.

Project Description

- WSDOT has a significant number of fish barrier removal projects to deliver.
- Many involve replacing existing substandard **Culverts** with new fish-friendly **Buried Structures**.
- To reduce design and construction costs, WSDOT has develop **Standard Plans**.

Photo Credit: Johnny Armstrong, wildsalmoncenter.org



WSDOT's Interactive Fish Passage Map

www.tinyurl.com/ wsdotfishpassage

Buried Structure Standard Plans

- Scope of Work
- Basis of Analysis
- Development
- Quality Reviews
- Publication & Beyond

Photo Credit: Adobe Stock

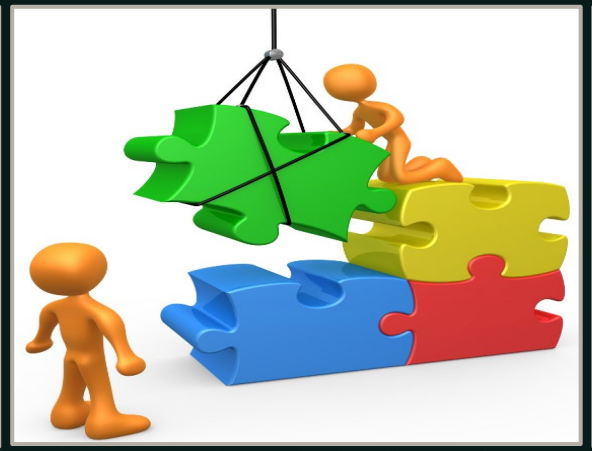


Photo Credit: Clipart-library.com/ n1244768

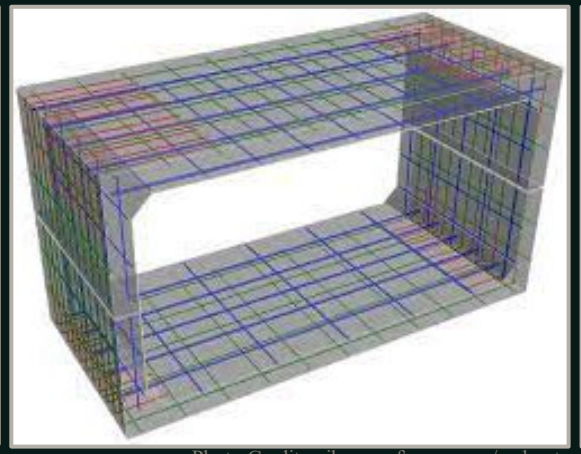


Photo Credit: erikssonsoftware.com/ culvert

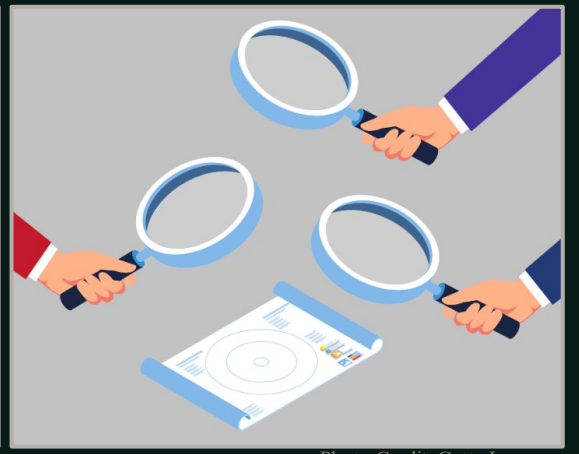


Photo Credit: Getty Images

Scope of Work

Analysis Phase

Design Phase

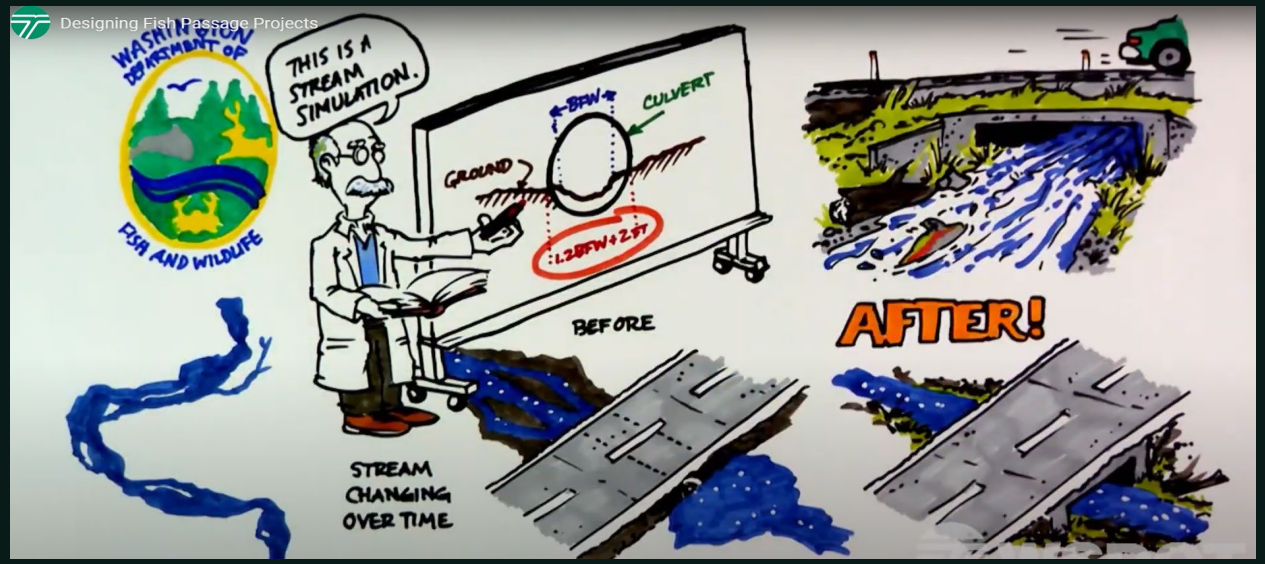
Deliverables & Schedule

Analysis Phase

WSDOT conducted initial parametric studies, prescribing feasible deign ranges.

WSP then preformed the structural and load rating analyses.

Hydrology – Geology – Seismic Hazard – Settlement – Burial Depth – Span Length



Design Phase

WSDOT then selected what spans and cover to develop **Standard Plans** for.

WSP then developed the necessary **Standard Plan** details.

WSDOT simultaneously revised agency publications and specs.

Deliverables

Standard Plans

Design Calculations

Design Examples

Load Rating Calculations

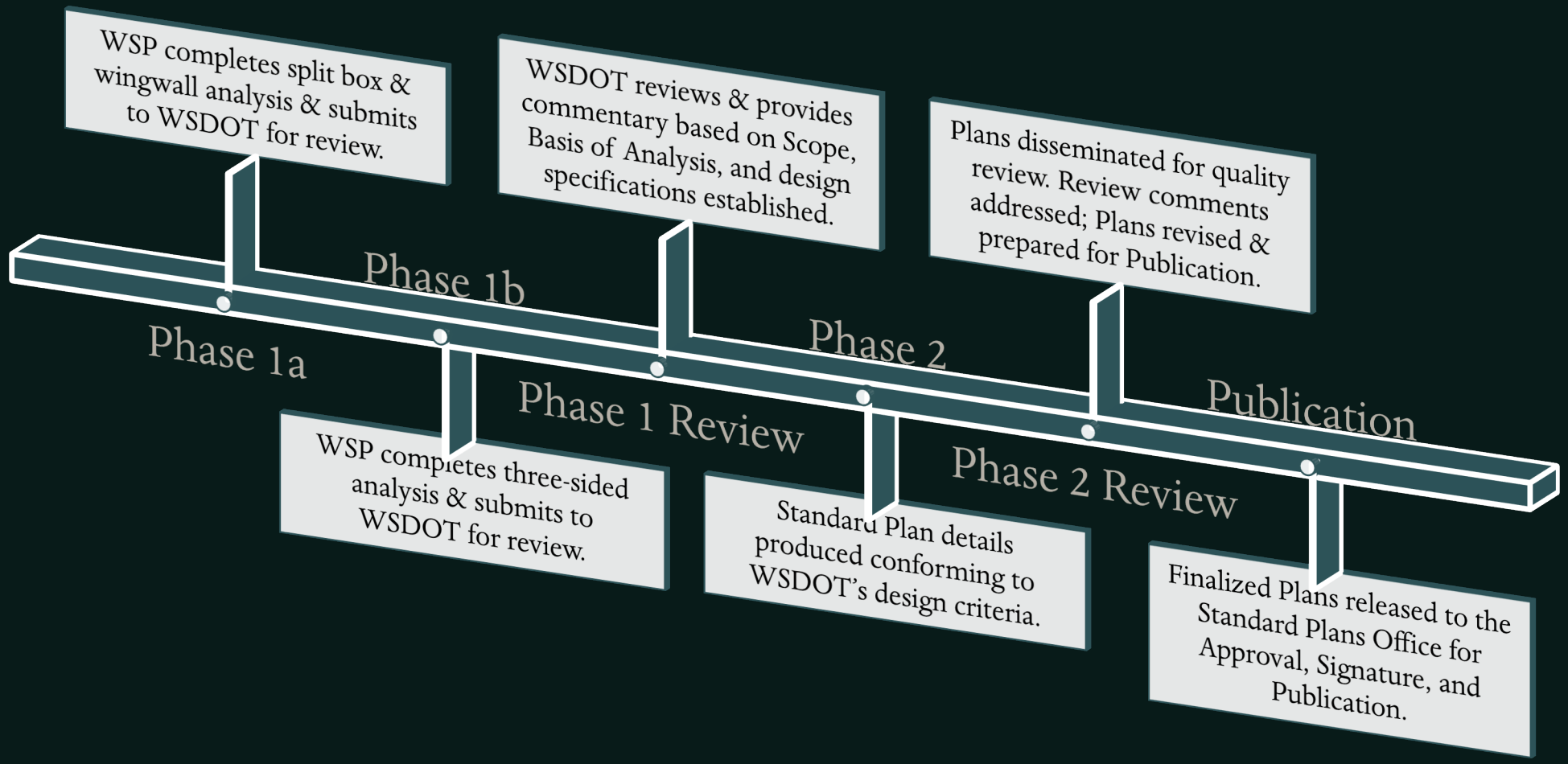
Photo Credit: Ladadik Art, Getty Images

Photo Credit: Meegan M. Reid / Kitsap Sun, File

Photo Credit: William J. Miller III

Photo Credit: WSDOT

Schedule


WSP completes split box & wingwall analysis & submits to WSDOT for review.
WSDOT reviews & provides commentary based on Scope, Basis of Analysis, and design specifications established.
Plans disseminated for quality review. Review comments addressed; Plans revised & prepared for Publication.
Phase 1a
Phase 1b
Phase 1 Review
Phase 2
Phase 2 Review
Publication
WSP completes three-sided analysis & submits to WSDOT for review.
Standard Plan details produced conforming to WSDOT's design criteria.
Finalized Plans released to the Standard Plans Office for Approval, Signature, and Publication.

Basis of Analysis

Split Box

Three-Sided

Wingwalls

WSDOT Provided Recommendations

HYDROLOGY

Photo Credit: interfluve.com

GEOTECHNICAL

Photo Credit: centralgeotech.com

MATERIAL

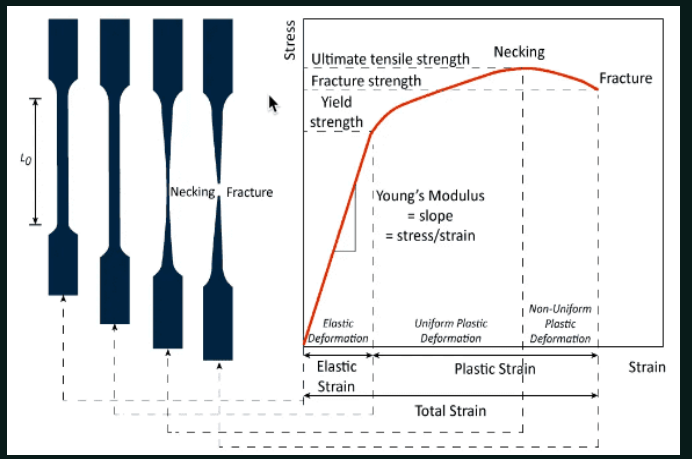


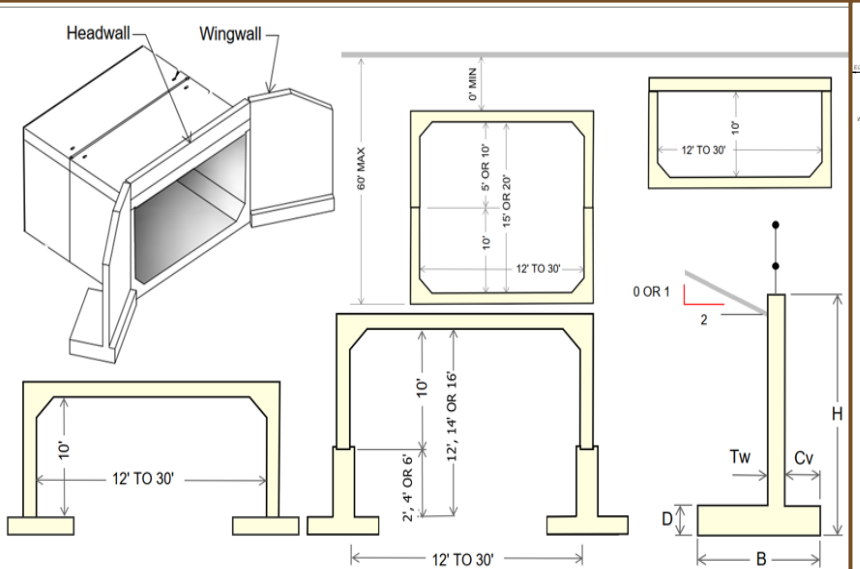
Photo Credit: simscale.com

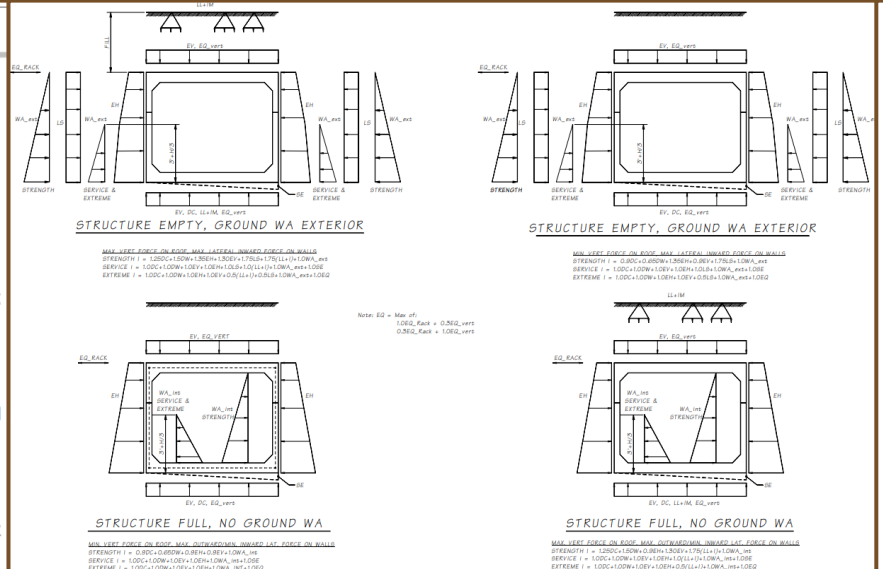
Basis of Analysis

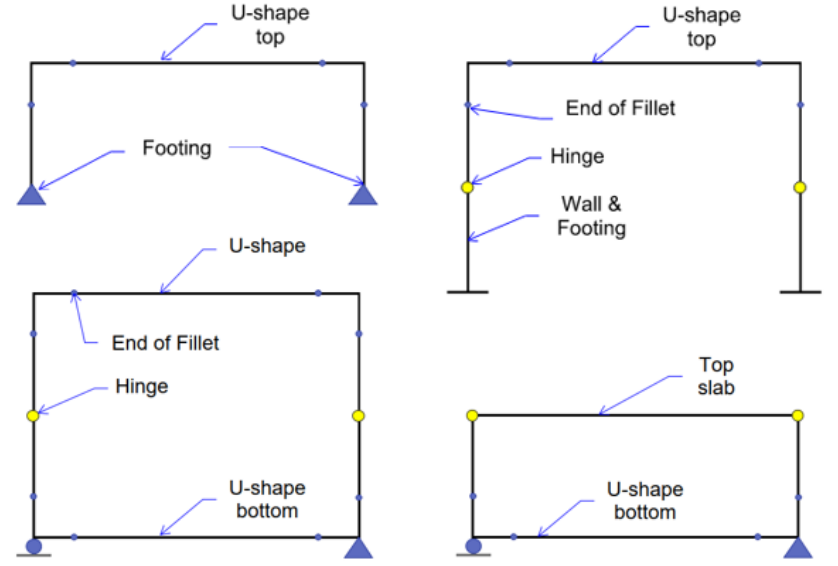
Defines the design criteria used for developing **Standard Plans** for split box and three-sided **Buried Structures**, including wingwall and headwall elements.

Geometrics – Materials – Loads – Factors – Combinations – Structural Analysis

Modeling – Limit States – Resistance Factors – Principals of Design







Development

Eriksson Software

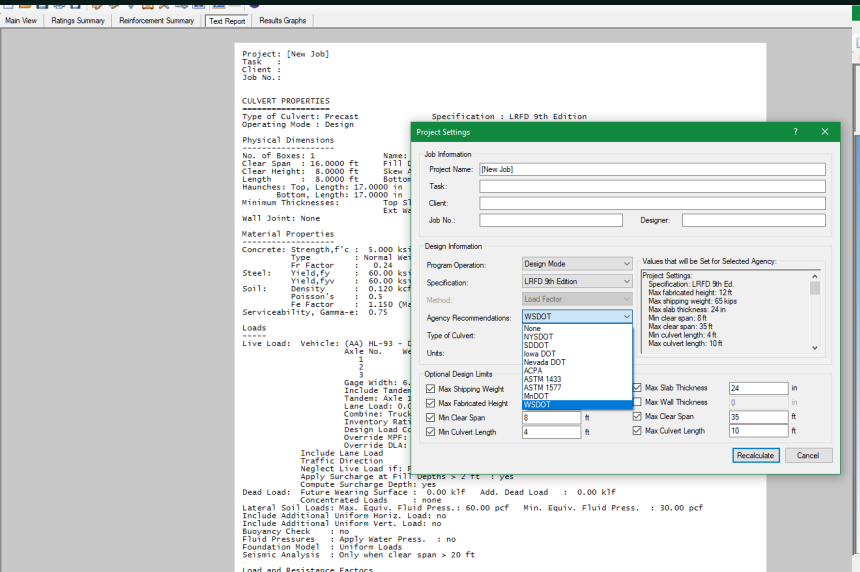
Coordination Efforts

Technical Challenges

Eriksson Software

The Bridge Office worked with Eriksson's software development team to incorporate WSDOT's "wish-list" into their product *Culvert*.

This effort provided us with a specialized design tool catered to WSDOT's specific design criteria.



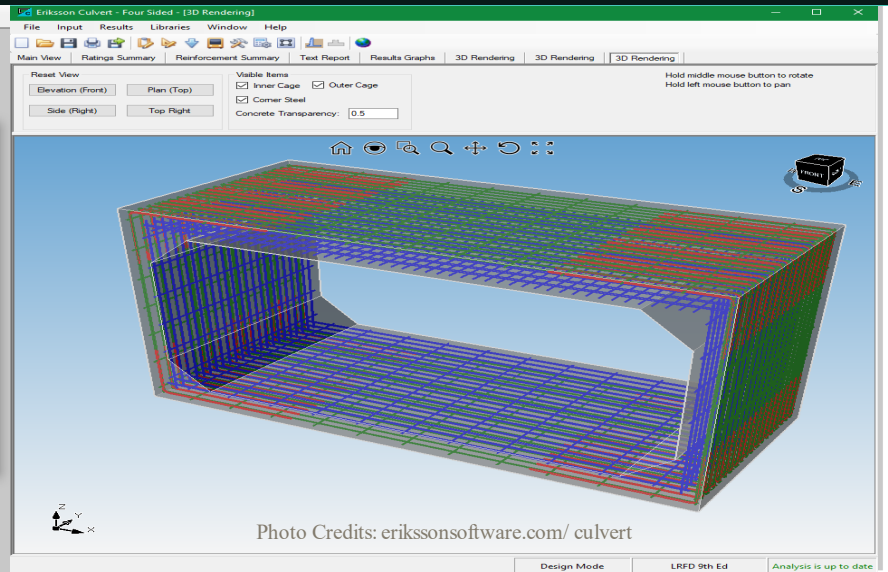
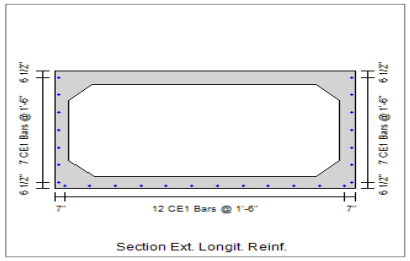


Photo Credits: erikssonsoftware.com/ culvert

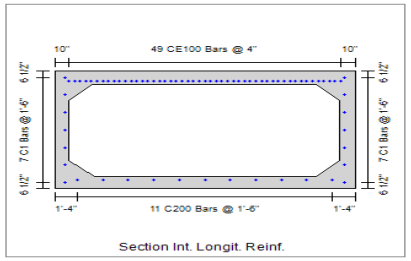
Concrete Summary
Volume of Concrete: 2.006 cy/ft Total Volume of Concrete: 16.045 cy

Reinforcing Steel Bar Schedule (lb)

Location	Mark	Qty	Size	Spacing	Type	Length	Hor.Leg	Ver.Leg	Tot.Weight
Top Slab(Int)	AE100 (AS2)	16	6	6"	S	17'-3"	--	--	415.0
Bot Slab(Int)	A200 (AS3)	20	5	5"	S	17'-3"	--	--	360.0
Top Slab(Ext)	AE300 (AS7)	24	3	4"	S	17'-3"	--	--	156.0
Bot Slab(Ext)	A400 (AS8)	24	3	4"	S	17'-3"	--	--	156.0
Corner(Top)	AE1 (AS1)	40	5	5"	L	7'-2"	4'-7"	2'-7"	299.0
Corner(Bot)	A2 (AS1)	40	5	5"	L	7'-3"	4'-9"	2'-6"	302.0
Wall(Int)	B1 (AS4)	48	3	4"	S	8'-6"	--	--	153.0
Wall(Ext)	B2 (AS1)	40	5	5"	S	8'-0"	--	--	334.0
Longit. Top (Ext)	CE1 (AS6)	0	3	1'-6"	S	7'-11"	--	--	0.0
Longit. Top (Int)	CE100 (AS5)	49	3	4"	S	7'-11"	--	--	146.0
Longit. Bot (Int)	C200	11	3	1'-6"	S	7'-11"	--	--	33.0
Longit. Bot (Ext)	CE1 (AS6)	12	3	1'-6"	S	7'-11"	--	--	35.8
Longit. Wall (Ext)	CE1 (AS6)	14	3	1'-6"	S	7'-11"	--	--	41.7
Longit. Wall (Int)	C1 (AS6)	14	3	1'-6"	S	7'-11"	--	--	41.7
									2473



Section Ext. Longit. Reinf.



Section Int. Longit. Reinf.

Development

WSDOT held roundtable meetings with our Geotechnical Office & hosted weekly check-in meetings with WSP.

Photo Credit: Jessi Reel, Blog.prototypr.io

Photo Credit: Grady Reese, Getty Images

Spotlighting Technical Challenges

- Tie Plates
- Shear Transfer
- Approach Slab Seats
- Seismic Requirements

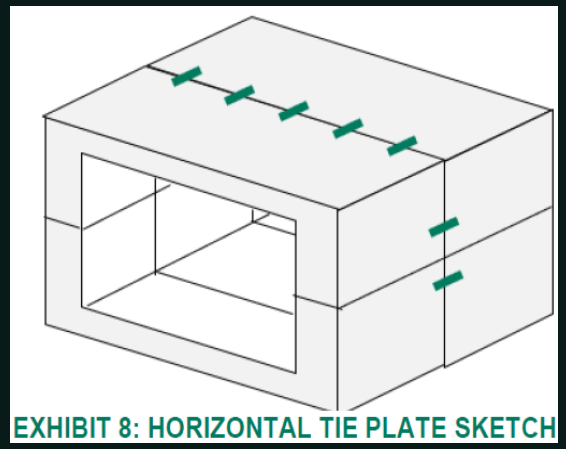
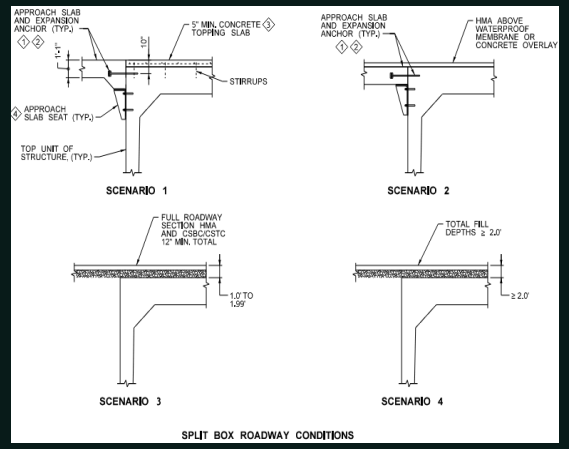
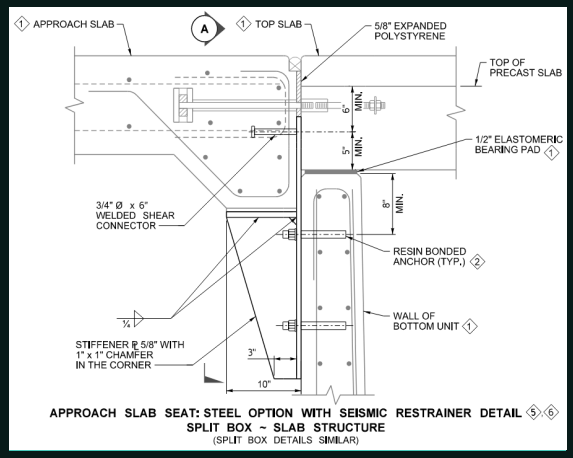


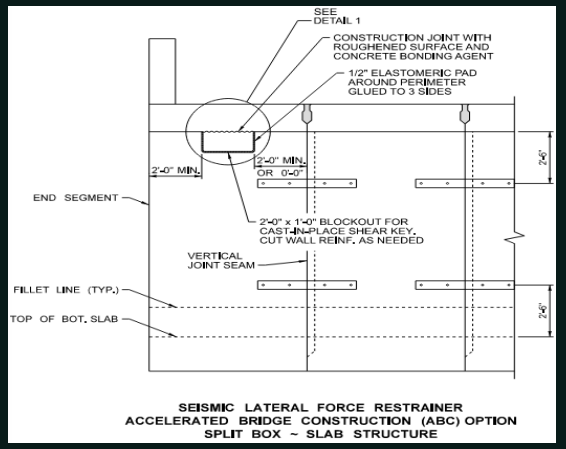
EXHIBIT 8: HORIZONTAL TIE PLATE SKETCH



SPLIT BOX ROADWAY CONDITIONS



APPROACH SLAB SEAT: STEEL OPTION WITH SEISMIC RESTRAINER DETAIL
SPLIT BOX ~ SLAB STRUCTURE
(SPLIT BOX DETAILS SIMILAR)

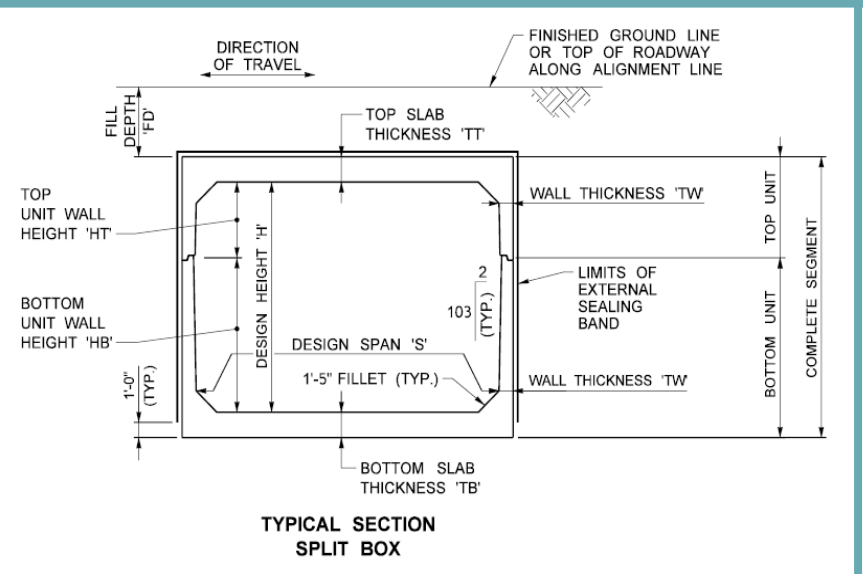


SEISMIC LATERAL FORCE RESTRAINER
ACCELERATED BRIDGE CONSTRUCTION (ABC) OPTION
SPLIT BOX ~ SLAB STRUCTURE

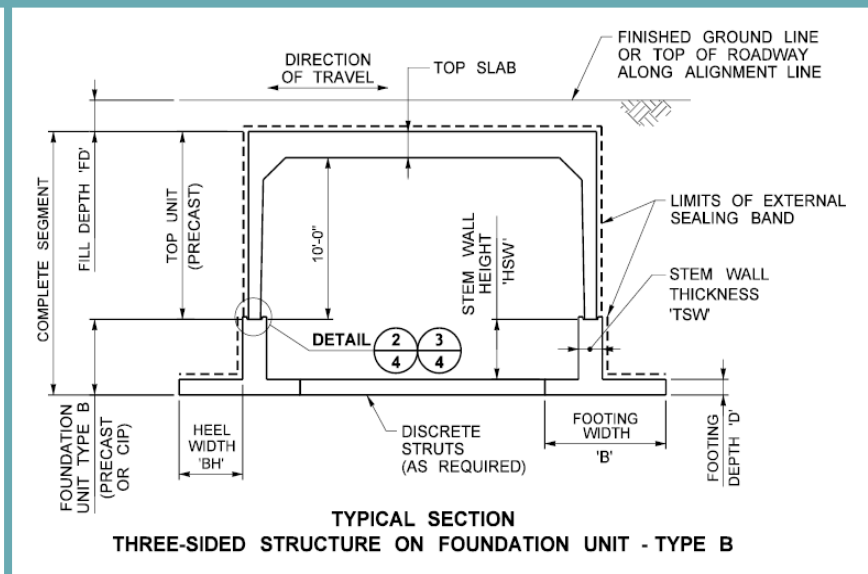
Development

WSDOT's NEW **Standard Plans**:

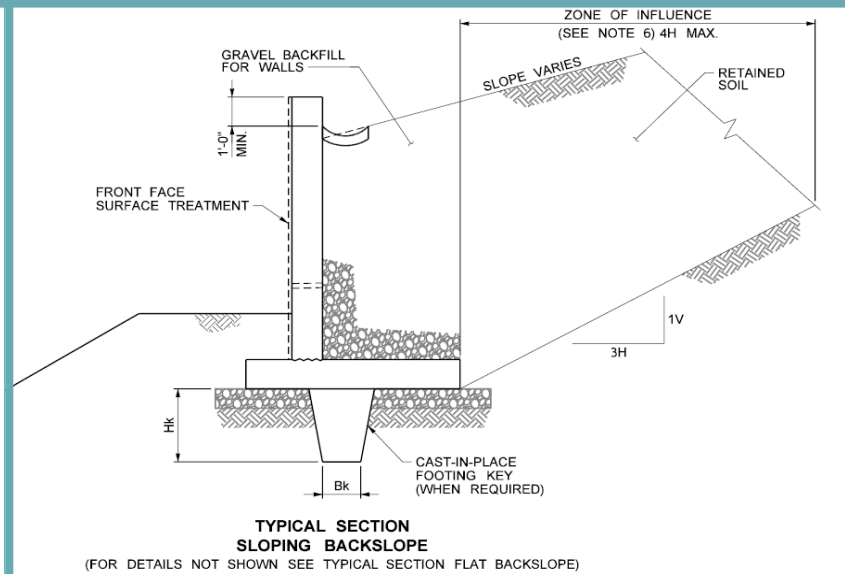
- E-20.10-00 **Buried Structure** Split Box
- E-20.20-00 **Buried Structure** Three-Sided
- D-20.10-00 Precast Reinforced Concrete Retaining Wall (for wingwalls)



TYPICAL SECTION
SPLIT BOX



TYPICAL SECTION
THREE-SIDED STRUCTURE ON FOUNDATION UNIT - TYPE B



TYPICAL SECTION
SLOPING BACKSLOPE
(FOR DETAILS NOT SHOWN SEE TYPICAL SECTION FLAT BACKSLOPE)

Quality Reviews

Industry – Constructability

Statewide – Agency and Regional

Federal – FHWA

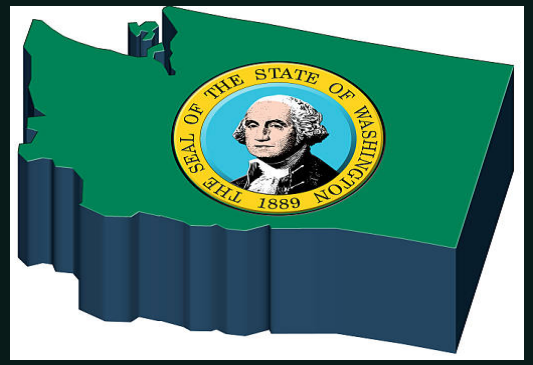
Quality Reviews

Internal Review

Colleagues
S.M.E.'s
Technical Committees

Industry Review

Manufacturers
AGC Teams:
Roadway &
Structures



Statewide Review

Headquarters
Region
Local Agencies

FHWA Review

Federal Evaluation

Publication & Beyond

Remaining Timeline

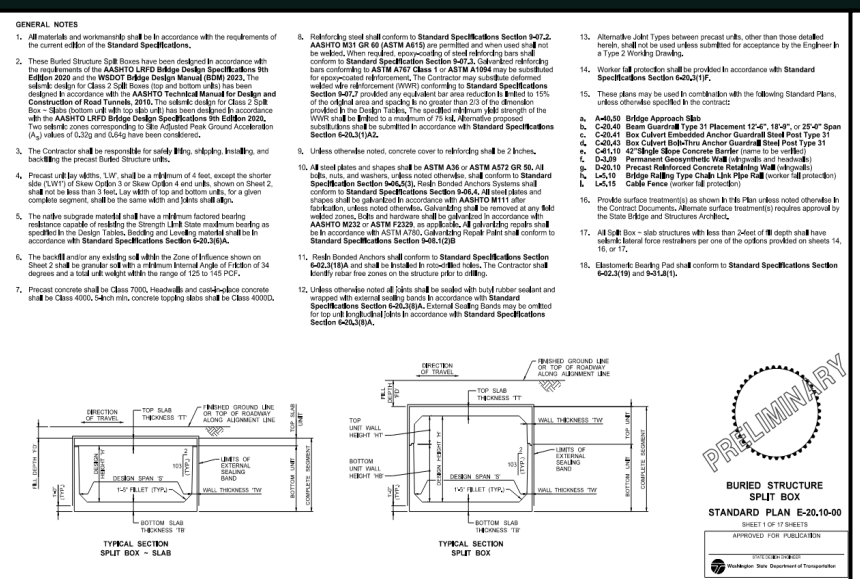
Approval & Publishing

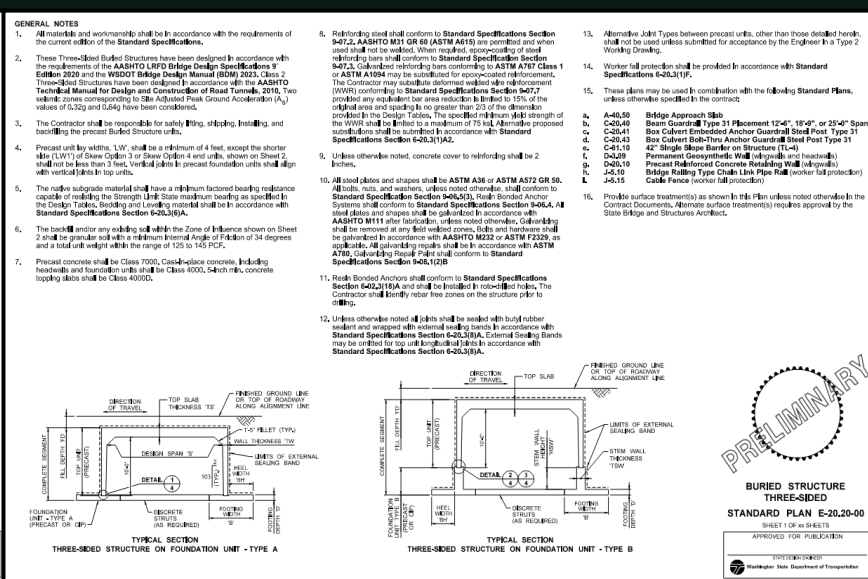
What's Next

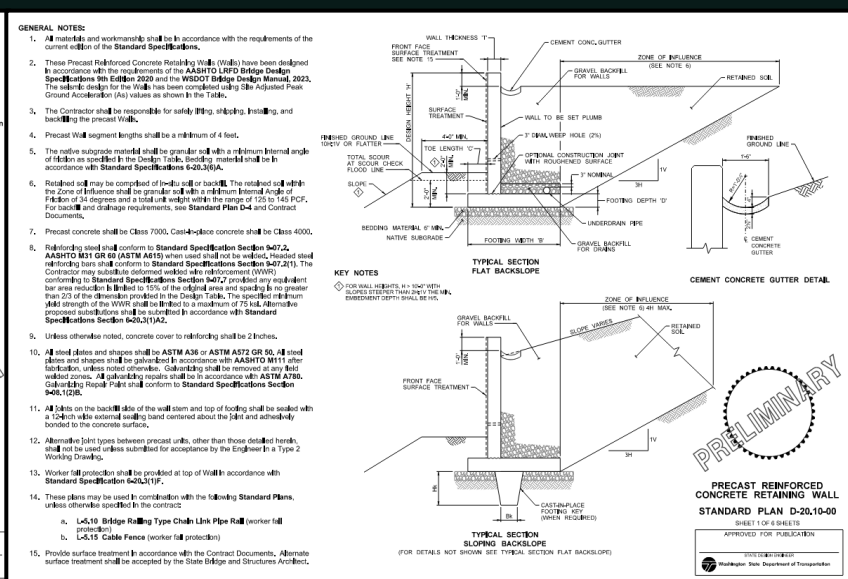
Publication

- FHWA approval is received on Plans
- HQ-Bridge release to Standard Plans Office for final preparations
- Approval and signatures from the appropriate appointed authorities requested.

These new **Standard Plans** are scheduled to be published this September!







What's Next

Questions - Training - Education - Lessons Learned - Reactionary Updates

In Summary

- Facilitates Delivery of a Large Fish Program
- Streamlines Design Efforts
- Establishes Consistency for Design & Fabrication
- Reduces Design & Review of Design Timelines
- The culmination of over three decades of effort
- Allows versatility in navigating summer month's weather, events, and design challenges.

GENERAL NOTES

1. All materials and workmanship shall be in accordance with the requirements of the current edition of the **Standard Specifications**.

2. These Buried Structure Split Boxes have been designed in accordance with the requirements of the **AASHTO LRFD Bridge Design Specifications 9th Edition 2020** and the **WSDOT Bridge Design Manual (BDM) 2023**. The seismic design for Class 2 Split Boxes (top and bottom units) has been designed in accordance with the **AASHTO Technical Manual for Design and Construction of Road Tunnels, 2010**. The seismic design for Class 2 Split Box ~ Slabs (bottom unit with top slab unit) has been designed in accordance with the **AASHTO LRFD Bridge Design Specifications 9th Edition 2020**. Two seismic zones corresponding to Site Adjusted Peak Ground Acceleration (A_S) values of 0.32g and 0.64g have been considered.

3. The Contractor shall be responsible for safely lifting, shipping, installing, and backfilling the precast Buried Structure units.

4. Precast unit lay widths, 'LW', shall be a minimum of 4 feet, except the shorter side ('LW1') of Skew Option 3 or Skew Option 4 end units, shown on Sheet 2, shall not be less than 3 feet. Lay width of top and bottom units, for a given complete segment, shall be the same width and joints shall align.

5. The native subgrade material shall have a minimum factored bearing resistance capable of resisting the Strength Limit State maximum bearing as specified in the Design Tables. Bedding and Leveling material shall be in accordance with **Standard Specifications Section 6-20.3(6)A**.

6. The backfill and/or any existing soil within the Zone of Influence shown on Sheet 2 shall be granular soil with a minimum Internal Angle of Friction of 34 degrees and a total unit weight within the range of 120 to 145 PCF.

7. Precast concrete shall be Class 7000. Headwalls and cast-in-place concrete shall be Class 4000. 5-inch min. concrete topping slabs shall be Class 4000D.

8. Reinforcing steel shall conform to **Standard Specifications Section 9-07.2. AASHTO M31 GR 60 (ASTM A615)** are permitted and when used shall not be welded. When required, epoxy-coating of steel reinforcing bars shall conform to **Standard Specification Section 9-07.3**. Galvanized reinforcing bars conforming to **ASTM A767 Class 1** or **ASTM A1094** may be substituted for epoxy-coated reinforcement. The Contractor may substitute deformed welded wire reinforcement (WWR) conforming to **Standard Specifications Section 9-07.7** provided any equivalent bar area reduction is limited to 15% of the original area and spacing is no greater than 2/3 of the dimension provided in the Design Tables. The specified minimum yield strength of the WWR shall be limited to a maximum of 75 ksi. Alternative proposed substitutions shall be submitted in accordance with **Standard Specifications Section 6-20.3(1)A2**.

9. Unless otherwise noted, concrete cover to reinforcing shall be 2 inches.

10. All steel plates and shapes shall be **ASTM A36** or **ASTM A572 GR 50**. All bolts, nuts, and washers, unless noted otherwise, shall conform to **Standard Specification Section 9-06.5(3)**. Resin Bonded Anchors Systems shall conform to **Standard Specifications Section 9-06.4**. All steel plates and shapes shall be galvanized in accordance with **AASHTO M111** after fabrication, unless noted otherwise. Galvanizing shall be removed at any field welded zones. Bolts and hardware shall be galvanized in accordance with **AASHTO M232** or **ASTM F2329**, as applicable. All galvanizing repairs shall be in accordance with ASTM A780. Galvanizing Repair Paint shall conform to **Standard Specifications Section 9-08.1(2)B**

11. Resin Bonded Anchors shall conform to **Standard Specifications Section 6-02.3(18)A** and shall be installed in roto-drilled holes. The Contractor shall identify rebar free zones on the structure prior to drilling.

12. Unless otherwise noted all joints shall be sealed with Butyl Rubber Sealant and wrapped with External Sealing Bands in accordance with **Standard Specifications Section 6-20.3(8)A**.

13. **Alternative Joint Types between precast units, other than those detailed herein, shall not be used unless submitted for acceptance by the Engineer in a Type 2 Working Drawing.**

14. **Worker, Pedestrian and Bicycle Fall Protection shall be provided in accordance with Standard Specifications Section 6-20.3(1)F.**

15. **These plans may be used in combination with the following Standard Plans, unless otherwise specified in the contract:**

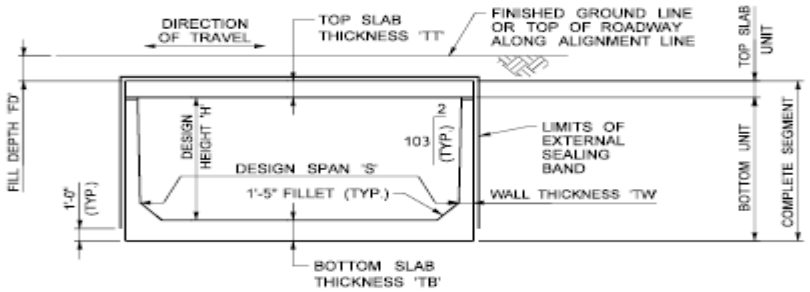
a.	A-40.50	Bridge Approach Slab
b.	C-20.40	Beam Guardrail Type 31 Placement 12'-6", 18'-9", or 25'-0" Span
c.	C-20.41	Box Culvert Embedded Anchor Guardrail Steel Post Type 31
d.	C-20.43	Box Culvert Bolt-Thru Anchor Guardrail Steel Post Type 31
e.	C-81.10	42"Single Slope Barrier on Structure (TL-4)
f.	D-3.09	Permanent Geosynthetic (wingwall and headwalls)
g.	D-20.10	Precast Reinforced Concrete Retaining Wall (wingwalls)
h.	L-5.10	Bridge Railing Type Chain Link Pipe Rail (worker fall protection)
i.	L-5.15	Cable Fence (worker fall protection)

16. **Provide surface treatment(s) as shown in this Plan unless noted otherwise in the Contract Documents. Alternate surface treatment(s) requires approval by the State Bridge and Structures Architect.**

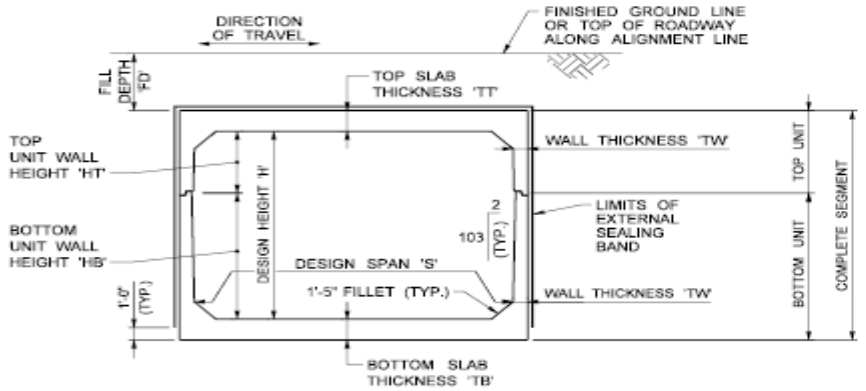
17. **All Split Box ~ Slab structures with less than 2 feet of Fill Depth shall have seismic lateral force restrainers per one of the options provided on sheets 14, 16, or 17.**

18. **Elastomeric Bearing Pad shall conform to Standard Specifications Section 6-02.3(19) and 9-31.8(1).**

19. **For Structure Free Zone, freeboard, and maintenance clearance, see Contract Documents.**



TYPICAL SECTION
SPLIT BOX ~ SLAB



TYPICAL SECTION
SPLIT BOX

BURIED STRUCTURE
SPLIT BOX

STANDARD PLAN E-20.10-00

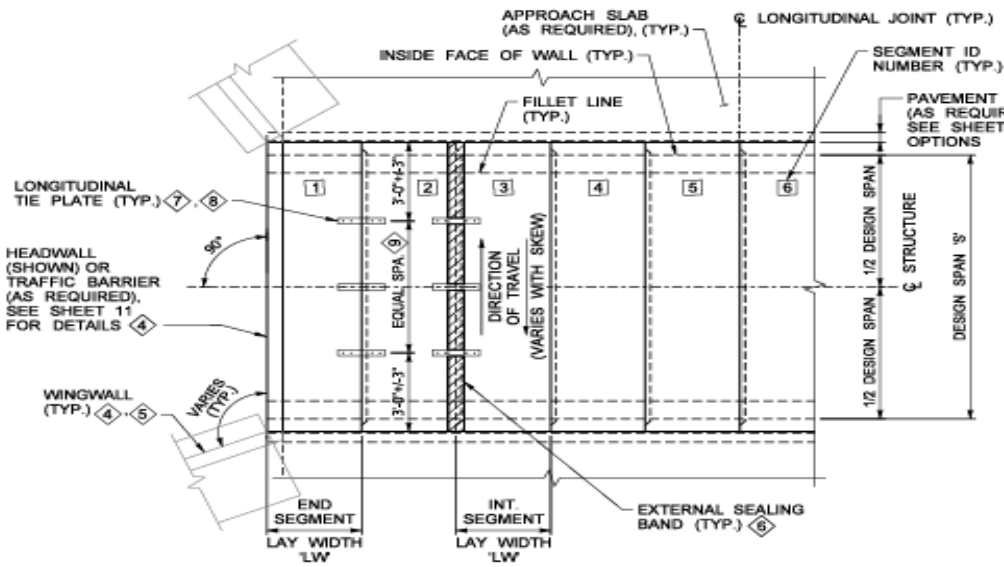
SHEET 1 OF 17 SHEETS

APPROVED FOR PUBLICATION

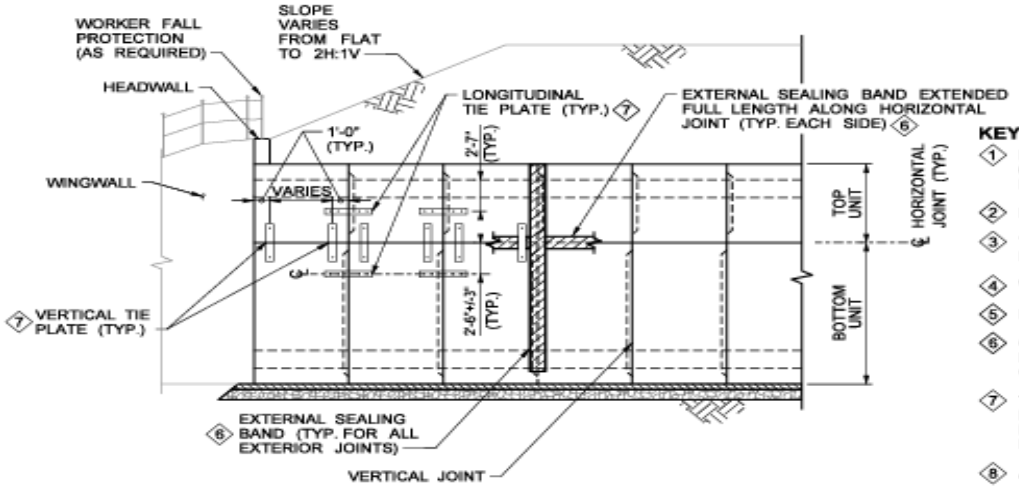
STATE DESIGN ENGINEER

Washington State Department of Transportation

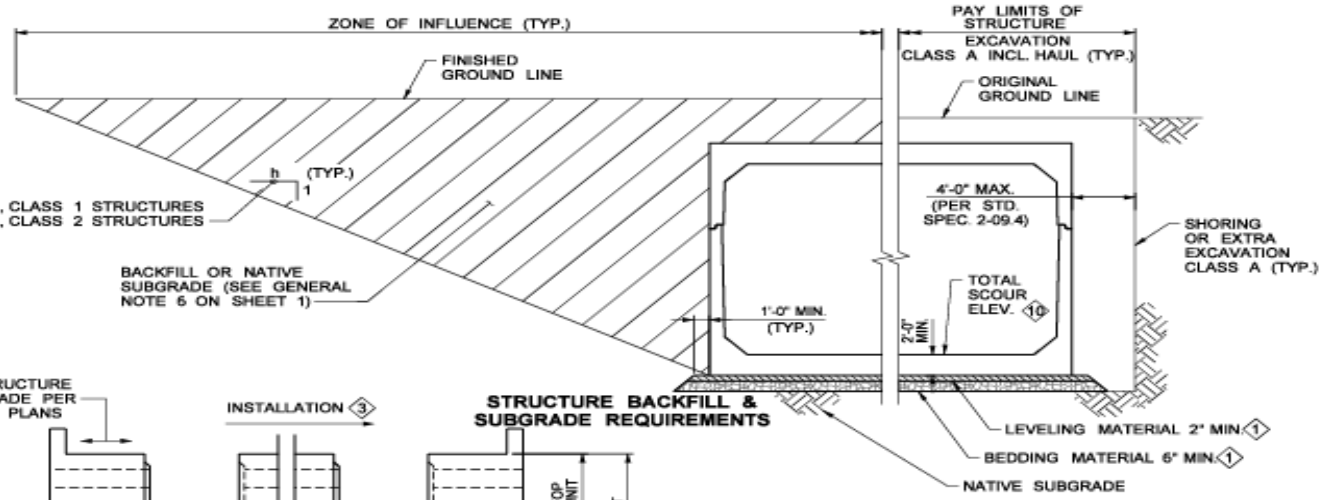
General Notes & Typical Section



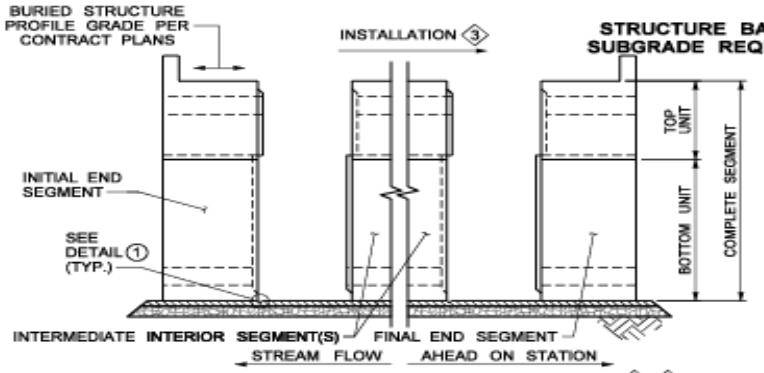
PLAN
SEGMENT LAYOUT
NORMAL, SPLIT BOX LAYOUT SHOWN, SPLIT BOX ~ SLAB SIMILAR
FOR SKEWED LAYOUT OPTIONS SEE SHEET 3



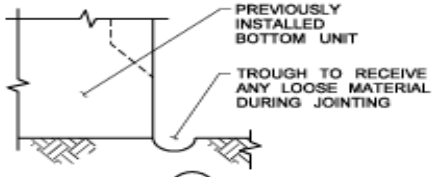
ELEVATION
SEGMENT LAYOUT
NORMAL, SPLIT BOX SHOWN, SPLIT BOX ~ SLAB SIMILAR
FOR SKEWED LAYOUT OPTIONS SEE SHEET 3



STRUCTURE BACKFILL & SUBGRADE REQUIREMENTS



SUGGESTED INSTALLATION PROCEDURE 2 4
TIE PLATES NOT SHOWN FOR CLARITY



DETAIL 1
SUGGESTED JOINTING PREPARATION

KEY NOTES

1. PREPARE BEDDING AND LEVELING MATERIALS IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS 6-20.3(6). WHEN APPLICABLE, SEE CONTRACT DOCUMENTS FOR OVER-EXCAVATION AND QUARRY SPALL REQUIREMENTS.
2. PLACEMENT AND ASSEMBLY SHALL BE IN ACCORDANCE WITH STANDARD SPECIFICATIONS SECTION 6-20.3(8).
3. THE PRECAST UNITS SHOULD BE INSTALLED IN SEQUENCE AS SHOWN. THE BOTTOM UNITS SHOULD BE INSTALLED AT LEAST ONE UNIT AHEAD OF THE TOP UNITS.
4. WORKER FALL PROTECTION NOT SHOWN FOR CLARITY.
5. FOR WINGWALL AND HEADWALL DETAILS, SEE CONTRACT DOCUMENTS.
6. CONTINUOUS ALONG EXTERIOR FACES, CENTERED AT JOINT, OMIT 1'-0" FROM BASE OF BOTTOM UNIT(S). EXTERNAL SEALING BANDS SHALL PASS UNDER TIE PLATES (TYP.) SEE TYPICAL SECTION(S) ON SHEET 1 FOR GRAPHIC OF LIMITS.
7. TIE PLATES ARE REQUIRED FOR THE FIRST THREE SEGMENTS AT EACH END, OR FOR A MINIMUM OF 12.0 FT. INBOARD FROM EACH END WHICHEVER IS GREATER. OMIT UPPER LONGITUDINAL AND VERTICAL TIE PLATES ON WALL FOR SPLIT BOX ~ SLABS. SEE SHEET 12 FOR TIE PLATE DETAILS. ADJUST HORIZONTAL LOCATION AS NECESSARY WHEN RESTRAINERS ARE REQUIRED.
8. AS APPLICABLE, DEPENDING ON SITE ROADWAY SCENARIO, SEE SHEET 8.
9. TRANSVERSE SPACING BETWEEN TIE PLATES SHALL BE LIMITED TO 4'-0" WHEN BOTH, THE SITE PEAK GROUND ACCELERATION (A_s) VALUE EXCEEDS 0.55g AND THE BACKFILL SLOPE RETAINED BY THE HEADWALL IS STEEPER THAN 2.5H:1V. FOR ALL OTHER CONDITIONS SPACING SHALL BE LIMITED TO 6'-0".
10. DETERMINED BY THE TOTAL SCOUR RESULTING FROM THE WORST-CASE CONDITION BETWEEN THE SCOUR DESIGN FLOOD AND THE SCOUR CHECK FLOOD, IN ACCORDANCE WITH THE WSDOT HYDRAULICS MANUAL.

BURIED STRUCTURE SPLIT BOX
STANDARD PLAN E-20.10-00
SHEET 2 OF 17 SHEETS

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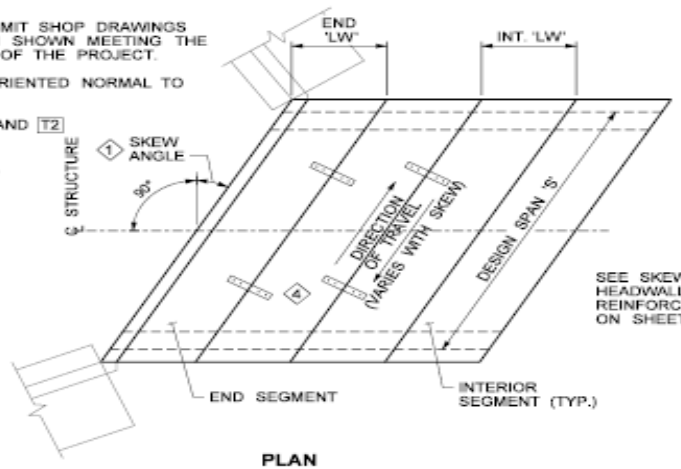
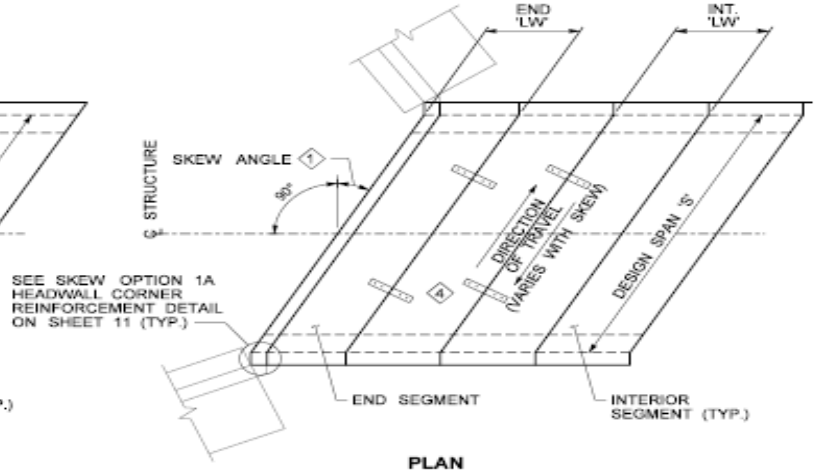
Plan, Layout, Subgrade & Backfill, and Installation

KEY NOTES

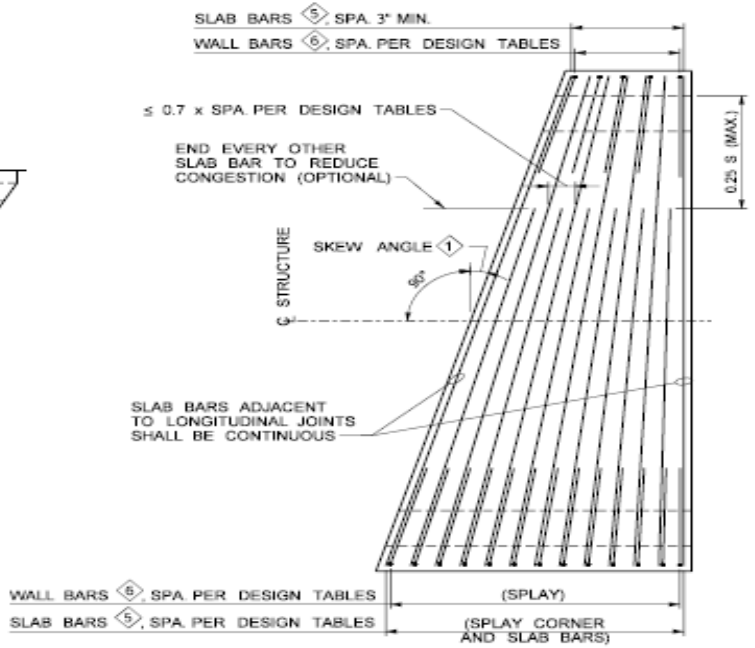
1. SKEW ANGLE SHALL NOT EXCEED 30 DEGREES.
2. FOR DETAILS NOT SHOWN SEE SEGMENT LAYOUT ON SHEET 2.
3. CONTRACTORS MAY SUBMIT SHOP DRAWINGS FOR ANY SKEW OPTION SHOWN MEETING THE DESIGN REQUIREMENTS OF THE PROJECT.
4. TIE PLATES, SHALL BE ORIENTED NORMAL TO JOINT (TYP).
5. SLAB BARS: B1, B2, T1 AND T2 (SEE SHEET 4)
6. WALL BARS: B3, B4, B5, T3, T4 AND T5 (SEE SHEET 4)



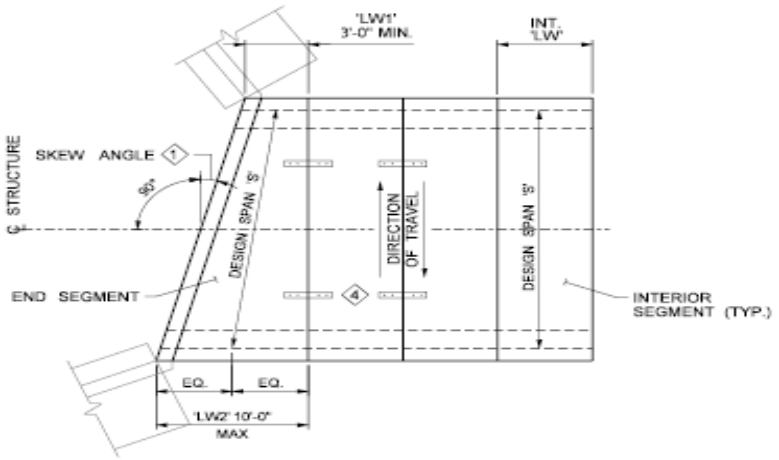
PLAN
SKEW OPTION 1
UNIFORM SKEW SEGMENT LAYOUT 2, 3



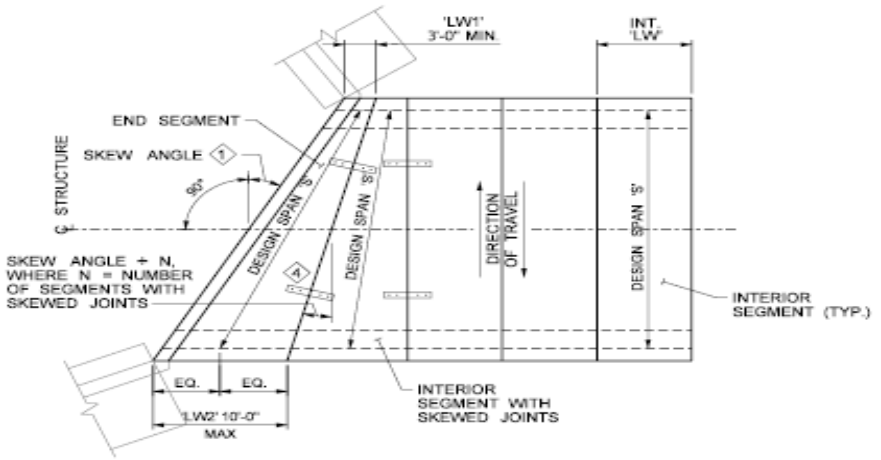
PLAN
SKEW OPTION 2
SKEWED SLAB, NORMAL WALL SEGMENT LAYOUT 2, 3



PLAN
SKEW OPTION 3/4
REINFORCEMENT SPLAY DETAILS
ONLY SELECTED REINFORCING SHOWN FOR CLARITY



PLAN
SKEW OPTION 3
TRAPEZOIDAL END SEGMENT LAYOUT 2, 3



PLAN
SKEW OPTION 4
TRANSITIONING END SEGMENT LAYOUT 2, 3

BURIED STRUCTURE
SPLIT BOX
STANDARD PLAN E-20.10-00

SHEET 3 OF 17 SHEETS

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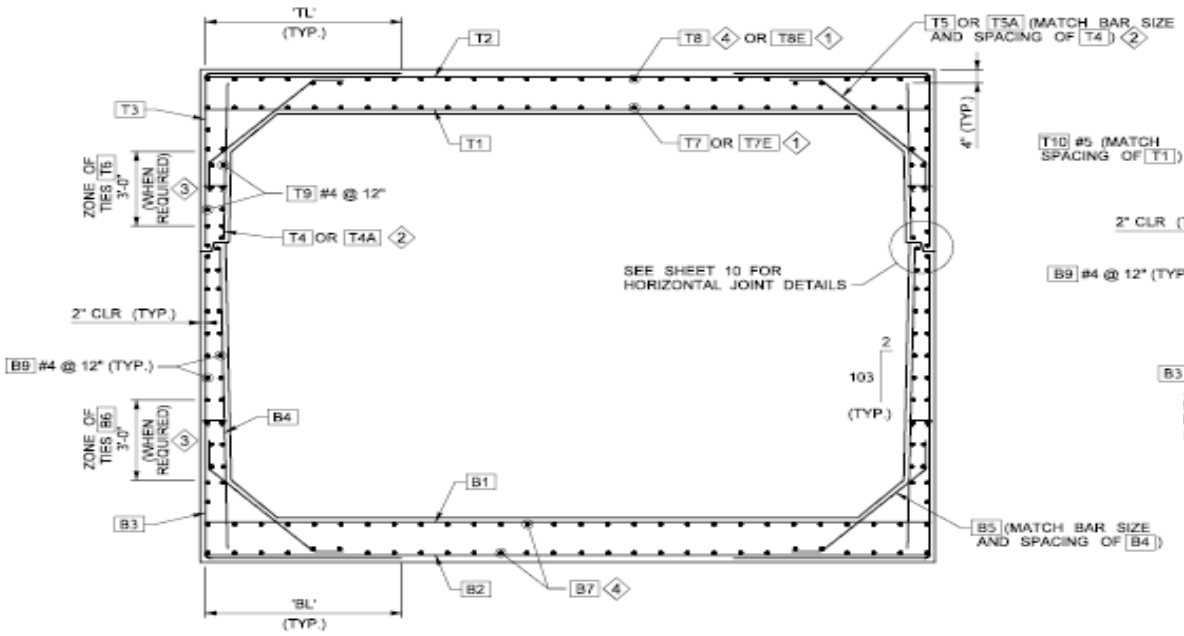
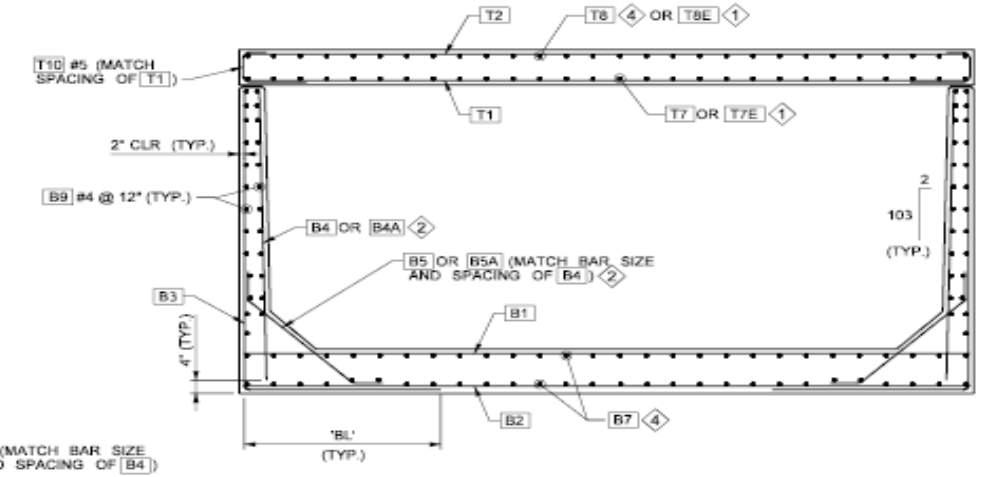
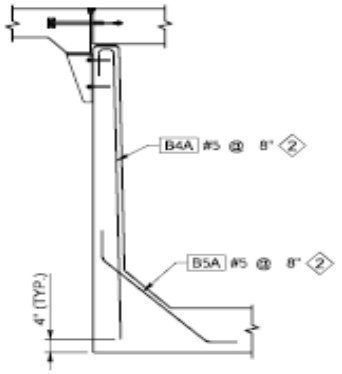
Skew Options



TYPICAL SECTION
SPLIT BOX REINFORCEMENT

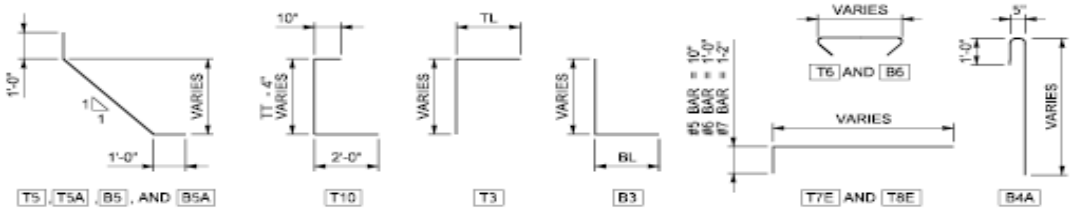


TYPICAL SECTION
SPLIT BOX ~ SLAB REINFORCEMENT



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

BENDING DIAGRAM



(ALL DIMENSIONS ARE OUT TO OUT)

KEY NOTES

1. BARS T7E AND T8E SHALL BE INSTALLED IN THE END SEGMENTS. ROTATE 90° HOOK AS NECESSARY TO PROVIDE THE SPECIFIED CLEARANCE.

   SIZE AND SPACING OF BARS T7E SHALL MATCH T7

   BARS T8E SHALL BE AS FOLLOWS:

   END SEGMENT WITHOUT HEADWALL OR TRAFFIC BARRIER: #5 @ 12"
   END SEGMENT WITH UP TO 2'-0" HEADWALL: #6 @ 12"
   END SEGMENT WITH UP TO 4'-0" HEADWALL: #6 @ 6"
   END SEGMENT WITH TRAFFIC BARRIER: #7 @ 6"
   FOR ADDITIONAL END SEGMENT DETAILS SEE SHEET 11.

2. WHEN AN APPROACH SLAB SEAT IS PRESENT, ADDITIONAL REINFORCEMENT IS REQUIRED AS FOLLOWS:

   FOR SPLIT BOX – SLAB STRUCTURES:
   ADD B4A #5 @ 8" AND B5A #5 @ 8". BUNDLE WITH TYPICAL B4 AND B5 RESPECTIVELY.

   FOR SPLIT BOX STRUCTURES:
   ADD T4A #5 @ 8" AND T5A #5 @ 8". BUNDLE WITH TYPICAL T4 AND T5 RESPECTIVELY.

3. TIES T6 #4 AND B6 #4 SHALL BE SPACED AT 6" MAX. VERTICALLY AND AT 2'-0" MAX. HORIZONTALLY. EACH TIE SHALL BE HOOKED AROUND LONGITUDINAL BARS T9 OR B9. ADDITIONAL BARS T9 AND B9 MAY BE ADDED TO FACILITATE PLACEMENT OF TIES AS REQUIRED.

4. BARS B7 AND T8 SHALL BE #4 @ 12" WHEN CORRESPONDING SLAB THICKNESS ≤ 20 INCHES, AND #4 @ 9" FOR THICKER SLABS.

BURIED STRUCTURE
SPLIT BOX
STANDARD PLAN E-20.10-00

SHEET 4 OF 17 SHEETS

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Reinforcement Identity & Bending Diagram

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

DESIGN SPAN S ①	DESIGN HEIGHT			FILL DEPTH FD ②	MEMBER THICKNESS			TOP UNIT REINFORCEMENT ③									BOTTOM UNIT REINFORCEMENT ③										MATERIAL QUANTITIES				STR. I BEARING DEMAND (PSF) ④	REQ'D HORIZ. JOINT TYPE ⑥
	TOTAL H	TOP UNIT WALL HT	BOT. UNIT WALL HB		WALLS TW	TOP SLAB TT	BOT. SLAB TB	T1 (SLAB INTERIOR)		T2 (SLAB EXTERIOR)		T3 (CORNER)			T4 (WALL INTERIOR)		T6 (TIES) ⑦	T7 (BOT.)		B1 (SLAB INTERIOR)		B2 (SLAB EXTERIOR)		B3 (CORNER)			B4 (WALL INTERIOR)		B6 (TIES) ⑦	TOP UNIT ⑧		BOTTOM UNIT ⑩			
								SIZE	SPA.	SIZE	SPA.	SIZE	SPA.	TL	SIZE	SPA.		SIZE	SPA.	SIZE	SPA.	SIZE	SPA.	SIZE	SPA.	BL	SIZE	SPA.		CONC. (CY/FT)	STEEL (LBS/FT)	CONC. (CY/FT)	STEEL (LBS/FT)		
12'	10'	N/A	10'	0' ≤ FD < 2'	10"	12"	10"	#7	6"	#5	12"	N/A			#4	8"	N/A	#5	10"	#6	6"	#7	5"	#7	5"	3'-2"	#4	8"	N/A	0.58	106.1	1.06	322.5	2397	2
				2'≤ FD ≤ 4'	10"	12"	10"	#7	6"	#5	12"				#4	8"		#4	12"	#6	6"	#7	5"	#7	5"	3'-2"	#4	8"		0.58	98.4	1.06	322.5	2490	2
				4'< FD ≤ 6'	12"	12"	12"	#8	6"	#5	12"				#4	8"		#4	12"	#6	6"	#6	5"	#7	5"	4'-3"	#4	8"		0.59	112.8	1.28	318.9	2901	2
				6'< FD ≤ 8'	12"	12"	12"	#8	6"	#5	12"				#4	8"		#4	12"	#6	6"	#7	5"	#7	5"	3'-4"	#4	8"		0.59	112.8	1.28	327.7	3255	2
				8'< FD ≤ 10'	12"	12"	12"	#9	6"	#5	12"				#4	8"		#6	10"	#7	6"	#7	5"	#8	5"	3'-8"	#4	8"		0.59	150.3	1.28	382.2	3631	2
15'	10'	N/A	10'	0' ≤ FD < 2'	10"	12"	10"	#9	6"	#5	12"	N/A			#4	8"	N/A	#4	12"	#8	6"	#6	5"	#7	5"	3'-11"	#4	8"	N/A	0.69	157.2	1.15	361.0	2269	2
				2'≤ FD ≤ 4'	10"	12"	10"	#8	6"	#5	12"				#4	8"		#4	12"	#8	6"	#6	5"	#7	5"	5'-1"	#4	8"		0.69	138.3	1.15	378.8	2313	2
				4'< FD ≤ 8'	12"	14"	12"	#9	6"	#5	10"				#4	8"		#4	12"	#9	6"	#6	5"	#7	5"	4'-1"	#4	8"		0.81	163.6	1.39	396.5	3147	2
				8'< FD ≤ 10'	12"	16"	14"	#9	6"	#6	12"				#4	8"		#5	10"	#8	6"	#6	5"	#8	5"	3'-7"	#4	8"		0.91	183.0	1.50	422.7	3625	2
	12' TO 15'	5'	7' TO 10'	0' ≤ FD < 2'	10"	12"	10"	#9	6"	#6	7"	#6	7"	3'-0"	#4	8"		#5	9"	#8	6"	#5	10"	#6	5"	4'-4"	#4	8"		0.99	272.1	1.15	301.1	2030	1
				2'≤ FD ≤ 4'	10"	12"	10"	#9	6"	#6	7"	#6	7"	3'-0"	#4	8"		#4	12"	#8	6"	#5	12"	#6	6"	4'-9"	#4	8"		0.99	260.1	1.15	282.2	1992	1
				4'< FD ≤ 8'	10"	14"	12"	#9	6"	#5	10"	#5	5"	5'-2"	#4	8"	N/A	#4	12"	#9	6"	#5	10"	#6	5"	3'-9"	#4	8"	N/A	1.09	244.9	1.26	315.9	2792	1
				8'< FD ≤ 12'	12"	16"	14"	#10	6"	#6	12"	#5	6"	3'-10"	#4	8"		#4	12"	#9	6"	#6	12"	#7	6"	3'-5"	#4	8"		1.27	273.3	1.50	342.9	3739	1
				12'< FD ≤ 16'	12"	18"	16"	#10	6"	#6	12"	#6	6"	3'-9"	#4	8"		#4	12"	#9	6"	#6	10"	#7	5"	3'-7"	#4	8"		1.38	292.3	1.60	375.3	4436	1
				16'< FD ≤ 20'	12"	20"	18"	#10	6"	#5	6"	#6	6"	3'-9"	#4	8"		#4	12"	#10	6"	#6	12"	#8	6"	3'-9"	#4	8"		1.48	303.5	1.71	417.2	5372	1
				20'< FD ≤ 24'	12"	22"	22"	#10	6"	#6	10"	#6	5"	3'-11"	#4	8"	Y	#4	12"	#10	6"	#6	9"	#8	6"	3'-11"	#4	8"	Y	1.59	327.1	1.92	443.4	6342	1
				24'< FD ≤ 28'	12"	22"	22"	#11	6"	#6	10"	#7	5"	3'-11"	#4	8"	Y	#4	12"	#10	6"	#6	10"	#8	5"	3'-11"	#4	8"	Y	1.59	387.9	1.92	473.0	7209	1
				28'< FD ≤ 32'	12"	24"	24"	#11	6"	#7	10"	#7	5"	4'-1"	#4	8"	Y	#4	12"	#11	6"	#7	10"	#8	5"	4'-1"	#4	8"	Y	1.69	402.5	2.02	522.3	8145	1
				32'< FD ≤ 38'	12"	24"	24"	#11	5"	#7	10"	#8	5"	4'-1"	#4	8"	Y	#4	12"	#11	6"	#7	10"	#8	5"	4'-1"	#4	8"	Y	1.69	470.2	2.02	522.3	9445	1
18'	10'	N/A	10'	0' ≤ FD < 2'	10"	16"	12"	#8	6"	#6	12"	N/A			#4	8"	N/A	#4	12"	#9	6"	#6	5"	#7	5"	3'-2"	#4	8"	N/A	1.04	164.2	1.37	422.3	2259	2
				2'≤ FD ≤ 4'	10"	14"	12"	#9	6"	#5	10"				#4	8"		#4	12"	#9	6"	#6	5"	#7	5"	3'-2"	#4	8"		0.92	188.0	1.37	420.7	2348	2
				4'< FD ≤ 6'	12"	16"	14"	#9	6"	#6	12"				#4	8"		#4	12"	#10	6"	#7	10"	#7	5"	4'-3"	#4	8"		1.06	195.9	1.63	445.0	2731	2
				6'< FD ≤ 8'	12"	18"	16"	#9	6"	#6	12"				#4	8"		#4	12"	#9	6"	#7	10"	#7	5"	3'-10"	#4	8"		1.18	196.3	1.75	412.6	3165	2
				8'< FD ≤ 10'	12"	18"	16"	#10	6"	#6	12"				#4	8"		#4	12"	#9	6"	#6	5"	#8	5"	3'-6"	#4	8"		1.18	196.3	1.75	483.8	3576	2
	12' TO 15'	5'	7' TO 10'	0' ≤ FD < 2'	10"	14"	12"	#9	6"	#6	9"	#6	9"	3'-1"	#4	8"		#5	8"	#8	6"	#6	10"	#6	5"	3'-1"	#4	8"		1.22	290.0	1.37	328.2	1877	1
				2'≤ FD ≤ 4'	10"	14"	12"	#9	6"	#5	8"	#6	8"	4'-0"	#4	8"		#4	12"	#9	6"	#6	10"	#6	5"	3'-1"	#4	8"		1.22	272.9	1.37	356.4	2001	1
				4'< FD ≤ 6'	10"	16"	14"	#9	6"	#5	9"	#5	6"	3'-8"	#4	8"	N/A	#4	12"	#9	6"	#5	10"	#7	5"	3'-6"	#4	8"	N/A	1.34	261.4	1.49	381.6	2349	1
				6'< FD ≤ 10'	10"	18"	16"	#10	6"	#6	12"	#6	6"	3'-5"	#4	8"		#4	12"	#10	6"	#6	10"	#7	5"	3'-5"	#4	8"		1.47	316.1	1.61	428.4	3198	1
				10'< FD ≤ 14'	12"	20"	18"	#11	6"	#5	6"	#5	6"	3'-9"	#4	8"		#4	12"	#10	6"	#6	10"	#7	5"	3'-9"	#4	8"		1.67	360.8	1.87	444.3	3984	1
				14'< FD ≤ 18'	12"	22"	22"	#11	6"	#5	7"	#6	7"	3'-11"	#4	8"	Y	#4	12"	#10	6"	#6	10"	#7	5"	3'-11"	#4	8"	Y	1.79	380.4	2.12	461.9	4973	1
				18'< FD ≤ 22'	12"	22"	22"	#11	5"	#6	10"	#6	5"	3'-11"	#4	8"	Y	#4	12"	#11	6"	#6	10"	#8	5"	3'-11"	#4	8"	Y	1.79	443.9	2.12	548.0	5841	1
				22'< FD ≤ 30'	12"	24"	24"	#10 ⑨	4"	#7	10"	#6	5"	4'-1"	#4	8"	Y	#4	12"	#10 ⑨	4"	#7	10"	#8	5"	4'-1"	#4	8"	Y	1.92	462.7	2.24	610.4	7643	1

KEY NOTES

① DESIGN SPAN 'S', SHALL BE TAKEN EQUAL TO THE HORIZONTAL DISTANCE BETWEEN INSIDE FACE OF WALLS AT THE CORNER BETWEEN THE FILLET AND THE WALL AS SHOWN ON SHEET 1. FOR SEGMENTS WITH A SKEW SEE GRAPHICAL CLARIFICATION OF DESIGN SPAN ON SHEET 3. IF THE DESIGN SPAN FALLS IN BETWEEN A DESIGN SPAN VALUE IN THE TABLES, USE REINFORCEMENT FOR THE LONGER SPAN. CLASS 1 STRUCTURES WITH SPANS GREATER THAN 18 FEET AND LESS THAN 20 FEET SHALL USE GEOMETRY AND REINFORCEMENT FOR 21 FOOT SPAN CLASS 2 STRUCTURES WITH A PGA = 0.32G.

② THE MAXIMUM FILL DEPTH OVER THE ENTIRE BURIED STRUCTURE SHALL BE USED WHEN SELECTING DESIGN FILL DEPTH.

③ FOR REINFORCING DETAILS SEE SHEET 4.

④ MAXIMUM REQUIRED BEARING RESISTANCE FOR STRENGTH LIMIT STATE.

⑤ THESE STRUCTURES HAVE BEEN DESIGNED FOR A TRAVERSE DIFFERENTIAL SETTLEMENTS DISPLACEMENT EQUAL TO 2 INCHES PER 100 FEET OF STRUCTURAL SPAN (DESIGN SPAN + 1.0 FOOT).

⑥ FOR HORIZONTAL JOINT TYPE DETAILS SEE SHEET 10.

⑦ WALL TIES T6 AND B6 ARE REQUIRED WHEN INDICATED BY LETTER 'Y'.

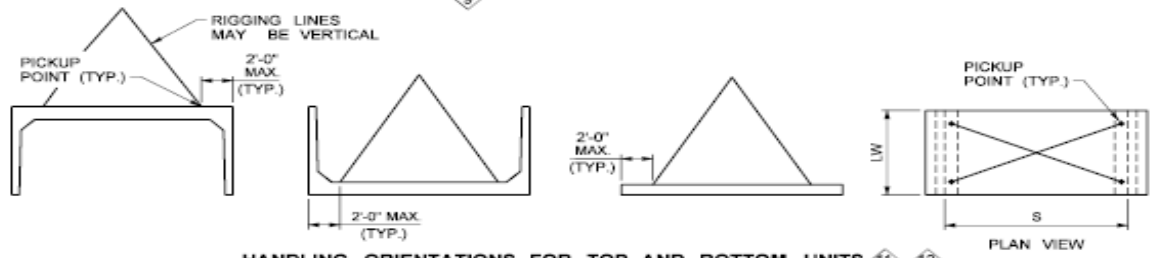
⑧ MATERIAL QUANTITIES ARE FOR A TYPICAL INTERIOR SEGMENT. STEEL WEIGHT DOES NOT INCLUDE ADDITIONAL REINFORCING REQUIRED FOR APPROACH SLAB SEAT.

⑨ SINGLE BARS SPACED AT 4 INCHES MAY BE SUBSTITUTED BY TWO-BAR BUNDLES SPACED AT 8".

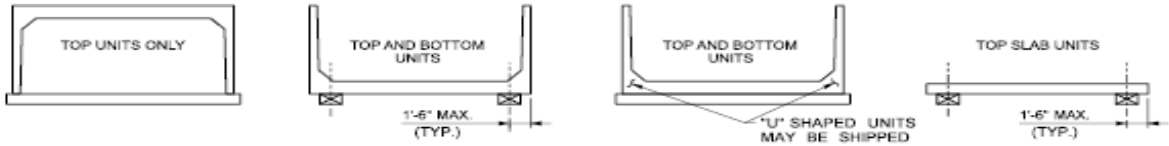
⑩ QUANTITIES OF BOTTOM UNIT CORRESPOND TO 'HB' = 10'-0".

⑪ REINFORCING OF PRECAST UNITS HAVE BEEN DESIGNED FOR HANDLING AND SHIPPING ORIENTATIONS PRESENTED ON THIS SHEET. ALTERNATE SHIPPING OR HANDLING ORIENTATIONS SHALL BE ANALYZED BY THE CONTRACTOR.

⑫ CONCRETE COMPRESSIVE STRENGTH SHALL BE AT LEAST F'CI = 3.5 KSI FOR HANDLING AND F'C = 7.0 KSI FOR SHIPPING.



HANDLING ORIENTATIONS FOR TOP AND BOTTOM UNITS ⑪, ⑫



SHIPPING ORIENTATIONS ⑪, ⑫

GEOFFREY D. SWETT — STATE OF WASHINGTON — 32820 — STRUCTURAL ENGINEER — PROFESSIONAL ENGINEER

BURIED STRUCTURE SPLIT BOX

STANDARD PLAN E-20.10-00

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STATE DESIGN ENGINEER

Washington State Department of Transportation

Class 1 Design Tables w/ Shipping & Handling

DESIGN TABLE – PGA = 0.32g – CLASS II STRUCTURES – SPANS 21', 24', 27' AND 30'

DESIGN SPAN S ⟨1⟩	DESIGN HEIGHT			FILL DEPTH FD ⟨2⟩	MEMBER THICKNESS			TOP UNIT REINFORCEMENT ⟨3⟩												BOTTOM UNIT REINFORCEMENT ⟨3⟩										MATERIAL QUANTITIES				DESIGN VALUES		
	TOTAL H	TOP UNIT WALL HT	BOT. UNIT WALL HB		WALLS TW	TOP SLAB TT	BOT. SLAB TB	T1 (SLAB INTERIOR)		T2 (SLAB EXTERIOR)		T3 (CORNER)			T4 (WALL INTERIOR)		T6 (TIES) ⟨7⟩	T7 (BOT.)		B1 (SLAB INTERIOR)		B2 (SLAB EXTERIOR)		B3 (CORNER)			B4 (WALL INTERIOR)		B6 (TIES) ⟨7⟩	TOP UNIT ⟨8⟩		BOTTOM UNIT ⟨10⟩		STR. I BEARING DEMAND (PSF) ⟨4⟩	RACKING DISPL. ⟨5⟩	REQ'D HORIZ. JOINT TYPE ⟨6⟩
								SIZE	SPA.	SIZE	SPA.	SIZE	SPA.	TL	SIZE	SPA.				SIZE	SPA.	SIZE	SPA.	SIZE	SPA.	BL	SIZE	SPA.		CONC. (CY/FT)	STEEL (LBS/FT)	CONC. (CY/FT)	STEEL (LBS/FT)			
21'	10'	N/A	10'	0' ≤ FD < 2'	12"	16"	14"	#9	6"	#6	12"		N/A			N/A		N/A	#6	12"	#9	6"	#5	6"	#6	6"	3'-4"	#4	8"	N/A	1.21	250.9	1.76	382.2	2177	N/A	2
				2' ≤ FD ≤ 4'	12"	16"	14"	#9	6"	#6	12"		N/A			N/A		N/A	#4	12"	#9	6"	#5	6"	#7	6"	4'-4"	#4	8"	N/A	1.21	230.9	1.76	421.5	2365	N/A	2
				4'< FD ≤ 6'	12"	18"	16"	#10	6"	#6	12"		N/A			N/A		N/A	#4	12"	#10	6"	#7	10"	#7	5"	3'-5"	#4	8"	N/A	1.35	272.2	1.90	488.9	2777	N/A	2
	12' TO 15'	5'	7' TO 10'	0' ≤ FD < 2'	12"	14"	12"	#10	6"	#6	8"	#5	8"	3'-4"	#4	8"		N/A	#6	9"	#9	6"	#5	6"	#7	6"	3'-7"	#4	8"	N/A	1.43	376.7	1.61	413.5	1762	0.16"	1A
				2' ≤ FD ≤ 4'	12"	16"	14"	#10	6"	#6	8"	#5	8"	3'-5"	#4	8"		N/A	#4	12"	#9	6"	#5	6"	#7	6"	3'-7"	#4	8"	N/A	1.57	347.4	1.76	415.4	2015	0.18"	1A
				4'< FD ≤ 8'	12"	18"	16"	#11	6"	#5	7"	#5	7"	3'-7"	#4	8"		N/A	#4	12"	#10	6"	#7	10"	#7	5"	3'-7"	#4	8"	N/A	1.71	388.5	1.90	490.6	2767	0.21"	1
				8'< FD ≤ 12'	12"	20"	20"	#11	6"	#5	6"	#5	6"	3'-9"	#4	8"		N/A	#4	12"	#11	6"	#6	6"	#8	6"	3'-9"	#4	8"	N/A	1.86	403.0	2.18	566.2	3660	0.25"	1
				12'< FD ≤ 16'	12"	22"	22"	#11	5"	#6	10"	#6	5"	3'-11"	#4	8"		N/A	#4	9"	#11	6"	#6	10"	#8	5"	4'-0"	#4	8"	N/A	2.00	492.9	2.32	624.2	4455	0.28"	1
	17' TO 20'	7' TO 10'	10'	0' ≤ FD ≤ 2'	12"	14"	14"	#9	6"	#6	5"	#6	5"	5'-0"	#4	8"		N/A	#6	12"	#9	6"	#6	5"	#8	5"	4'-9"	#4	8"	N/A	1.76	553.5	1.76	530.3	1830	0.27"	1
24'	10'	N/A	10'	0' ≤ FD < 2'	12"	16"	16"	#9	6"	#6	12"		N/A			N/A		N/A	#6	12"	#9	6"	#5	6"	#7	6"	3'-5"	#4	8"	N/A	1.52	282.7	2.05	446.5	2137	N/A	2
				2' ≤ FD ≤ 4'	12"	16"	16"	#10	6"	#6	12"		N/A			N/A		N/A	#4	12"	#10	6"	#5	6"	#7	6"	3'-5"	#4	8"	N/A	1.52	306.5	2.05	492.9	2350	N/A	2
				4'< FD ≤ 6'	12"	16"	18"	#11	6"	#6	12"		N/A			N/A		N/A	#4	12"	#10	6"	#7	10"	#7	5"	3'-7"	#4	8"	N/A	1.52	358.4	2.21	528.2	2733	N/A	2
	12' TO 15'	5'	7' TO 10'	0' ≤ FD < 2'	12"	18"	16"	#10	6"	#6	8"	#5	8"	3'-7"	#4	8"		N/A	#6	10"	#8	6"	#7	10"	#6	5"	3'-7"	#4	8"	N/A	1.88	415.5	2.05	406.6	1773	0.17"	1
				2' ≤ FD ≤ 4'	12"	18"	16"	#10	6"	#6	8"	#5	8"	3'-7"	#4	8"		N/A	#4	12"	#9	6"	#7	10"	#7	5"	3'-7"	#4	8"	N/A	1.88	385.5	2.05	481.4	1984	0.18"	1
				4'< FD ≤ 8'	12"	20"	18"	#11	6"	#6	8"	#6	8"	3'-9"	#4	8"		N/A	#4	12"	#10	6"	#5	6"	#8	6"	3'-10"	#4	8"	N/A	2.04	452.8	2.21	536.1	2776	0.22"	1
				8'< FD ≤ 10'	12"	22"	22"	#11	6"	#6	8"	#6	8"	3'-11"	#4	8"		N/A	#4	9"	#11	6"	#7	10"	#7	5"	3'-11"	#4	8"	N/A	2.20	470.8	2.53	637.9	3260	0.24"	1
				10'< FD ≤ 14'	12"	24"	24"	#10 ⟨9⟩	4"	#6	7"	#6	7"	4'-1"	#4	8"		N/A	#4	9"	#10 ⟨9⟩	4"	#7	10"	#7	5"	4'-1"	#4	8"	N/A	2.36	546.5	2.69	747.5	4150	0.27"	1
	17' TO 20'	7' TO 10'	10'	0' ≤ FD < 2'	12"	16"	16"	#9	6"	#6	5"	#8	5"	3'-10"	#4	8"		N/A	#6	12"	#9	6"	#6	5"	#8	5"	3'-11"	#4	8"	N/A	2.05	578.9	2.05	557.4	1817	0.25"	1
				2' ≤ FD ≤ 4'	12"	16"	16"	#10	6"	#6	5"	#8	5"	4'-3"	#4	8"		N/A	#4	12"	#10	6"	#6	5"	#8	5"	4'-3"	#4	8"	N/A	2.05	608.0	2.05	608.0	2028	0.29"	1
27'	10'	N/A	10'	0' ≤ FD < 2'	12"	18"	16"	#10	6"	#6	12"		N/A			N/A		N/A	#6	10"	#10	6"	#6	6"	#6	6"	3'-9"	#4	8"	N/A	1.68	374.9	2.19	525.6	2107	N/A	2
				2' ≤ FD ≤ 4'	12"	18"	18"	#11	6"	#6	12"		N/A			N/A		N/A	#4	12"	#10	6"	#6	6"	#7	6"	3'-9"	#4	8"	N/A	1.68	398.8	2.37	558.5	2401	N/A	2
				4'< FD ≤ 6'	12"	22"	20"	#11	6"	#6	10"		N/A			N/A		N/A	#4	9"	#11	6"	#7	6"	#8	6"	3'-9"	#4	8"	N/A	2.04	420.1	2.55	588.8	2850	N/A	2
	12' TO 15'	5'	7' TO 10'	0' ≤ FD < 2'	12"	18"	16"	#10	6"	#7	8"	#5	8"	3'-7"	#4	8"		N/A	#6	10"	#9	6"	#8	10"	#7	5"	3'-7"	#4	8"	N/A	2.05	479.4	2.19	534.7	1679	0.17"	1
				2' ≤ FD ≤ 4'	12"	20"	18"	#11	6"	#7	8"	#6	8"	3'-9"	#4	8"		N/A	#4	12"	#10	6"	#8	10"	#7	5"	3'-9"	#4	8"	N/A	2.23	518.7	2.37	590.2	1974	0.19"	1
				4'< FD ≤ 6'	12"	22"	20"	#11	6"	#7	8"	#6	8"	3'-11"	#4	8"		N/A	#4	9"	#10	6"	#8	10"	#7	5"	3'-11"	#4	8"	N/A	2.40	538.0	2.55	594.0	2394	0.21"	1
				6'< FD ≤ 10'	12"	24"	24"	#10 ⟨9⟩	4"	#7	9"	#6	9"	4'-1"	#4	8"		N/A	#4	9"	#11	5"	#8	10"	#7	5"	4'-1"	#4	8"	N/A	2.58	580.3	2.91	770.4	3266	0.24"	1
	17' TO 20'	7' TO 10'	10'	0' ≤ FD < 2'	12"	18"	18"	#10	7"	#8	10"	#8	5"	3'-8"	#4	8"		N/A	#6	12"	#9	6"	#8	10"	#8	5"	3'-10"	#4	8"	N/A	2.37	622.1	2.37	582.7	1782	0.28"	1
				2'< FD ≤ 4'	12"	16"	18"	#10	6"	#8	10"	#8	5"	4'-0"	#4	8"		N/A	#4	12"	#10	6"	#8	10"	#8	5"	4'-0"	#4	8"	N/A	2.37	636.6	2.37	636.6	2009	0.3"	1
30'	10'	N/A	10'	0' ≤ FD < 2'	12"	20"	18"	#10	6"	#6	11"		N/A			N/A		N/A	#6	10"	#11	6"	#6	5"	#8	5"	3'-9"	#4	8"	N/A	2.05	416.4	2.54	751.6	2101	N/A	2
				2' ≤ FD ≤ 4'	12"	20"	18"	#11	6"	#6	11"		N/A			N/A		N/A	#4	12"	#11	6"	#7	6"	#7	6"	3'-9"	#4	8"	N/A	2.05	443.8	2.54	696.9	2322	N/A	2
				4'< FD ≤ 6'	12"	22"	20"	#11	5"	#6	10"		N/A			N/A		N/A	#4	9"	#11	5"	#7	6"	#8	6"	4'-0"	#4	8"	N/A	2.25	531.8	2.74	806.9	2737	N/A	2
	12' TO 15'	5'	7' TO 10'	0' ≤ FD < 2'	12"	20"	18"	#11	6"	#7	7"	#5	7"	3'-9"	#4	8"		N/A	#6	9"	#10	6"	#6	5"	#7	5"	3'-9"	#4	8"	N/A	2.41	610.8	2.54	642.3	1713	0.15"	1
				2' ≤ FD ≤ 4'	12"	22"	20"	#11	6"	#7	7"	#5	7"	3'-11"	#4	8"		N/A	#4	9"	#10	6"	#6	5"	#7	5"	3'-11"	#4	8"	N/A	2.61	588.7	2.74	646.1	1999	0.19"	1
				4'< FD ≤ 6'	12"	24"	22"	#11	5"	#7	7"	#6	7"	4'-1"	#4	8"		N/A	#4	9"	#11	6"	#6	5"	#8	5"	4'-1"	#4	8"	N/A	2.81	674.5	2.93	817.7	2414	0.21"	1
				6'< FD ≤ 8'	12"	24"	24"	#10 ⟨9⟩	4"	#7	7"	#6	7"	4'-1"	#4	8"		N/A	#4	9"	#11	5"	#6	5"	#8	5"	4'-1"	#4	8"	N/A	2.81	679.5	3.13	885.4	2821	0.23"	1
	17' TO 20'	7' TO 10'	10'	0' ≤ FD < 2'	12"	18"	18"	#10	6"	#6	6"	#8	6"	4'-2"	#4	8"		N/A	#6	10"	#10	6"	#6	5"	#8	5"	3'-9"	#4	8"	N/A	2.54	675.6	2.54	685.5	1743	0.26"	1
				2' ≤ FD ≤ 4'	12"	20"	20"	#11	6"	#6	5"	#8	5"	3'-9"	#4	8"		N/A	#4	12"	#11	6"	#6	5"	#8	5"	3'-9"	#4	8"	N/A	2.74	752.1	2.74	752.1	2028	0.3"	1

KEY NOTES

⟨1⟩ DESIGN SPAN 'S', SHALL BE TAKEN EQUAL TO THE HORIZONTAL DISTANCE BETWEEN INSIDE FACE OF WALLS AT THE CORNER BETWEEN THE FILLET AND THE WALL AS SHOWN ON SHEET 1. FOR SEGMENTS WITH A SKEW SEE GRAPHICAL CLARIFICATION OF DESIGN SPAN ON SHEET 3. IF THE DESIGN SPAN FALLS INBETWEEN A DESIGN SPAN VALUE IN THE TABLES, USE REINFORCEMENT FOR THE LONGER SPAN.

⟨2⟩ THE MAXIMUM FILL DEPTH OVER THE ENTIRE BURIED STRUCTURE SHALL BE USED WHEN SELECTING DESIGN FILL DEPTH.

⟨3⟩ FOR REINFORCING DETAILS SEE SHEET 4.

⟨4⟩ MAXIMUM REQUIRED BEARING RESISTANCE FOR STRENGTH LIMIT STATE.

⟨5⟩ THE STRUCTURE HAS BEEN DESIGNED FOR THE RACKING DISPLACEMENTS PRESENTED HERE. THESE DESIGN VALUES ARE DETERMINED BASED ON THE DESIGN CRITERIA AS OUTLINED IN THE BDM. THESE STRUCTURES HAVE BEEN DESIGNED FOR A TRAVERSE DIFFERENTIAL SETTLEMENT DISPLACEMENT EQUAL TO 2 INCHES PER 100 FEET OF STRUCTURAL SPAN (DESIGN SPAN + 1.0 FOOT).

⟨6⟩ FOR HORIZONTAL JOINT TYPE DETAILS SEE SHEET 10.

⟨7⟩ WALL TIES T6 AND B6 ARE REQUIRED WHEN INDICATED BY LETTER 'Y'.

⟨8⟩ MATERIAL QUANTITIES ARE FOR TYPICAL INTERIOR SEGMENT. STEEL WEIGHT DOES NOT INCLUDE ADDITIONAL REINFORCING REQUIRED FOR APPROACH SLAB SEAT.

⟨9⟩ SINGLE BARS SPACED AT 4 INCHES MAY BE SUBSTITUTED BY TWO-BAR BUNDLES SPACED AT 8".

⟨10⟩ QUANTITIES OF BOTTOM UNIT CORRESPOND TO 'HB' = 10'-0".

⟨11⟩ SEE SHEET 5 FOR HANDLING AND SHIPPING ORIENTATIONS.

GEOFFREY D. SWETT
STATE OF WASHINGTON
32820
STRUCTURAL ENGINEER
PROFESSIONAL ENGINEER

BURIED STRUCTURE
SPLIT BOX
STANDARD PLAN E-20.10-00
SHEET 6 OF 17 SHEETS

APPROVED FOR PUBLICATION

STATE DESIGN ENGINEER
Washington State Department of Transportation

Class 2 (0.32g) Design Tables

DESIGN TABLE – PGA = 0.64g – CLASS II STRUCTURES – SPANS 21', 24', 27' AND 30'

DESIGN SPAN S ⟨1⟩	DESIGN HEIGHT			FILL DEPTH FD ⟨2⟩	MEMBER THICKNESS			TOP UNIT REINFORCEMENT ⟨3⟩												BOTTOM UNIT REINFORCEMENT ⟨3⟩										MATERIAL QUANTITIES				DESIGN VALUES		
	TOTAL H	TOP UNIT WALL HT	BOT. UNIT WALL HB		WALLS TW	TOP SLAB TT	BOT. SLAB TB	T1 (SLAB INTERIOR)		T2 (SLAB EXTERIOR)		T3 (CORNER)			T4 (WALL INTERIOR)		T6 (TIES) ⟨7⟩	T7 (BOT.)		B1 (SLAB INTERIOR)		B2 (SLAB EXTERIOR)		B3 (CORNER)			B4 (WALL INTERIOR)		B6 (TIES) ⟨7⟩	TOP UNIT ⟨8⟩		BOTTOM UNIT ⟨10⟩		STR. I BEARING DEMAND (PSF) ⟨4⟩	RACKING DISPL. ⟨5⟩	REQ'D HORIZ JOINT TYPE ⟨6⟩
								SIZE	SPA.	SIZE	SPA.	SIZE	SPA.	TL	SIZE	SPA.		SIZE	SPA.	SIZE	SPA.	SIZE	SPA.	SIZE	SPA.	BL	SIZE	SPA.		CONC. (CY/FT)	STEEL (LBS/FT)	CONC. (CY/FT)	STEEL (LBS/FT)			
21'	10'	N/A	10'	0' ≤ FD < 2'	12"	16"	14"	#9	6"	#6	12"		N/A			N/A		N/A	#6	12"	#9	6"	#6	6"	#7	6"	4'-8"	#4	8"	N/A	1.21	250.9	1.76	445.0	2177	N/A	2
				2' ≤ FD ≤ 4'	12"	16"	14"	#9	6"	#6	12"		N/A			N/A		N/A	#4	12"	#9	6"	#6	5"	#7	5"	3'-4"	#4	8"	N/A	1.21	230.9	1.76	471.2	2365	N/A	2
				4'< FD ≤ 6'	12"	18"	16"	#10	6"	#6	12"		N/A			N/A		N/A	#4	12"	#10	6"	#7	10"	#7	5"	3'-5"	#4	8"	N/A	1.35	272.2	1.90	488.9	2777	N/A	2
	12' TO 15'	5'	7' TO 10'	0' ≤ FD < 2'	12"	14"	12"	#10	6"	#6	8"	#5	8"	3'-4"	#4	8"	N/A	#6	9"	#9	6"	#5	6"	#7	6"	3'-7"	#4	8"	N/A	1.43	376.7	1.61	413.5	1762	0.5'	1A
				2' ≤ FD ≤ 4'	12"	16"	14"	#10	6"	#6	8"	#5	8"	3'-5"	#4	8"	N/A	#4	12"	#9	6"	#5	6"	#7	6"	3'-7"	#4	8"	N/A	1.57	347.4	1.76	415.4	2015	0.56"	1A
				4'< FD ≤ 8'	12"	18"	16"	#11	6"	#5	7"	#5	7"	3'-7"	#4	8"	N/A	#4	12"	#10	6"	#7	10"	#7	5"	3'-7"	#4	8"	N/A	1.71	388.5	1.90	490.6	2767	0.66"	1
				8'< FD ≤ 12'	12"	20"	20"	#11	6"	#5	6"	#5	6"	3'-9"	#5	9"	Y	#4	12"	#11	6"	#6	6"	#8	6"	3'-9"	#5	9"	Y	1.86	425.9	2.18	593.0	3660	0.77"	1
				12'< FD ≤ 16'	12"	22"	22"	#11	5"	#6	10"	#6	5"	3'-11"	#5	8"	Y	#4	9"	#11	6"	#6	10"	#8	5"	4'-0"	#5	8"	Y	2.00	520.4	2.32	658.6	4455	0.85"	1
	17' TO 20'	7' TO 10'	10'	0' ≤ FD ≤ 2'	12"	14"	14"	#9	6"	#6	5"	#8	5"	5'-0"	#4	8"	N/A	#6	12"	#9	6"	#6	5"	#8	5"	4'-9"	#4	8"	N/A	1.76	553.5	1.76	530.3	1830	0.84"	1
24'	10'	N/A	10'	0' ≤ FD < 2'	12"	18"	16"	#9	6"	#6	12"		N/A			N/A		N/A	#6	12"	#9	6"	#7	10"	#7	6"	3'-9"	#4	8"	N/A	1.52	282.7	2.05	458.6	2137	N/A	2
				2' ≤ FD ≤ 4'	12"	18"	16"	#10	6"	#6	12"		N/A			N/A		N/A	#4	12"	#10	6"	#7	10"	#7	5"	3'-5"	#4	8"	N/A	1.52	306.5	2.05	526.1	2350	N/A	2
				4'< FD ≤ 6'	12"	18"	18"	#11	6"	#6	12"		N/A			N/A		N/A	#4	12"	#10	6"	#7	10"	#7	5"	3'-7"	#4	8"	N/A	1.52	358.4	2.21	528.2	2733	N/A	2
	12' TO 15'	5'	7' TO 10'	0' ≤ FD < 2'	12"	18"	16"	#10	6"	#6	8"	#5	8"	3'-7"	#4	8"	N/A	#6	10"	#8	6"	#7	10"	#6	5"	3'-7"	#4	8"	N/A	1.88	415.5	2.05	405.6	1773	0.51"	1A
				2' ≤ FD ≤ 4'	12"	18"	16"	#10	6"	#6	8"	#5	8"	3'-7"	#4	8"	N/A	#4	12"	#9	6"	#7	10"	#7	5"	3'-7"	#4	8"	N/A	1.88	385.5	2.05	481.4	1984	0.57"	1A
				4'< FD ≤ 8'	12"	20"	18"	#11	6"	#6	8"	#6	8"	3'-9"	#4	8"	N/A	#4	12"	#10	6"	#5	6"	#8	6"	3'-10"	#4	8"	N/A	2.04	452.8	2.21	536.1	2776	0.66"	1
				8'< FD ≤ 10'	12"	22"	22"	#11	6"	#6	8"	#6	8"	3'-11"	#5	9"	Y	#4	9"	#11	6"	#7	10"	#7	5"	3'-11"	#5	9"	Y	2.20	493.9	2.53	666.2	3260	0.73"	1
				10'< FD ≤ 14'	12"	24"	24"	#10⟨9⟩	4"	#6	7"	#7	7"	4'-1"	#5	8"	N/A	#4	9"	#10⟨9⟩	4"	#7	10"	#8	5"	4'-1"	#5	8"	N/A	2.36	580.9	2.69	767.5	4150	0.84"	1
	17' TO 20'	7' TO 10'	10'	0' ≤ FD < 2'	12"	16"	16"	#9	6"	#6	5"	#8	5"	3'-10"	#4	8"	N/A	#6	12"	#9	6"	#6	5"	#8	5"	3'-11"	#4	8"	N/A	2.05	578.9	2.05	557.4	1817	0.75"	1
				2' ≤ FD ≤ 4'	12"	16"	16"	#10	6"	#6	5"	#8	5"	4'-3"	#4	8"	N/A	#4	12"	#10	6"	#8	8"	#8⟨9⟩	4"	3'-7"	#4	8"	N/A	2.05	608.0	2.05	656.5	2028	0.92"	1
27'	10'	N/A	10'	0' ≤ FD < 2'	12"	18"	16"	#10	6"	#6	12"		N/A			N/A		N/A	#6	10"	#10	6"	#6	6"	#7	6"	3'-9"	#4	8"	N/A	1.68	374.9	2.19	558.0	2107	N/A	2
				2' ≤ FD ≤ 4'	12"	18"	18"	#11	6"	#6	12"		N/A			N/A		N/A	#4	12"	#10	6"	#6	5"	#7	5"	3'-9"	#4	8"	N/A	1.68	391.9	2.37	600.1	2401	N/A	2
				4'< FD ≤ 6'	12"	22"	20"	#11	6"	#6	10"		N/A			N/A		N/A	#4	9"	#11	6"	#7	6"	#8	6"	3'-9"	#4	8"	N/A	2.04	466.1	2.55	666.6	2655	N/A	2
	12' TO 15'	5'	7' TO 10'	0' ≤ FD < 2'	12"	18"	16"	#10	6"	#7	8"	#5	8"	3'-7"	#4	8"	N/A	#6	10"	#9	6"	#8	10"	#7	5"	3'-7"	#4	8"	N/A	2.05	479.4	2.19	534.7	1679	0.52"	1A
				2' ≤ FD ≤ 4'	12"	20"	18"	#11	6"	#7	8"	#6	8"	3'-9"	#4	8"	N/A	#4	12"	#10	6"	#8	10"	#7	5"	3'-9"	#4	8"	N/A	2.23	518.7	2.37	590.2	1974	0.56"	1A
				4'< FD ≤ 6'	12"	22"	20"	#11	6"	#7	8"	#6	8"	3'-11"	#4	8"	N/A	#4	9"	#10	6"	#8	10"	#7	5"	3'-11"	#4	8"	N/A	2.40	538.0	2.55	594.0	2394	0.64"	1
				6'< FD ≤ 10'	12"	24"	24"	#10⟨9⟩	4"	#7	9"	#6	9"	4'-1"	#4	7"	N/A	#4	9"	#11	5"	#8	10"	#8	5"	4'-1"	#4	7"	N/A	2.58	594.0	2.91	822.9	3266	0.75"	1
	17' TO 20'	7' TO 10'	10'	0' ≤ FD < 2'	12"	18"	18"	#10	7"	#8	10"	#8	5"	3'-8"	#4	8"	N/A	#6	12"	#9	6"	#8	10"	#8	5"	3'-10"	#4	8"	N/A	2.37	622.1	2.37	582.7	1782	0.83"	1
				2'< FD ≤ 4'	12"	18"	18"	#10	6"	#8	10"	#8	5"	4'-0"	#4	8"	N/A	#4	12"	#10	6"	#8	10"	#8	5"	4'-0"	#4	8"	N/A	2.37	636.6	2.37	636.6	2009	0.94"	1
30'	10'	N/A	10'	0' ≤ FD < 2'	12"	20"	18"	#10	6"	#6	11"		N/A			N/A		N/A	#6	10"	#11	6"	#7	6"	#8	5"	3'-9"	#4	8"	N/A	2.05	416.4	2.54	751.6	2101	N/A	2
				2' ≤ FD ≤ 4'	12"	20"	18"	#11	6"	#6	11"		N/A			N/A		N/A	#4	12"	#11	6"	#6	5"	#7	5"	3'-9"	#4	8"	N/A	2.05	443.8	2.54	706.3	2322	N/A	2
				4'< FD ≤ 6'	12"	22"	20"	#11	5"	#6	10"		N/A			N/A		N/A	#4	9"	#11	5"	#6	5"	#8	5"	4'-0"	#4	8"	N/A	2.25	518.5	2.74	824.7	2737	N/A	2
	12' TO 15'	5'	7' TO 10'	0' ≤ FD < 2'	12"	20"	18"	#11	6"	#7	7"	#5	7"	3'-9"	#4	8"	N/A	#6	9"	#10	6"	#6	5"	#7	5"	3'-9"	#4	8"	N/A	2.41	610.8	2.54	642.3	1713	0.48"	1A
				2' ≤ FD ≤ 4'	12"	22"	20"	#11	6"	#7	7"	#5	7"	3'-11"	#4	8"	N/A	#4	9"	#10	6"	#6	5"	#7	5"	3'-11"	#4	8"	N/A	2.61	588.7	2.74	646.1	1999	0.56"	1
				4'< FD ≤ 6'	12"	24"	22"	#11	5"	#7	7"	#6	7"	4'-1"	#4	8"	N/A	#4	9"	#11	6"	#6	5"	#8	5"	4'-1"	#4	8"	N/A	2.81	667.9	2.93	817.7	2414	0.65"	1
				6'< FD ≤ 8'	12"	24"	24"	#10⟨9⟩	4"	#7	7"	#6	7"	4'-1"	#4	8"	N/A	#4	9"	#11	5"	#6	5"	#8	5"	4'-1"	#4	8"	N/A	2.81	679.5	3.13	885.4	2821	0.71"	1
	17' TO 20'	7' TO 10'	10'	0' ≤ FD < 2'	12"	18"	18"	#10	6"	#6	6"	#8	6"	4'-2"	#4	8"	N/A	#6	10"	#10	6"	#6	5"	#8	5"	3'-9"	#4	8"	N/A	2.54	675.6	2.54	685.5	1743	0.8'	1
				2' ≤ FD ≤ 4'	12"	20"	20"	#11	6"	#6	5"	#8	5"	3'-9"	#4	8"	N/A	#4	12"	#11	6"	#6	5"	#8	5"	3'-9"	#4	8"	N/A	2.74	752.1	2.74	752.1	2028	0.95"	1

KEY NOTES

⟨1⟩ DESIGN SPAN 'S', SHALL BE TAKEN EQUAL TO THE HORIZONTAL DISTANCE BETWEEN INSIDE FACE OF WALLS AT THE CORNER BETWEEN THE FILLET AND THE WALL AS SHOWN ON SHEET 1. FOR SEGMENTS WITH A SKEW SEE GRAPHICAL CLARIFICATION OF DESIGN SPAN ON SHEET 3. IF THE DESIGN SPAN FALLS INBETWEEN A DESIGN SPAN VALUE IN THE TABLES, USE REINFORCEMENT FOR THE LONGER SPAN.

⟨2⟩ THE MAXIMUM FILL DEPTH OVER THE ENTIRE BURIED STRUCTURE SHALL BE USED WHEN SELECTING DESIGN FILL DEPTH.

⟨3⟩ FOR REINFORCING DETAILS SEE SHEET 4.

⟨4⟩ MAXIMUM REQUIRED BEARING RESISTANCE FOR STRENGTH LIMIT STATE.

⟨5⟩ THE STRUCTURE HAS BEEN DESIGNED FOR THE RACKING DISPLACEMENTS PRESENTED HERE. THESE DESIGN VALUES ARE DETERMINED BASED ON THE DESIGN CRITERIA AS OUTLINED IN THE BDM. THESE STRUCTURES HAVE BEEN DESIGNED FOR A TRAVERSE DIFFERENTIAL SETTLEMENT DISPLACEMENT EQUAL TO 2 INCHES PER 100 FEET OF STRUCTURAL SPAN (DESIGN SPAN + 1.0 FOOT).

⟨6⟩ FOR HORIZONTAL JOINT TYPE DETAILS SEE SHEET 10.

⟨7⟩ WALL TIES T6 AND B6 ARE REQUIRED WHEN INDICATED BY LETTER 'Y'.

⟨8⟩ MATERIAL QUANTITIES ARE FOR TYPICAL INTERIOR SEGMENT. STEEL WEIGHT DOES NOT INCLUDE ADDITIONAL REINFORCING REQUIRED FOR APPROACH SLAB SEAT.

⟨9⟩ SINGLE BARS SPACED AT 4 INCHES MAY BE SUBSTITUTED BY TWO-BAR BUNDLES SPACED AT 8".

⟨10⟩ QUANTITIES OF BOTTOM UNIT CORRESPOND TO 'HB' = 10'-0".

⟨11⟩ SEE SHEET 5 FOR HANDLING AND SHIPPING ORIENTATIONS.

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32820
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BURIED STRUCTURE
SPLIT BOX
STANDARD PLAN E-20.10-00
SHEET 7 OF 17 SHEETS

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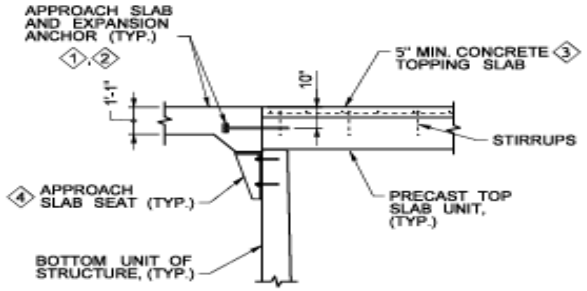
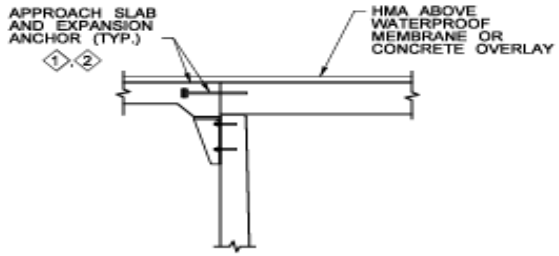
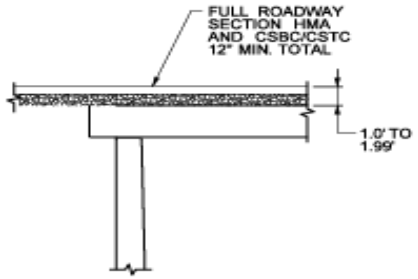
Class 2 (0.64g) Design Tables



SCENARIO 1



SCENARIO 2



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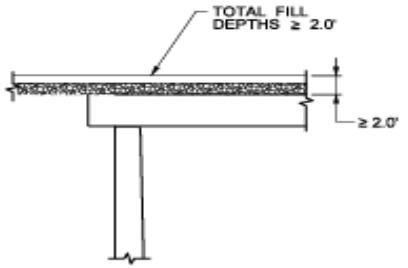
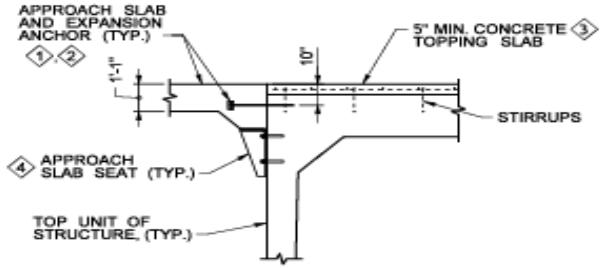
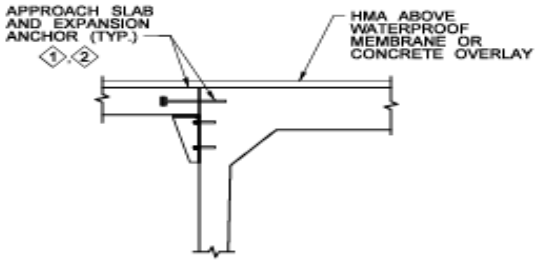


SCENARIO 4

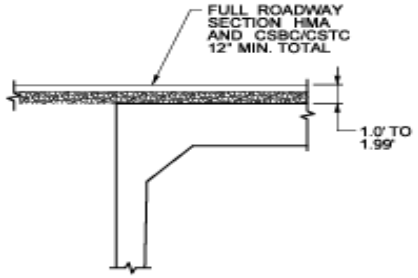
SPLIT BOX ~ SLAB ROADWAY CONDITIONS



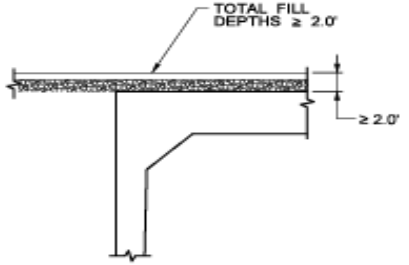
SCENARIO 1



SCENARIO 2



SCENARIO 3



SCENARIO 4

SPLIT BOX ROADWAY CONDITIONS

DESIGN OPTIONS	
APPROACH SLAB SEAT	
CONCRETE:	
C.I.P.	SHEET 15
C.I.P. END DIAPHRAGM	SHEET 17
STEEL:	
W/O RESTRAINER	SHEET 13
W/RESTRAINER	SHEET 14
SEISMIC RESTRAINERS	
LONGITUDINAL: (REQ'D FOR SPLIT BOX-SLABS)	
EXTENDED SEAT WIDTH OR PROVIDE AN:	SHEET 10
APPROACH SLAB	SHEET 13-15
TRANSVERSE:	
STEEL APPR. SEAT	SHEET 14
ACCEL. BRIDGE CONST.	SHEET 16
C.I.P. END DIAPHRAGM	SHEET 17

TOP UNIT LONGITUDINAL JOINT SELECTION CRITERIA 5				
ROADWAY CONDITION	SCENARIO 1	SCENARIO 2	SCENARIO 3	SCENARIO 4
SCENARIO DESCRIPTION	5" MIN CONCRETE TOPPING SLAB	HMA OR CONCRETE OVERLAY	12" MIN. FULL ROADWAY SECTION (HMA & CSBC)	ROADWAY SECTION AND/OR BACKFILL
FILL DEPTH 'FD'	TOPPING SLAB	OVERLAY	1' TO 1.99'	≥ 2.0'
VERTICAL SHEAR TRANSFER ACROSS JOINTS OF ADJACENT SEGMENTS	NOT REQUIRED	REQUIRED	NOT REQUIRED	NOT REQUIRED
ACCEPTABLE JOINT TYPE	TYPE 2A	TYPES 3 & 4	TYPES 1 & 3	TYPES 1, 2 & 3
EPOXY COATED REINF. REQUIRED IN TOP SLAB	NO	YES	YES	NO
CLEAR COVER TO TOP MAT OF REINF.	2"	HMA 2.5" / CONC. 2"	2"	2"
LONG. CONNECTION AT TOP SLAB BETWEEN FIRST THREE SEGMENTS AT EACH END	NOT REQUIRED	WELD TIES (SEE SHEET 12)	LONGITUDINAL TIE PLATES (SEE SHEETS 2 AND 12)	

KEY NOTES

1. PROVIDE APPROACH SLAB WHEN REQUIRED IN THE CONTRACT DOCUMENTS.
2. APPROACH SLAB AND EXPANSION ANCHOR SHALL BE PER STANDARD PLAN A-40.50 AND PER ADDITIONAL DETAILS ON SHEET 13.
3. SEE SHEET 11 FOR 5" MIN. CONCRETE TOPPING SLAB DETAILS.
4. FOR APPROACH SLAB SEAT DETAILS SEE SHEETS 13, 14, 15, AND 17.
5. SEE SHEET 9 FOR TYPES AND DETAILS OF TOP SLAB LONGITUDINAL JOINTS.

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BURIED STRUCTURE
SPLIT BOX
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SHEET 8 OF 17 SHEETS

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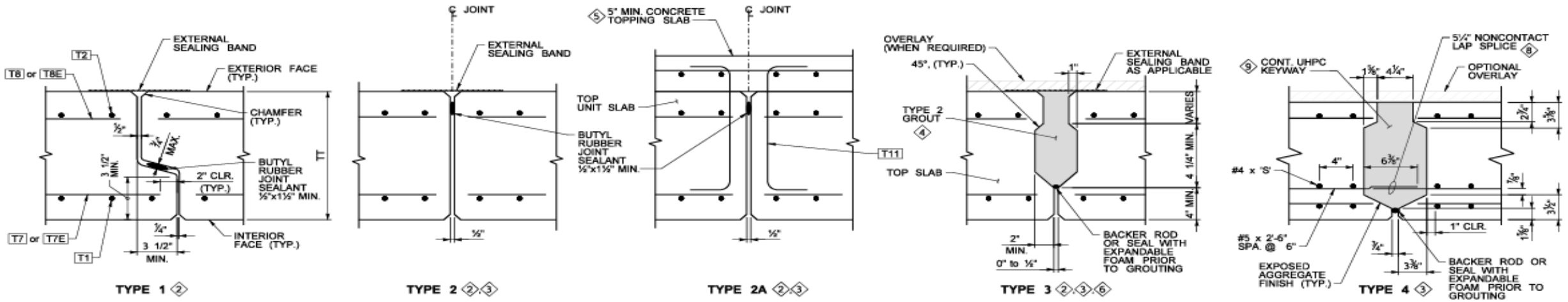
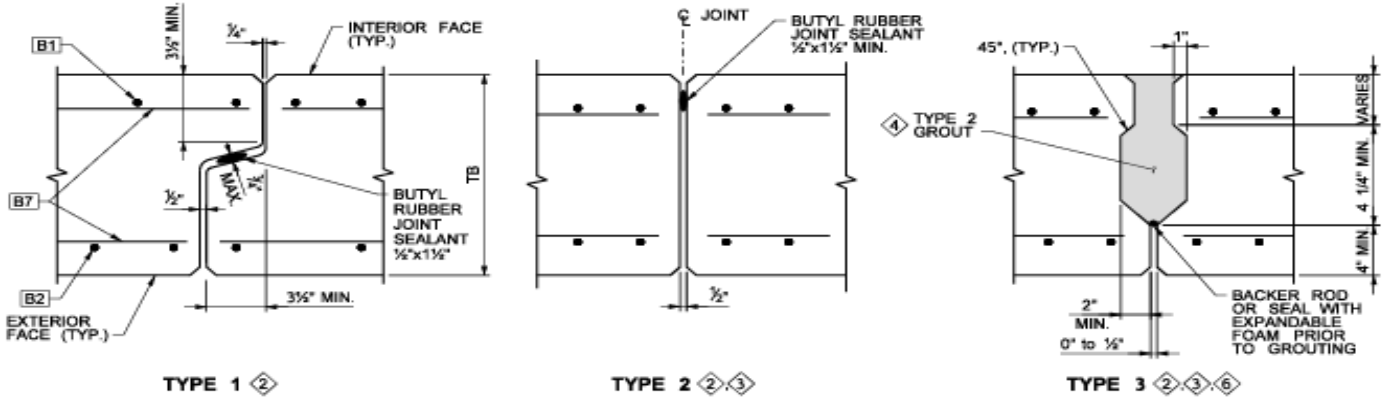
Roadway Scenario's, Shear Transfer, and Top Joint Criteria



ELEVATION
TOP SLAB LONGITUDINAL JOINTS ALTERNATIVES ①



ELEVATION
BOTTOM SLAB LONGITUDINAL JOINTS ALTERNATIVES ⑦

KEY NOTES

① SEE SHEET 8 FOR JOINT TYPE SELECTION CRITERIA

② THIS JOINT CAN BE USED IN COMBINATION WITH WELD TIES. SEE SHEET 12 FOR DETAILS.

③ SEE JOINT TYPE 1 FOR TYPICAL REINFORCING AND DETAILS NOT SHOWN.

④ GROUT SHALL CONFORM TO STANDARD SPEC. 9.20.3(2) AND SHALL ACHIEVE A MINIMUM COMPRESSIVE STRENGTH OF 2,500 PSI BEFORE BACKFILL PLACEMENT

⑤ SEE SHEET 11 FOR 5" MIN. CONCRETE TOPPING SLAB DETAILS.

⑥ MANUFACTURER VARIATIONS OR NOMINAL ADJUSTMENTS TO THE DETAILED JOINT GEOMETRICS SHALL BE SHOWN IN THE FABRICATION SHOP DRAWINGS.

⑦ BOTTOM SLAB LONGITUDINAL JOINT TYPE 1, TYPE 2 OR TYPE 3 ARE PERMISSIBLE. THE SAME JOINT TYPE SHALL BE USED FOR BOTH TOP AND BOTTOM UNITS FOR EACH STRUCTURE EXCEPT TYPE 4 IS ONLY REQUIRED FOR TOP JOINT. JOINT TYPE SHALL NOT BE INTERCHANGED WITHIN THE STRUCTURE.

⑧ STAGGER EXTENDED #5 BAR BETWEEN TOP UNIT SLABS TO PROVIDE 3" CENTER-TO-CENTER SPACING.

⑨ REFER TO SPECIAL PROVISIONS FOR UHPC REQUIREMENTS.

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BURIED STRUCTURE
SPLIT BOX

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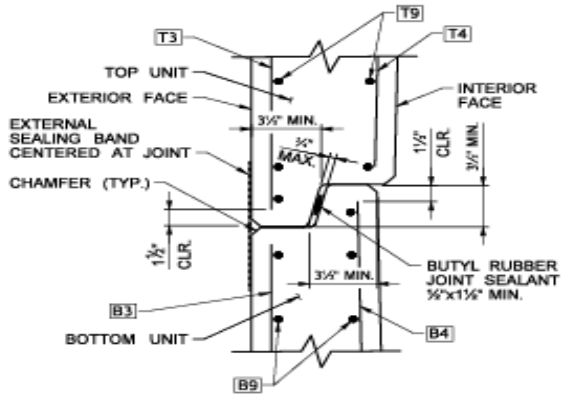
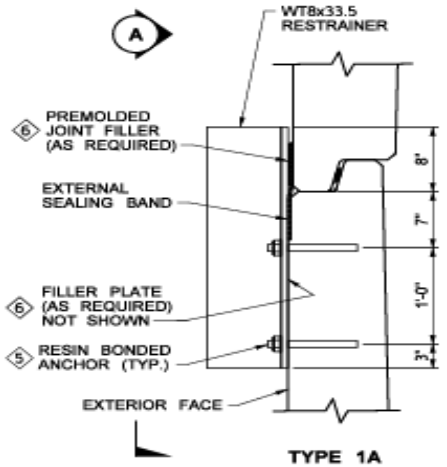
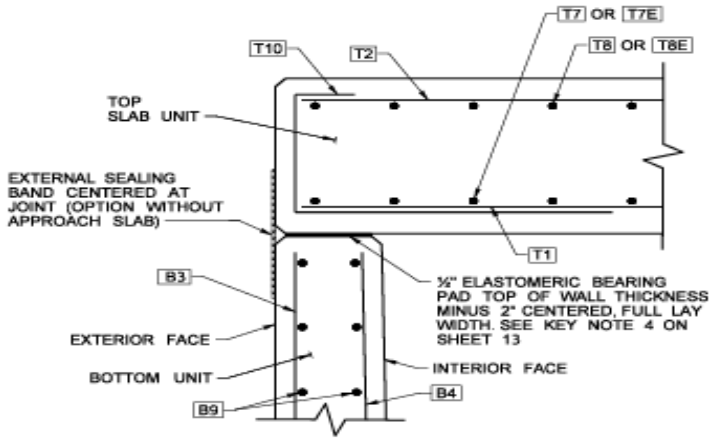
Top & Bottom Slab Longitudinal Joint Types



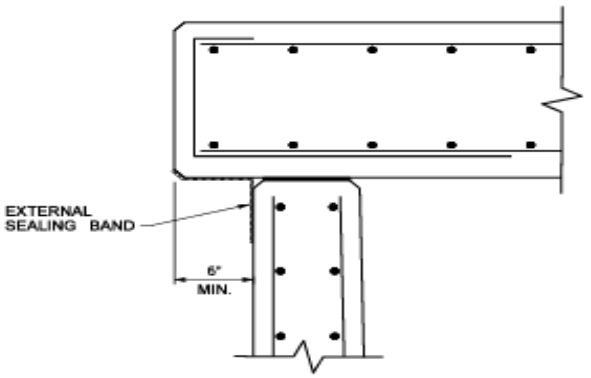
TYPE 1



TYPE 1A
(ADDED RESTRAINERS)
SEE JOINT TYPE 1 FOR DETAILS NOT SHOWN

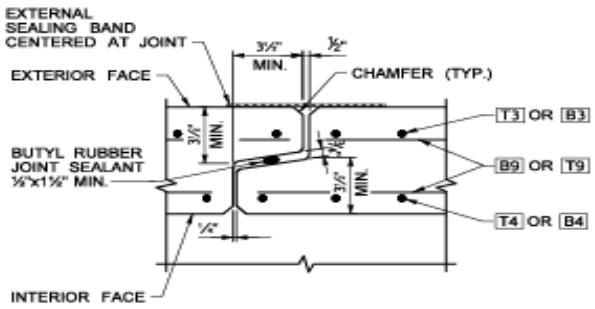


TYPE 2

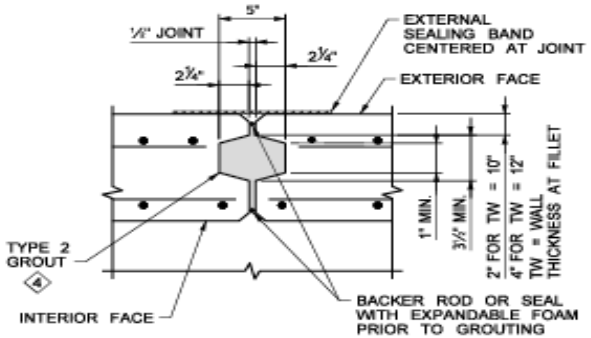


TYPE 2A 8
(EXTENDED SEAT WIDTH)
SEE JOINT TYPE 2 FOR DETAILS NOT SHOWN

WALL HORIZONTAL JOINTS (SECTION) 1

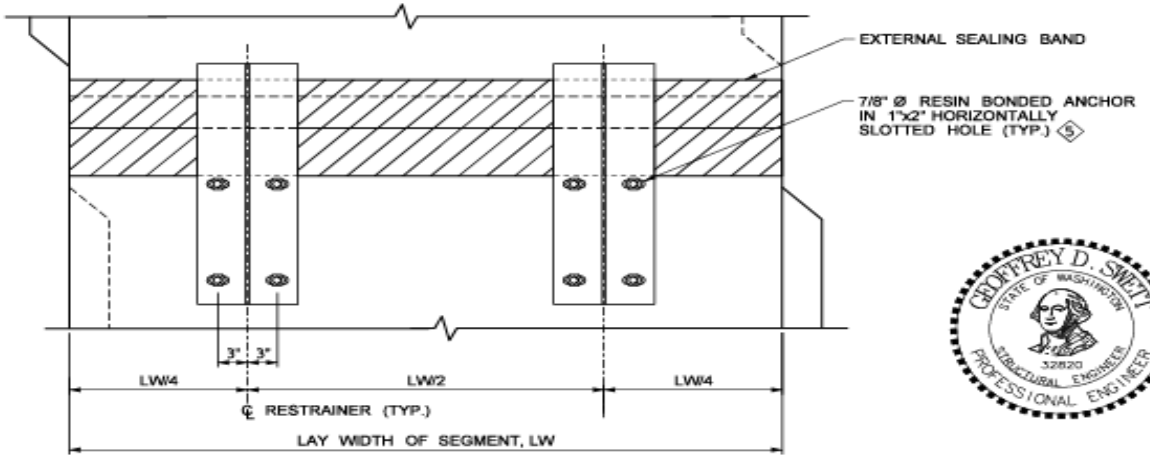


TYPE 1



TYPE 2 3,7
SEE JOINT TYPE 1 FOR TYPICAL REBAR CALLOUTS

WALL VERTICAL JOINTS (PLAN) 2



SECTION A

KEY NOTES:

1. SEE DESIGN TABLES FOR APPLICABLE WALL HORIZONTAL JOINT TYPES.
2. EITHER VERTICAL WALL JOINT TYPE 1 OR TYPE 2 IS PERMISSIBLE.
3. MANUFACTURER VARIATIONS OR NOMINAL ADJUSTMENTS TO THE DETAILED JOINT GEOMETRICS SHALL BE SHOWN IN THE FABRICATION SHOP DRAWINGS.
4. THE CONTRACTOR SHALL PLACE THE GROUT BEFORE PLACING THE BACKFILL ON TOP OR AGAINST THE SIDES OF THE STRUCTURE. GROUT SHALL CONFORM TO STANDARD SPEC. 9.20.3(2) AND SHALL ACHIEVE A MINIMUM COMPRESSIVE STRENGTH OF 2,500 PSI BEFORE BACKFILL PLACEMENT.
5. ANCHORS SHALL BE 7/8" DIA. SET IN 6" LONG HOLES. MANUFACTURER AND CONTRACTOR SHALL COORDINATE SPACING OF WALL REINFORCING BARS AND LOCATION OF RESIN BONDED ANCHORS TO AVOID CONFLICT DURING INSTALLATION.
6. IF EXTERIOR SURFACES OF TOP AND BOTTOM UNITS ARE MISALIGNED BY 1/4" OR GREATER, PLACE PREMOLDED JOINT FILLER (PMJF) IN THE GAP BETWEEN RESTRAINER AND TOP UNIT OR STEEL FILLER PLATE IN THE GAP AT THE BOTTOM UNIT. FILLER PLATE OR PMJF SHALL BE SIZED FOR THE FULL WIDTH AND HEIGHT OF CONTACT AREA WITH WT RESTRAINER.
7. THIS JOINT CAN BE USED IN COMBINATION WITH WELD TIES. ALTERNATIVELY, SHEAR KEY AND GROUT MAY BE ELIMINATED IF WELD TIES ARE UTILIZED. SEE SHEET 12 FOR WELD TIE DETAILS.
8. THIS JOINT SHALL BE USED FOR CLASS 2 STRUCTURES WITHOUT AN APPOACH SLAB.

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BURIED STRUCTURE SPLIT BOX

STANDARD PLAN E-20.10-00

SHEET 10 OF 17 SHEETS

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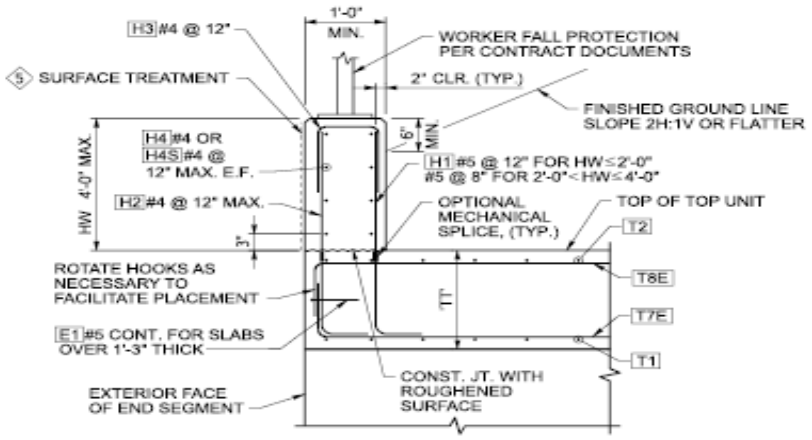
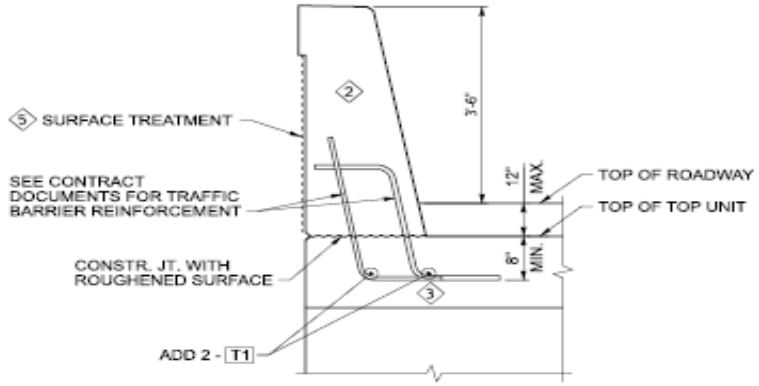
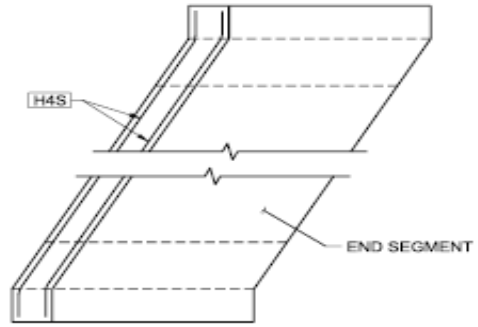
Wall Joints (Horizontal & Vertical) and Restrainers



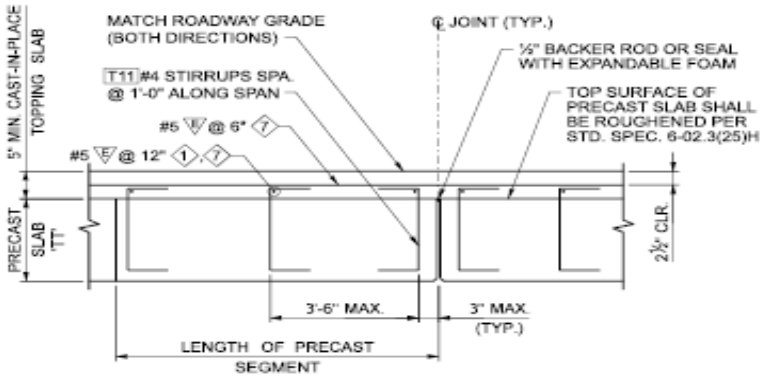
HEADWALL DETAIL 6 (AS REQUIRED)



TRAFFIC BARRIER DETAIL 4 (AS REQUIRED)



SKEW OPTION 1A HEADWALL CORNER REINFORCEMENT DETAIL

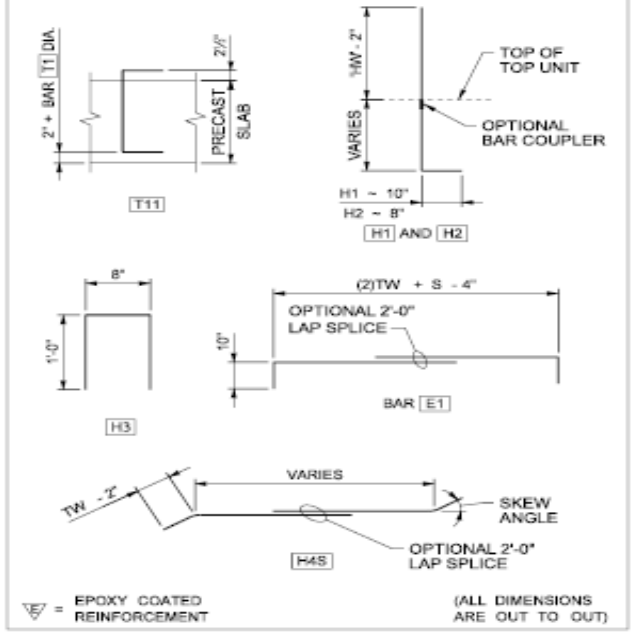


5" MINIMUM CONCRETE TOPPING SLAB DETAIL (AS REQUIRED)

CONSTRUCTION AIDS (E.G. WELD TABS) CAN BE PROVIDED AT CONTRACTOR'S DISCRETION.

IF TOPPING SLAB THICKNESS EXCEEDS 7", ADD SECOND MAT OF #5 REINFORCEMENT

BENDING DIAGRAM



E = EPOXY COATED REINFORCEMENT

(ALL DIMENSIONS ARE OUT TO OUT)

KEY NOTES

1. RUN PARALLEL TO SKEW FOR SKEWED SEGMENTS
2. FOR TRAFFIC BARRIER DETAILS SEE CONTRACT DOCUMENTS
3. TOP UNIT REINFORCEMENT IS NOT SHOWN. SEE HEADWALL DETAIL THIS SHEET FOR TYPICAL REINFORCING IN TOP SLAB OF END UNIT.
4. TOP SLAB DESIGN IS BASED ON A SINGLE SLOPE 42" TRAFFIC BARRIER (TL4) WITH MAX 12" FILL OR ROADWAY ON SLAB.
5. SURFACE TREATMENT(S) SHALL BE PROVIDED AS FOLLOWS; TRAFFIC BARRIER SHALL BE FRACTURED FIN, HEADWALLS, WINGWALLS, AND STRUCTURES SHALL BE IN ACCORDANCE WITH STD. SPEC. 6-02.3(14). UNLESS OTHERWISE SHOWN IN THE CONTRACT DOCUMENTS.
6. A PERMANENT GEOSYNTHETIC WALL MAY BE EMPLOYED AS A HEADWALL (SEE STANDARD PLAN D-3.09 FOR DETAILS).
7. 2'-0" MIN. LAP SPLICE. ALTERNATE LAP SPLICE LOCATION ON ADJACENT REINFORCEMENT SO THAT NO MORE THAN 50% OF REINFORCEMENT IS SPLICED IN THE SAME LOCATION.

BURIED STRUCTURE SPLIT BOX

STANDARD PLAN E-20.10-00

SHEET 11 OF 17 SHEETS

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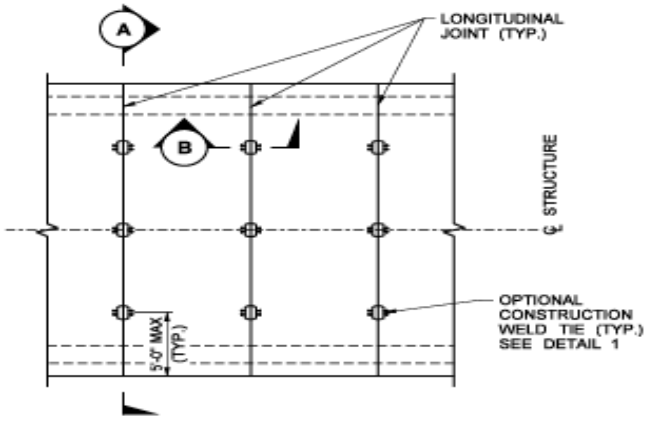
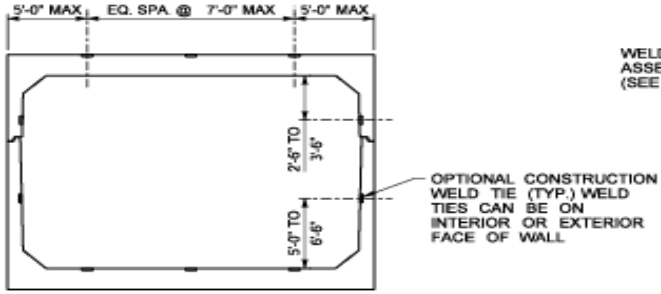
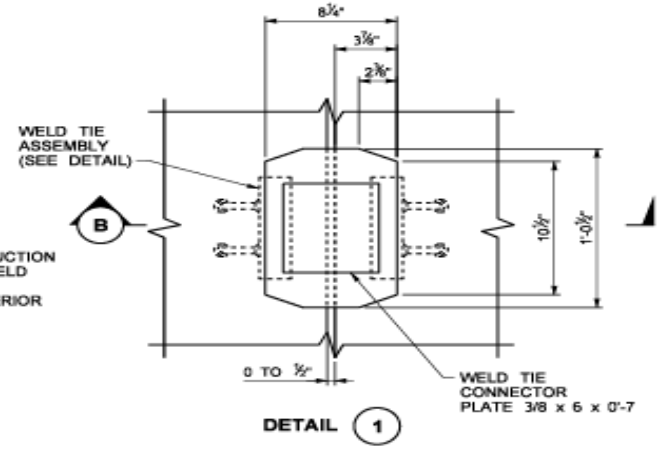
Headwall, Traffic Barrier, & Topping Slab Details



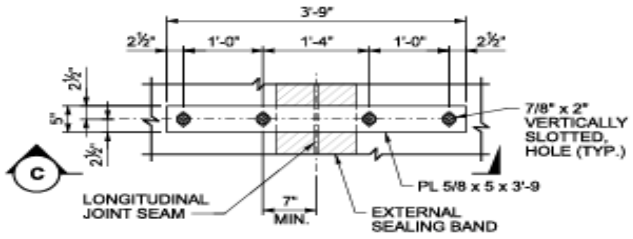
PLAN
TOP SLAB WELD TIE LAYOUT



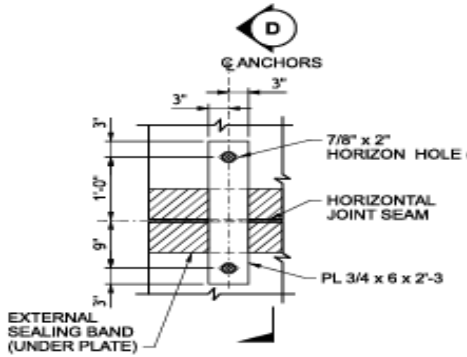
SECTION (A)
AT LONGITUDINAL JOINT



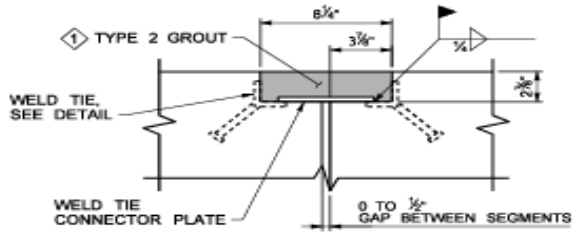
DETAIL (1)



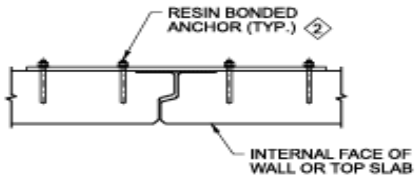
LONGITUDINAL TIE DETAIL (3)



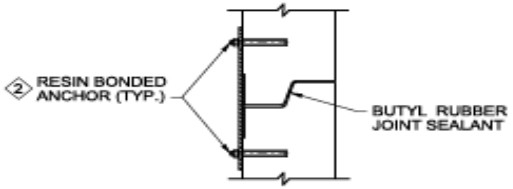
VERTICAL TIE DETAIL (3)



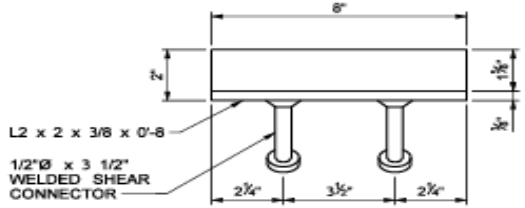
SECTION (B)



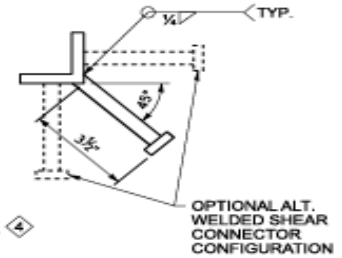
SECTION (C)



SECTION (D)



WELD TIE DETAIL (4)



KEY NOTES

1. THE CONTRACTOR SHALL PLACE THE GROUT BEFORE PLACING THE BACKFILL AGAINST THE STRUCTURE. GROUT SHALL CONFORM TO STANDARD SPEC. 9-20.3(2) AND SHALL ACHIEVE A MINIMUM COMPRESSIVE STRENGTH OF 2,500 PSI BEFORE BACKFILL PLACEMENT.
2. ANCHORS SHALL BE ¾" DIA. SET IN 6" LONG HOLES. MANUFACTURER AND CONTRACTOR SHALL COORDINATE SPACING OF WALL REINFORCING BARS AND LOCATION OF RESIN BONDED ANCHORS TO AVOID CONFLICT DURING INSTALLATION.
3. WELD TIES CAN BE SUBSTITUTED FOR TIE PLATES PROVIDED THE SAME SPACING IS MAINTAINED.
4. WELD TIES AND ANGLES MAY BE INSTALLED UNCOATED AND COATED WITH ZINC RICH PRIMER AFTER INSTALLATION AND WELDING.

BURIED STRUCTURE
SPLIT BOX
STANDARD PLAN E-20.10-00

SHEET 12 OF 17 SHEETS

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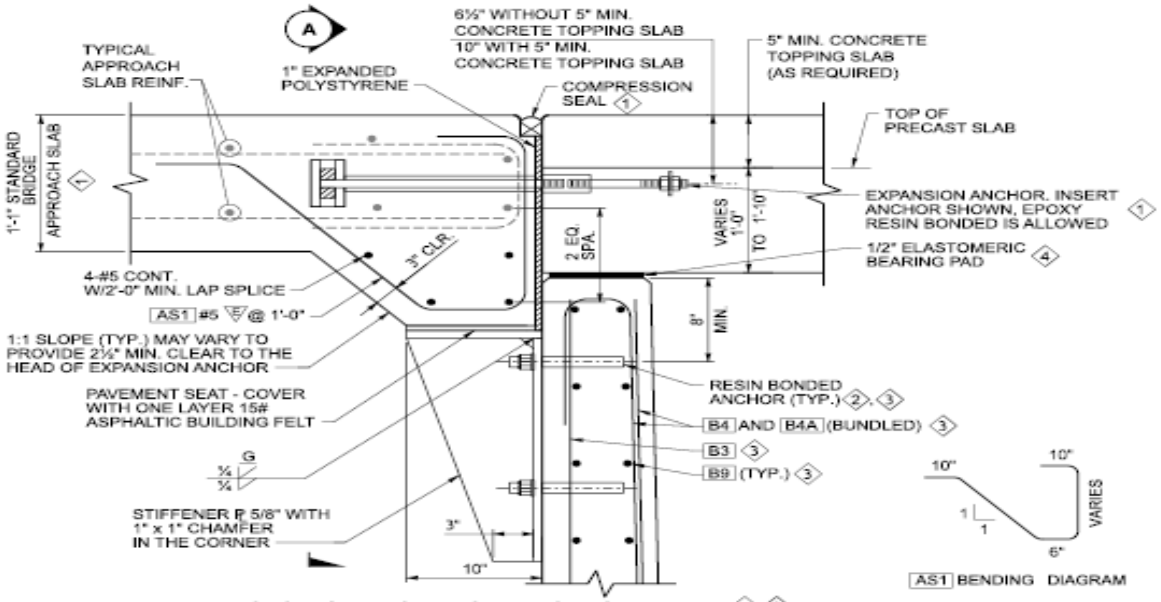
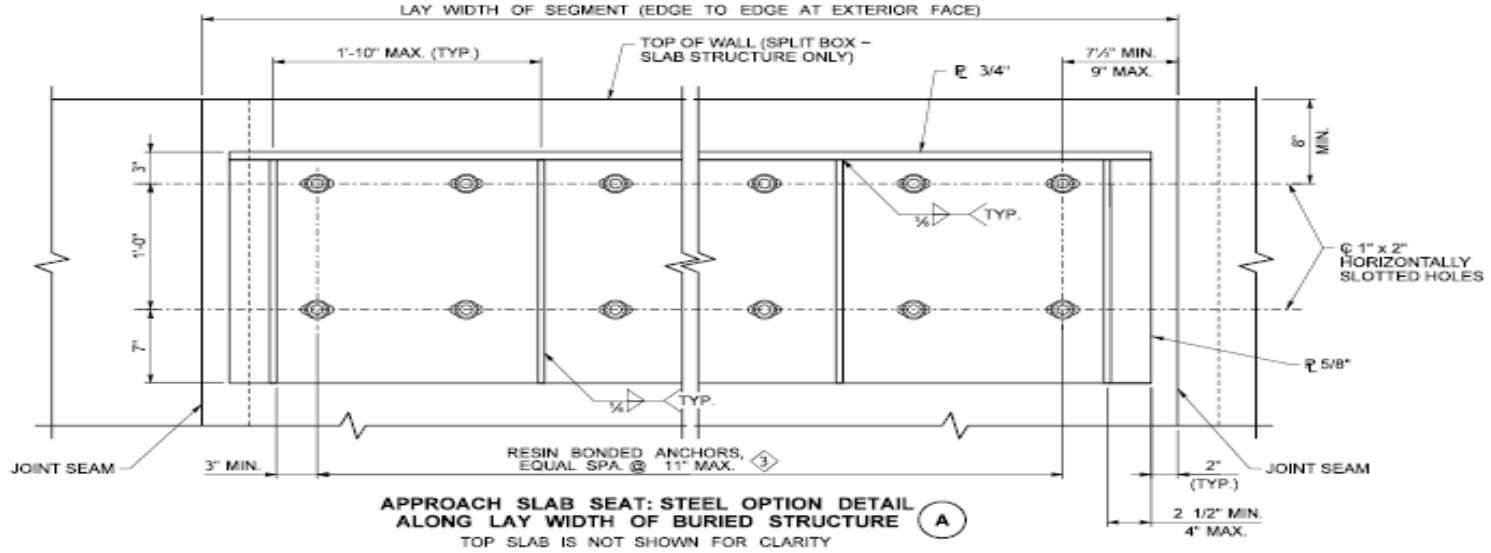
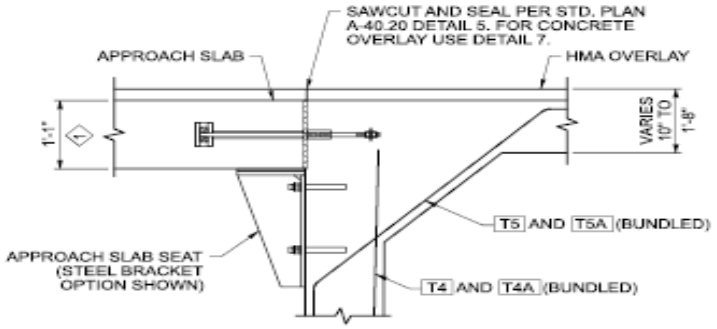
Tie Plate & Optional Constr. Weld Tie Details



APPROACH SLAB SEAT: STEEL OPTION DETAIL 5, 6
SPLIT BOX ~ SLAB STRUCTURE
(SPLIT BOX DETAILS SIMILAR)



APPROACH SLAB SEAT: STEEL OPTION DETAIL (A) ALONG LAY WIDTH OF BURIED STRUCTURE
TOP SLAB IS NOT SHOWN FOR CLARITY



APPROACH SLAB SEAT: STEEL OPTION DETAIL 5, 6
SPLIT BOX STRUCTURE

FOR DETAILS NOT SHOWN SEE APPROACH SLAB SEAT: STEEL OPTION DETAIL SPLIT BOX ~ SLAB STRUCTURE THIS SHEET.
FOR REINFORCEMENT NOT SHOWN SEE TYPICAL SECTION ON SHEET 4.

KEY NOTES

1. FOR APPROACH SLAB DETAILS INCLUDING REINFORCING, EXPANSION ANCHOR, COMPRESSION SEAL AND OTHER, SEE STANDARD PLAN A-40.50.
2. ANCHORS SHALL BE 7/8" DIA. SET IN 6-INCH LONG HOLES.
3. MANUFACTURER AND CONTRACTOR SHALL COORDINATE SPACING OF WALL REINFORCING BARS AND LOCATION OF RESIN BONDED ANCHORS TO AVOID CONFLICT DURING INSTALLATION.
4. THE CONTRACTOR MAY ADD A 1" MINIMUM THICK GROUT PAD FOR LEVELING TOP OF BOTTOM UNIT PRIOR TO SETTING BEARING PAD. ADJUST FINAL ELEVATIONS AS NEEDED. THE CONTRACTOR MAY SUBMIT ALTERNATE METHODS OF VERTICAL ADJUSTMENT TO THE ENGINEER FOR ACCEPTANCE.
5. ADDITIONAL REINFORCEMENT IS REQUIRED FOR TOP AND BOTTOM UNITS, SEE SHEET 4 FOR DETAILS.
6. FOR DETAILS OF STEEL APPROACH SLAB SEAT OPTION WITH SEISMIC RESTRAINER SEE SHEET 14. FOR DETAILS OF C.I.P. APPROACH SLAB SEAT OPTION SEE SHEET 15.

GEOFFREY D. SWETT
STATE OF WASHINGTON
32820
STRUCTURAL ENGINEER
PROFESSIONAL ENGINEER

BURIED STRUCTURE
SPLIT BOX
STANDARD PLAN E-20.10-00
SHEET 13 OF 17 SHEETS

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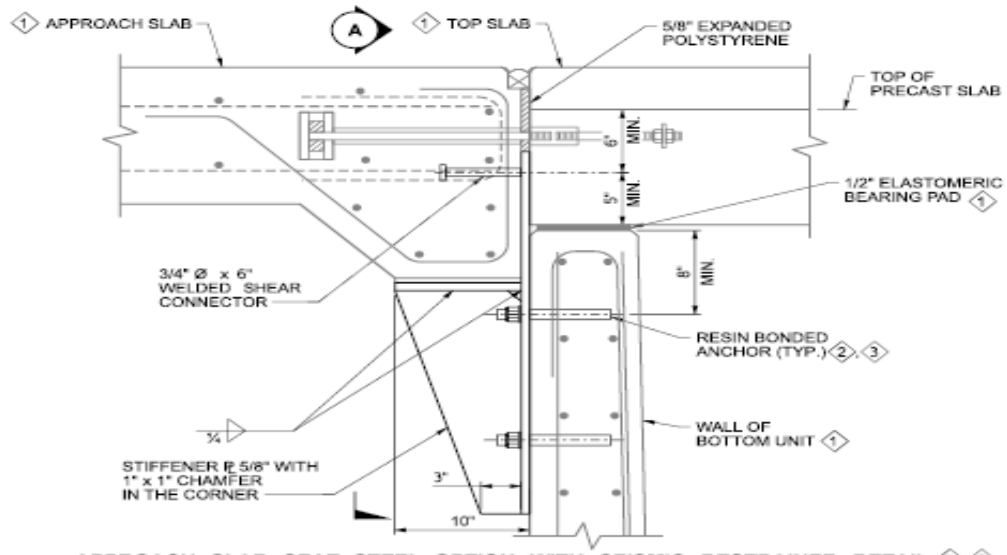
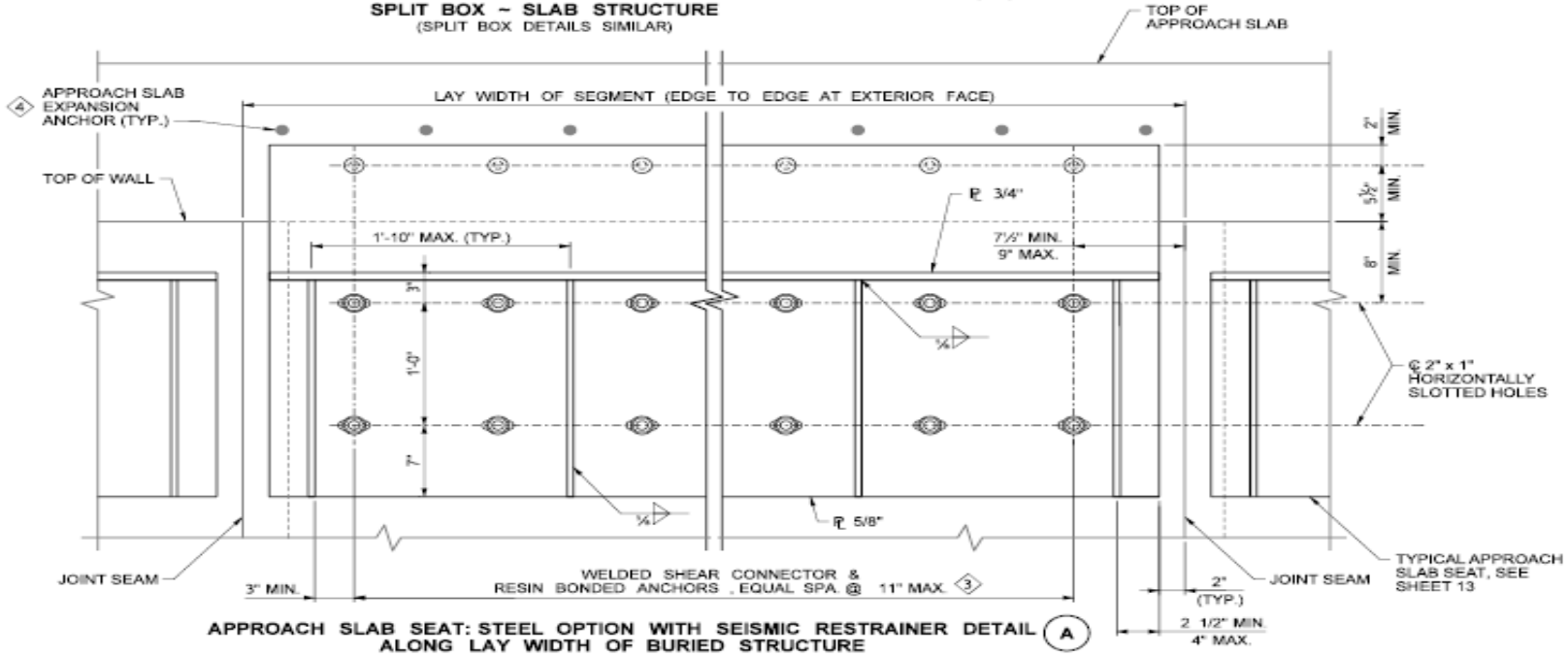
Washington State Department of Transportation

Approach Slab Seat ~ Steel Option



APPROACH SLAB SEAT: STEEL OPTION WITH SEISMIC RESTRAINER DETAIL 5, 6
SPLIT BOX ~ SLAB STRUCTURE
(SPLIT BOX DETAILS SIMILAR)



APPROACH SLAB SEAT: STEEL OPTION WITH SEISMIC RESTRAINER DETAIL A
ALONG LAY WIDTH OF BURIED STRUCTURE

SEISMIC LATERAL FORCE RESTRAINER SELECTION CRITERIA

1. Seismic lateral force restraint is required for Split Box ~ Slab structures with less than 2 feet of Fill Depth. Options for Lateral Seismic Restraint are as follows:
   a. Steel Option with Seismic Restrainer. See details this Sheet.
   b. Accelerated Bridge Construction (ABC) Option. See details on Sheet 16.
   c. C.I.P. End Diaphragm with Girder Stop Option. See Sheet 17.
2. Seats with lateral restrainers shall be installed symmetrically in both walls of the segment. Minimum two segments with lateral restrainers are required along the length of buried structure. The total length (feet) of seats with lateral restrainers along each wall shall not be less than LR = w L PGA(2R), where:

w (kip/ft) - Weight per linear foot of structure and roadway above the walls

L (ft) - Total length of structure

PGA - Effective Site Peak Ground Acceleration Coefficient

R = 10 kip/ft - Average shear resistance of anchors in the approach slab per foot length of bracket

KEY NOTES

1. FOR DETAILS AND NOTATIONS NOT SHOWN SEE SHEET 13.
2. ANCHORS SHALL BE 7/8" DIA. SET IN 6-INCH LONG HOLES.
3. MANUFACTURER AND CONTRACTOR SHALL COORDINATE SPACING OF WALL REINFORCING BARS AND LOCATION OF RESIN BONDED ANCHORS TO AVOID CONFLICT DURING INSTALLATION.
4. ARRANGE SPACING OF APPROACH SLAB EXPANSION ANCHORS AND WELDED SHEAR CONNECTORS TO PROVIDE MINIMUM 3 INCH DISTANCE BETWEEN.
5. ADDITIONAL REINFORCEMENT IS REQUIRED FOR TOP AND BOTTOM UNITS, SEE SHEET 4 FOR DETAILS.
6. FOR DETAILS OF STEEL APPROACH SLAB SEAT OPTION WITHOUT SEISMIC RESTRAINER SEE SHEET 13. FOR DETAILS OF C.I.P. APPROACH SLAB SEAT OPTION SEE SHEET 15.

BURIED STRUCTURE
SPLIT BOX
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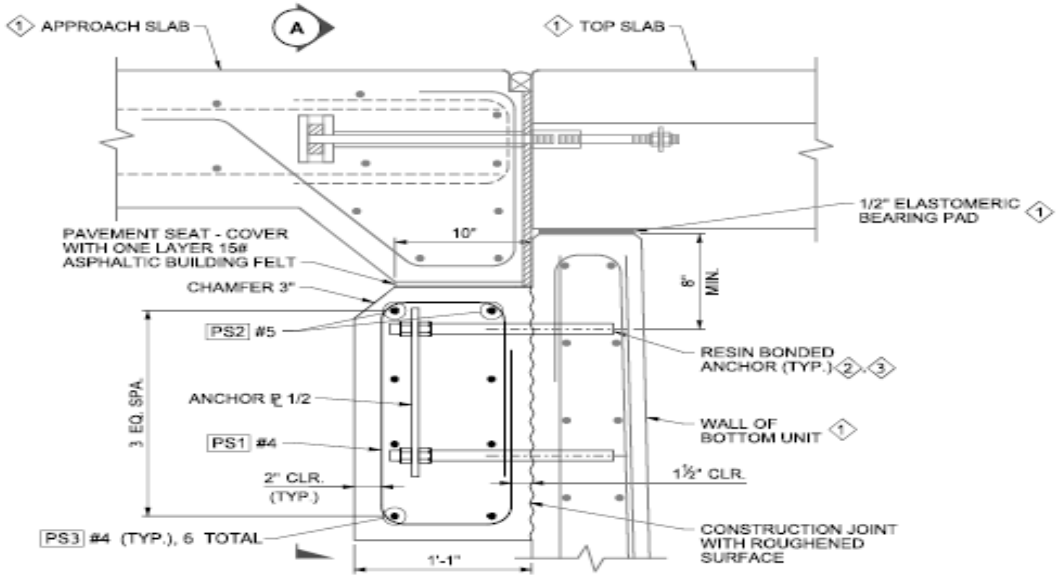
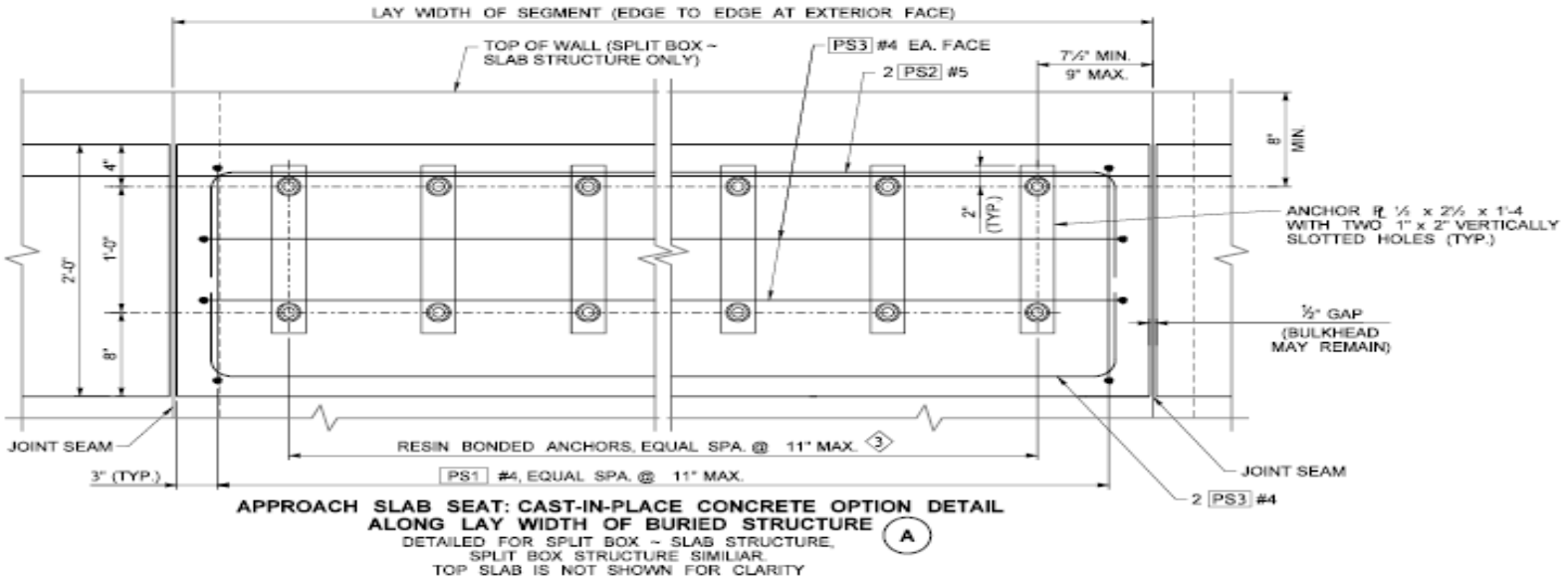
Approach Slab Seat ~ Steel Option w/Seismic Restrainer

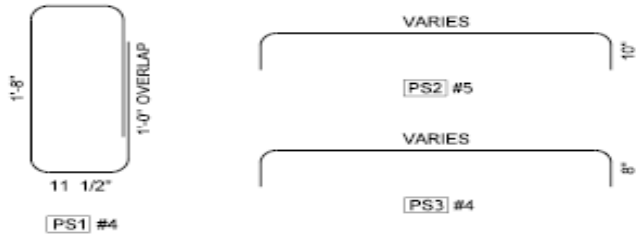


APPROACH SLAB SEAT: CAST-IN-PLACE CONCRETE OPTION DETAIL 4 5
SPLIT BOX ~ SLAB STRUCTURE
(SPLIT BOX DETAILS SIMILAR)



APPROACH SLAB SEAT: CAST-IN-PLACE CONCRETE OPTION DETAIL ALONG LAY WIDTH OF BURIED STRUCTURE A
DETAILED FOR SPLIT BOX ~ SLAB STRUCTURE, SPLIT BOX STRUCTURE SIMILIAR.
TOP SLAB IS NOT SHOWN FOR CLARITY

BENDING DIAGRAM



KEY NOTES

1. FOR DETAILS AND NOTATIONS NOT SHOWN SEE SHEET 13.
2. ANCHORS SHALL BE 7/8" DIA. SET IN 6-INCH LONG HOLES.
3. MANUFACTURER AND CONTRACTOR SHALL COORDINATE SPACING OF WALL REINFORCING BARS AND LOCATION OF RESIN BONDED ANCHORS TO AVOID CONFLICT DURING INSTALLATION.
4. ADDITIONAL REINFORCEMENT IS REQUIRED FOR TOP AND BOTTOM UNITS, SEE SHEET 4 FOR DETAILS.
5. FOR DETAILS OF STEEL APPROACH SLAB SEAT OPTION WITHOUT SEISMIC RESTRAINER SEE SHEET 13. FOR DETAILS OF STEEL APPROACH SLAB SEAT OPTION WITH SEISMIC RESTRAINER SEE SHEET 14.

BURIED STRUCTURE
SPLIT BOX
STANDARD PLAN E-20.10-00
SHEET 15 OF 17 SHEETS

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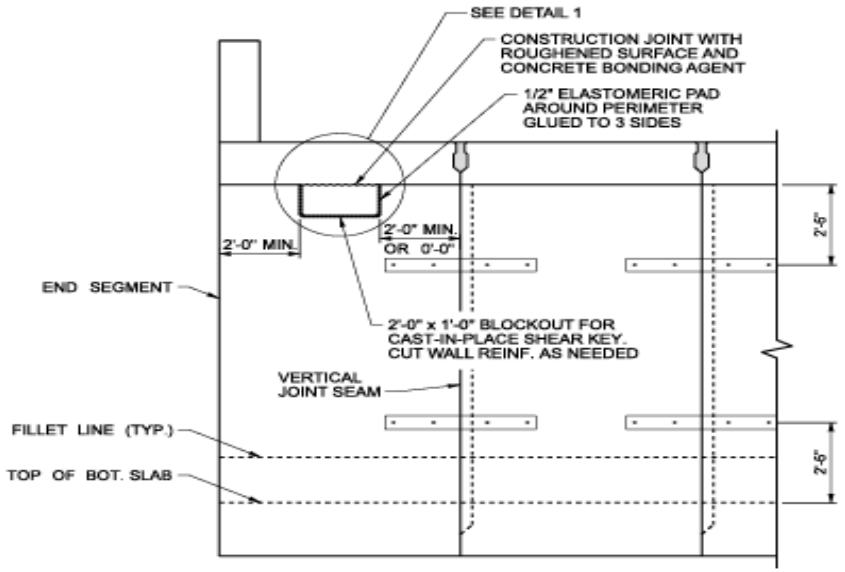
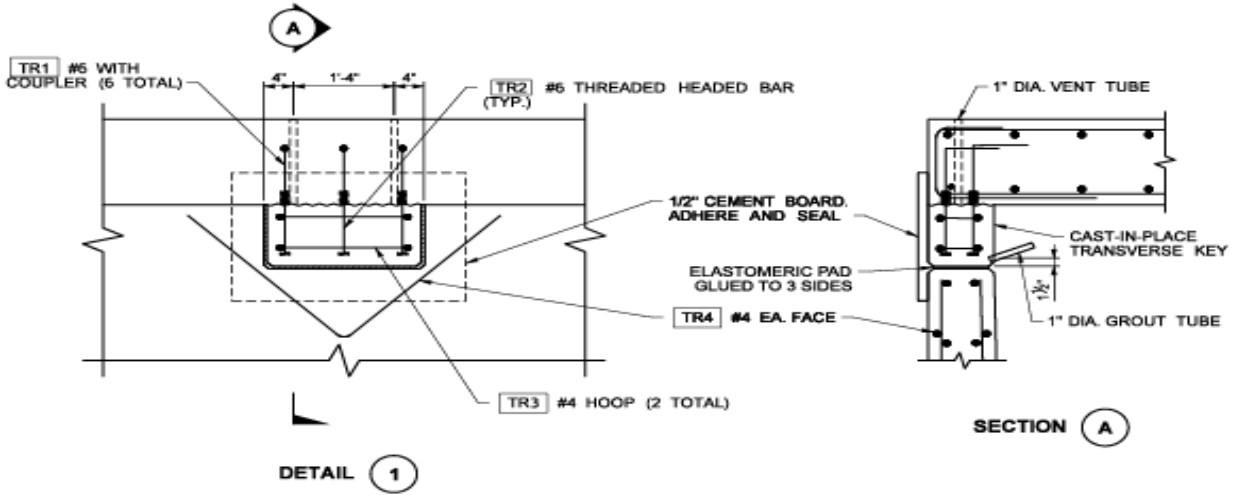
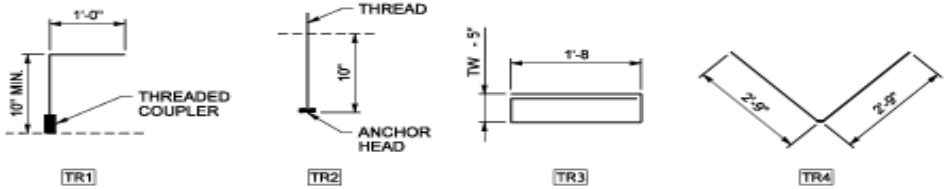
Approach Slab Seat ~ C.I.P. Option



SEISMIC LATERAL FORCE RESTRAINER
ACCELERATED BRIDGE CONSTRUCTION (ABC) OPTION
SPLIT BOX ~ SLAB STRUCTURE



BENDING DIAGRAM



(ALL DIMENSIONS ARE OUT TO OUT)

SEISMIC LATERAL FORCE RESTRAINER SELECTION CRITERIA:

1. Seismic lateral force restraint is required for Split Box ~ Slab structures with less than 2 feet of Fill Depth. Options for Lateral Seismic Restraint are as follows:
   a. Accelerated Bridge Construction (ABC) Option. See details this Sheet.
   b. Steel Option with Seismic Restrainer. See details on Sheet 14.
   c. C.I.P. End Diaphragm with Girder Stop Option. See Sheet 17.
2. Two lateral restrainers shall be installed symmetrically in both walls of the segment. Minimum two segments with lateral restrainers are required along the length of buried structure. The number of segments with lateral restrainers can be calculated using formula: $N = w\,L\,PGA\,/(2R)$ (rounded up to integer), where:
   w (kip/ft) - Weight per linear foot of structure and roadway above the walls
   L (ft) - Total length of structure
   PGA - Effective Site Peak Ground Acceleration Coefficient
   R = 100 kips, shear key lateral resistance
3. The lateral restrainers shall be installed in the end segments and spaced equally along the length of the structure.
4. Shear key material shall be self-consolidating concrete placed using a 'bird feeder' technique, or a Type 2 Grout for Nonshrink Applications in accordance with Std. Spec. 9-20.3(2), placed via grout tubes.
5. Shear keys can be installed after backfilling and open to traffic when applicable.
6. This option not applicable with approach slabs.

BURIED STRUCTURE
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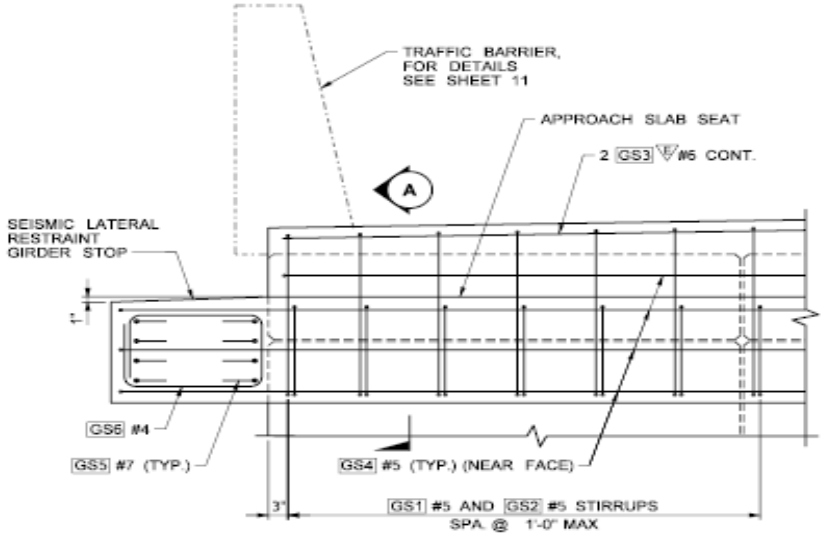
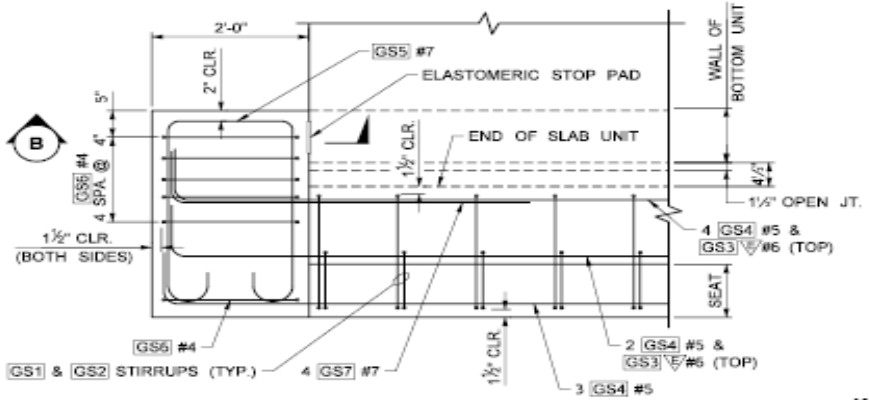
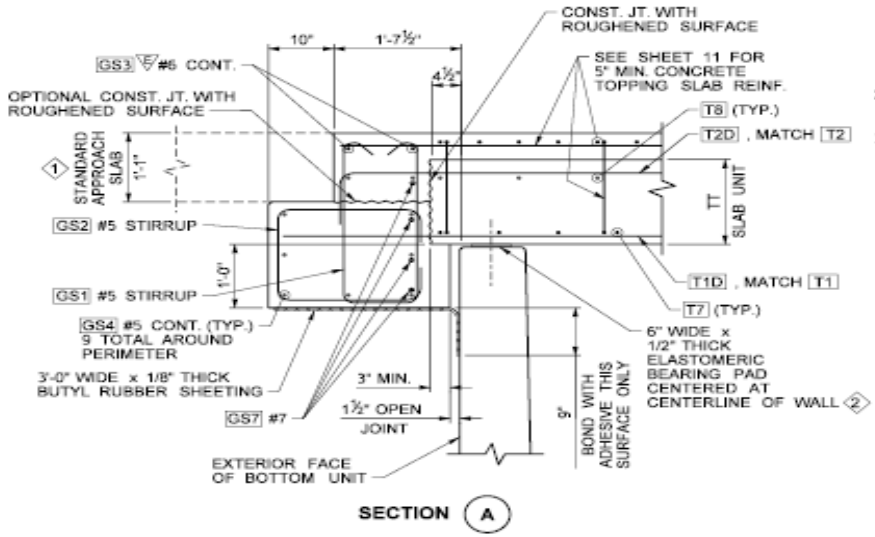
Seismic Lateral Force Restrainer ~ A.B.C. Option



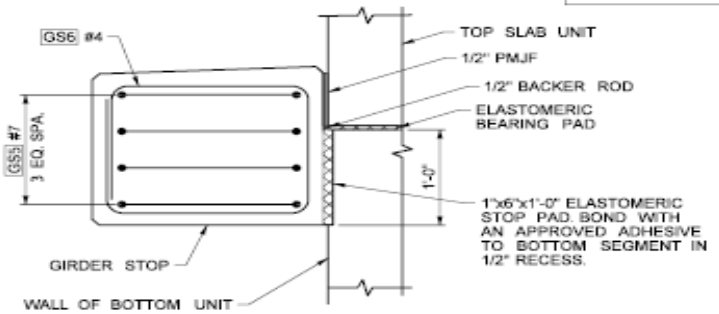
ELEVATION
SEISMIC LATERAL FORCE RESTRAINER
C.I.P. END DIAPHRAGM WITH GIRDER STOP OPTION DETAIL
SPLIT BOX ~ SLAB STRUCTURE



PLAN
SEISMIC LATERAL FORCE RESTRAINER
C.I.P. END DIAPHRAGM WITH GIRDER STOP OPTION DETAIL
SPLIT BOX ~ SLAB STRUCTURE
5" MIN. CONCRETE TOPPING SLAB
REINFORCING NOT SHOWN FOR CLARITY



SECTION (A)



SECTION (B)

KEY NOTES

1. FOR APPROACH SLAB DETAILS INCLUDING REINFORCING, EXPANSION ANCHOR, COMPRESSION SEAL, AND OTHER, SEE STANDARD PLAN A-40.50.
2. THE CONTRACTOR MAY ADD A 1" MINIMUM THICK GROUT PAD FOR LEVELING TOP OF BOTTOM UNIT PRIOR TO SETTING BEARING PAD. ADJUST FINAL ELEVATIONS AS NEEDED. THE CONTRACTOR MAY SUBMIT ALTERNATIVE METHODS OF VERTICAL ADJUSTMENT TO THE ENGINEER FOR ACCEPTANCE.

SEISMIC LATERAL FORCE RESTRAINER SELECTION CRITERIA

1. Seismic lateral force restraint is required for Split Box ~ Slab structures with less than 2 feet of Fill Depth. C.I.P. End Diaphragm with Girder Stop details may be used for Split Box ~ Slab structures with 5" min. concrete topping slab and approach slab. Options for Lateral Seismic Restraint are as follows:
   a. C.I.P. End Diaphragm with Girder Stop Option. See details this Sheet.
   b. Steel Option with Seismic Restrainer. See details on Sheet 14.
   c. Accelerated Bridge Construction (ABC) Option. See Sheet 16.
2. Partial length of the structure is shown. End Diaphragm must be installed along a full length of both walls. Four girder stops shall be installed (two at each end of the structure).
3. Lateral resistance of each girder stop, R=80 kips. Earthquake force per one girder stop shall not exceed its resistance. Earthquake force can be calculated using formula:

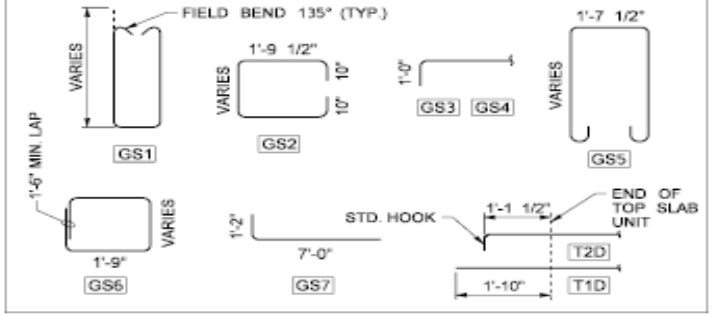
   V = 0.5 w L PGA, where:

   w (kip/ft) - Weight per linear foot of structure and roadway above the wall

   L (ft) - Total length of structure

   PGA - Effective Site Peak Ground Acceleration Coefficient

BENDING DIAGRAM



MINIMUM LAP SPLICE LENTGH	
#4	2'-1"
#5	2'-7"
#6	3'-1"
#6 (E)	3'-8"
#7	3'-7"

GEOFFREY D. SWETT — STATE OF WASHINGTON — 32820 — STRUCTURAL ENGINEER — PROFESSIONAL ENGINEER

BURIED STRUCTURE
SPLIT BOX
STANDARD PLAN E-20.10-00

SHEET 17 OF 17 SHEETS

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Washington State Department of Transportation

Seismic Lateral Force Restrainer ~ Semi-Integral Diaph.

Thank you

William J. Miller III

millewi@wsdot.wa.gov

wsdot.wa.gov