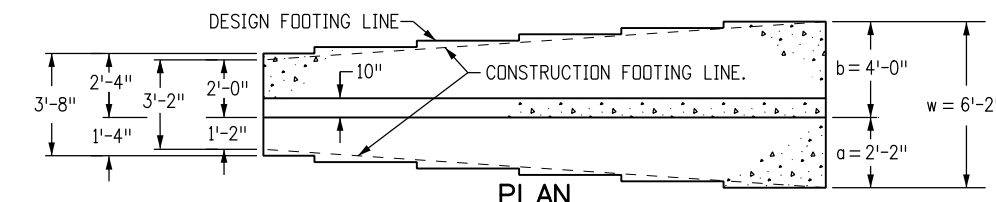


**BOX ELEVATION**

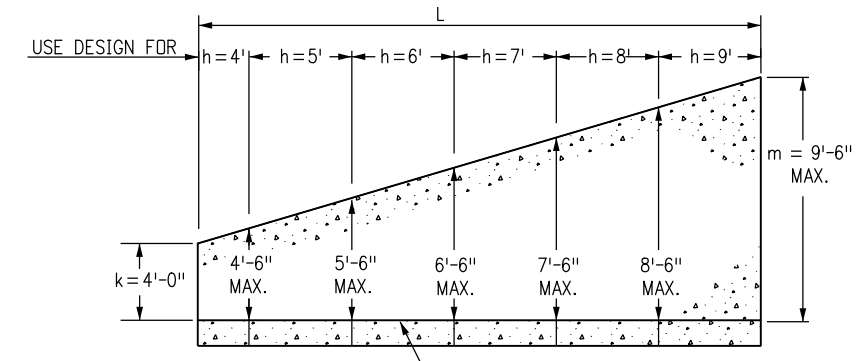
$m = h, B_a \text{ OR RISE} + (1'-4")$   
UNLESS OTHERWISE SHOWN ON PLANS

h =	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'	14'
a =	1'-0"	1'-2"	1'-4"	1'-6"	1'-8"	1'-10"	2'-0"	2'-2"	2'-4"	2'-6"	2'-8"	2'-10"	3'-0"
b =	1'-8"	2'-0"	2'-4"	2'-8"	3'-0"	3'-4"	3'-8"	4'-0"	4'-4"	4'-8"	5'-0"	5'-4"	5'-8"
w =	2'-8"	3'-2"	3'-8"	4'-2"	4'-8"	5'-2"	5'-8"	6'-2"	6'-8"	7'-2"	7'-8"	8'-2"	8'-8"
d-BARS	#4 @ 9"	#4 @ 9"	#4 @ 9"	#4 @ 9"	#4 @ 9"	#4 @ 9"	#5 @ 11"	#5 @ 10"	#5 @ 10"	#5 @ 8"	#6 @ 8"	#7 @ 9"	#7 @ 7"
* CONC. CY/LF	0.161	0.210	0.259	0.309	0.358	0.407	0.457	0.506	0.556	0.605	0.654	0.704	0.753

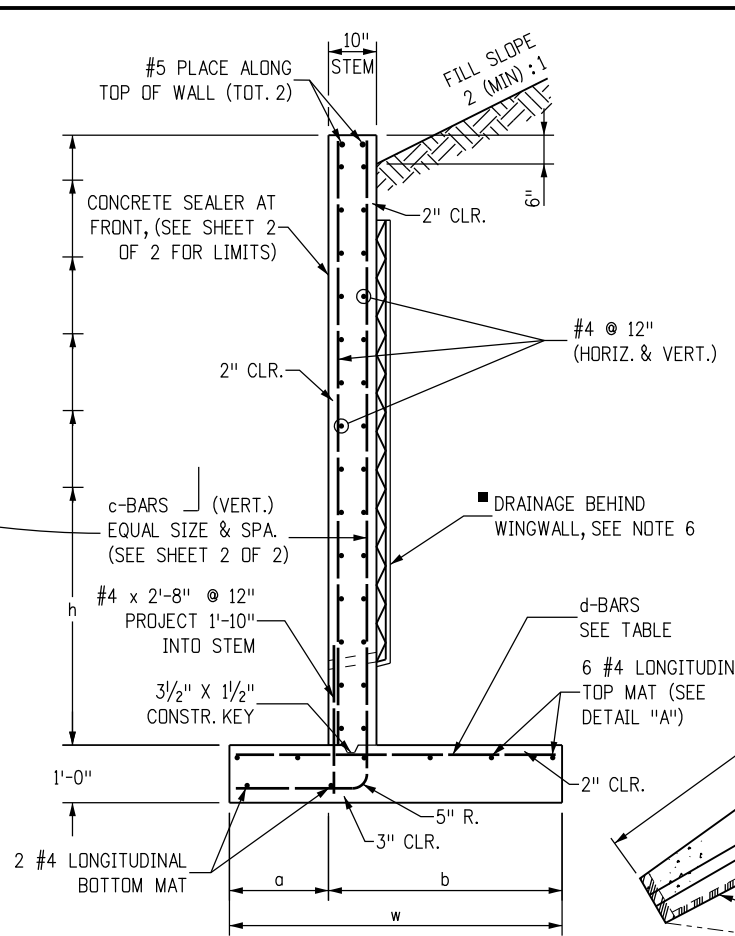
\* DOES NOT INCLUDE TOE WALL QUANTITIES SEE SHEET 2 OF 2 FOR REINFORCING STEEL QUANTITY ■ REQUIRED DRAINAGE BEHIND WINGWALLS SEE NOTE 6



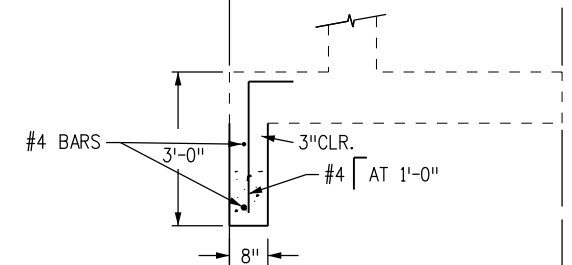
**PLAN**



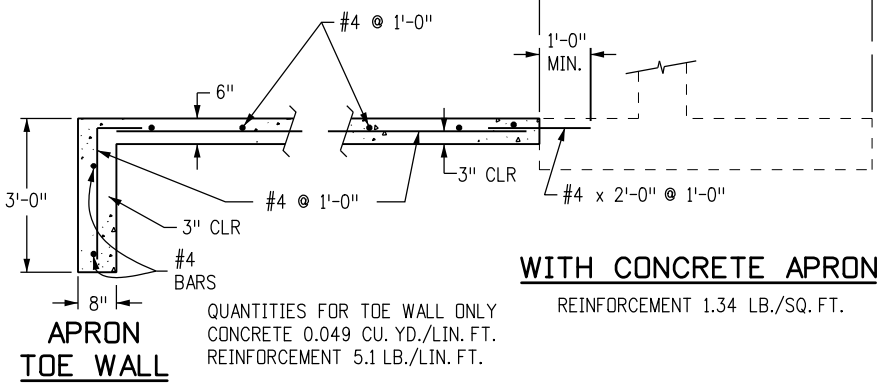
**ELEVATION DESIGN EXAMPLE**



**TYPICAL SECTION**

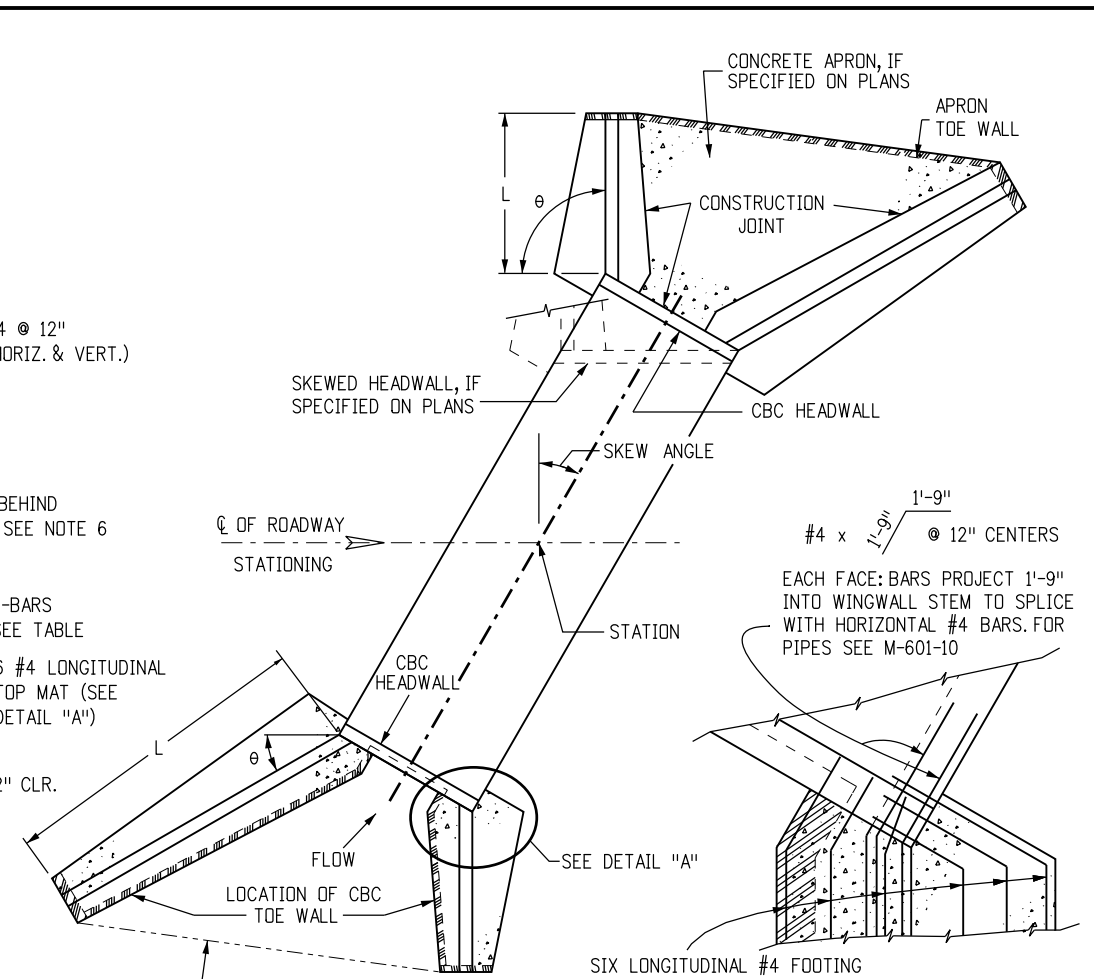


**WITH TOE WALL**



**WITH CONCRETE APRON**

QUANTITIES FOR TOE WALL ONLY  
CONCRETE 0.049 CU. YD./LIN. FT.  
REINFORCEMENT 5.1 LB./LIN. FT.



**TYPICAL CULVERT LAYOUT**

**DESIGN DATA:**

AASHTO LRFD EIGHTH EDITION, 2017  
DESIGN METHOD: LOAD AND RESISTANCE FACTOR DESIGN, YIELD LINE METHOD

REINFORCED CONCRETE:  
CONCRETE CLASS D (BOX CULVERT):  $f'_c = 4,500 \text{ PSI}$   
REINFORCING STEEL:  $f_y = 60,000 \text{ PSI}$

LOADING:  
AT-REST EARTH (FLUID) PRESSURE FOR CONCRETE STEM DESIGN = 55 PCF FOR 2 (MIN.):1 SLOPED BACKFILL  
ACTIVE EARTH (FLUID) PRESSURE FOR CONCRETE FOOTING DESIGN = 40 PCF FOR 2 (MIN.):1 SLOPED BACKFILL  
LIVE LOAD SURCHARGE = 2'  
MINIMUM RESISTANCE FOR SOIL BEARING = 5.5 KSF  
SOIL BEARING RESISTANCE FACTOR = 0.45

**GENERAL NOTES:**

- ALL EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED 3/4 IN.
- WINGWALL FOOTING AND FLOOR OF BOX CULVERT SHALL BE PLACED MONOLITHICALLY.
- DIMENSIONS "h", "k", "L", "m" AND ANGLE "θ" FOR WINGWALL SHALL BE AS SHOWN ON THE PLANS.
- MINIMUM CLASS B LAP SPLICE LENGTH FOR BLACK REINFORCING BARS:  
BAR SIZE: #4 #5 #6 #7  
SPLICE LENGTH: 1'-6" 1'-11" 2'-3" 2'-7"
- DESIGN DOES NOT CONSIDER ANY SCOUR EFFECTS.
- WINGWALL DRAIN SHALL BE REQUIRED IF "h" ≥ 12.0 FT., SEE SHEET 2 OF 2 FOR DETAILS.

**Computer File Information**

Creation Date: 07/31/19	(R-X)
Designer Initials: JBK	(R-X)
Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

**Sheet Revisions**

Date:	Comments

Colorado Department of Transportation  
2829 West Howard Place  
CDOT HQ, 3rd Floor  
Denver, CO 80204  
Phone: 303-757-9021 FAX: 303-757-9868  
Project Development Branch JBK

**WINGWALLS FOR PIPE OR BOX CULVERTS**  
Issued by the Project Development Branch: July 31, 2019

**STANDARD PLAN NO.**  
M-601-20  
Standard Sheet No. 1 of 2  
Project Sheet Number:

