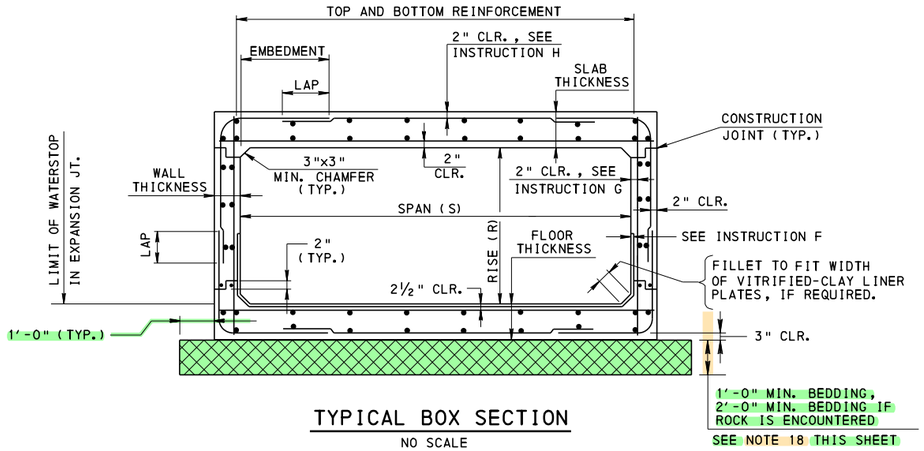
CHANGE 1

CHANGE 2

CHANGE 5



TYPICAL BOX SECTION

NO SCALE

DESIGN DATA FOR CAST-IN-PLACE BOX CULVERT

1. f'c = 3000 P.S.I. FOR CLASS A CEMENT CONCRETE
2. f'c = 4000 P.S.I. FOR TOP SLAB AT GRADE (CLASS AAAP CEMENT CONCRETE)
3. fy = 60,000 P.S.I. FOR REINFORCEMENT BARS
4. fy = 70,000 P.S.I. FOR PLAIN WELDED WIRE FABRIC
5. fy = 75,000 P.S.I. FOR DEFORMED WELDED WIRE FABRIC

INSTRUCTIONS

A. MINIMUM SLAB THICKNESS = 10"

B. MINIMUM WALL THICKNESS = 10" FOR RISE < 5'-0"

C. MINIMUM WALL THICKNESS = 1'-0" FOR RISE > 5'-0"

D. ADD 1½" (½" AT THE TOP AND 1" AT BOTTOM) TO THE EFFECTIVE DESIGN THICKNESS OF BOTTOM SLAB OF BOX CULVERTS, FOR THE TOTAL (PROVIDED) THICKNESS.

E. FOR BOX CULVERTS AT GRADE, ADD ½"INTEGRAL WEARING SURFACE TO THE TOP DECK SLAB THICKNESS.

F. IF SPECIFIED, VITRIFIED-CLAY LINER PLATES WITH TYPE B POINTING (INCLUDE COST IN THE PRICE OF CONCRETE TO WHICH ATTACHED.)

G. 3" CLEAR IF LINER PLATES ARE USED

H. 2½" CLEAR IF AT GRADE

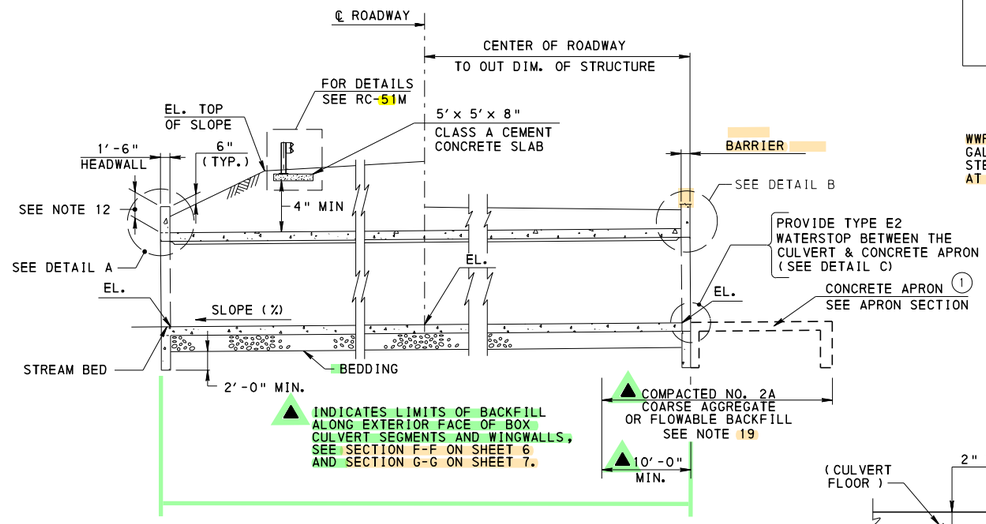
I. PLACE MAIN CIRCUMFERENTIAL REINFORCEMENT NORMAL TO THE CENTERLINE OF THE CULVERT.

J. PROVIDE EXPANSION JOINTS AT APPROXIMATELY 90' INTERVALS AND CONSTRUCTION JOINTS AT APPROXIMATELY 30' INTERVALS. PROVIDE EXPANSION JOINTS IN BOTTOM SLAB.

K. FOR ADDITIONAL WELDED WIRE FABRIC INFORMATION, SEE SHEET 5.

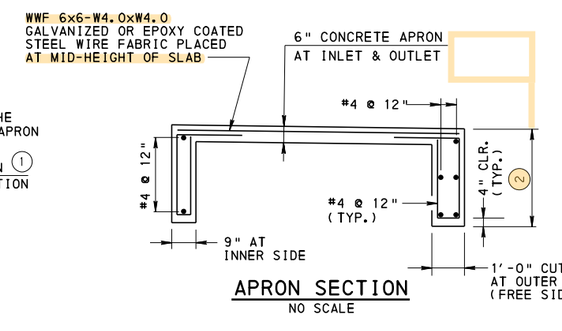
NOTES

1. PROVIDE GRADE 60 DEFORMED REINFORCING BARS THAT MEET THE REQUIREMENTS OF ASTM A615, A996 OR A706. DO NOT WELD REINFORCEMENT STEEL. DO NOT USE RAIL STEEL (A996) WHERE BENDING OR WELDING OF REINFORCEMENT BARS IS INDICATED.
2. DESIGN SPECIFICATIONS: AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS AND AS SUPPLEMENTED BY THE DESIGN MANUAL, PART 4, STRUCTURES.
3. PROVIDE MATERIALS AND PERFORM WORK IN ACCORDANCE WITH PUBLICATION 408.
4. DEAD LOADS: INCLUDES SURFACE AREA DENSITY OF 30 P.S.F. FOR FUTURE WEARING SURFACE FOR BOXES AT GRADE.
5. USE EPOXY COATED REINFORCEMENT BARS IN THE FOLLOWING CONDITIONS:
   - TOP SLAB AND HEADWALL WITHIN 2'-0" OF GRADE.
   - ALL CURBS AND BARRIERS.
   - THROUGHOUT THE CULVERT WHEN VITRIFIED CLAY LINER PLATES ARE USED.
   - IN ALL APRON SLABS.
6. PROVIDE 2" CONCRETE COVER ON REINFORCEMENT BARS EXCEPT AS NOTED.
7. FOR HYDRAULIC DESIGN REFER TO DESIGN MANUAL, PART 2.
8. FOR LOW FLOW FISH PASSAGE DESIGN COMMENTARY REFER TO DESIGN MANUAL, PART 2.
9. INDICATE FACTORED BEARING RESISTANCE AND MAXIMUM DESIGN FOUNDATION PRESSURE ON THE PLANS.
10. PLACE HEADWALLS, APRON WALLS AND WINGWALL FOOTINGS BELOW FROST DEPTH OR 3'-6" WHICH EVER IS GREATER.
11. USE 4" Ø FORMED WEEP HOLES AT 15'-0" MAXIMUM CENTERS PLACED AT A MINIMUM 1'-9" ABOVE BOTTOM OF SLAB OR 6" ABOVE NORMAL FLOW LINE, FOR DETAILS SEE BC-751M. FOR WEEP HOLES LOCATED IN THE COMPACTED NO. 2A COARSE AGGREGATE AREAS OR FLOWABLE BACKFILL AREAS, PROVIDE PREFORMED DRAIN CONFORMING TO PUBLICATION 408 SECTION 623.2(a), WHICH IS 2'-0" MINIMUM HIGH x 4'-0" WIDE CENTERED HORIZONTALLY ON WEEP HOLE, SEE PREFORMED DRAIN DETAIL ON SHEET 6.
12. CONCRETE HEADWALL REINFORCEMENT WILL REQUIRE A SEPARATE DESIGN IF HEIGHT IS GREATER THAN 2'-0".
13. USE THIS STANDARD DRAWING IN CONJUNCTION WITH THE APPLICABLE ROADWAY CONSTRUCTION STANDARDS FOR GUIDE RAIL.
14. REFER TO DESIGN DRAWINGS FOR SPACING OF POSTS.
15. THOROUGHLY COAT ALL SURFACES OF THE BASE PLATES IN CONTACT WITH CONCRETE WITH CAULKING COMPOUNDS PRIOR TO ERECTION. AFTER ERECTION AND ALIGNMENT, SEAL OPENINGS BETWEEN THE METAL SURFACES AND THE CONCRETE WITH CAULKING COMPOUND MEETING THE REQUIREMENTS OF PUBLICATION 408, SECTION 705.
16. FOR JOINT DETAILS SEE BC-735M. WHEN EXPANSION JOINTS ARE USED, WATERSTOPS ARE REQUIRED IN THE TOP AND BOTTOM SLABS AND THE WALLS.
17. FOR BARRIER TRANSITION DETAILS, SEE SHEET 4.
18. INDICATES ADDITIONAL EXCAVATION FOR BEDDING MATERIAL BELOW THE BOTTOM OF R.C. BOX CULVERT WITH LIMITS AS SHOWN. BACKFILL WITH 2A OR #8 COARSE AGGREGATE. LEVEL BEARING AREA FOR PRECAST BOX SEGMENT WITH MINIMUM THICKNESS OF FINE AGGREGATE.
19. PROVIDE COMPACTED NO. 2A COARSE AGGREGATE BACKFILL OR TYPE B FLOWABLE BACKFILL AT INLET END OF CULVERTS FOR A MINIMUM LENGTH OF 10'-0" PLUS WINGWALLS. HEIGHT OF COMPACTED NO. 2A COARSE AGGREGATE OR FLOWABLE BACKFILL IS A MINIMUM OF 2'-0" ABOVE NORMAL STREAM. ELEVATION EXTENDING TO THE BOTTOM OF WINGWALL FOOTING OR BOTTOM OF ROCK LINING WHICHEVER IS DEEPER, 3'-6" MINIMUM.
20. CLASS A TYPE 4 GEOTEXTILE IS PERMITTED TO BE PLACED BETWEEN THE BEDDING MATERIAL AND EXCAVATION OR TO ENCASE THE BEDDING MATERIAL.



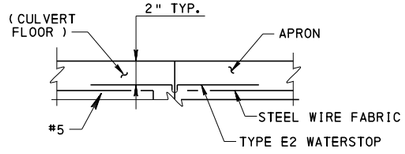
SECTION ALONG ℄ CULVERT

NO SCALE



APRON SECTION

NO SCALE



DETAIL C

NO SCALE

ABBREVIATIONS

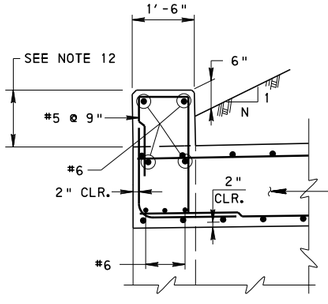
E.F. :	DENOTES EACH FACE
F.F. :	DENOTES FRONT FACE
R.F. :	DENOTES REAR FACE
EL. :	DENOTES ELEVATION
C.I.P. :	DENOTES CAST-IN-PLACE
B.B. :	DENOTES BACK BATTER

LEGEND

(1) USE APRON AT INLET AND OUTLET IF WARRANTED. SEE APRON SECTION THIS SHEET. FOR ALTERNATE DESIGN BY CONTRACTOR, PROVIDE THE APRONS ON THE PLANS.

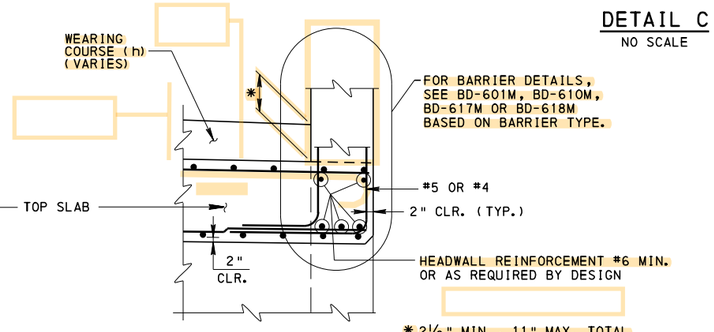
(2) EXTEND CUTOFF WALL TO BOTTOM OF WINGWALL FOOTING OR BOTTOM OF ROCK LINING, WHICHEVER IS DEEPER, 3'-6" MIN. FROM TOP OF CULVERT BOTTOM SLAB. SEE NOTE 10.

(3) AN ALTERNATE CUTOFF WALL WITH GROUTED ROCK IS PERMITTED, SEE DETAILS ON SHEET 7



DETAIL A

IMPROVEMENT CONDITION
NO SCALE



DETAIL B

NO SCALE

REFERENCE DRAWINGS

RC-50M	GUIDE RAIL TO BRIDGE BARRIER TRANSITIONS
RC-51M	TYPE 31 STRONG POST GUIDE RAIL
BD-601M	CONCRETE DECK SLAB
BD-610M	PA BRIDGE BARRIER
BD-617M	PA TYPE 10M BRIDGE BARRIER
BD-621M	REINFORCED CONCRETE ABUTMENTS
BD-622M	R.C. ABUTMENTS WITH BACKWALL
BD-624M	R.C. ABUTMENTS WITHOUT BACKWALL
BD-625M	WINGWALL LENGTH
BD-631M	END WALL DETAILS
BC-734M	ANCHOR SYSTEMS
BC-735M	WALL CONSTRUCTION AND EXPANSION JOINT DETAILS
BC-736M	REINFORCEMENT BAR FABRICATION DETAILS
BC-751M	BRIDGE DRAINAGE
BC-788M	TYPICAL WATERPROOFING AND EXPANSION DETAILS
BC-798M	MECHANICAL CONNECTION DETAILS

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE OFFICE

STANDARD R.C. BOX CULVERT CAST-IN-PLACE

RECOMMENDED NOV. 23, 2022
CHIEF BRIDGE ENGINEER

RECOMMENDED NOV. 23, 2022
CHIEF ENGINEER, HIGHWAY ADMIN.

SHEET 1 OF 16

BD-632M

THE SHEET INTENTIONALLY LEFT BLANK

PA STRUCTURE MOUNTED GUIDE RAIL
IS BEING DISCONTINUED

REPLACEMENT PA 3-RAIL
BRIDGE BARRIER IS PENDING

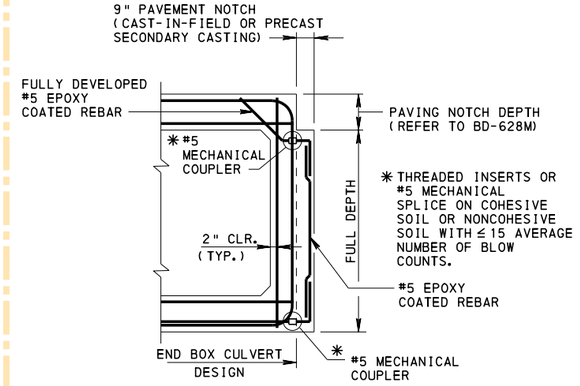
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE OFFICE

STANDARD
R.C. BOX CULVERT
CAST-IN-PLACE

RECOMMENDED NOV. 23, 2022
CHIEF BRIDGE ENGINEER

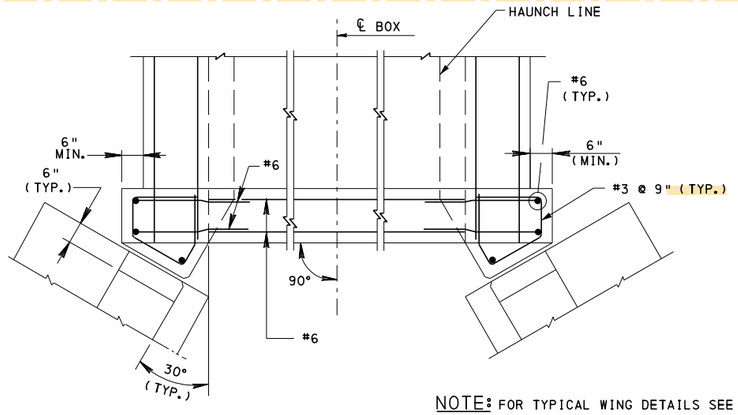
RECOMMENDED NOV. 23, 2022
CHIEF ENGINEER, HIGHWAY ADMIN.

BD-632M

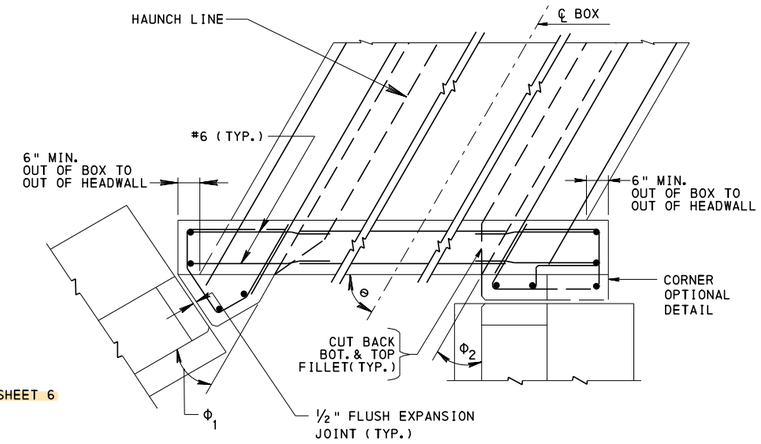


PAVEMENT NOTCH DETAIL

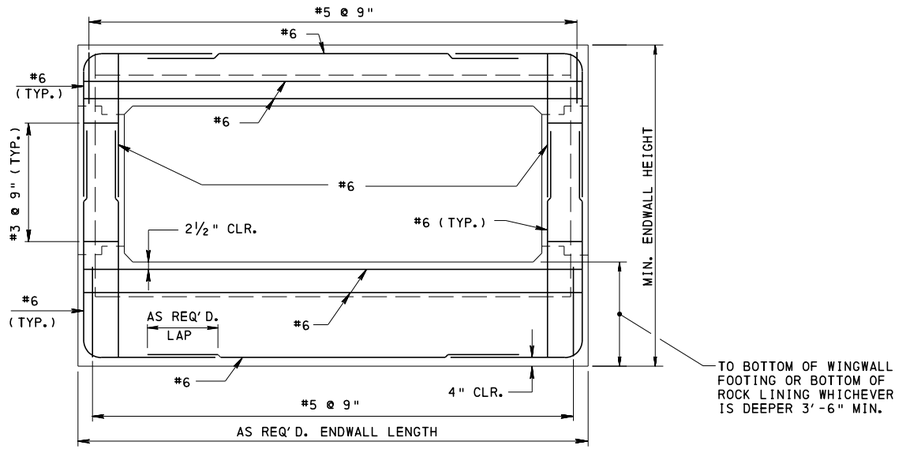
AT GRADE WHEN APPROACH SLAB IS REQUIRED



NOTE: FOR TYPICAL WING DETAILS SEE SHEET 6

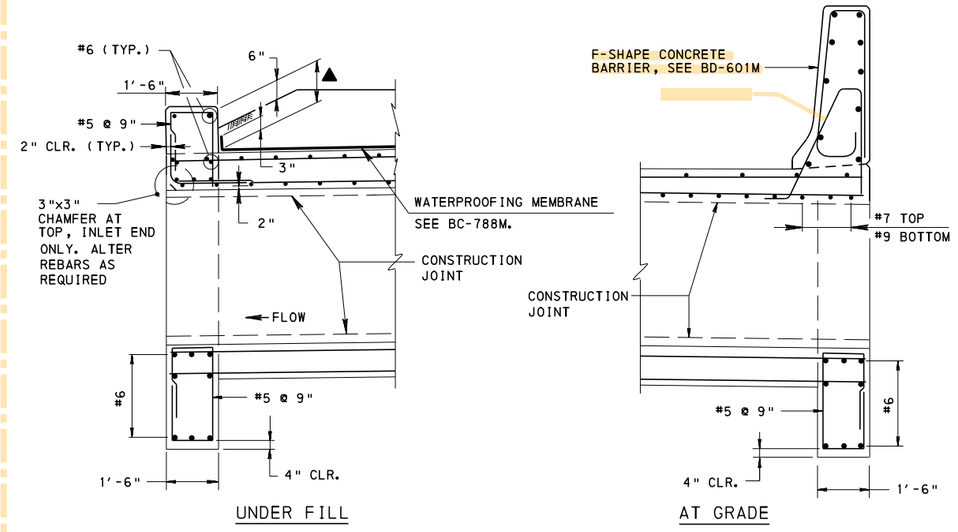


TYPICAL CULVERT HEADWALL DETAILS



TYPICAL HEADWALL ELEVATION

MINIMUM REINFORCEMENT SHOWN
NO SCALE



TYPICAL HEADWALL SECTIONS

LEGEND:

- Θ = SKEW ANGLE
- ϕ_1 = 30° FOR Θ ≥ 60°
- ϕ_1 = $\frac{\Theta}{2}$ FOR Θ < 60°
- ϕ_2 = 30° FOR Θ ≥ 60°
- ϕ_2 = 90°-Θ FOR Θ < 60°
- ▲ SEE NOTE 12, SHEET 1.

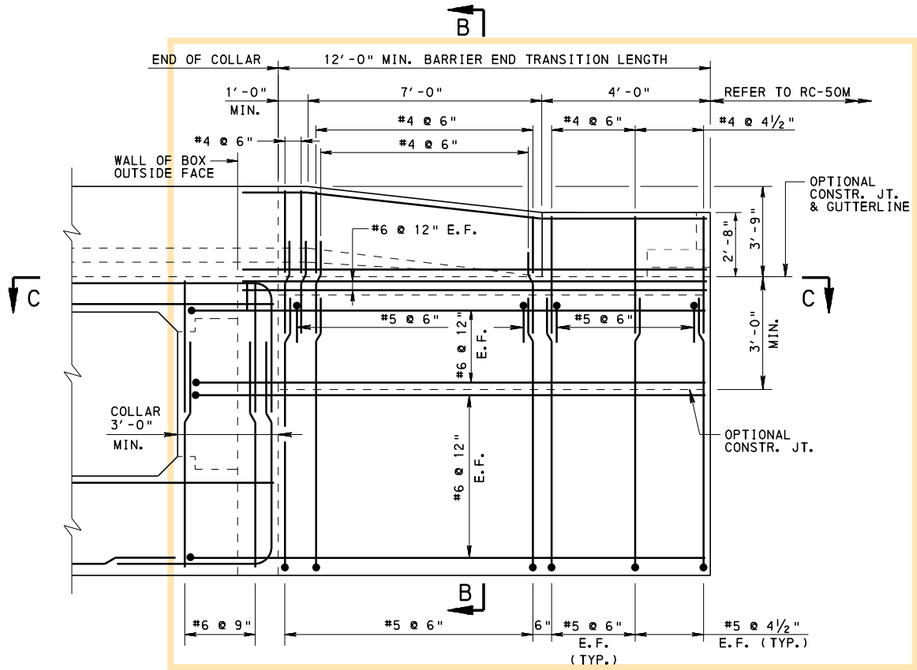
NOTE:

1. FOR ADDITIONAL END BARRIER TRANSITION, SEE BD-601M AND BD-624M.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE OFFICE

STANDARD
R.C. BOX CULVERT
CAST-IN-PLACE
HEADWALL DETAILS

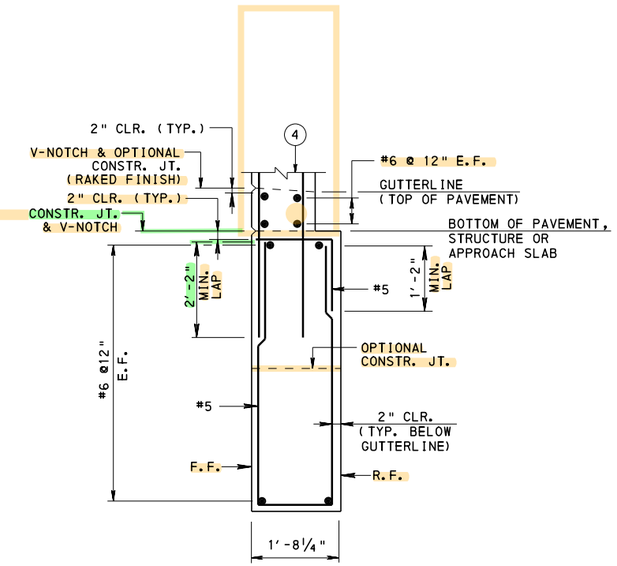
RECOMMENDED NOV. 23, 2022	RECOMMENDED NOV. 23, 2022	SHEET 3 OF 16
CHIEF BRIDGE ENGINEER	CHIEF ENGINEER, HIGHWAY ADMIN.	BD-632M



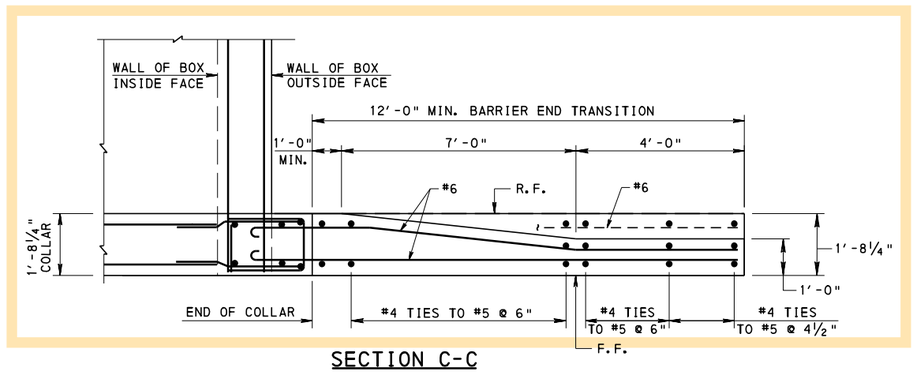
BARRIER TRANSITION SUPPORT WALL (4)(5)

45" F-SHAPE CONCRETE BARRIER SHOWN, 32" AND 42" F-SHAPE CONCRETE BARRIER SIMILAR.

NOTE: HOOKS ON BARS EXTENDING FROM BARRIER TRANSITION INTO THE COLLAR MAY BE TURNED IN ANY DIRECTION.



SECTION B-B



SECTION C-C

LEGEND

(4) FOR REINFORCEMENT DETAILS SEE BD-610M FOR PA BRIDGE BARRIER, BD-617M FOR PA TYPE 10M BRIDGE BARRIER, BD-618M FOR VERTICAL WALL CONCRETE BARRIER AND BD-622M AND BD-624M FOR F-SHAPE CONCRETE BARRIER.

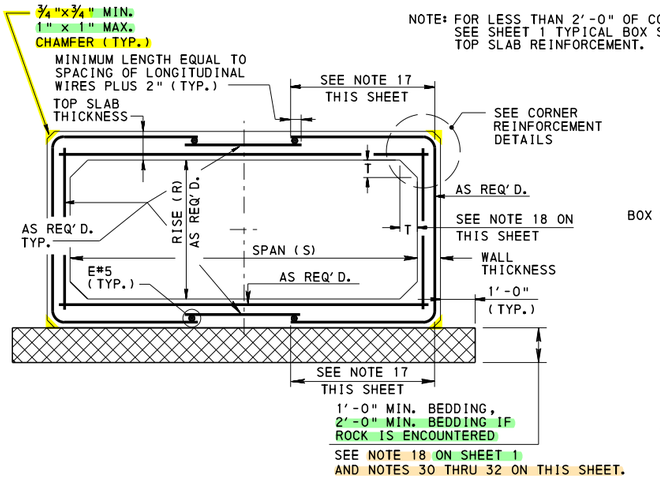
(5) THE BARRIER AND BARRIER TRANSITION MAY BE SUPPORTED BY A BURIED MOMENT SLAB (SEE BD-627M) IN LIEU OF THE BARRIER TRANSITION SUPPORT WALL.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE OFFICE

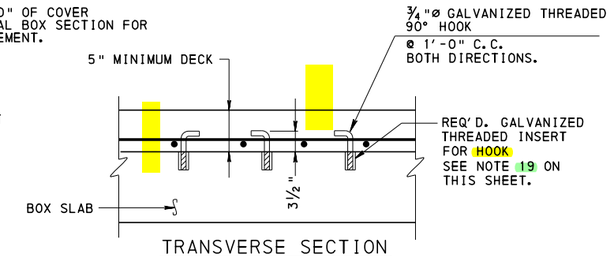
STANDARD
R.C. BOX CULVERT
CAST-IN-PLACE

RECOMMENDED NOV. 23, 2022
CHIEF BRIDGE ENGINEER

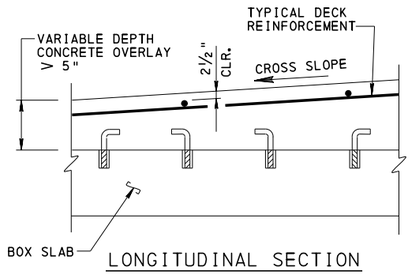
RECOMMENDED NOV. 23, 2022
CHIEF ENGINEER, HIGHWAY ADMIN.



NOTE: FOR LESS THAN 2'-0" OF COVER SEE SHEET 1 TYPICAL BOX SECTION FOR TOP SLAB REINFORCEMENT.



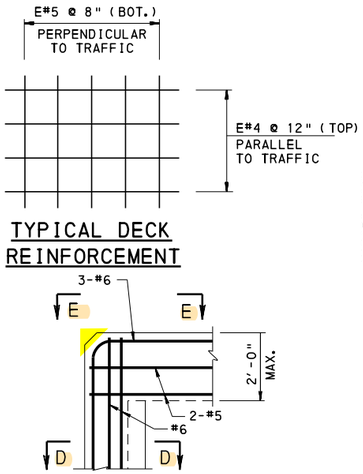
TRANSVERSE SECTION



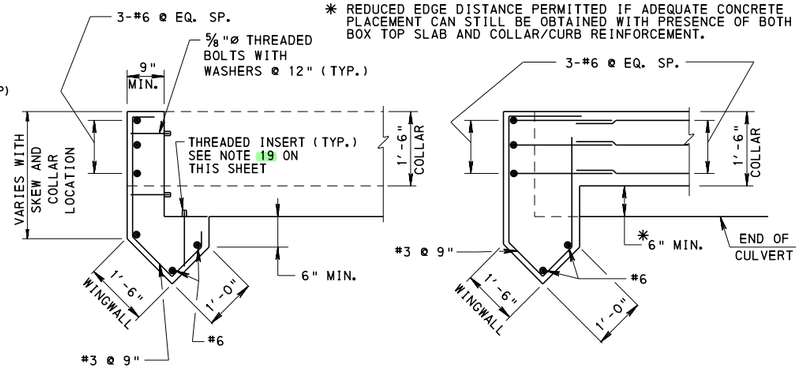
LONGITUDINAL SECTION

BOX DETAILS - WELDED WIRE FABRIC

(FOR 2'-0" OR MORE OF COVER)
SEE BC-798M FOR POST TENSION STRAND DETAILS



TYPICAL DECK REINFORCEMENT

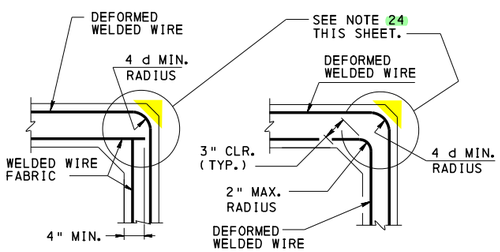


SECTION D-D

SECTION E-E

* REDUCED EDGE DISTANCE PERMITTED IF ADEQUATE CONCRETE PLACEMENT CAN STILL BE OBTAINED WITH PRESENCE OF BOTH BOX TOP SLAB AND COLLAR/CURB REINFORCEMENT.

COLLAR CORNER DETAILS



DETAIL OPTION

CORNER REINFORCEMENT DETAILS

WELDED WIRE FABRIC

NOTES:

- FOR LESS THAN 2'-0" OF COVER SEE SHEET 1 TYPICAL BOX SECTION FOR TOP SLAB REINFORCEMENT.
- FOR POST TENSIONING DETAILS, SEE BC-798M.

DECK CONNECTION DETAILS

DESIGN DATA:

- f'c = 5000 P.S.I. MINIMUM FOR CONCRETE
- f'c = 3000 P.S.I. MINIMUM FOR FISH BAFFLES/WEIRS
- f'c = 2000 P.S.I. MINIMUM FOR MUD SLABS
- fy = 60,000 P.S.I. FOR STEEL REINFORCING BARS
- fy = 70,000 P.S.I. FOR PLAIN WELDED WIRE FABRIC (IN FLAT SHEET)
- fy = 75,000 P.S.I. FOR DEFORMED WELDED WIRE FABRIC

INSTRUCTIONS:

SPAN S	POST TENSIONING DUCT LOCATION	MINIMUM SLAB OR WALL THICKNESS
8'-12'	HAUNCH	S/12
>12'	HAUNCH OR WALL	13"

- MINIMUM COVER FOR WELDED WIRE FABRIC :
  1. PROVIDE 1½", EXCEPT 2" FOR THE TOP WIRES OF THE TOP SLAB WHERE BOX FILL HEIGHT IS LESS THAN 2'-0".
  2. USE ½" MORE COVER FOR THE TOP WIRES OF THE BOTTOM SLAB.
- MINIMUM COVER FOR CONVENTIONAL REINFORCEMENT BARS: PROVIDE 2" FOR THE TOP BARS OF TOP AND BOTTOM SLABS, AND 1½" FOR ALL OTHER BARS, EXCEPT USE 2½" FOR TOP BARS WHEN SLAB IS AT GRADE.
- FOR WELDED WIRE FABRIC, SPACE CIRCUMFERENTIAL WIRES CENTER TO CENTER NOT LESS THAN 2" OR MORE THAN 4", AND SPACE LONGITUDINAL WIRES CENTER TO CENTER NOT MORE THAN 8".

REFER TO SHEET 15 FOR END SECTION SKEW ORIENTATION REQUIREMENTS.

NOTES

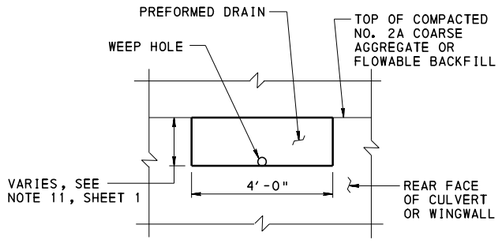
1. PROVIDE GRADE 60 DEFORMED REINFORCING BARS THAT MEET THE REQUIREMENTS OF ASTM A615, A996 OR A706. DO NOT WELD REINFORCEMENT STEEL. DO NOT USE RAIL STEEL (A996) WHERE BENDING OR WELDING OF REINFORCEMENT BARS IS INDICATED.
2. WELDED WIRE FABRIC WILL MEET THE REQUIREMENTS OF ASTM A1064 GRADE 70, AND DEFORMED WELDED WIRE FABRIC WILL MEET THE REQUIREMENTS OF ASTM A1064 GRADE 75.
3. USE EPOXY COATED REINFORCEMENT AND EPOXY OR GALVANIZED WELDED WIRE FABRIC IN THE FOLLOWING CONDITIONS:
   - IN THE CAST IN PLACE DECK AND HEADWALLS IF A DECK IS USED.
   - IN THE TOP SLAB AND HEADWALL WITHIN 2'-0" OF GRADE IF A CAST IN PLACE DECK IS NOT USED.
   - ALL CURBS AND BARRIERS.
   - THROUGHOUT THE CULVERT WHEN VITRIFIED CLAY LINER PLATES ARE USED.
   - IN ALL CAST-IN-PLACE APRON SLABS (SEE SHEET 1)

   IF EPOXY COATED WELDED WIRE FABRIC IS USED IT MUST MEET THE REQUIREMENTS OF ASTM A884, TYPE I, CLASS A.
4. DESIGN SPECIFICATIONS: AASHTO LRFD "BRIDGE DESIGN SPECIFICATION" AND AS SUPPLEMENTED BY THE DESIGN MANUAL, PART 4, STRUCTURES.
5. PROVIDE MATERIALS AND PERFORM WORK IN ACCORDANCE WITH PUBLICATION 408.
6. DEAD LOADS: INCLUDE A WEIGHT OF 30 P.S.F. FOR FUTURE WEARING SURFACE FOR BOXES AT GRADE.
7. PROVIDE MINIMUM LAP AND EMBEDMENT LENGTH OF REINFORCEMENT IN ACCORDANCE WITH LRFD SPECIFICATIONS: SEE BC-736M.
8. PROVIDE 2" CONCRETE COVER ON REINFORCEMENT BARS EXCEPT AS NOTED IN INSTRUCTIONS BELOW.
9. FOR HYDRAULIC DESIGN REFER TO DESIGN MANUAL, PART 2.
10. FOR LOW FLOW FISH PASSAGE DESIGN REFER TO DESIGN MANUAL, PART 2, AND SEE SHEETS 11, 12 AND 14.
11. INDICATE ALLOWABLE AND MAXIMUM DESIGN FOUNDATION PRESSURE ON PLANS.
12. PLACE HEADWALL AND WINGWALL FOOTINGS BELOW FROST DEPTH OR 3'-6" MINIMUM, WHICH EVER IS GREATER.
13. PROVIDE WATERPROOFING MEMBRANE FOR THE ENTIRE TOP WIDTH AND LENGTH OF THE BOX AND 2'-0" WIDTH ± ALONG THE SIDE JOINTS IN ACCORDANCE WITH PUBLICATION 408, SECTION 680.2(a) OR 680.2(b). FOR ADDITIONAL DETAILS REFER TO BC-788M.
14. USE 4"ø FORMED WEEPHOLES AT EVERY OTHER SEGMENT PLACED AT A MINIMUM 1'-9" ABOVE THE BOTTOM SLAB OR 6" ABOVE NORMAL FLOW LINE. FOR WEEPHOLE PLACEMENT, THE WEEPHOLE LOCATION MAY BE ADJUSTED BY A MAXIMUM OF 2" IN ANY DIRECTION, OR RELOCATE REINFORCEMENT BY A MAXIMUM OF ½". DO NOT CUT REINFORCEMENT BARS. NO ADDITIONAL WEEPHOLE REINFORCEMENT WILL BE REQUIRED. IF WIRE MESH IS USED, MAY CUT THE MESH TO FIT WEEPHOLE CONDUIT BUT REPLACE EQUIVALENT STEEL WITH ADDITIONAL WIRE MESH PLACED ON EACH SIDE OF WIRE MESH MAT.
15. PRECAST BOX CULVERTS AT GRADE (i.e. ≤ 2'-0" OF FILL) REQUIRE AN ADDITIONAL 5" MINIMUM REINFORCED CONCRETE DECK. THIS 5" DECK WILL BE MAINTAINED FOR ENTIRE BOX CULVERT. REFER TO TYPICAL DECK REINFORCEMENT (THIS SHT.) FOR DETAILS. FOR ADT ≤ 750 AND A.D.T.T. ≤ 25, AN ASPHALT PAVEMENT OVERLAY MAY BE UTILIZED IN LIEU OF A CONCRETE DECK.
16. DESIGN PRECAST REINFORCED CONCRETE BOXES TO HAVE OPENINGS IN 6" INCREMENTS WITH MINIMUM RISE OF 3'-0".
17. REQUIRED DIMENSION FOR BAR LENGTH IS THE TOTAL OF THE THEORETICAL CUT-OFF LENGTH PLUS THE REQUIRED ANCHORAGE.
18. HAUNCH SIZE SHOWN (T) IS BASED ON AASHTO M273. HAUNCH MAY BE MODIFIED IF THE BOX IS CUSTOM DESIGNED TO SATISFY DESIGN, TRANSPORTATION AND CONSTRUCTION REQUIREMENTS, BUT NOT LESS THAN 6" x 6".
19. THREADED INSERTS TO BE INCORPORATED IN PRECAST BOX AND DETAILED BY THE FABRICATOR.
20. CONCRETE HEADWALL REINFORCEMENT WILL REQUIRE A SEPARATE DESIGN IF HEIGHT IS GREATER THAN 2'-0".
21. IF APPROACH ROADWAY UTILIZES CURB, ADJUST DIMENSION TO MATCH CURB HEIGHT.
22. USE EPOXY BONDING COMPOUND WHERE EVER CAST-IN-PLACE CEMENT CONCRETE COMES IN CONTACT WITH PRECAST CEMENT CONCRETE. THE EPOXY BONDING COMPOUND IS TYPE 2, GRADE 2, AS DESCRIBED IN ASTM-C881-90.
23. THE USE OF PRECAST END SECTION IS NOT PRECLUDED BUT WILL BE REVIEWED ON AN INDIVIDUAL BASIS BY THE DISTRICT BRIDGE ENGINEER. HAUNCH SIZE MUST MATCH THAT OF BOX CULVERT SEGMENTS.
24. POST-TENSIONING DUCTS MAY BE PLACED AT EITHER CORNER OR HAUNCH TO SATISFY DESIGN AND CONSTRUCTION REQUIREMENTS. PROVIDE A 3" CONCRETE CLEARENCE. HAUNCH DUCT MUST BE SECURED TO INSIDE FACE REINFORCEMENT, SEE SHEETS 8 AND 10.
25. FOR DECK CONNECTION DETAIL FOR VARIABLE DEPTH CONCRETE DECKS, THE DECK REINFORCEMENT WILL BE INDEPENDENT OF ANCHOR BOLT AND MUST MAINTAIN CLEARANCE AND FOLLOW CROSS SLOPE.
26. SEE NOTE 19 ON SHEET 1 FOR BACKFILL REQUIREMENTS AT INLET END OF CULVERT AND NOTE 11 ON SHEET 1 FOR TREATMENT OF WEEP HOLES IN BACKFILL AREAS AT INLET END OF CULVERT.
27. SPECIFY 4'-0" MINIMUM SEGMENT LENGTH ON THE CONTRACT DRAWINGS.
28. FOR SKEWED SEGMENTS, A SQUARED (NORMAL) CONNECTION IS AN ACCEPTABLE OPTION DURING PHASE CONSTRUCTION.
29. CLASS A, TYPE 4 GEOTEXTILE IS PERMITTED TO BE PLACED BETWEEN THE BEDDING MATERIAL AND EXCAVATION OR TO ENCASEE THE BEDDING MATERIAL.
30. A 4" MINIMUM THICKNESS MUD SLAB MAY BE USED FOR PRECAST CULVERT INSTALLATION. BACKFILL BELOW MUD SLAB TO LIMITS OF EXCAVATION SHOWN IN DETAIL ON THIS SHEET. EXCAVATION AND BACKFILL LIMITS ARE MEASURED FROM TOP OF MUD SLAB.
31. USE CLASS C CEMENT CONCRETE FOR MUD SLABS.
32. TROWEL FINISH THE TOP OF MUD SLAB TO PROVIDE A SMOOTH SURFACE.

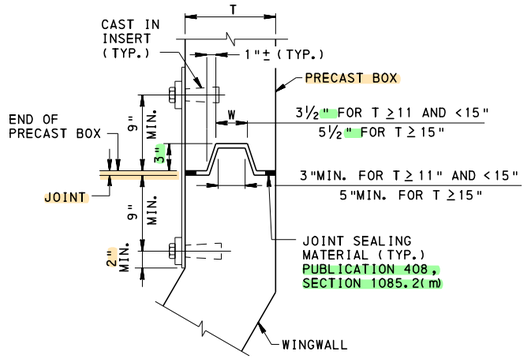
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE OFFICE

STANDARD
R.C. BOX CULVERT
PRECAST

RECOMMENDED NOV. 23, 2022	RECOMMENDED NOV. 23, 2022	SHEET 5 OF 16
CHIEF BRIDGE ENGINEER	CHIEF ENGINEER, HIGHWAY ADMIN.	BD-632M



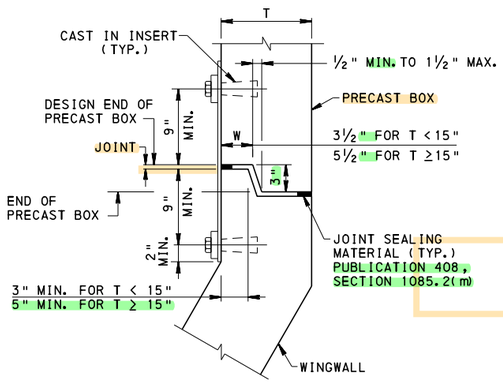
PREFORMED DRAIN DETAIL



PARTIAL PLAN

KEYED JOINT

DISCONTINUOUS IF POST TENSIONING IS REQUIRED



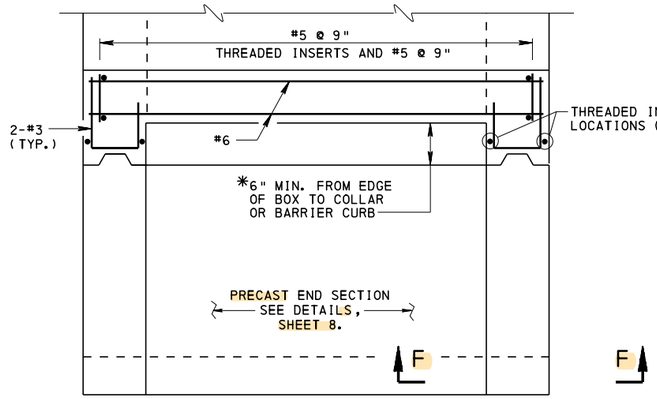
PARTIAL PLAN

SHIP LAP JOINT

DISCONTINUOUS IF POST TENSIONING IS REQUIRED

PRECAST WINGWALL CONNECTION DETAILS

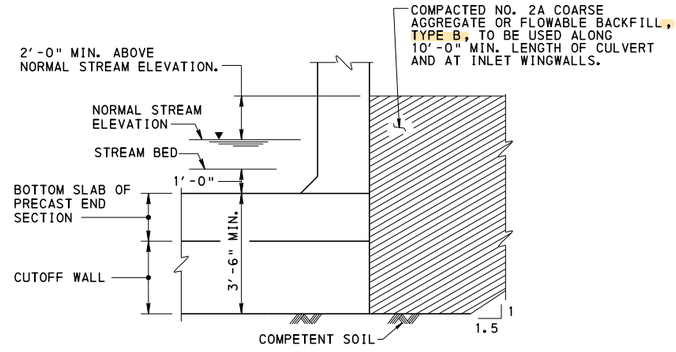
NOTES:
1. NO BOLT THROUGH CONNECTIONS CAN BE USED.
2. EITHER SHIP LAP OR KEYWAY JOINTS CAN BE USED. NO FLUSH BUTT JOINTS.
3. ONE (1) ROW OF JOINT SEALING FLEXIBLE FOAM MATERIAL EACH FACE.
4. FOR T <11", USE SHIP LAP DETAIL.



PLAN

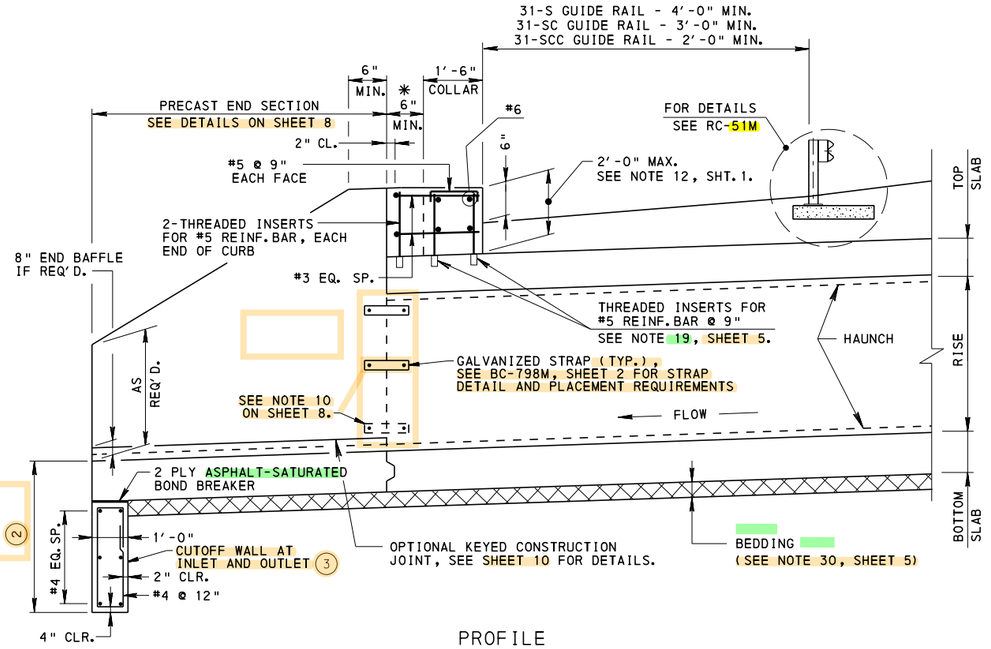
PRECAST END SECTION

* REDUCED EDGE DISTANCE PERMITTED IF ADEQUATE CONCRETE PLACEMENT CAN STILL BE OBTAINED WITH PRESENCE OF BOTH BOX TOP SLAB AND COLLAR/CURB REINFORCEMENT.



SECTION F-F

NOTE:
DESIGNER TO MODIFY AMOUNT OF COMPACTED NO. 2A COARSE AGGREGATE OR FLOWABLE BACKFILL TO PROVIDE ADEQUATE PROTECTION AGAINST PIPING OF STREAM FLOW THROUGH FILL AT INLET END OF CULVERT.



PROFILE

PRECAST CULVERT WITH PRECAST END SECTION

NOTES:
- SEE NOTE 23, SHEET 5.
- FOR SCOUR PROTECTION SEE "PRECAST CULVERT WITH CAST-IN-PLACE WINGWALLS" DETAIL, ON SHEET 7.
- IF SLAB THICKNESSES ARE LESS THAN 13", SEE NOTE 10 ON SHEET 8.
- POST TENSION BOTTOM SLAB OF END SECTION PRIOR TO INSTALLATION OF CUTOFF WALL.

LEGEND

(2) EXTEND CUTOFF WALL TO BOTTOM OF WINGWALL FOOTING OR BOTTOM OF ROCK LINING, WHICHEVER IS DEEPER, 3'-6" MIN. FROM TOP OF BOTTOM SLAB. SEE NOTE 12, SHEET 5.

(3) AN ALTERNATE CUTOFF WALL WITH GROUTED ROCK IS PERMITTED, SEE DETAILS ON SHEET 7

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE OFFICE

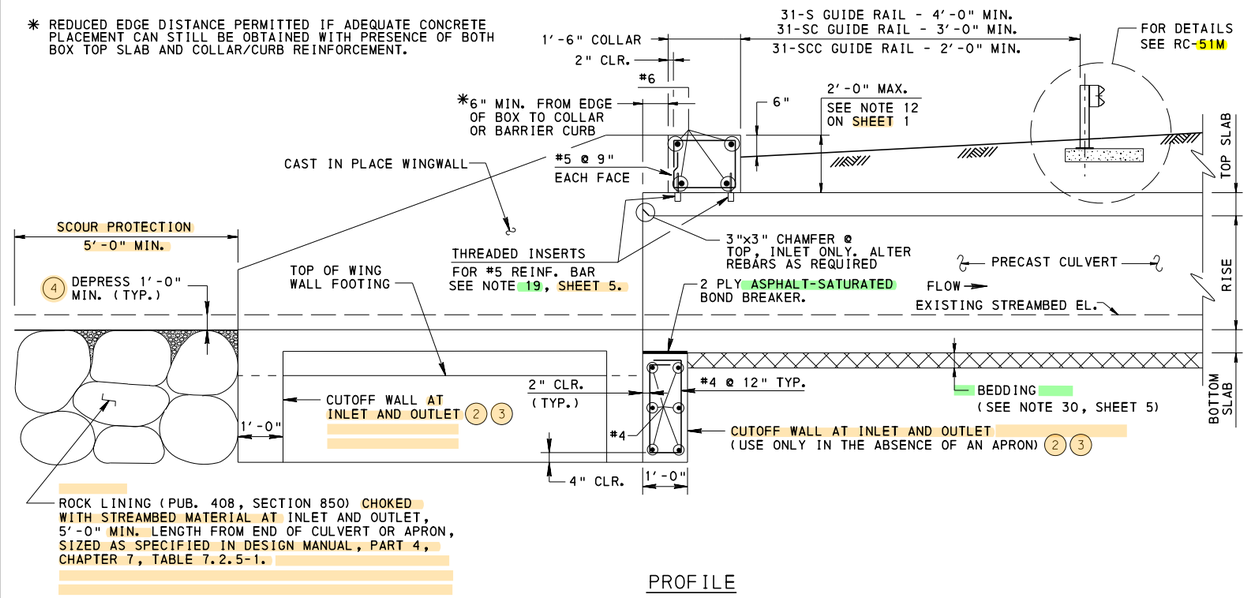
STANDARD
R.C. BOX CULVERT
PRECAST

RECOMMENDED NOV. 23, 2022
CHIEF BRIDGE ENGINEER

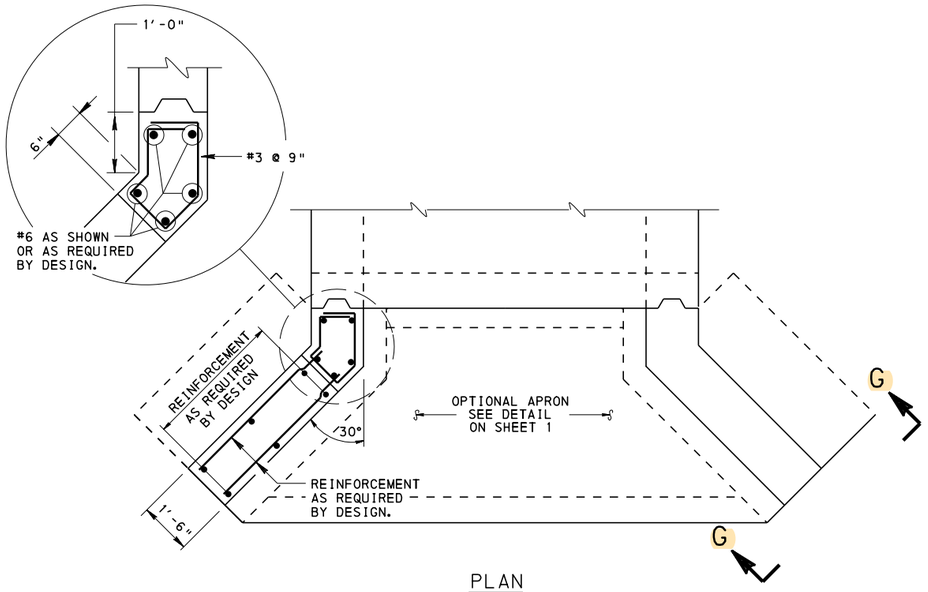
RECOMMENDED NOV. 23, 2022
CHIEF ENGINEER, HIGHWAY ADMIN.

SHEET 6 OF 16

BD-632M



PROFILE



PLAN

(COLLAR OR BARRIER CURB NOT SHOWN)

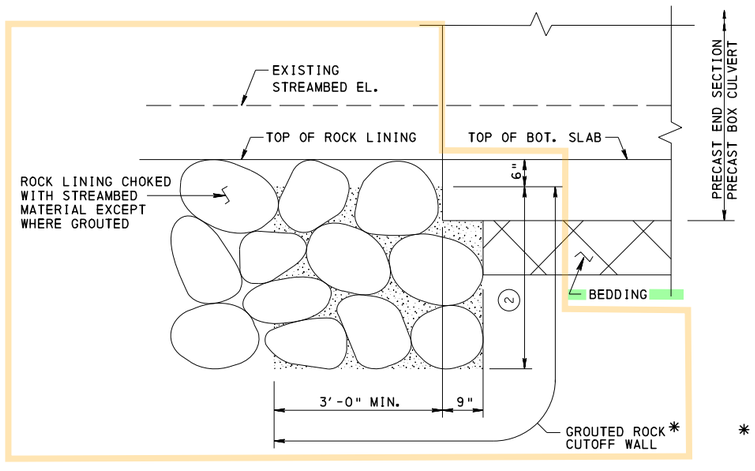
PRECAST CULVERT WITH CAST-IN-PLACE WINGWALLS

LEGEND

(2) EXTEND CUTOFF WALL TO BOTTOM OF WINGWALL FOOTING OR BOTTOM OF ROCK LINING, WHICHEVER IS DEEPER, 3'-6" MIN. FROM TOP OF CULVERT BOTTOM SLAB. SEE NOTE 12, SHEET 5.

(3) AN ALTERNATE CUTOFF WALL WITH GROUTED ROCK IS PERMITTED, SEE DETAILS D AND E THIS SHEET.

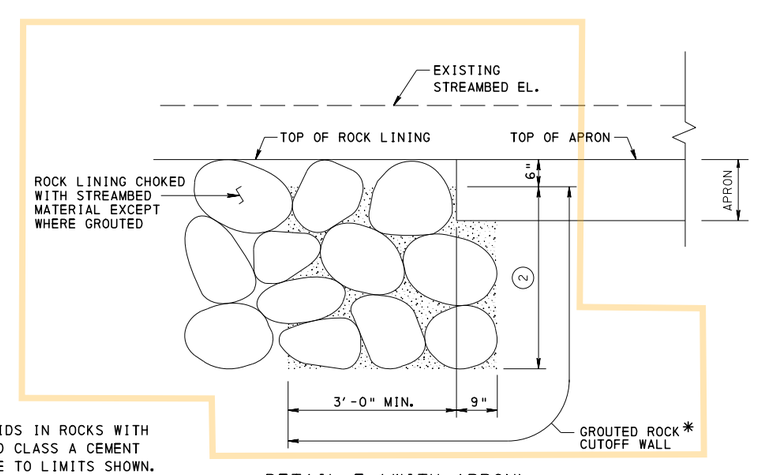
(4) PLACE 1'-0" OF STREAMBED MATERIAL ON TOP OF THE ROCK LINING.



DETAIL D (WITHOUT APRON)

(STREAMBED MATERIAL NOT SHOWN)

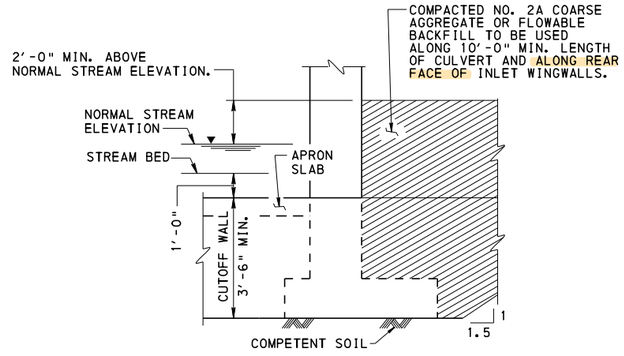
* FILL VOIDS IN ROCKS WITH VIBRATED CLASS A CEMENT CONCRETE TO LIMITS SHOWN.



DETAIL E (WITH APRON)

(STREAMBED MATERIAL NOT SHOWN)

ALTERNATIVE CUTOFF WALL WITH GROUTED ROCK



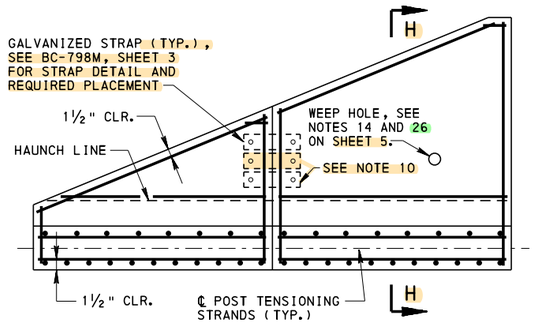
SECTION G-G

NOTE:
DESIGNER TO MODIFY AMOUNT OF COMPACTED NO. 2A COARSE AGGREGATE OR FLOWABLE BACKFILL TO PROVIDE ADEQUATE PROTECTION AGAINST PIPING OF STREAM FLOW THROUGH FILL AT INLET END OF CULVERT.

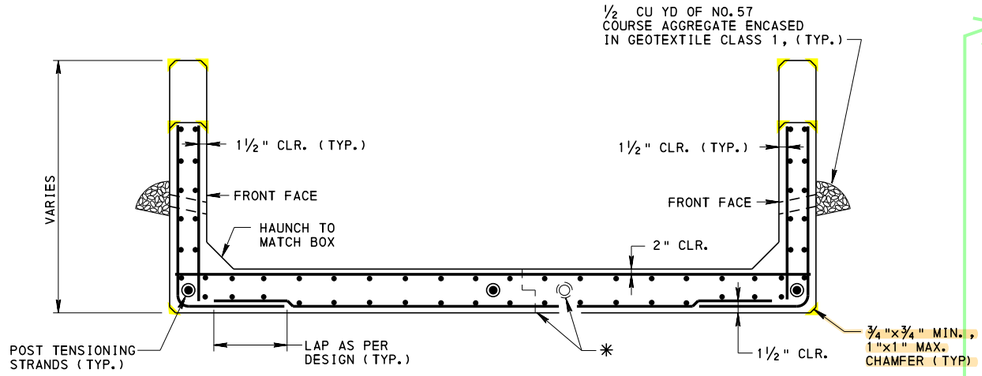
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE OFFICE

STANDARD
R.C. BOX CULVERT
PRECAST

RECOMMENDED NOV. 23, 2022	RECOMMENDED NOV. 23, 2022	SHEET 7 OF 16
CHIEF BRIDGE ENGINEER	CHIEF ENGINEER, HIGHWAY ADMIN.	BD-632M

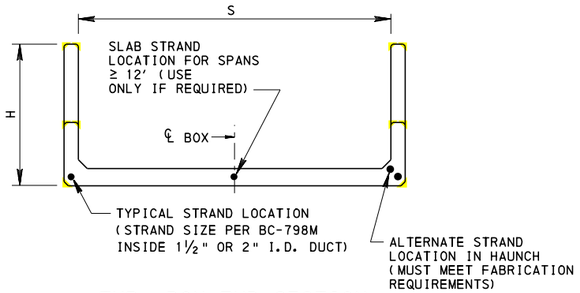


POST-TENSION END SECTION
SPAN >12 FEET

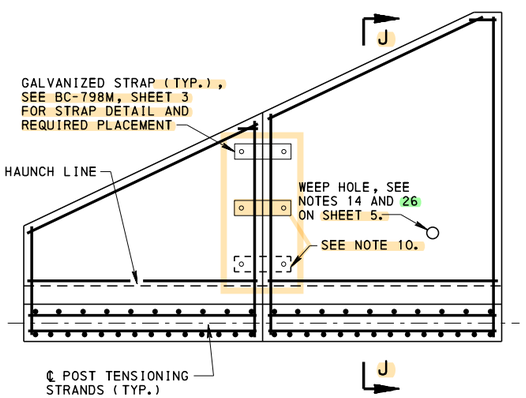


SECTION H-H

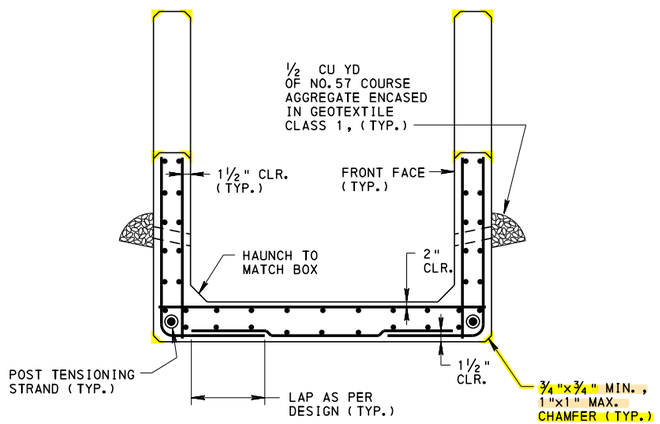
✳ SPECIFY JOINT AND ADDITIONAL END SECTION POST TENSION STRAND IF WIDTH IS RESTRICTED DUE TO SHIPPING RESTRAINTS.



TYP. BOX END SECTION
SHOWING STRAND LOCATIONS



POST-TENSION END SECTION
SPAN ≤ 12 FEET



SECTION J-J

GENERAL NOTES:

1. EPOXY COAT REINFORCEMENT AS PER R.C. BOX CULVERT DESIGN.
2. REBAR SHOWN IS FOR ORIENTATION ONLY, REBAR SIZE AND SPACING AS PER DESIGN.
3. WALL REINFORCEMENT CAN BE ADJUSTED TO ACCOMMODATE WEEPHOLE. DO NOT CUT REINFORCEMENT.
4. CAST-IN-PLACE CONCRETE IS PERMITTED IN ANY PORTION OF THE PRECAST END SECTIONS, ONLY IF HEIGHT OR WIDTH OF END SECTIONS ARE RESTRICTED DUE TO SHIPPING RESTRAINTS.

POST-TENSIONING NOTES:

1. EXTEND BOTTOM ROW OF POST-TENSIONING STRANDS THROUGH THE BOTTOM SLAB OF PRECAST CONCRETE INLET AND OUTLET END SECTIONS.
2. BOX SEGMENTS AND END SECTIONS ARE POST-TENSIONED IN STAGES. THE CONTRACTOR IS REQUIRED TO SUBMIT A PLAN FOR POST-TENSIONING SEQUENCE TO THE DEPARTMENT FOR APPROVAL PRIOR TO SETTING ANY SEGMENTS.
3. POST-TENSION BOX SEGMENTS FIRST, THEN PROVIDE:
   - MECHANICAL SPLICERS ON BOTTOM STRANDS TO CONNECT WITH THE INLET\OUTLET END SECTIONS AND POST-TENSION BOTTOM STRANDS THROUGH THE END SECTIONS.
   - STRAPS ON SIDES OF END SECTION AS SHOWN ON BC-798M. IF SLAB THICKNESSES ARE LESS THAN 13", SEE NOTE 10.
4. PROVIDE FULL CONTACT OF THE JOINT SEALING MATERIAL AROUND THE ENTIRE JOINT BETWEEN THE END SECTIONS AND THE BOX SECTIONS.
5. AFTER POST-TENSIONING IS APPROVED, CUT STRANDS TO PROVIDE A MINIMUM OF 2½" CLEAR FROM OUTSIDE FACE OF CONCRETE AND COAT RECESS WITH EPOXY BONDING COMPOUND AND FILL WITH NON-SHRINK GROUT.
6. THE NUMBER OF POST-TENSIONING STRANDS MAY BE INCREASED AND THEIR LOCATIONS MAY BE ADJUSTED BY THE FABRICATOR.
7. PRECAST CONCRETE SEGMENT LENGTH TO BE DETERMINED BY THE FABRICATOR.
8. STAGING, SPACING AND POST-TENSION FORCE TO BE SHOWN ON FABRICATOR'S SHOP DRAWINGS.
9. SEE BC-798M, SHEET 1 FOR ADDITIONAL POST-TENSIONING NOTES.
10. WHEN SLAB THICKNESSES ARE LESS THAN 13", A MINIMUM OF THREE (3) GALVANIZED STRAPS MAY BE INSTALLED ON EACH FACE AS AN ALTERNATIVE TO POST-TENSIONING. IF WINGS ARE FLARED ON SLAB THICKNESSES LESS THAN 13", THIS ALTERNATIVE SHOULD BE USED. SEE BC-798M, SHEET 2 FOR STRAP DETAILS AND PLACEMENT REQUIREMENTS.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE OFFICE

STANDARD
R.C. BOX CULVERT
PRECAST
POST-TENSIONED END SECTIONS

RECOMMENDED NOV. 23, 2022	RECOMMENDED NOV. 23, 2022	SHEET 8 OF 16
CHIEF BRIDGE ENGINEER	CHIEF ENGINEER, HIGHWAY ADMIN.	BD-632M

THE SHEET INTENTIONALLY LEFT BLANK

PA STRUCTURE MOUNTED GUIDE RAIL
IS BEING DISCONTINUED

REPLACEMENT PA 3-RAIL
BRIDGE BARRIER IS PENDING

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE OFFICE

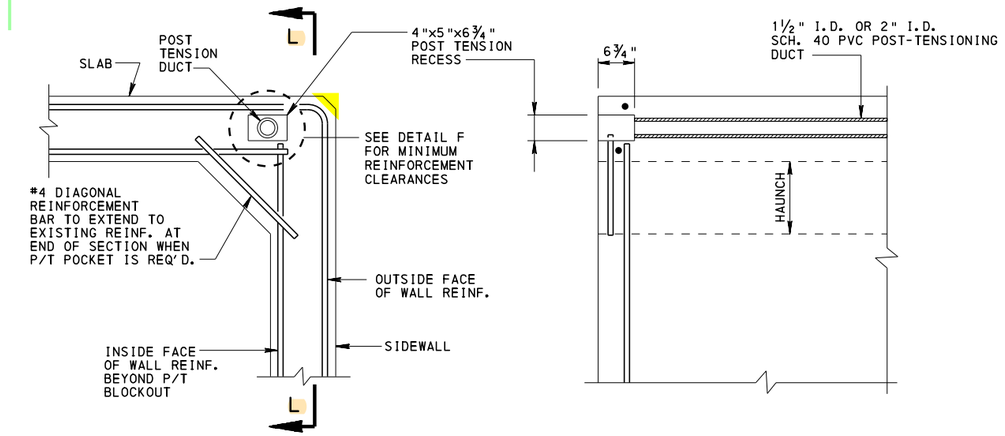
STANDARD
R.C. BOX CULVERT
PRECAST

RECOMMENDED NOV. 23, 2022
CHIEF BRIDGE ENGINEER

RECOMMENDED NOV. 23, 2022
CHIEF ENGINEER, HIGHWAY ADMIN.

SHEET 9 OF 16

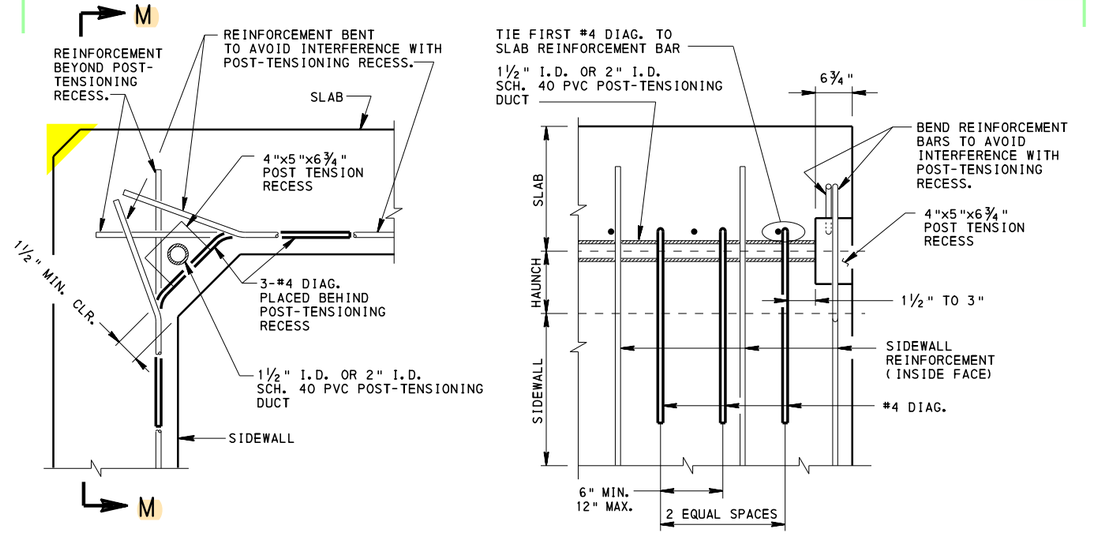
BD-632M



ELEVATION

SECTION L-L

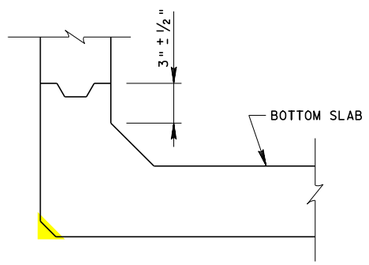
TYPICAL HAUNCH SECTION DETAIL



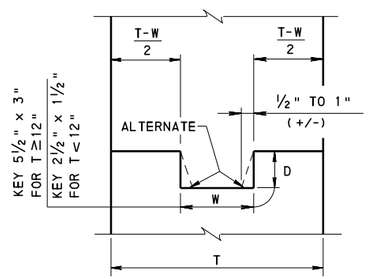
ELEVATION

SECTION M-M

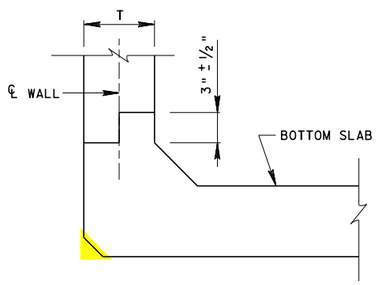
ALTERNATE HAUNCH SECTION DETAIL



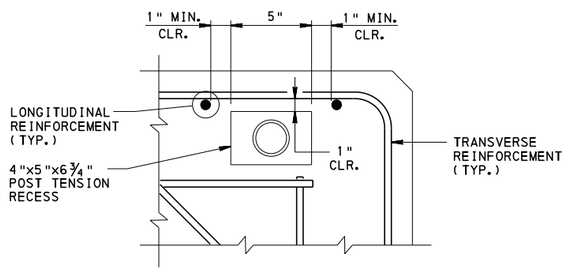
KEYED CONSTRUCTION JOINT



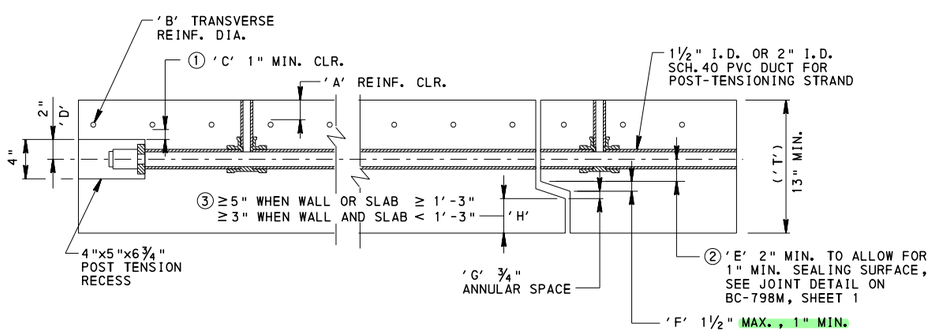
CONSTRUCTION JOINT DETAIL



ALTERNATE SHIP-LAP CONSTRUCTION JOINT



DETAIL F



CONFIGURATION FOR SLAB/WALL WITH POST-TENSIONING

MIN. SLAB/WALL THICKNESS ('T') DETERMINED TO ENSURE THE MIN. REQUIREMENTS ①②&③ ARE MET.

MIN. SLAB/WALL THICKNESS:
T = A + B + C + D + E + F + G + H

NOTE: PLACE POST-TENSIONING DUCTS ONLY IN CORNER HAUNCHES WHEN WALL THICKNESSES ARE <13".

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE OFFICE

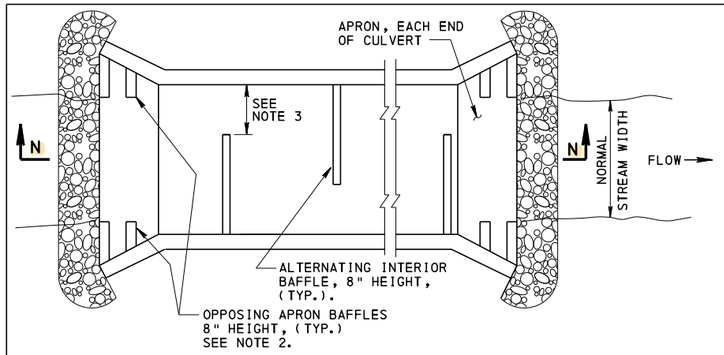
STANDARD
R.C. BOX CULVERT
MISCELLANEOUS DETAILS
PRECAST

RECOMMENDED NOV. 23, 2022
CHIEF BRIDGE ENGINEER

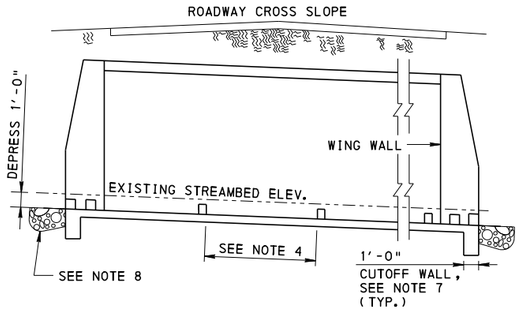
RECOMMENDED NOV. 23, 2022
CHIEF ENGINEER, HIGHWAY ADMIN.

SHEET 10 OF 16

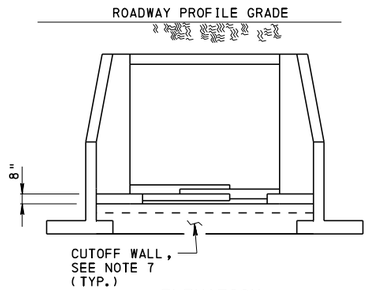
BD-632M



PLAN VIEW

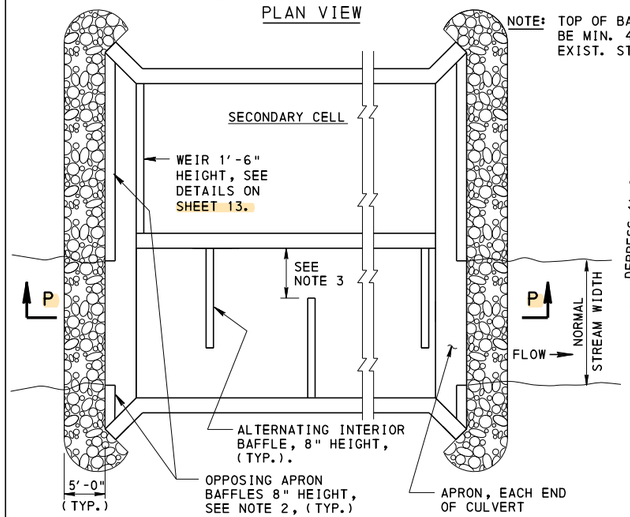


SECTION N-N

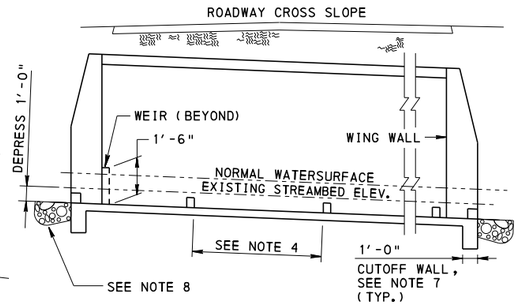


ELEVATION

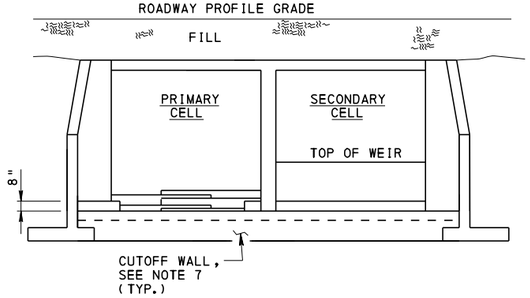
BOX CULVERTS



PLAN VIEW

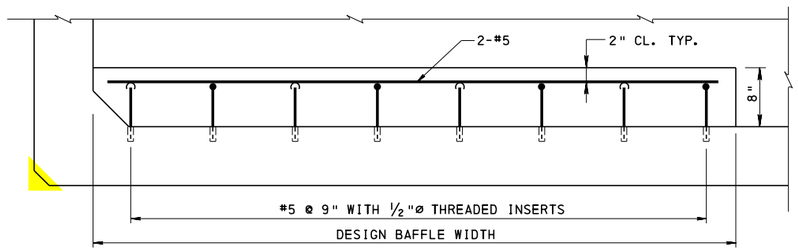


SECTION P-P

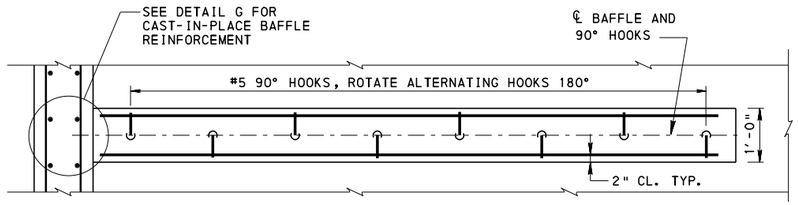


ELEVATION

TWIN CELL BOX CULVERTS



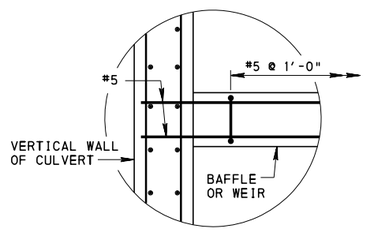
PROFILE



PLAN

TYPICAL BAFFLE

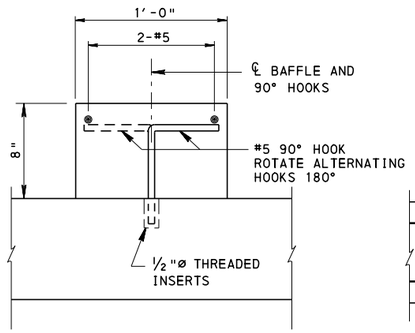
PRECAST REINFORCEMENT SHOWN, CAST-IN-PLACE REINFORCEMENT SIMILAR EXCEPT AS NOTED ON THIS STANDARD.



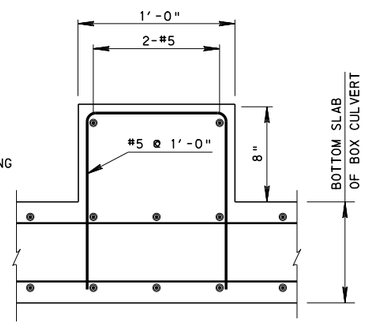
PLAN

DETAIL G

CAST-IN-PLACE BAFFLE/WEIR REINFORCEMENT



PRECAST BOX CULVERT
TYPICAL BAFFLE DETAIL



CAST-IN-PLACE BOX CULVERT
ALTERNATE BAFFLE DETAIL

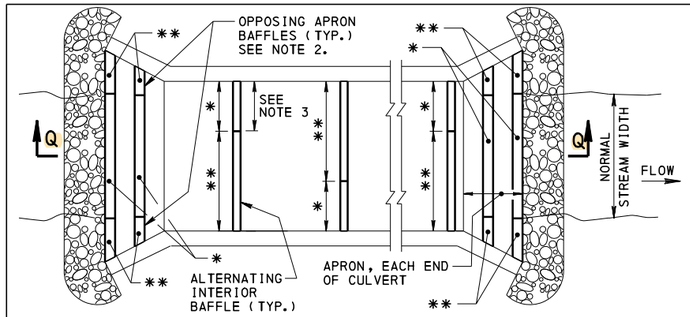
DESIGN NOTES:

1. THE BAFFLE SPACING AND OPENINGS SHOULD BE BASED ON THE NORMAL CHANNEL WIDTH UPSTREAM AND DOWNSTREAM OF THE STRUCTURE (I.E. EDGE OF WATER TO EDGE OF WATER DURING NORMAL FLOW). AT LEAST THREE (3) MEASUREMENTS SHOULD BE TAKEN UPSTREAM AND DOWNSTREAM OF THE STRUCTURE WHERE THE STREAM EXHIBITS NORMAL, STABLE CONDITIONS. AN AVERAGE OF THOSE SIX (6) MEASUREMENTS SHOULD THEN BE USED FOR THE BAFFLE CONFIGURATIONS.
   - MEASUREMENTS SHOULD NOT BE TAKEN WHERE THE CHANNEL HAS BEEN AFFECTED BY THE STRUCTURE OR SHOW SIGNS OF EROSION. BAFFLE CONFIGUATIONS SHOULD BE BASED ON NORMAL STREAM WIDTH (NOT TOP OF BANK TO TOP OF BANK OR WIDTH OF THE CULVERT).
2. THE OPENING IN THE APRON BAFFLES SHOULD BE EQUAL TO AVERAGE NORMAL WIDTH OF THE STREAM. THE APRON BAFFLES SHOULD CONNECT TO THE WINGWALLS AT EACH SIDE OF THE CULVERT. PLACE THE FIRST SET OF BAFFLES AT THE END OF THE APRON. IF THE APRON IS GREATER THAN 8'-0" LONG, A SECOND SET OF OPPOSING BAFFLES ARE REQUIRED TO BE SET AT ½ THE DISTANCE FROM THE END BAFFLE TO THE FACE OF THE BOX. FOR LONGER APRONS, BAFFLES NOT TO EXCEED 8'-0" SPACING.
3. THE OPENING IN THE INTERIOR BAFFLES SHOULD BE EQUAL TO 1/3 THE AVERAGE NORMAL WIDTH OF THE STREAM.
4. BAFFLES SHOULD BE SPACED AT THE AVERAGE NORMAL STREAM WIDTH OR 8', WHICHEVER IS GREATER. THE FIRST INTERIOR BAFFLE AT THE OUTLET SHOULD BE LOCATED AS CLOSE TO THE DOWNSTREAM END OF CULVERT AS POSSIBLE AND SPACED ACCORDINGLY FROM THAT POINT TO THE INLET.
5. IF BAFFLE SPACING NEEDS ADJUSTED DUE TO BOX SEGMENTS, THE SPACING SHOULD BE SHORTER NOT LONGER THAN CALCULATED SPACING.
6. THERE MAY BE UNUSUAL CIRCUMSTANCES IN WHICH THE STANDARD LAYOUT FOR BAFFLES WILL NOT ADEQUATELY ACCOMMODATE FISH PASSAGE. IN THESE CASES, THE PENNSYLVANIA FISH AND BOAT COMMISSION MUST PROVIDE SPECIFIC DESIGN GUIDANCE DURING PRELIMINARY DESIGN.
7. CUTOFF WALL IS TO ENSURE STREAMFLOW DOES NOT PASS BENEATH THE CULVERT. BOTTOM OF CUTOFF WALL IS TO EQUAL WING WALL FOOTINGS OR ROCK LINING WHICHEVER IS DEEPER 3'-6" MIN.
8. ROCK LINING AT THE INLET AND OUTLET SHOULD BE DEPRESSED THE ENTIRE LENGTH AND CHOKED WITH NATURAL STREAMBED MATERIAL. THE ROCK SHOULD BE FLUSH WITH THE CULVERT BOTTOM, NOT THE TOP OF THE BAFFLES. STREAMBED MATERIAL SALVAGED FROM EXCAVATION FOR THE BOX CULVERT SHOULD BE PLACED ON TOP OF THE ROCK LINING AND APRON TO THE MAXIMUM HEIGHT OF THE TOP OF THE BAFFLE TO THE LIMIT OF THE ROCK LINING TO FACILITATE THE DEVELOPEMENT OF A NATURAL STREAM BOTTOM IF FEASIBLE.
9. THE SLOPE OF THE NEW STRUCTURE SHOULD MATCH THE NATURAL STREAM SLOPE.
10. ADDITIONAL TWIN CELL DETAILS ARE SHOWN ON SHEET 12.
11. BAFFLES MAY BE SKEWED RELATIVE TO THE DIRECTION OF FLOW IN ORDER TO BE PARALLEL TO THE SECTION ENDS.
12. AN ALTERNATE DOUBLE WEIR BAFFLE DESIGN AS PROVIDED BY THE PENNSYLVANIA FISH AND BOAT COMMISSION IS PREFERRED AND MAY BE REQUIRED FOR SLOPES GREATER THAN 2% OR FOR BOXES THAT ARE SIGNIFICANTLY WIDER THAN THE NORMAL CHANNEL.

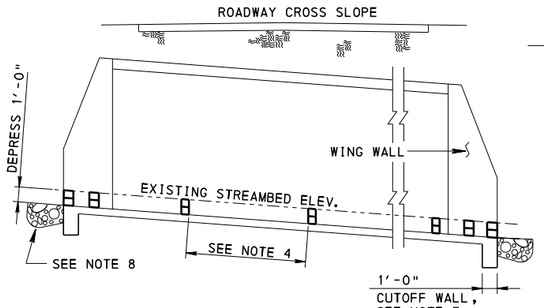
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE OFFICE

STANDARD
R.C. BOX CULVERT
MISCELLANEOUS DETAILS
STREAM GRADES ≤ 2%

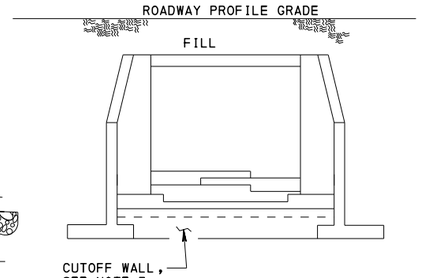
RECOMMENDED NOV. 23, 2022	RECOMMENDED NOV. 23, 2022	SHEET 11 OF 16
CHIEF BRIDGE ENGINEER	CHIEF ENGINEER, HIGHWAY ADMIN.	BD-632M



PLAN VIEW

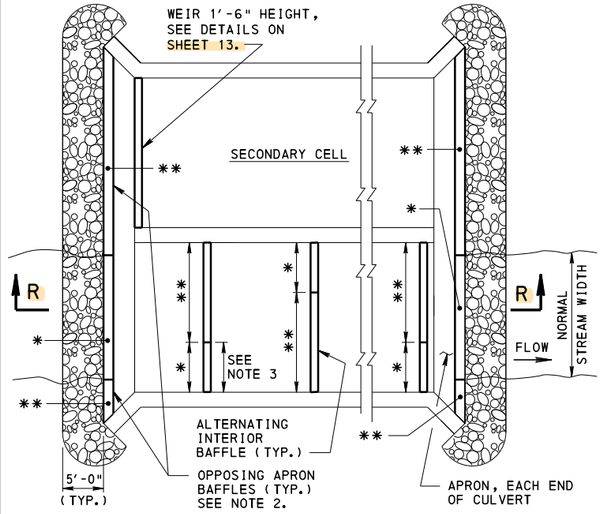


SECTION Q-Q

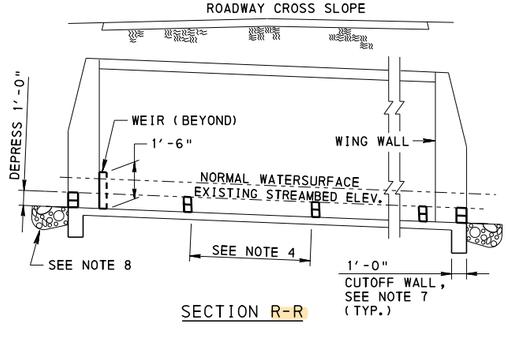


ELEVATION

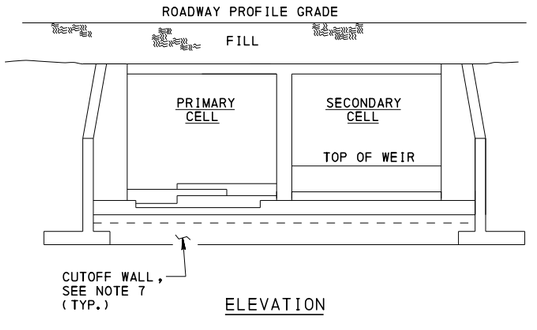
BOX CULVERTS



PLAN VIEW

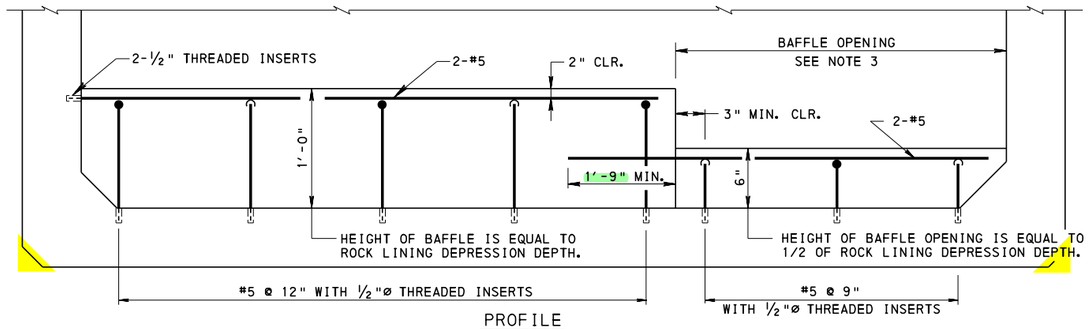


SECTION R-R

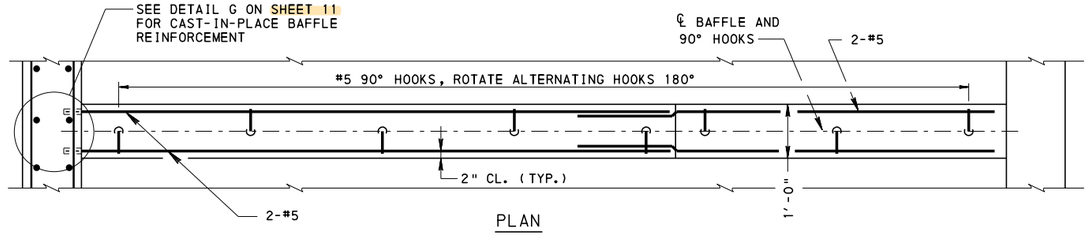


ELEVATION

TWIN CELL BOX CULVERTS



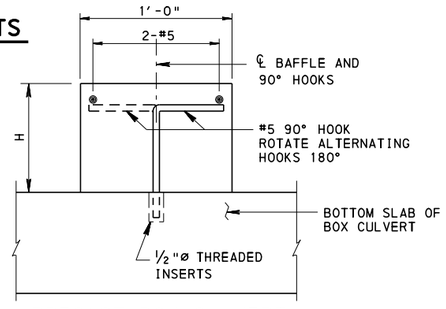
PROFILE



PLAN

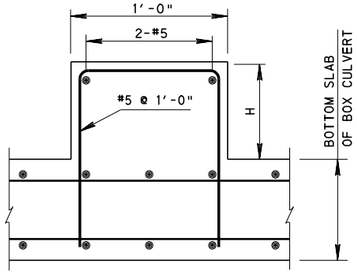
TYPICAL INTERIOR BAFFLE

PRECAST REINFORCEMENT SHOWN, CAST-IN-PLACE REINFORCEMENT SIMILAR EXCEPT AS NOTED ON THIS STANDARD.



PRECAST BOX CULVERT TYPICAL BAFFLE DETAIL

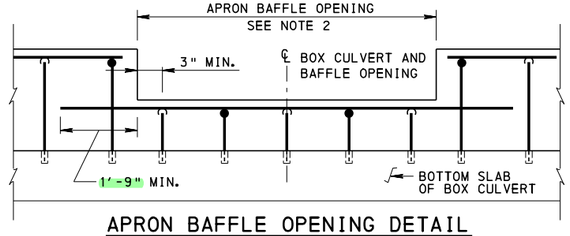
H = 1'-0" BAFFLE HEIGHT
6" BAFFLE HEIGHT AT OPENING



CAST-IN-PLACE BOX CULVERT ALTERNATE BAFFLE DETAIL

DESIGN NOTES:

1. THE BAFFLE SPACING AND OPENINGS SHOULD BE BASED ON THE NORMAL CHANNEL WIDTH UPSTREAM AND DOWNSTREAM OF THE STRUCTURE (I.E. EDGE OF WATER TO EDGE OF WATER DURING NORMAL FLOW). AT LEAST THREE (3) MEASUREMENTS SHOULD BE TAKEN UPSTREAM AND DOWNSTREAM OF THE STRUCTURE WHERE THE STREAM EXHIBITS NORMAL, STABLE CONDITIONS. AN AVERAGE OF THOSE SIX (6) MEASUREMENTS SHOULD THEN BE USED FOR THE BAFFLE CONFIGURATIONS.
   - MEASUREMENTS SHOULD NOT BE TAKEN WHERE THE CHANNEL HAS BEEN AFFECTED BY THE STRUCTURE OR SHOW SIGNS OF EROSION. BAFFLE CONFIGUATIONS SHOULD BE BASED ON NORMAL STREAM WIDTH (NOT TOP OF BANK TO TOP OF BANK OR WIDTH OF THE CULVERT).
2. THE OPENING IN THE APRON BAFFLES SHOULD BE EQUAL TO AVERAGE NORMAL WIDTH OF THE STREAM. THE APRON BAFFLES SHOULD CONNECT TO THE WINGWALLS AT EACH SIDE OF THE CULVERT. PLACE THE FIRST SET OF BAFFLES AT THE END OF THE APRON. IF THE APRON IS GREATER THAN 8'-0" LONG, A SECOND SET OF OPPOSING BAFFLES ARE REQUIRED TO BE SET AT ½ THE DISTANCE FROM THE END BAFFLE TO THE FACE OF THE BOX. FOR LONGER APRONS, BAFFLES NOT TO EXCEED 8'-0" SPACING.
3. THE OPENING IN THE INTERIOR BAFFLES SHOULD BE EQUAL TO 1/3 THE AVERAGE NORMAL WIDTH OF THE STREAM.
4. BAFFLES SHOULD BE SPACED AT THE AVERAGE NORMAL STREAM WIDTH OR 8', WHICHEVER IS GREATER. THE FIRST INTERIOR BAFFLE AT THE OUTLET SHOULD BE LOCATED AS CLOSE TO THE DOWNSTREAM END OF CULVERT AS POSSIBLE AND SPACED ACCORDINGLY FROM THAT POINT TO THE INLET.
5. IF BAFFLE SPACING NEEDS ADJUSTED DUE TO BOX SEGMENTS, THE SPACING SHOULD BE SHORTER NOT LONGER THAN CALCULATED SPACING.
6. THERE MAY BE UNUSUAL CIRCUMSTANCES IN WHICH THE STANDARD LAYOUT FOR BAFFLES WILL NOT ADEQUATELY ACCOMMODATE FISH PASSAGE. IN THESE CASES, THE PENNSYLVANIA FISH AND BOAT COMMISSION MUST PROVIDE SPECIFIC DESIGN GUIDANCE DURING PRELIMINARY DESIGN.
7. CUTOFF WALL IS TO ENSURE STREAMFLOW DOES NOT PASS BENEATH THE CULVERT. BOTTOM OF CUTOFF WALL IS TO EQUAL WING WALL FOOTINGS OR ROCK LINING WHICHEVER IS DEEPER 3'-6" MIN.
8. ROCK LINING AT THE INLET AND OUTLET SHOULD BE DEPRESSED THE ENTIRE LENGTH AND CHOKED WITH NATURAL STREAMBED MATERIAL. THE ROCK SHOULD BE FLUSH WITH THE CULVERT BOTTOM, NOT THE TOP OF THE BAFFLES. STREAMBED MATERIAL SALVAGED FROM EXCAVATION FOR THE BOX CULVERT SHOULD BE PLACED ON TOP OF THE ROCK LINING AND APRON TO THE MAXIMUM HEIGHT OF THE TOP OF THE BAFFLE TO THE LIMIT OF THE ROCK LINING TO FACILITATE THE DEVELOPEMENT OF A NATURAL STREAM BOTTOM IF FEASIBLE.
9. THE SLOPE OF THE NEW STRUCTURE SHOULD MATCH THE NATURAL STREAM SLOPE.
10. ADDITIONAL TWIN CELL DETAILS ARE SHOWN ON SHEET 12.
11. BAFFLES MAY BE SKEWED RELATIVE TO THE DIRECTION OF FLOW IN ORDER TO BE PARALLEL TO THE SECTION ENDS.
12. SEE NOTE 12 ON SHEET 11 FOR ALTERNATE BAFFLE DESIGN.



APRON BAFFLE OPENING DETAIL

APRON BAFFLE TYPICAL TO INTERIOR BAFFLE EXCEPT WHERE NOTED OTHERWISE.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE OFFICE

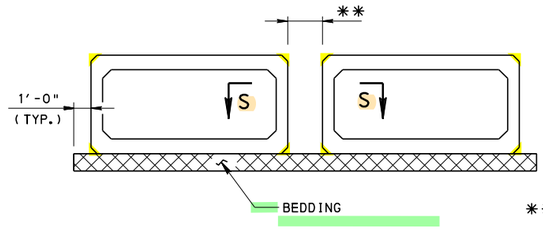
STANDARD
R.C. BOX CULVERT
MISCELLANEOUS DETAILS
STREAM GRADES > 2%

RECOMMENDED NOV. 23, 2022
CHIEF BRIDGE ENGINEER

RECOMMENDED NOV. 23, 2022
CHIEF ENGINEER, HIGHWAY ADMIN.

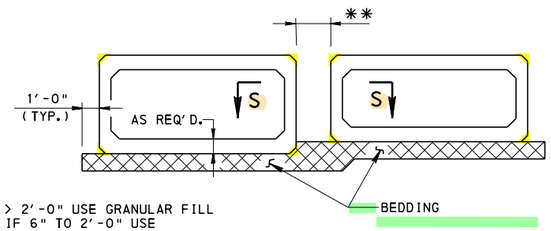
SHEET 12 OF 16

BD-632M



TYP. PRECAST SECTION (NORMAL)

SYMMETRICAL

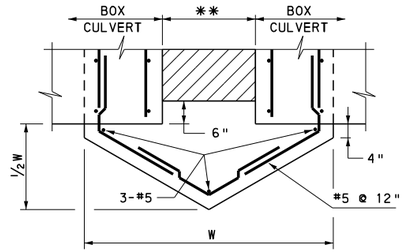


** IF > 2'-0" USE GRANULAR FILL
OR IF 6" TO 2'-0" USE
CLASS A CONCRETE.

NOTE:
DO NOT PLACE R.C. BOX CULVERTS
< 6" APART.

TYP. PRECAST SECTION (NORMAL)

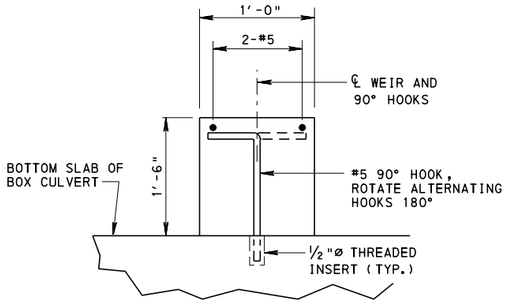
UNSYMMETRICAL - OPTION TO WEIR



NOTE: THREADED INSERTS MAY
BE USED AS AN ALTERNATE TO
BAR LAPS FOR #5 REINFORCEMENT.

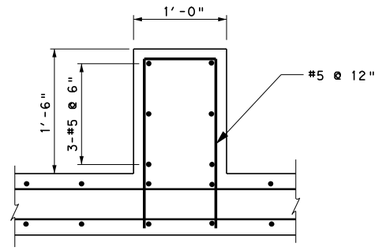
SECTION S-S

CONCRETE PLUG



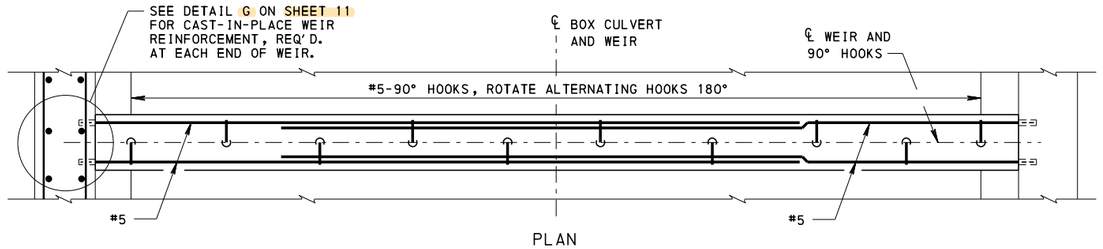
PRECAST BOX CULVERT
TYPICAL WEIR DETAIL

ALL STREAM GRADES

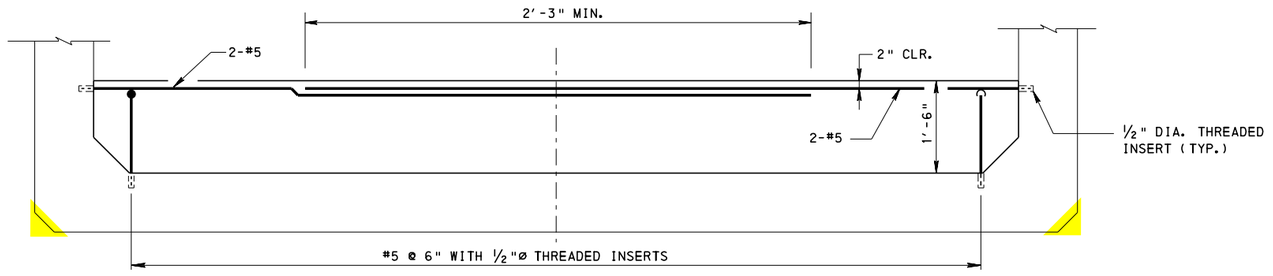


CAST-IN-PLACE BOX CULVERT
ALTERNATE WEIR DETAIL

ALL STREAM GRADES



PLAN



PROFILE

WEIR DETAIL

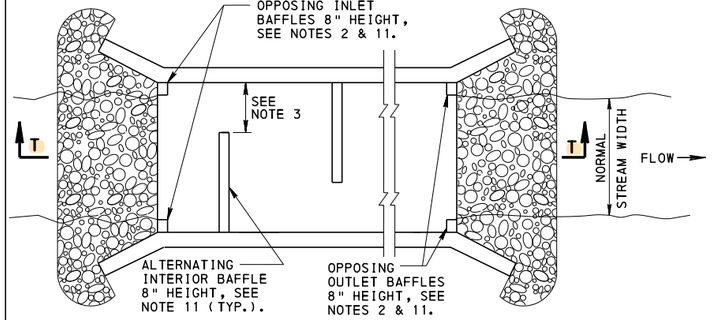
PRECAST REINFORCEMENT SHOWN, CAST-IN-PLACE REINFORCEMENT
SIMILAR EXCEPT AS NOTED ON THIS STANDARD.

DESIGN NOTE:
THERE MAY BE UNUSUAL CIRCUMSTANCES IN WHICH THE STANDARD LAYOUT FOR BAFFLES WILL NOT ADEQUATELY ACCOMMODATE FISH PASSAGE. IN THESE CASES, THE PENNSYLVANIA FISH AND BOAT COMMISSION MUST PROVIDE SPECIFIC DESIGN GUIDANCE DURING PRELIMINARY DESIGN.

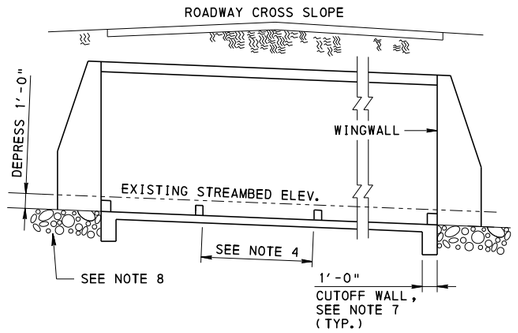
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE OFFICE

STANDARD
R.C. BOX CULVERT
MISCELLANEOUS TWIN CELL DETAILS

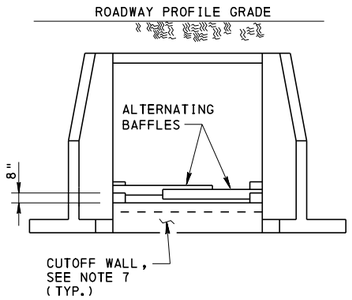
RECOMMENDED NOV. 23, 2022	RECOMMENDED NOV. 23, 2022	SHEET 13 OF 16
CHIEF BRIDGE ENGINEER	CHIEF ENGINEER, HIGHWAY ADMIN.	BD-632M



PLAN VIEW



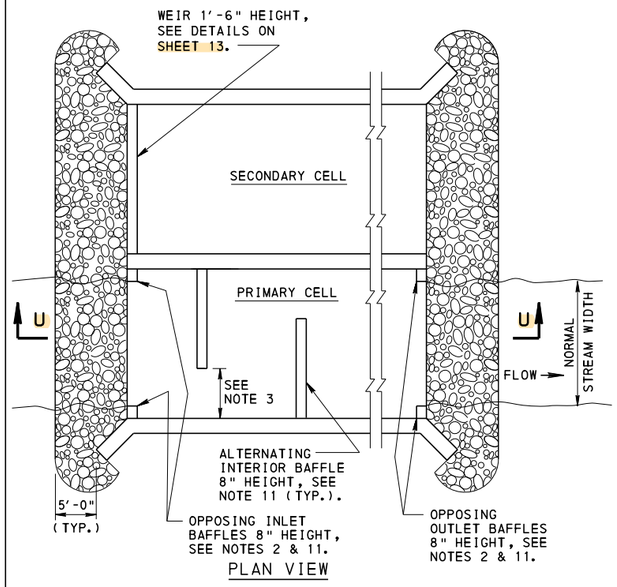
SECTION T-T



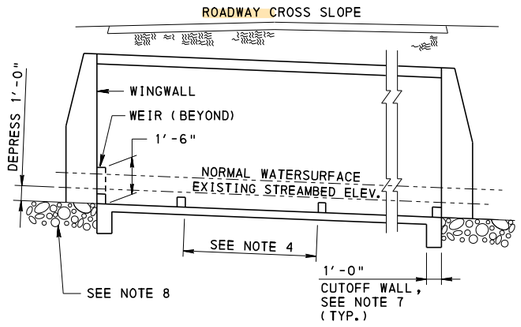
ELEVATION

NOTE: TOP OF BAFFLE SHALL BE MIN. 4" BELOW EXIST. STREAMBED ELEV.

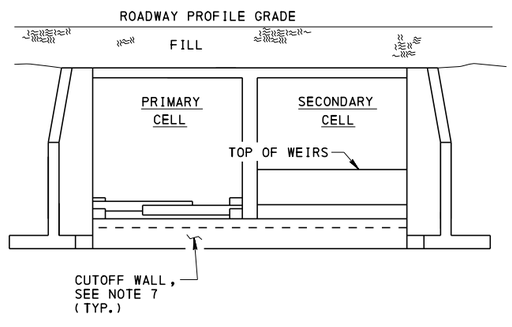
BOX CULVERTS



PLAN VIEW

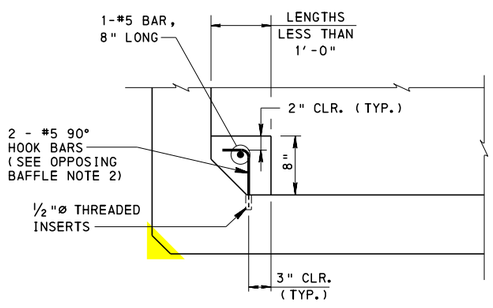


SECTION U-U



ELEVATION

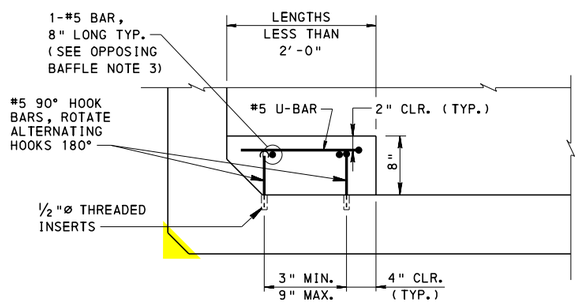
TWIN CELL BOX CULVERTS



OPPOSING BAFFLES LESS THAN 1'-0"

OPPOSING BAFFLE NOTES:

1. PRECAST REINFORCEMENT SHOWN, CAST-IN-PLACE REINFORCEMENT SIMILAR EXCEPT AS NOTED ON SHEET 11.
2. FOR OPPOSING BAFFLES LESS THAN 1'-0", CAST ADJACENT INSERTS 7" ON CENTER FOR THE 2 - #5 90° HOOK BARS.
3. FOR OPPOSING BAFFLES LESS THAN 2'-0", REPLACE 2-#5 BARS WITH A #5 U-BAR SUPPORTED BY 8" LONG #5 BARS TIED TO ALTERNATING #5 90° HOOK BARS.



OPPOSING BAFFLES LESS THAN 2'-0"

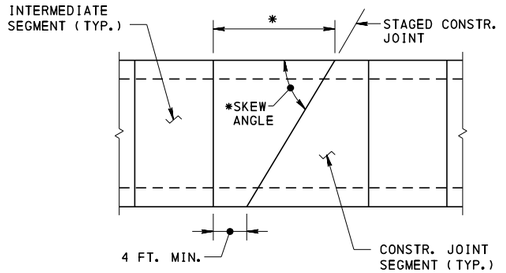
DESIGN NOTES:

1. THE BAFFLE SPACING AND OPENINGS SHOULD BE BASED ON THE NORMAL CHANNEL WIDTH UPSTREAM AND DOWNSTREAM OF THE STRUCTURE (I.E. EDGE OF WATER TO EDGE OF WATER DURING NORMAL FLOW). AT LEAST THREE (3) MEASUREMENTS SHOULD BE TAKEN UPSTREAM AND DOWNSTREAM OF THE STRUCTURE WHERE THE STREAM EXHIBITS NORMAL, STABLE CONDITIONS. AN AVERAGE OF THOSE SIX (6) MEASUREMENTS SHOULD THEN BE USED FOR THE BAFFLE CONFIGURATIONS.
   - MEASUREMENTS SHOULD NOT BE TAKEN WHERE THE CHANNEL HAS BEEN AFFECTED BY THE STRUCTURE OR SHOW SIGNS OF EROSION. BAFFLE CONFIGUATIONS SHOULD BE BASED ON NORMAL STREAM WIDTH (NOT TOP OF BANK TO TOP OF BANK OR WIDTH OF THE CULVERT).
2. OPPOSING BAFFLES SHOULD BE PLACED AT THE INLET AND THE OUTLET ENDS OF THE CULVERT. THE BAFFLE OPENING SHOULD BE A DISTANCE EQUAL TO THE AVERAGE NORMAL WIDTH OF THE STREAM.
3. THE OPENING IN THE INTERIOR BAFFLES SHOULD BE A DISTANCE EQUAL TO 1/3 THE AVERAGE NORMAL WIDTH OF THE STREAM.
4. INTERIOR BAFFLES SHOULD BE SPACED AT A DISTANCE EQUAL TO THE AVERAGE NORMAL STREAM WIDTH OR 8', WHICHEVER IS GREATER AND BE SPACED EVENLY BETWEEN THE INLET AND OUTLET BAFFLES.
5. IF BAFFLE SPACING NEEDS ADJUSTED DUE TO BOX SEGMENTS, THE SPACING SHOULD BE SHORTER NOT LONGER THAN CALCULATED SPACING.
6. THERE MAY BE UNUSUAL CIRCUMSTANCES IN WHICH THE STANDARD LAYOUT FOR BAFFLES WILL NOT ADEQUATELY ACCOMMODATE FISH PASSAGE. IN THESE CASES, THE PENNSYLVANIA FISH AND BOAT COMMISSION MUST PROVIDE SPECIFIC DESIGN GUIDANCE DURING PRELIMINARY DESIGN.
7. CUTOFF WALL IS TO ENSURE STREAMFLOW DOES NOT PASS BENEATH THE CULVERT. BOTTOM OF CUTOFF WALL IS TO EQUAL WING WALL FOOTINGS OR ROCK LINING WHICHEVER IS DEEPER 3'-6" MIN.
8. ROCK LINING AT THE INLET AND OUTLET SHOULD BE DEPRESSED THE ENTIRE LENGTH AND CHOKED WITH NATURAL STREAMBED MATERIAL. THE ROCK SHOULD BE FLUSH WITH THE CULVERT BOTTOM, NOT THE TOP OF THE BAFFLES. STREAMBED MATERIAL SALVAGED FROM EXCAVATION FOR THE BOX CULVERT SHOULD BE PLACED ON TOP OF THE ROCK LINING TO THE MAXIMUM HEIGHT OF THE TOP OF THE BAFFLE TO THE LIMIT OF THE ROCK LINING TO FACILITATE THE DEVELOPEMENT OF A NATURAL STREAM BOTTOM IF FEASIBLE.
9. THE SLOPE OF THE NEW STRUCTURE SHOULD MATCH THE NATURAL STREAM SLOPE.
10. ADDITIONAL TWIN CELL DETAILS ARE SHOWN ON SHEET 13.
11. FOR TYPICAL BAFFLE PLAN, PROFILE AND REINFORCEMENT DETAILS, SEE SHEET 11.
12. AN ALTERNATE DOUBLE WEIR BAFFLE DESIGN AS PROVIDED BY THE PENNSYLVANIA FISH AND BOAT COMMISSION IS PREFERRED AND MAY BE REQUIRED FOR SLOPES GREATER THAN 2% OR FOR BOXES THAT ARE SIGNIFICANTLY WIDER THAN THE NORMAL CHANNEL.

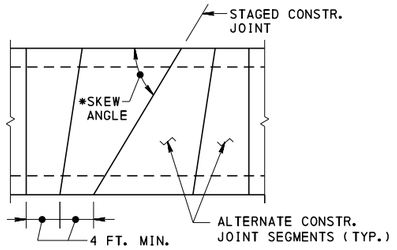
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE OFFICE

STANDARD
R.C. BOX CULVERT WITHOUT APRONS
MISCELLANEOUS DETAILS
STREAM GRADES ≤ 2%

RECOMMENDED NOV. 23, 2022	RECOMMENDED NOV. 23, 2022	SHEET 14 OF 16
CHIEF BRIDGE ENGINEER	CHIEF ENGINEER, HIGHWAY ADMIN.	BD-632M

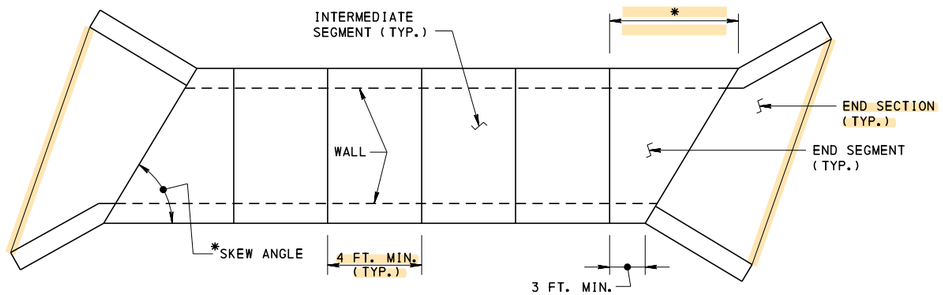


STAGED CONSTRUCTION JOINT DETAIL

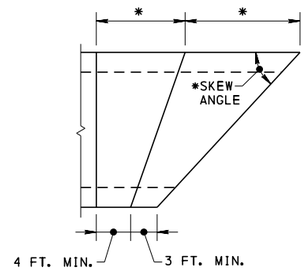


ALTERNATE STAGED CONSTRUCTION JOINT DETAIL

NOTE: DUAL CONSTRUCT JT. SEGMENTS SHOWN EACH SIDE OF JOINT; MORE THAN TWO CONSTR JT. SEGMENTS SIMILAR.



PLAN VIEW



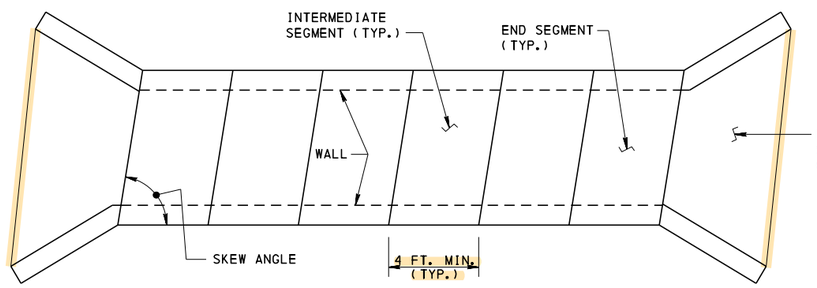
ALTERNATE END SEGMENTS DETAIL

NOTE: DUAL END SEGMENTS SHOWN; MORE THAN TWO END SEGMENTS SIMILAR.

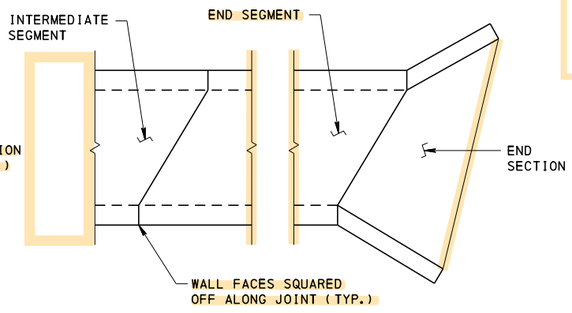
NOTE: AT THE SHOP DRAWING STAGE, THE FABRICATOR MAY SUBMIT ANY OPTION ON THIS STANDARD. IF THE OPTION SUBMITTED MEETS THE DESIGN, THE OPTION SHOULD BE ACCEPTED.

STANDARD SQUARED SEGMENT JOINTS

* SEE NOTE 2 AND FABRICATION LIMITATIONS THIS SHEET



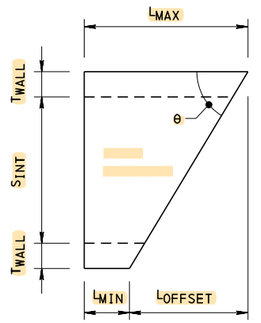
PLAN VIEW - SKEW ANGLE ≥ 75 DEG.



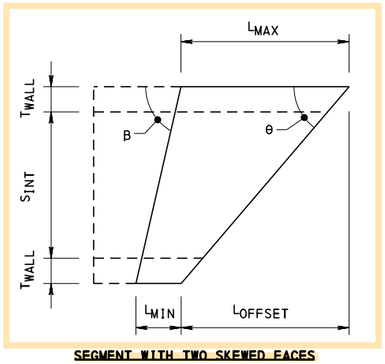
PARTIAL PLAN VIEW - SKEW ANGLE < 75 DEG.

ALTERNATE SKEWED SEGMENT JOINTS

FABRICATION LIMITATIONS



SEGMENT WITH ONE SKEWED FACE



SEGMENT WITH TWO SKEWED FACES

S_{INT} = INTERIOR CLEAR SPAN

T_{WALL} = WALL THICKNESS

W = OUT-TO-OUT WIDTH OF CULVERT = S_{INT} +2(T_{WALL})

L_{MAX} = MAXIMUM EXTERIOR LENGTH OF SEGMENT = H_{MOLD} - 4IN.

L_{MIN} = MINIMUM ALLOWED EXTERIOR LENGTH OF SEGMENT, SEE DETAILS ON THIS SHEET

L_{OFFSET} = OFFSET BETWEEN LONG AND SHORT SIDES

= L_{MAX} - L_{MIN} FOR SEGMENT WITH ONE SQUARE FACE

= L_{MAX} + (W/TAN β)- L_{MIN} FOR SEGMENT WITH TWO SKEWED FACES

H_{MOLD} = HEIGHT OF STEEL FORMING SYSTEM (TYPICALLY 8 FT. OR 10 FT.)

θ_{MIN} = MINIMUM SKEW ANGLE = 90 DEG. - ATAN (L_{OFFSET}/W)

β = SECONDARY SKEW ANGLE (IF BOTH FACES ARE SKEWED)

EXAMPLE CALCULATION - MINIMUM SKEW ANGLE

CALCULATE THE MINIMUM SKEW ANGLE THAT CAN BE FABRICATED WITH AN 8 FT. MOLD FOR AN END SEGMENT WITH SQUARED JOINT, S_{INT} = 10 FT., AND T_{WALL} = 12IN.

W = S_{INT} + 2(T_{WALL}) = 10FT. + 2(1FT.) = 12FT.

L_{MAX} = H_{MOLD} - 4IN. = 8FT. - 4IN. = 7.67FT.

L_{MIN} = 3FT. (END SEGMENT)

L_{OFFSET} = L_{MAX} - L_{MIN} = 7.667 FT. - 3FT. = 4.667FT

θ_{MIN} = 90 DEG. - ATAN (L_{OFFSET}/W) = 90 DEG. - ATAN(4.667 FT./12FT.) = 68.75 DEG.

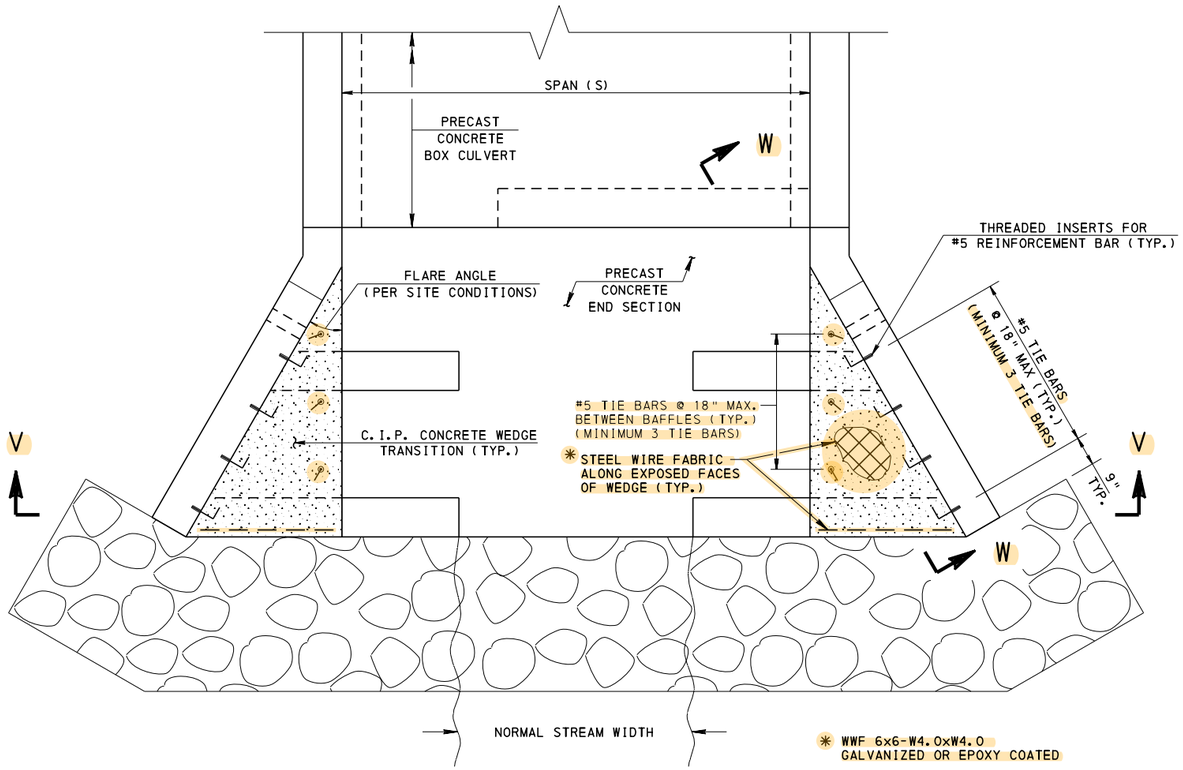
DESIGN NOTES

1. SQUARED SEGMENT JOINTS ARE PREFERRED DUE TO POST-TENSIONING EFFECTS. AT A MINIMUM, WALL FACES MUST BE SQUARED AT SEGMENT JOINTS FOR CULVERT SKEWS ANGLES LESS THAT 75 DEGREES.
2. THE MINIMUM SKEW ANGLE OF A CULVERT IS THE GREATER OF 35 DEGREES AND THE FABRICATION LIMIT AS ILLUSTRATED IN THE FABRICATION LIMITATIONS ON THIS SHEET.
3. THE MINIMUM SEGMENT LENGTH IS 4 FT. EXCEPT AS NOTED.
4. WHEN USING THE STANDARD SQUARED JOINTS, TWO OR MORE SEGMENTS ARE PERMITTED TO BE USED TO TRANSITION FROM THE SQUARED JOINTS TO THE SKEWED ENDS AND CONSTRUCTION JOINTS.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE OFFICE

STANDARD R.C. BOX CULVERT PRECAST CONCRETE SEGMENT JOINT DETAILS

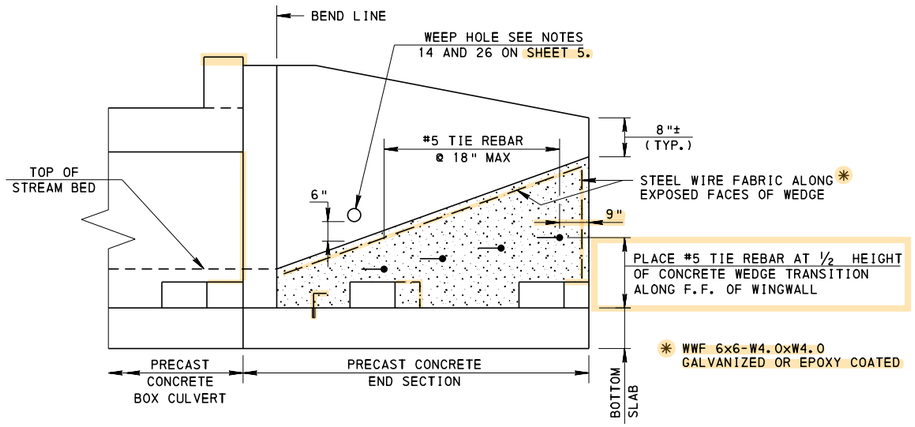
RECOMMENDED NOV. 23, 2022 CHIEF BRIDGE ENGINEER	RECOMMENDED NOV. 23, 2022 CHIEF ENGINEER, HIGHWAY ADMIN.	SHEET 15 OF 16
		BD-632M



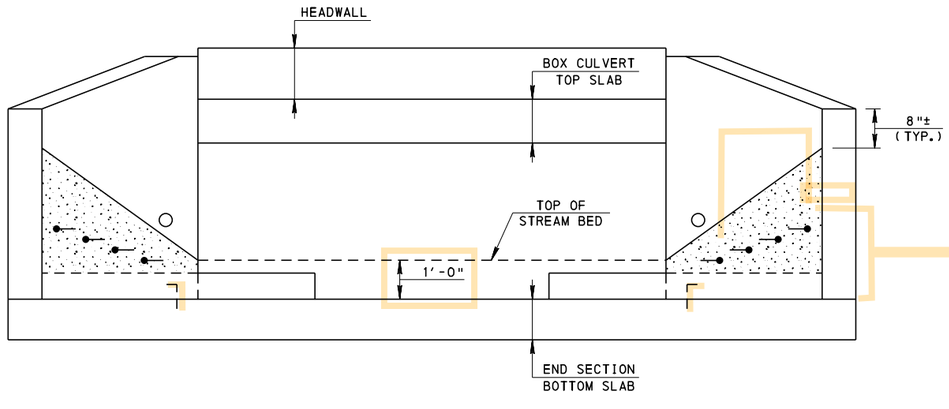
TYPICAL PLAN
NO SCALE

DESIGN NOTES:

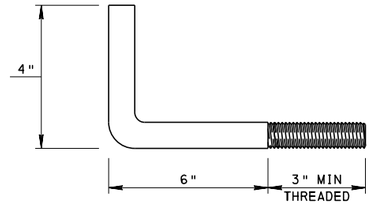
1. THE LAYOUT OF THE CONCRETE SLOPE TRANSITIONS SHOULD BE BASED ON THE REQUIRED GRADING AROUND THE WING WALLS.
2. CONSTRUCT CONCRETE SLOPE TRANSITIONS USING CLASS A CEMENT CONCRETE.
3. USE THIS DETAIL IN COORDINATION WITH THE DEPARTMENT OF ENVIRONMENTAL PROTECTION AND THE PENNSYLVANIA FISH AND BOAT COMMISSION DURING PRE-APP MEETING.



SECTION W-W
NO SCALE



SECTION V-V
NO SCALE
(STEEL WIRE FABRIC ALONG EXPOSED FACES OF WEDGES NOT SHOWN)



#5 TIE BAR DETAIL
NO SCALE

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BRIDGE OFFICE

STANDARD
PRECAST BOX CULVERT WITH APRONS
C. I. P CONCRETE WEDGE TRANSITION

RECOMMENDED NOV. 23, 2022 CHIEF BRIDGE ENGINEER	RECOMMENDED NOV. 23, 2022 CHIEF ENGINEER, HIGHWAY ADMIN.	SHEET 16 OF 16
		BD-632M