



# Triple Reinforced Concrete Box Culvert Standards - Flared Wing Headwalls

General Notes:

- 1. The RCB culvert sections are designed for HL-93 live load and earth fills of varying heights.
- 2. Vertical earth pressure, EV=0.120 kcf.  
Horizontal earth pressure, EHmax = 0.060 kcf max, EHmin = 0.030 kcf.
- 3. The RCB culvert sections are designed for Class 1 exposure conditions except:  
Class 2 exposure condition is utilized for the slab design in 0' fill instances.
- 4. All slab and floor reinforcing steel is to be supported at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- 5. The clear distance from face of concrete to near edge or end of reinforcing bar to be 2" unless otherwise noted.
- 6. Except for dowel bars 5r1 in slab, longitudinal reinforcing is not to extend thru the construction joints.
- 7. Floor of barrel is to be finished smooth. Sides of footing are to be formed to ensure correct line and grade.
- 8. The permissible construction joint at the top of the walls may be lowered at the Contractor's option with Engineer's approval.
- 9. The reinforcement supplied for this structure shall be Grade 60 reinforcement in accordance with the Standard Specifications. The design stresses are based on ASTM A706 Grade 60 reinforcement.
- 10. The vertical bars in the walls may be spliced above the footing at the Contractor's option as follows:

|                       |     |     |     |     |     |     |
|-----------------------|-----|-----|-----|-----|-----|-----|
| Bar Size Number       | 4   | 5   | 6   | 7   | 8   | 9   |
| Minimum Splice Length | 20" | 24" | 29" | 34" | 38" | 47" |

- This splice, if used, will be at the Contractor's expense.
- 11. Reinforcing bar clearances will be as follows:  
Edge clearances: 2" except  
Top of floor 2¼" to near transverse reinforcing bar  
Bottom of floor 3½" to near transverse reinforcing bar  
End clearances:  
Vertical top 2"  
Vertical bottom 3" or 3½" if overall height of the culvert is not to a full inch  
Transverse 2"
  - 12. All construction joints shall be formed with a beveled keyway except at bell joints.
  - 13. All beveled keyways shall be centered.
  - 14. Keyway size shall be 2"x4" except as follows:  
Keyway between the floor and wall shall be 2"x6" when the wall is greater than 10 inches wide.
  - 15. Keyway dimensions shown on the plans are based on nominal dimensions unless stated otherwise. In addition, the bevel used on the keyway shall be limited to a maximum of 10 degrees from vertical.
  - 16. If 0' of fill is specified, details for paving notch and reference to epoxy coating of slab reinforcing steel, if applicable, shall be included in the final plans.
  - 17. All dimensions are in feet and inches unless otherwise noted or shown.
  - 18. Dimensions with parenthesis ( ) indicate a reference dimension.
  - 19. See current Standard Specifications regarding concrete form removal.
  - 20. These culvert standards label all reinforcing steel with English notation (5a1 is ⅝ inch diameter bar). English reinforcing steel received in the field may display the following "bar designation". The "bar designation" is the stamped impression on the reinforcing bars, and is equivalent to the bar diameter in millimeters.

|                 |    |    |    |    |    |    |
|-----------------|----|----|----|----|----|----|
| English Size    | 4  | 5  | 6  | 7  | 8  | 9  |
| Bar Designation | 13 | 16 | 19 | 22 | 25 | 29 |

- 21. In the event the slab thickness at the barrel end section exceeds 18 inches, the culvert parapet shall extend a minimum of 6 inches above the top of the culvert slab. Refer to the Culvert Design Manual for instructions. These details are to be included in the design plans to address these situations.
- 22. For barrel details used in conjunction with these flared wing headwall standards, see the Triple Reinforced Concrete Box Culvert Standards (TRRCB).

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Specifications:

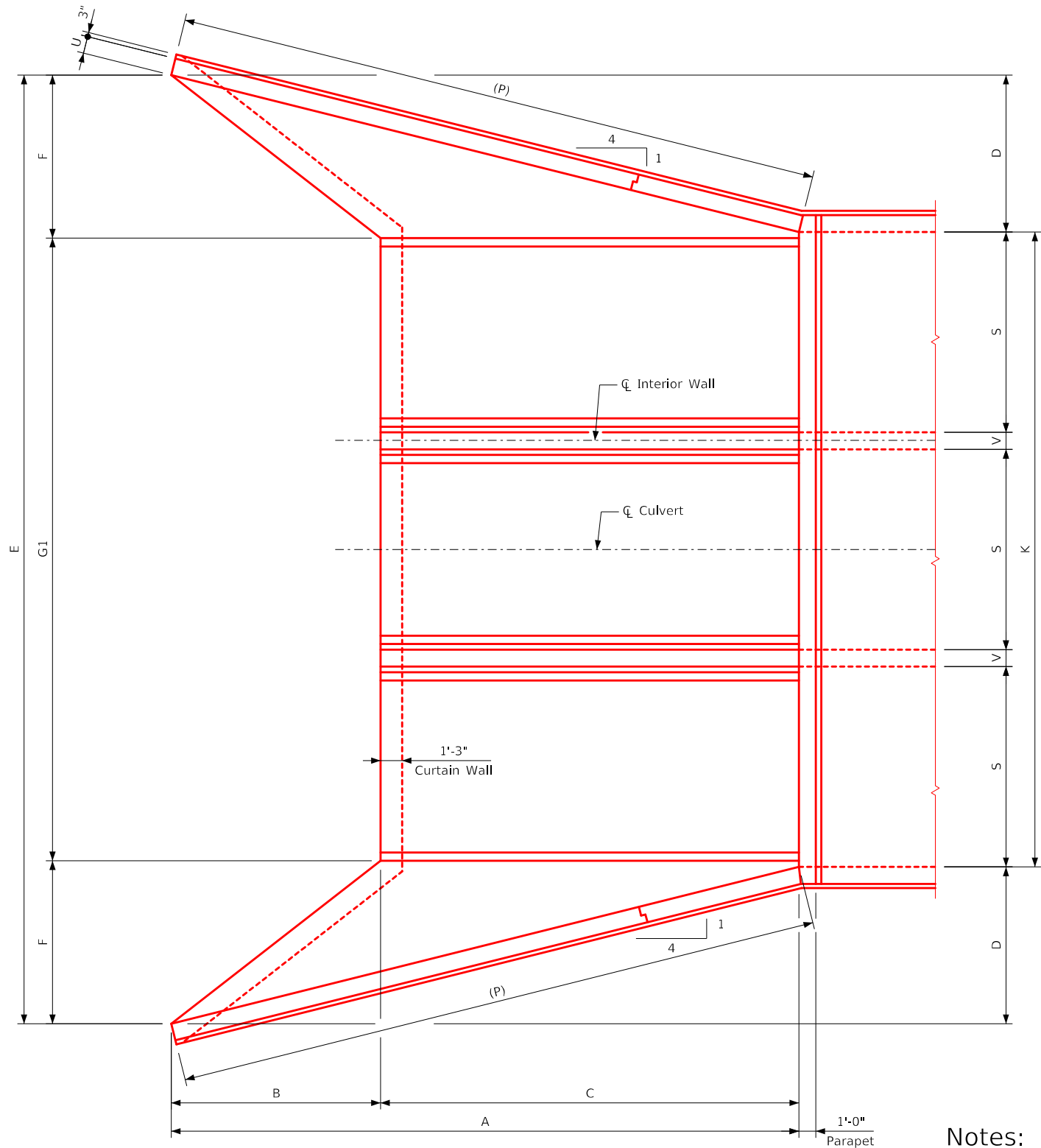
Design:  
AASHTO LRFD Bridge Design Specifications, 8th Ed., Series of 2017.

Construction:  
Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction, current series, plus applicable General Supplemental Specifications, Developmental Specifications, Supplemental Specifications and Special Provisions

Design Stresses:

Design stresses for the following materials are in accordance with the AASHTO LRFD Bridge Design Specifications, 8th Ed., Series of 2017:  
Reinforcing steel in accordance with AASHTO LRFD Section 5, Grade 60.  
Concrete in accordance with AASHTO LRFD Section 5, f'c = 4.0 ksi.

|                      |                                                                                                                      |                                                                                                                                                    |             |
|----------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| LATEST REVISION DATE | <br>APPROVED BY BRIDGE ENGINEER | <br>Standard Design - Triple Reinforced Concrete Box Culverts |             |
|                      |                                                                                                                      | Flared Wing Headwalls<br>February, 2021                                                                                                            |             |
|                      |                                                                                                                      | Index of Sheets, General Notes & Specifications                                                                                                    | TRFWH G1-21 |



Plan View

- Notes:
1. See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
  2. See Sheet TRFWH 0-2-21 thru TRFWH 0-4-21 for location of certain dimensions tabulated.
  3. Dimensions are in feet and inches unless otherwise noted.

| Dimension Table |                     |                     |                      |                      |                     |                      |                     |                     |                     |       |
|-----------------|---------------------|---------------------|----------------------|----------------------|---------------------|----------------------|---------------------|---------------------|---------------------|-------|
| S x H           | 12' x 12'           | 12' x 11'           | 12' x 10'            | 12' x 9'             | 12' x 8'            | 12' x 7'             | 12' x 6'            | 12' x 5'            | 12' x 4'            | S x H |
| A               | 37'-0               | 34'-0               | 31'-0                | 28'-0                | 25'-0               | 22'-0                | 19'-0               | 16'-0               | 13'-0               | A     |
| B               | 12'-4               | 11'-4               | 10'-4                | 9'-4                 | 8'-4                | 7'-4                 | 6'-4                | 5'-4                | 4'-4                | B     |
| C               | 24'-8               | 22'-8               | 20'-8                | 18'-8                | 16'-8               | 14'-8                | 12'-8               | 10'-8               | 8'-8                | C     |
| D               | 9'-3                | 8'-6                | 7'-9                 | 7'-0                 | 6'-3                | 5'-6                 | 4'-9                | 4'-0                | 3'-3                | D     |
| E               | 56'-6               | 54'-10              | 53'-2                | 51'-8                | 50'-2               | 48'-6                | 47'-0               | 45'-6               | 44'-0               | E     |
| F               | 9'-7                | 8'-10               | 8'-1                 | 7'-4                 | 6'-7                | 5'-10                | 5'-1                | 4'-4                | 3'-7                | F     |
| G1              | 37'-4               | 37'-2               | 37'-0                | 37'-0                | 37'-0               | 36'-10               | 36'-10              | 36'-10              | 36'-10              | G1    |
| G2              | 38'-6 $\frac{3}{8}$ | 38'-4 $\frac{3}{8}$ | 38'-2 $\frac{3}{8}$  | 38'-2 $\frac{3}{8}$  | 38'-2 $\frac{1}{2}$ | 38'-0 $\frac{1}{2}$  | 38'-0 $\frac{3}{4}$ | 38'-0 $\frac{1}{2}$ | 38'-0 $\frac{1}{8}$ | G2    |
| G3              | 15'-7 $\frac{3}{8}$ | 14'-4 $\frac{3}{8}$ | 13'-1 $\frac{3}{8}$  | 11'-10 $\frac{3}{8}$ | 10'-7 $\frac{1}{2}$ | 9'-4 $\frac{1}{2}$   | 8'-1 $\frac{1}{2}$  | 6'-10 $\frac{1}{2}$ | 5'-7 $\frac{1}{2}$  | G3    |
| G4              | 16'-5 $\frac{3}{8}$ | 15'-0 $\frac{1}{2}$ | 13'-7                | 12'-4                | 11'-1 $\frac{1}{8}$ | 9'-7 $\frac{3}{4}$   | 8'-4 $\frac{3}{4}$  | 7'-1 $\frac{1}{8}$  | 5'-11               | G4    |
| G5              | 3 $\frac{3}{8}$     | 5 $\frac{3}{8}$     | 7 $\frac{3}{8}$      | 7 $\frac{3}{8}$      | 7 $\frac{3}{8}$     | 9 $\frac{3}{8}$      | 9 $\frac{3}{4}$     | 9 $\frac{3}{4}$     | 9 $\frac{3}{8}$     | G5    |
| K               | 38'-0               | 37'-10              | 37'-8                | 37'-8                | 37'-8               | 37'-6                | 37'-6               | 37'-6               | 37'-6               | K     |
| P               | 38'-1 $\frac{1}{8}$ | 35'-0 $\frac{1}{2}$ | 31'-11 $\frac{1}{2}$ | 28'-10 $\frac{3}{8}$ | 25'-9 $\frac{1}{4}$ | 22'-8 $\frac{3}{8}$  | 19'-7               | 16'-5 $\frac{3}{8}$ | 13'-4 $\frac{3}{4}$ | P     |
| R1              | 40'-1               | 36'-10              | 33'-7                | 30'-4                | 27'-1               | 23'-10               | 20'-7               | 17'-4               | 14'-1               | R1    |
| R2              | 27'-0 $\frac{3}{8}$ | 24'-9 $\frac{1}{4}$ | 22'-6 $\frac{1}{2}$  | 20'-3 $\frac{3}{4}$  | 18'-0 $\frac{3}{8}$ | 15'-10 $\frac{3}{8}$ | 13'-7 $\frac{3}{8}$ | 11'-4 $\frac{3}{4}$ | 9'-2                | R2    |
| T               | 1'-2                | 1'-2                | 1'-2                 | 1'-2                 | 1'-2                | 1'-2                 | 1'-2                | 1'-2                | 1'-2                | T     |
| U               | 1'-0                | 11                  | 10                   | 10                   | 10                  | 9                    | 9                   | 9                   | 9                   | U     |
| V               | 1'-0                | 11                  | 10                   | 10                   | 10                  | 9                    | 9                   | 9                   | 9                   | V     |
| W               | 5'-0                | 4'-9                | 4'-6                 | 4'-3                 | 4'-0                | 3'-9                 | 3'-6                | 3'-6                | 3'-6                | W     |

| Dimension Table |                     |                     |                      |                      |                     |                      |                     |                     |                     |       |
|-----------------|---------------------|---------------------|----------------------|----------------------|---------------------|----------------------|---------------------|---------------------|---------------------|-------|
| S x H           | 10' x 12'           | 10' x 11'           | 10' x 10'            | 10' x 9'             | 10' x 8'            | 10' x 7'             | 10' x 6'            | 10' x 5'            | 10' x 4'            | S x H |
| A               | 37'-0               | 34'-0               | 31'-0                | 28'-0                | 25'-0               | 22'-0                | 19'-0               | 16'-0               | 13'-0               | A     |
| B               | 12'-4               | 11'-4               | 10'-4                | 9'-4                 | 8'-4                | 7'-4                 | 6'-4                | 5'-4                | 4'-4                | B     |
| C               | 24'-8               | 22'-8               | 20'-8                | 18'-8                | 16'-8               | 14'-8                | 12'-8               | 10'-8               | 8'-8                | C     |
| D               | 9'-3                | 8'-6                | 7'-9                 | 7'-0                 | 6'-3                | 5'-6                 | 4'-9                | 4'-0                | 3'-3                | D     |
| E               | 50'-6               | 48'-10              | 47'-2                | 45'-8                | 44'-2               | 42'-6                | 41'-0               | 39'-6               | 38'-0               | E     |
| F               | 9'-7                | 8'-10               | 8'-1                 | 7'-4                 | 6'-7                | 5'-10                | 5'-1                | 4'-4                | 3'-7                | F     |
| G1              | 31'-4               | 31'-2               | 31'-0                | 31'-0                | 31'-0               | 30'-10               | 30'-10              | 30'-10              | 30'-10              | G1    |
| G2              | 32'-6 $\frac{3}{8}$ | 32'-4 $\frac{3}{8}$ | 32'-2 $\frac{3}{8}$  | 32'-2 $\frac{3}{8}$  | 32'-2 $\frac{1}{2}$ | 32'-0 $\frac{1}{2}$  | 32'-0 $\frac{3}{8}$ | 32'-0 $\frac{1}{4}$ | 32'-0 $\frac{1}{8}$ | G2    |
| G3              | 15'-7 $\frac{3}{8}$ | 14'-4 $\frac{3}{8}$ | 13'-1 $\frac{3}{8}$  | 11'-10 $\frac{3}{8}$ | 10'-7 $\frac{1}{2}$ | 9'-4 $\frac{1}{2}$   | 8'-1 $\frac{1}{2}$  | 6'-10 $\frac{1}{2}$ | 5'-7 $\frac{1}{2}$  | G3    |
| G4              | 16'-5 $\frac{3}{8}$ | 15'-0 $\frac{1}{2}$ | 13'-7                | 12'-4                | 11'-1 $\frac{1}{8}$ | 9'-7 $\frac{3}{4}$   | 8'-4 $\frac{3}{4}$  | 7'-1 $\frac{1}{8}$  | 5'-11               | G4    |
| G5              | 3 $\frac{3}{8}$     | 5 $\frac{3}{8}$     | 7 $\frac{3}{8}$      | 7 $\frac{3}{8}$      | 7 $\frac{3}{8}$     | 9 $\frac{3}{8}$      | 9 $\frac{3}{4}$     | 9 $\frac{3}{4}$     | 9 $\frac{3}{8}$     | G5    |
| K               | 32'-0               | 31'-10              | 31'-8                | 31'-8                | 31'-8               | 31'-6                | 31'-6               | 31'-6               | 31'-6               | K     |
| P               | 38'-1 $\frac{1}{8}$ | 35'-0 $\frac{1}{2}$ | 31'-11 $\frac{1}{2}$ | 28'-10 $\frac{3}{8}$ | 25'-9 $\frac{1}{4}$ | 22'-8 $\frac{3}{8}$  | 19'-7               | 16'-5 $\frac{3}{8}$ | 13'-4 $\frac{3}{4}$ | P     |
| R1              | 40'-1               | 36'-10              | 33'-7                | 30'-4                | 27'-1               | 23'-10               | 20'-7               | 17'-4               | 14'-1               | R1    |
| R2              | 27'-0 $\frac{3}{8}$ | 24'-9 $\frac{1}{4}$ | 22'-6 $\frac{1}{2}$  | 20'-3 $\frac{3}{4}$  | 18'-0 $\frac{3}{8}$ | 15'-10 $\frac{3}{8}$ | 13'-7 $\frac{3}{8}$ | 11'-4 $\frac{3}{4}$ | 9'-2                | R2    |
| T               | 1'-1                | 1'-1                | 1'-1                 | 1'-1                 | 1'-1                | 1'-1                 | 1'-1                | 1'-1                | 1'-1                | T     |
| U               | 1'-0                | 11                  | 10                   | 10                   | 10                  | 9                    | 9                   | 9                   | 9                   | U     |
| V               | 1'-0                | 11                  | 10                   | 10                   | 10                  | 9                    | 9                   | 9                   | 9                   | V     |
| W               | 5'-0                | 4'-9                | 4'-6                 | 4'-3                 | 4'-0                | 3'-9                 | 3'-6                | 3'-6                | 3'-6                | W     |

LATEST REVISION DATE

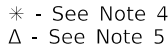
  
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Standard Design - Triple Reinforced Concrete Box Culverts

Flared Wing Headwalls  
February, 2021

Dimension Plan & Table  
0° Skew

TRFWH  
0-1-21

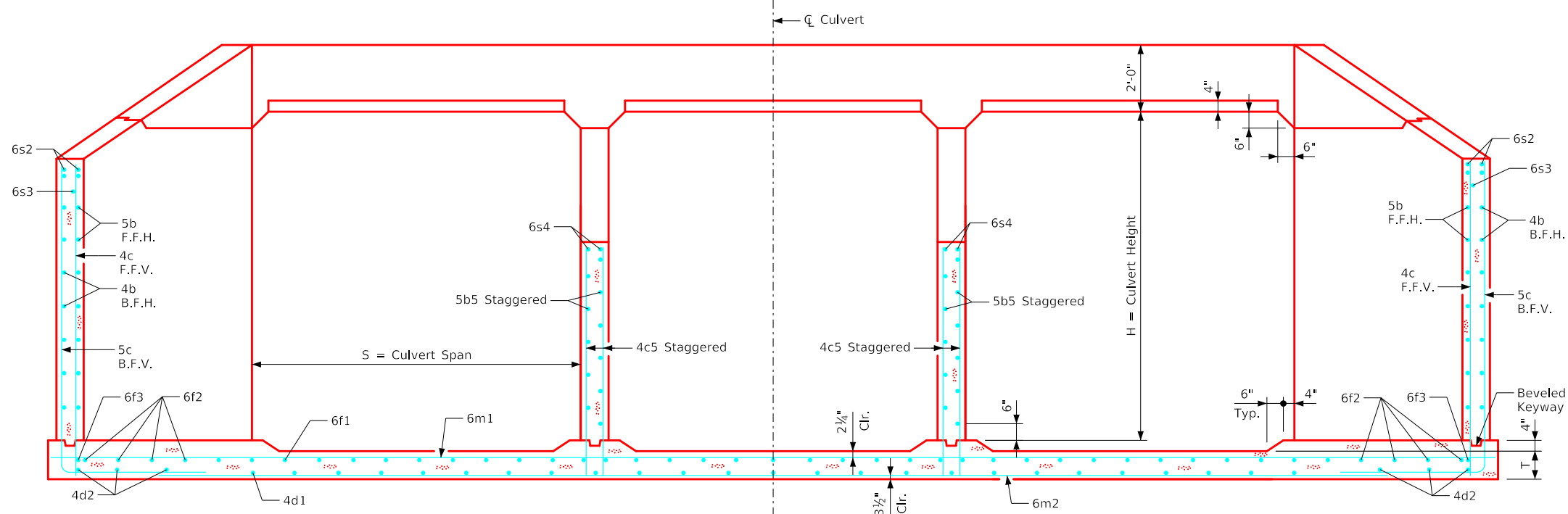


### Plan View - Top & Bottom of Apron Reinforcing

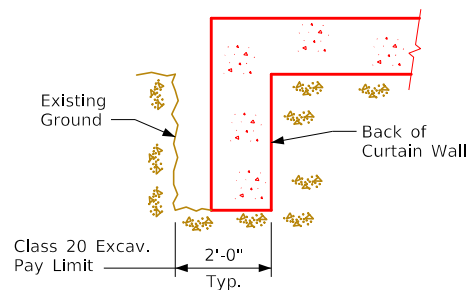
1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Wingwall bars consistently referenced from end of wing for all headwalls.
3. Top transverse floor bars are referenced approximately 4" from the back of the parapet for all headwalls.
4. There are no 5c8 bars in the 4' & 5' height headwalls.
5. 4c2 bars used only in the 9', 10', 11' & 12' height headwalls.
6. For dimension table see Sheet TRFWH 0-1-21.
7. For reinforcing in curtain wall see Curtain Wall Details on Sheet TRFWH 0-3-21.

|                                                                                                                                                  |                                                                                                                                                                               |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| LATEST REVISION DATE<br><br><br>APPROVED BY BRIDGE ENGINEER |                                                                                          |                 |
|                                                                                                                                                  | Standard Design - Triple Reinforced Concrete Box Culverts<br><br><h2 style="text-align: center;">Flared Wing Headwalls</h2> <p style="text-align: center;">February, 2021</p> |                 |
|                                                                                                                                                  | Apron Details<br>0° Skew                                                                                                                                                      | TRFWH<br>0-2-21 |

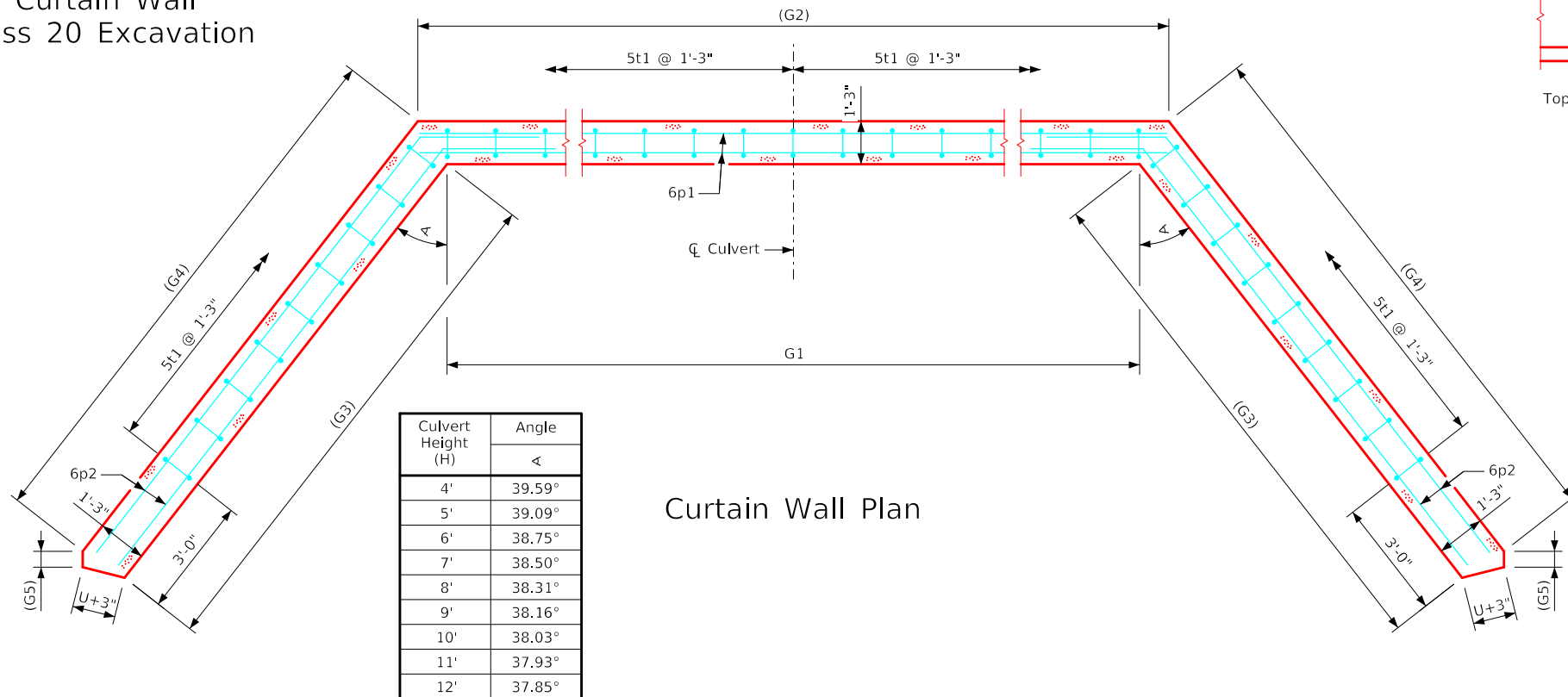
ENGLISHLRFDDESIGNEDTRIPLECULVERTSFHW.DGN - TRFWH 0-3-21 - THIS SHEET ISSUED 02-2021.



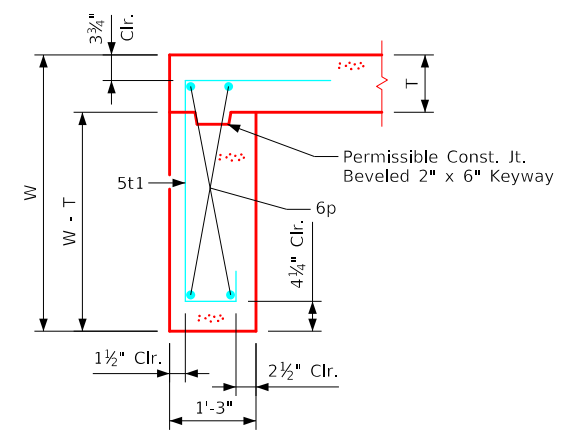
Typical Section - Near Center of Apron



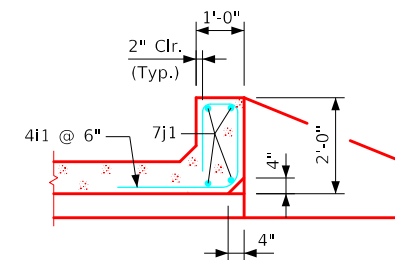
Curtain Wall  
Class 20 Excavation



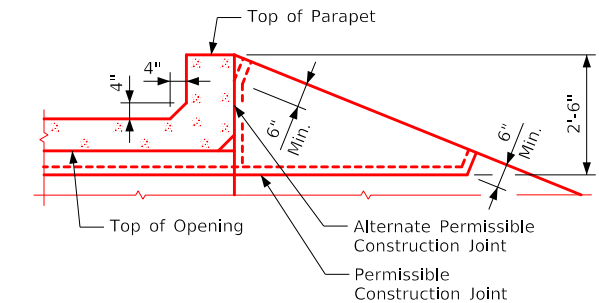
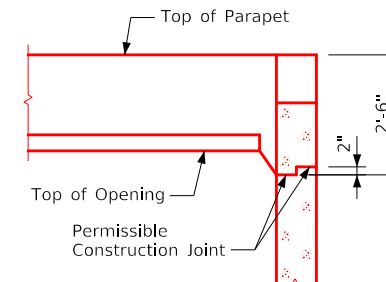
Curtain Wall Plan



Section thru Curtain Wall



Section thru Parapet



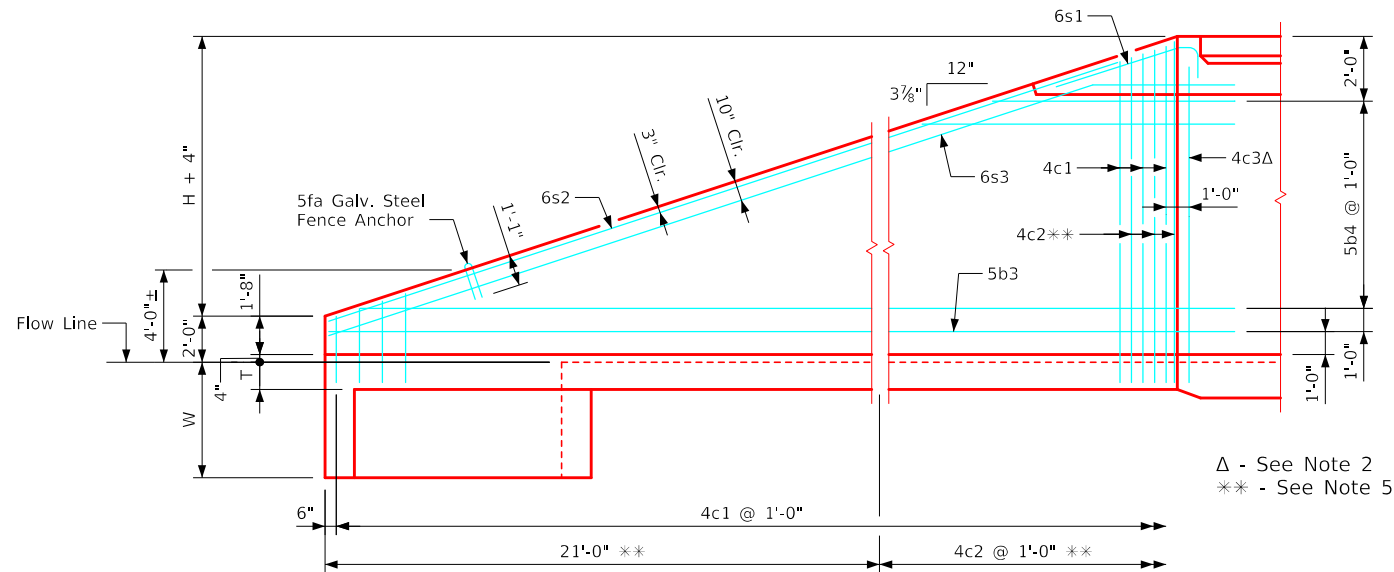
Top of Wingwall Details

Notes:

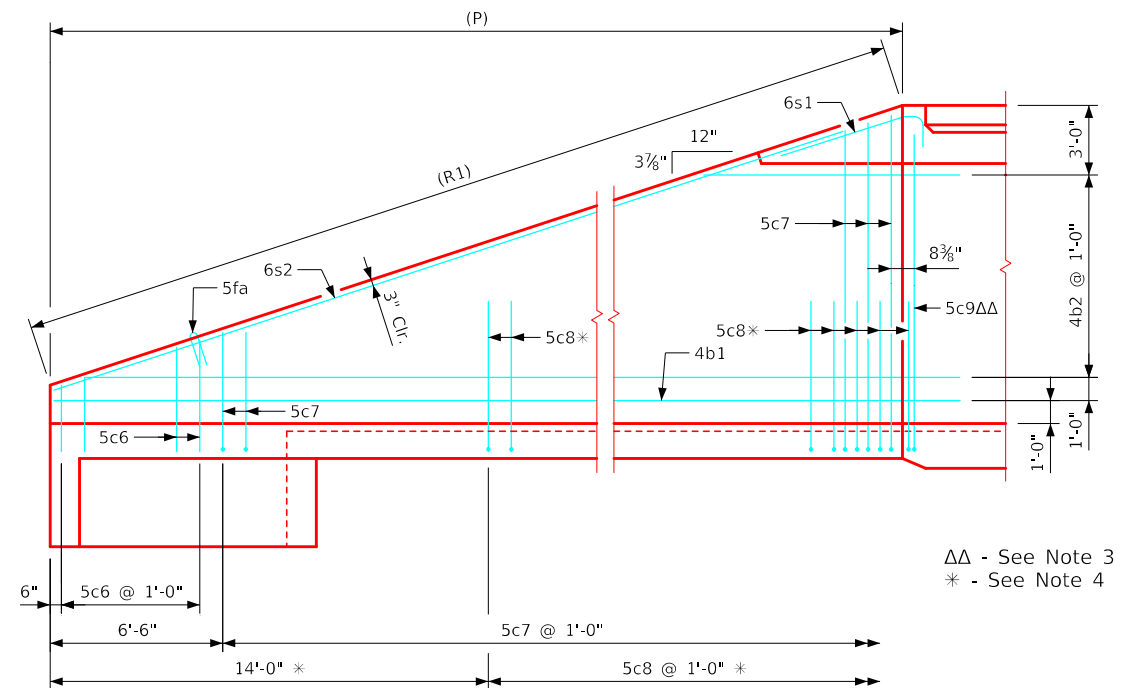
1. See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. For dimension table see Sheet TRFWH 0-1-21.

|                      |                                                                                                                      |                                                                                       |                 |
|----------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-----------------|
| LATEST REVISION DATE | <br>APPROVED BY BRIDGE ENGINEER |  |                 |
|                      |                                                                                                                      | Standard Design - Triple Reinforced Concrete Box Culverts                             |                 |
|                      |                                                                                                                      | Flared Wing Headwalls                                                                 |                 |
|                      |                                                                                                                      | February, 2021                                                                        |                 |
|                      |                                                                                                                      | Parapet & Curtain<br>Wall Details<br>0° Skew                                          | TRFWH<br>0-3-21 |

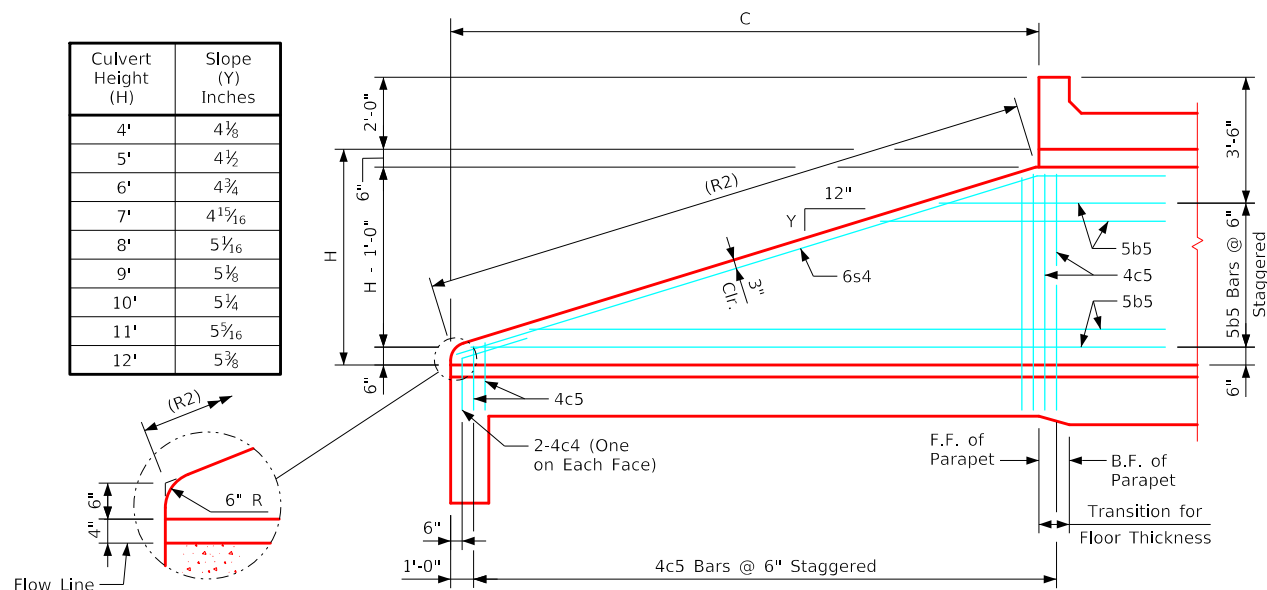
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Typical View - Front Face Wingwall Reinforcing



Typical View - Back Face Wingwall Reinforcing



Typical View - Interior Wall

#### Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Two 4c3 bars for 4', 5', 11' & 12' height headwalls. One 4c3 bar for 6' thru 10' height headwalls.
3. Two 5c9 bars for 4', 5', 11' & 12' headwalls. One 5c9 bar for 6' thru 10' height headalls.
4. Not applicable for 4' & 5' height headwalls.
5. Not applicable for 4' thru 8' height headwalls.
6. For dimension table, see sheet TRFWH 0-1-21.
7. Top of wall slope may be rounded in some instances.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER

**IOWA DOT** Highway Division

Standard Design - Triple Reinforced Concrete Box Culverts

Flared Wing Headwalls

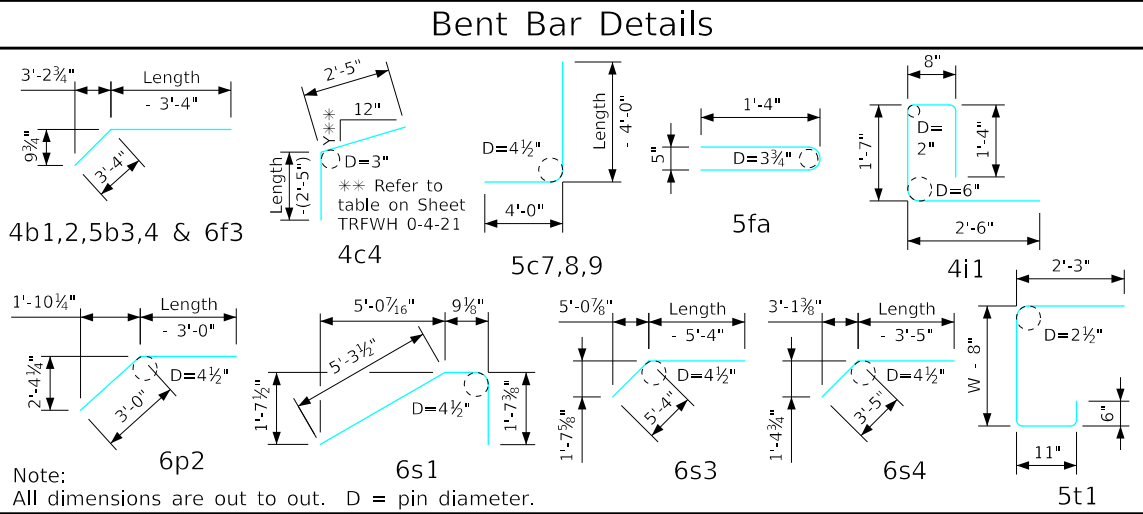
February, 2021

Wingwall Details  
0° Skew

TRFWH  
0-4-21

ENGLISHLRFDDESIGNEDTRIPLECULVERTSFHW.DGN - TRFWH 0-5-21 S1 - THIS SHEET ISSUED 02-2021.

| Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height |                                         |              |           |                              |          |           |                              |      |           |                              |      |          |                              |      |          |                              |      |          |                              |      |     |
|--------------------------------------------------------------------|-----------------------------------------|--------------|-----------|------------------------------|----------|-----------|------------------------------|------|-----------|------------------------------|------|----------|------------------------------|------|----------|------------------------------|------|----------|------------------------------|------|-----|
| Bar                                                                | Location                                | Shape        | 12' x 12' |                              |          | 12' x 11' |                              |      | 12' x 10' |                              |      | 12' x 9' |                              |      | 12' x 8' |                              |      | 12' x 7' |                              |      | Bar |
|                                                                    |                                         |              | No.       | Length                       | Wt.      | No.       | Length                       | Wt.  | No.       | Length                       | Wt.  | No.      | Length                       | Wt.  | No.      | Length                       | Wt.  | No.      | Length                       | Wt.  |     |
| 5fa                                                                | Fence Anchor (Galv.)                    |              | 2         | 2'-10                        | 6        | 2         | 2'-10                        | 6    | 2         | 2'-10                        | 6    | 2        | 2'-10                        | 6    | 2        | 2'-10                        | 6    | 2        | 2'-10                        | 6    | 5fa |
| 4b1                                                                | Wingwall, B.F.H.                        |              | 2         | 41'-2                        | 58       | 2         | 38'-1                        | 51   | 2         | 35'-0                        | 47   | 2        | 31'-11                       | 43   | 2        | 28'-10                       | 39   | 2        | 25'-9                        | 34   | 4b1 |
| 4b2                                                                | Wingwall, B.F.H.                        |              | 20 Var.   | 2 Each<br>11'-11 to<br>39'-9 | 345      | 18 Var.   | 2 Each<br>11'-11 to<br>36'-8 | 292  | 16 Var.   | 2 Each<br>11'-11 to<br>33'-7 | 243  | 14 Var.  | 2 Each<br>11'-11 to<br>30'-6 | 198  | 12 Var.  | 2 Each<br>11'-11 to<br>27'-5 | 158  | 10 Var.  | 2 Each<br>11'-11 to<br>24'-4 | 121  | 4b2 |
| 5b3                                                                | Wingwall, F.F.H.                        |              | 2         | 41'-3                        | 91       | 2         | 38'-2                        | 80   | 2         | 35'-1                        | 73   | 2        | 32'-0                        | 67   | 2        | 28'-11                       | 60   | 2        | 25'-9                        | 54   | 5b3 |
| 5b4                                                                | Wingwall, F.F.H.                        |              | 22 Var.   | 2 Each<br>8'-10 to<br>39'-10 | 558      | 20 Var.   | 2 Each<br>8'-10 to<br>36'-9  | 475  | 18 Var.   | 2 Each<br>8'-11 to<br>33'-8  | 400  | 16 Var.  | 2 Each<br>8'-11 to<br>30'-7  | 330  | 14 Var.  | 2 Each<br>8'-11 to<br>27'-6  | 266  | 12 Var.  | 2 Each<br>8'-11 to<br>24'-4  | 208  | 5b4 |
| 5b5                                                                | Interior Wall, Both F.H.                |              | 42 Var.   | 2 Each<br>5'-2 to<br>27'-8   | 719      | 38 Var.   | 2 Each<br>5'-3 to<br>25'-8   | 613  | 34 Var.   | 2 Each<br>5'-3 to<br>23'-7   | 511  | 30 Var.  | 2 Each<br>5'-3 to<br>21'-7   | 420  | 26 Var.  | 2 Each<br>5'-4 to<br>19'-7   | 338  | 22 Var.  | 2 Each<br>5'-5 to<br>17'-7   | 264  | 5b5 |
| 4c1                                                                | Wingwall, F.F.V.                        |              | 76 Var.   | 2 Each<br>2'-10 to<br>14'-10 | 448      | 70 Var.   | 2 Each<br>2'-10 to<br>13'-10 | 390  | 64 Var.   | 2 Each<br>2'-10 to<br>12'-11 | 337  | 58 Var.  | 2 Each<br>2'-10 to<br>11'-11 | 286  | 52 Var.  | 2 Each<br>2'-10 to<br>10'-11 | 239  | 46 Var.  | 2 Each<br>2'-10 to<br>10'-0  | 197  | 4c1 |
| 4c2                                                                | Wingwall, F.F.V.                        |              | 36 Var.   | 2 Each<br>9'-6 to<br>15'-0   | 295      | 30 Var.   | 2 Each<br>9'-6 to<br>14'-0   | 235  | 24 Var.   | 2 Each<br>9'-6 to<br>13'-1   | 181  | 18 Var.  | 2 Each<br>9'-6 to<br>12'-1   | 130  | --       | --                           | --   | --       | --                           | --   | 4c2 |
| 4c3                                                                | Wingwall, F.F.V.                        |              | 4         | 13'-9                        | 37       | 4         | 12'-9                        | 34   | 2         | 11'-9                        | 16   | 2        | 10'-9                        | 14   | 2        | 9'-9                         | 13   | 2        | 8'-9                         | 12   | 4c3 |
| 4c4                                                                | Interior Wall, Both F.V.                |              | 4         | 4'-2                         | 11       | 4         | 4'-2                         | 11   | 4         | 4'-2                         | 11   | 4        | 4'-2                         | 11   | 4        | 4'-2                         | 11   | 4        | 4'-2                         | 11   | 4c4 |
| 4c5                                                                | Interior Wall, Both F.V.                |              | 100 Var.  | 2 Each<br>2'-0 to<br>12'-11  | 498      | 92 Var.   | 2 Each<br>2'-0 to<br>11'-11  | 428  | 84 Var.   | 2 Each<br>2'-0 to<br>10'-11  | 362  | 76 Var.  | 2 Each<br>1'-11 to<br>9'-11  | 300  | 68 Var.  | 2 Each<br>1'-11 to<br>8'-11  | 246  | 60 Var.  | 2 Each<br>1'-11 to<br>7'-10  | 195  | 4c5 |
| 5c6                                                                | Wingwall, B.F.V.                        |              | 12 Var.   | 2 Each<br>2'-10 to<br>4'-6   | 46       | 12 Var.   | 2 Each<br>2'-10 to<br>4'-6   | 46   | 12 Var.   | 2 Each<br>2'-10 to<br>4'-6   | 46   | 12 Var.  | 2 Each<br>2'-10 to<br>4'-6   | 46   | 12 Var.  | 2 Each<br>2'-10 to<br>4'-6   | 46   | 12 Var.  | 2 Each<br>2'-10 to<br>4'-6   | 46   | 5c6 |
| 5c7                                                                | Wingwall, B.F.V.                        |              | 64 Var.   | 2 Each<br>8'-10 to<br>18'-10 | 923      | 58 Var.   | 2 Each<br>8'-10 to<br>17'-10 | 807  | 52 Var.   | 2 Each<br>8'-10 to<br>16'-11 | 698  | 46 Var.  | 2 Each<br>8'-10 to<br>15'-11 | 594  | 40 Var.  | 2 Each<br>8'-10 to<br>14'-11 | 495  | 34 Var.  | 2 Each<br>8'-10 to<br>14'-0  | 405  | 5c7 |
| 5c8                                                                | Wingwall, B.F.V.                        |              | 50        | 10'-6                        | 548      | 44        | 10'-6                        | 482  | 38        | 10'-6                        | 416  | 32       | 10'-6                        | 350  | 26       | 10'-6                        | 285  | 20       | 10'-6                        | 219  | 5c8 |
| 5c9                                                                | Wingwall, B.F.V.                        |              | 4         | 17'-9                        | 74       | 4         | 16'-9                        | 70   | 2         | 15'-9                        | 33   | 2        | 14'-9                        | 31   | 2        | 13'-9                        | 29   | 2        | 12'-9                        | 27   | 5c9 |
| 4d1                                                                | Apron, Longit., Bott.                   |              | 25        | 27'-11                       | 466      | 25        | 25'-11                       | 433  | 25        | 23'-11                       | 399  | 25       | 21'-11                       | 366  | 25       | 19'-11                       | 333  | 25       | 17'-11                       | 299  | 4d1 |
| 4d2                                                                | Apron, Longit., Bott.                   |              | 6         | 36'-3                        | 145      | 6         | 33'-2                        | 133  | 6         | 30'-1                        | 121  | 6        | 27'-0                        | 108  | 6        | 23'-11                       | 96   | 6        | 20'-10                       | 84   | 4d2 |
| 6f1                                                                | Apron, Longit., Top                     |              | 37        | 27'-11                       | 1551     | 37        | 25'-11                       | 1440 | 37        | 23'-11                       | 1329 | 37       | 21'-11                       | 1218 | 37       | 19'-11                       | 1107 | 37       | 17'-11                       | 996  | 6f1 |
| 6f2                                                                | Apron, Longit., Top                     |              | 16 Var.   | 2 Each<br>5'-10 to<br>24'-10 | 368      | 16 Var.   | 2 Each<br>3'-10 to<br>22'-10 | 320  | 14 Var.   | 2 Each<br>4'-6 to<br>20'-10  | 266  | 12 Var.  | 2 Each<br>5'-3 to<br>18'-10  | 217  | 10 Var.  | 2 Each<br>5'-11 to<br>16'-10 | 171  | 10 Var.  | 2 Each<br>3'-11 to<br>14'-10 | 141  | 6f2 |
| 6f3                                                                | Apron, Longit., Top                     |              | 2         | 41'-3                        | 131      | 2         | 38'-2                        | 115  | 2         | 35'-1                        | 105  | 2        | 32'-0                        | 96   | 2        | 28'-11                       | 87   | 2        | 25'-9                        | 77   | 6f3 |
| 4i1                                                                | Parapet, Vertical                       |              | 77        | 6'-1                         | 313      | 75        | 6'-1                         | 305  | 75        | 6'-1                         | 305  | 75       | 6'-1                         | 305  | 75       | 6'-1                         | 305  | 75       | 6'-1                         | 305  | 4i1 |
| 7j1                                                                | Parapet, Horizontal                     |              | 4         | 39'-8                        | 324      | 4         | 39'-4                        | 322  | 4         | 39'-0                        | 319  | 4        | 39'-0                        | 319  | 4        | 39'-0                        | 319  | 4        | 38'-8                        | 316  | 7j1 |
| 6m1                                                                | Apron, Trans., Top                      |              | 34 Var.   | 39'-10 to 52'-3              | 2471     | 31 Var.   | 39'-6 to 50'-9               | 2206 | 29 Var.   | 39'-2 to 49'-8               | 2029 | 26 Var.  | 39'-2 to 48'-7               | 1797 | 23 Var.  | 39'-2 to 47'-5               | 1568 | 21 Var.  | 38'-10 to 46'-4              | 1405 | 6m1 |
| 6m2                                                                | Apron, Trans., Bott.                    |              | 24 Var.   | 33'-9 to 45'-3               | 1464     | 22 Var.   | 33'-7 to 44'-1               | 1316 | 20 Var.   | 33'-5 to 42'-11              | 1168 | 18 Var.  | 33'-5 to 41'-11              | 1033 | 16 Var.  | 33'-5 to 40'-11              | 900  | 14 Var.  | 33'-3 to 39'-9               | 768  | 6m2 |
| 6p1                                                                | Curtain, Horizontal                     |              | 4         | 38'-3                        | 230      | 4         | 38'-1                        | 229  | 4         | 37'-11                       | 228  | 4        | 37'-11                       | 228  | 4        | 37'-11                       | 228  | 4        | 37'-9                        | 227  | 6p1 |
| 6p2                                                                | Curtain, Horizontal                     |              | 8         | 18'-7                        | 223      | 8         | 17'-4                        | 208  | 8         | 16'-1                        | 193  | 8        | 14'-10                       | 178  | 8        | 13'-7                        | 163  | 8        | 12'-4                        | 148  | 6p2 |
| 6s1                                                                | Wing Slope, Both F.                     |              | 4         | 7'-8                         | 46       | 4         | 7'-8                         | 46   | 4         | 7'-8                         | 46   | 4        | 7'-8                         | 46   | 4        | 7'-8                         | 46   | 4        | 7'-8                         | 46   | 6s1 |
| 6s2                                                                | Wing Slope, Both F.                     |              | 4         | 37'-1                        | 223      | 4         | 33'-10                       | 203  | 4         | 30'-7                        | 184  | 4        | 27'-4                        | 164  | 4        | 24'-1                        | 145  | 4        | 20'-10                       | 125  | 6s2 |
| 6s3                                                                | Wing Slope, F.F.                        |              | 2         | 43'-2                        | 137      | 2         | 39'-11                       | 120  | 2         | 36'-8                        | 110  | 2        | 33'-5                        | 100  | 2        | 30'-2                        | 91   | 2        | 26'-11                       | 81   | 6s3 |
| 6s4                                                                | Interior Wall, Both F.                  |              | 4         | 30'-3                        | 182      | 4         | 28'-0                        | 168  | 4         | 25'-9                        | 155  | 4        | 23'-6                        | 141  | 4        | 21'-4                        | 128  | 4        | 19'-1                        | 115  | 6s4 |
| 5t1                                                                | Curtain, Vertical                       |              | 51        | 8'-0                         | 426      | 49        | 7'-9                         | 396  | 47        | 7'-6                         | 368  | 45       | 7'-3                         | 340  | 43       | 7'-0                         | 314  | 41       | 6'-9                         | 289  | 5t1 |
|                                                                    | Estimated<br>Quantities<br>One Headwall | Reinf. Steel | 13,357 LB |                              |          | 11,980 LB |                              |      | 10,705 LB |                              |      | 9482 LB  |                              |      | 8232 LB  |                              |      | 7221 LB  |                              |      |     |
|                                                                    |                                         |              | Parapet Δ | 3.8                          |          | 3.7       |                              |      | 3.6       |                              |      | 3.6      |                              |      | 3.6      |                              |      | 3.5      |                              |      |     |
|                                                                    |                                         | Concrete     | Wingwalls | 34.0                         | 112.5 CY | 26.5      | 97.2 CY                      |      | 20.4      | 83.7 CY                      |      | 16.9     | 73.7 CY                      |      | 13.7     | 63.1 CY                      |      | 9.7      | 53.6 CY                      |      |     |
|                                                                    |                                         |              | Apron *   | 74.7                         |          | 67.0      |                              |      | 59.7      |                              |      | 53.2     |                              |      | 45.8     |                              |      | 40.4     |                              |      |     |
|                                                                    |                                         |              |           |                              |          |           |                              |      |           |                              |      |          |                              |      |          |                              |      |          |                              |      |     |



### Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1" and "6f3" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

Δ Includes top of wingwall quantities.

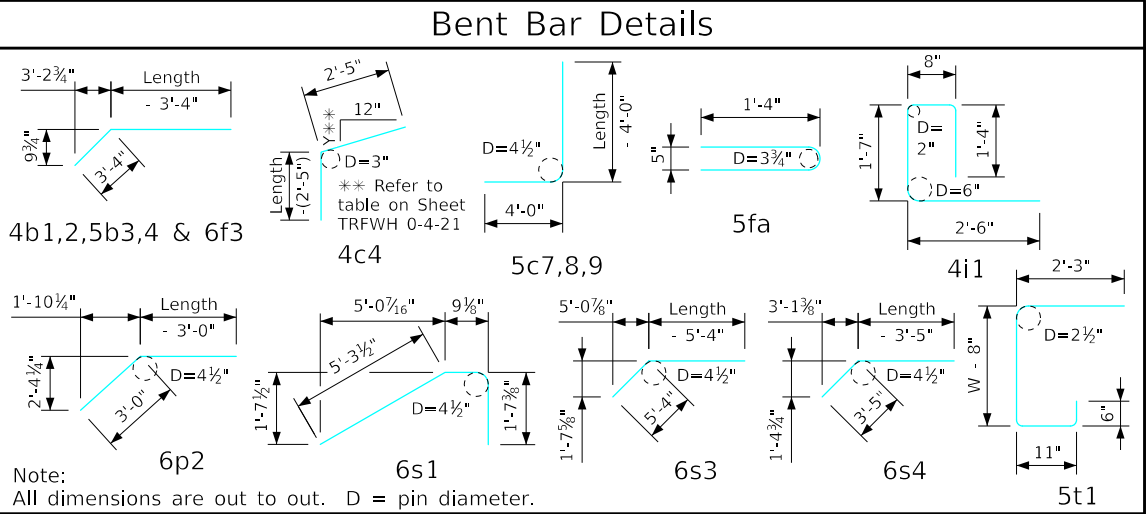
\* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

|                      |                                                                                                                      |                                                                                                                                                    |                                 |
|----------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| LATEST REVISION DATE | <br>APPROVED BY BRIDGE ENGINEER | <br>Standard Design - Triple Reinforced Concrete Box Culverts |                                 |
|                      |                                                                                                                      | Flared Wing Headwalls<br>February, 2021                                                                                                            |                                 |
|                      |                                                                                                                      | Quantity Tabulation<br>12'-0" Span<br>0° Skew                                                                                                      | TRFWH<br>0-5-21<br>Sheet 1 of 2 |

ENGLISHLRFDSTRIPECULVERTSFWH.DGN - TRFWH 0-5-21 S2 - THIS SHEET ISSUED 02-2021.

| Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height |                                         |                                                                                       |           |                              |         |          |                              |      |          |                              |     |     |  |
|--------------------------------------------------------------------|-----------------------------------------|---------------------------------------------------------------------------------------|-----------|------------------------------|---------|----------|------------------------------|------|----------|------------------------------|-----|-----|--|
| Bar                                                                | Location                                | Shape                                                                                 | 12' x 6'  |                              |         | 12' x 5' |                              |      | 12' x 4' |                              |     | Bar |  |
|                                                                    |                                         |                                                                                       | No.       | Length                       | Wt.     | No.      | Length                       | Wt.  | No.      | Length                       | Wt. |     |  |
| 5fa                                                                | Fence Anchor (Galv.)                    |    | 2         | 2'-10                        | 6       | 2        | 2'-10                        | 6    | 2        | 2'-10                        | 6   | 5fa |  |
| 4b1                                                                | Wingwall, B.F.H.                        |    | 2         | 22'-8                        | 30      | 2        | 19'-7                        | 26   | 2        | 16'-6                        | 22  | 4b1 |  |
| 4b2                                                                | Wingwall, B.F.H.                        |    | 8 Var.    | 2 Each<br>11'-11 to<br>21'-3 | 89      | 6 Var.   | 2 Each<br>11'-11 to<br>18'-2 | 60   | 4 Var.   | 2 Each<br>11'-11 to<br>15'-1 | 36  | 4b2 |  |
| 5b3                                                                | Wingwall, F.F.H.                        |    | 2         | 22'-8                        | 47      | 2        | 19'-7                        | 41   | 2        | 16'-6                        | 34  | 5b3 |  |
| 5b4                                                                | Wingwall, F.F.H.                        |    | 10 Var.   | 2 Each<br>8'-11 to<br>21'-3  | 157     | 8 Var.   | 2 Each<br>8'-11 to<br>18'-2  | 113  | 6 Var.   | 2 Each<br>8'-11 to<br>15'-1  | 75  | 5b4 |  |
| 5b5                                                                | Interior Wall, Both F.H.                |    | 18 Var.   | 2 Each<br>5'-5 to<br>15'-7   | 197     | 14 Var.  | 2 Each<br>5'-7 to<br>13'-7   | 140  | 10 Var.  | 2 Each<br>5'-9 to<br>11'-6   | 90  | 5b5 |  |
| 4c1                                                                | Wingwall, F.F.V.                        |    | 40 Var.   | 2 Each<br>2'-10 to<br>9'-0   | 158     | 32 Var.  | 2 Each<br>2'-10 to<br>7'-9   | 113  | 26 Var.  | 2 Each<br>2'-10 to<br>6'-9   | 83  | 4c1 |  |
| 4c2                                                                | Wingwall, F.F.V.                        |    | --        | --                           | --      | --       | --                           | --   | --       | --                           | --  | 4c2 |  |
| 4c3                                                                | Wingwall, F.F.V.                        |    | 2         | 7'-9                         | 10      | 4        | 6'-9                         | 18   | 4        | 5'-9                         | 15  | 4c3 |  |
| 4c4                                                                | Interior Wall, Both F.V.                |    | 4         | 4'-2                         | 11      | 4        | 4'-2                         | 11   | 4        | 4'-1                         | 11  | 4c4 |  |
| 4c5                                                                | Interior Wall, Both F.V.                |    | 52 Var.   | 2 Each<br>1'-11 to<br>6'-10  | 152     | 44 Var.  | 2 Each<br>1'-11 to<br>5'-10  | 114  | 36 Var.  | 2 Each<br>1'-11 to<br>4'-10  | 81  | 4c5 |  |
| 5c6                                                                | Wingwall, B.F.V.                        |    | 12 Var.   | 2 Each<br>2'-10 to<br>4'-6   | 46      | 12 Var.  | 2 Each<br>2'-10 to<br>4'-6   | 46   | 12 Var.  | 2 Each<br>2'-10 to<br>4'-6   | 46  | 5c6 |  |
| 5c7                                                                | Wingwall, B.F.V.                        |    | 28 Var.   | 2 Each<br>8'-10 to<br>13'-0  | 319     | 20 Var.  | 2 Each<br>8'-10 to<br>11'-9  | 215  | 14 Var.  | 2 Each<br>8'-10 to<br>10'-9  | 143 | 5c7 |  |
| 5c8                                                                | Wingwall, B.F.V.                        |    | 14        | 10'-6                        | 153     | --       | --                           | --   | --       | --                           | --  | 5c8 |  |
| 5c9                                                                | Wingwall, B.F.V.                        |    | 2         | 11'-9                        | 25      | 4        | 10'-9                        | 45   | 4        | 9'-9                         | 41  | 5c9 |  |
| 4d1                                                                | Apron, Longit., Bott.                   |    | 25        | 15'-11                       | 266     | 25       | 13'-11                       | 232  | 25       | 11'-11                       | 199 | 4d1 |  |
| 4d2                                                                | Apron, Longit., Bott.                   |    | 6         | 17'-8                        | 71      | 6        | 14'-7                        | 58   | 6        | 11'-6                        | 46  | 4d2 |  |
| 6f1                                                                | Apron, Longit., Top                     |    | 37        | 15'-11                       | 885     | 37       | 13'-11                       | 773  | 37       | 11'-11                       | 662 | 6f1 |  |
| 6f2                                                                | Apron, Longit., Top                     |    | 8 Var.    | 2 Each<br>4'-7 to<br>12'-10  | 105     | 6 Var.   | 2 Each<br>5'-4 to<br>10'-10  | 73   | 4 Var.   | 2 Each<br>6'-1 to<br>8'-10   | 45  | 6f2 |  |
| 6f3                                                                | Apron, Longit., Top                     |    | 2         | 22'-8                        | 68      | 2        | 19'-7                        | 59   | 2        | 16'-6                        | 50  | 6f3 |  |
| 4i1                                                                | Parapet, Vertical                       |    | 75        | 6'-1                         | 305     | 75       | 6'-1                         | 305  | 75       | 6'-1                         | 305 | 4i1 |  |
| 7j1                                                                | Parapet, Horizontal                     |   | 4         | 38'-8                        | 316     | 4        | 38'-8                        | 316  | 4        | 38'-8                        | 316 | 7j1 |  |
| 6m1                                                                | Apron, Trans., Top                      |  | 18 Var.   | 38'-10 to 45'-3              | 1187    | 15 Var.  | 38'-10 to 44'-1              | 974  | 13 Var.  | 38'-10 to 43'-4              | 835 | 6m1 |  |
| 6m2                                                                | Apron, Trans., Bott.                    |  | 12 Var.   | 33'-3 to 38'-9               | 649     | 10 Var.  | 33'-3 to 37'-9               | 533  | 8 Var.   | 33'-3 to 36'-9               | 421 | 6m2 |  |
| 6p1                                                                | Curtain, Horizontal                     |  | 4         | 37'-9                        | 227     | 4        | 37'-9                        | 227  | 4        | 37'-9                        | 227 | 6p1 |  |
| 6p2                                                                | Curtain, Horizontal                     |  | 8         | 11'-1                        | 133     | 8        | 9'-10                        | 118  | 8        | 8'-7                         | 103 | 6p2 |  |
| 6s1                                                                | Wing Slope, Both F.                     |  | 4         | 7'-8                         | 46      | 4        | 7'-8                         | 46   | 4        | 7'-8                         | 46  | 6s1 |  |
| 6s2                                                                | Wing Slope, Both F.                     |  | 4         | 17'-7                        | 106     | 4        | 14'-4                        | 86   | 4        | 11'-1                        | 67  | 6s2 |  |
| 6s3                                                                | Wing Slope, F.F.                        |  | 2         | 23'-8                        | 71      | 2        | 20'-5                        | 61   | 2        | 17'-2                        | 52  | 6s3 |  |
| 6s4                                                                | Interior Wall, Both F.                  |  | 4         | 16'-10                       | 101     | 4        | 14'-7                        | 88   | 4        | 12'-4                        | 74  | 6s4 |  |
| 5t1                                                                | Curtain, Vertical                       |  | 39        | 6'-6                         | 264     | 37       | 6'-6                         | 251  | 35       | 6'-6                         | 237 | 5t1 |  |
|                                                                    | Estimated<br>Quantities<br>One Headwall | Reinf. Steel                                                                          |           | 6200 LB                      |         |          | 5148 LB                      |      |          | 4368 LB                      |     |     |  |
|                                                                    |                                         | Concrete                                                                              | Parapet Δ | 3.5                          | 45.5 CY | 3.5      | 38.6 CY                      | 3.5  | 32.1 CY  |                              |     |     |  |
|                                                                    |                                         |                                                                                       | Wingwalls | 7.4                          |         | 5.4      |                              | 3.7  |          |                              |     |     |  |
|                                                                    |                                         |                                                                                       | Apron *   | 34.6                         |         | 29.7     |                              | 24.9 |          |                              |     |     |  |



Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1" and "6f3" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

Δ Includes top of wingwall quantities.  
\* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

LATEST REVISION DATE

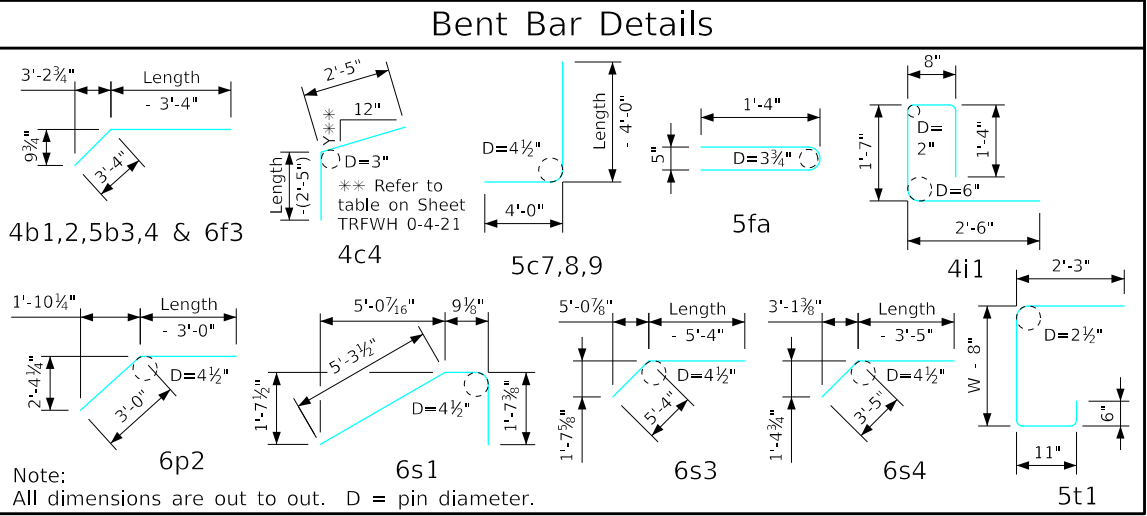
APPROVED BY BRIDGE ENGINEER

Standard Design - Triple Reinforced Concrete Box Culverts  
**Flared Wing Headwalls**  
February, 2021  
Quantity Tabulation  
12'-0" Span  
0° Skew

TRFWH  
0-5-21  
Sheet 2 of 2

ENGLISHLRFDSignedTRIPLECulvertsFWH.DGN - TRFWH 0-6-21 S1 - THIS SHEET ISSUED 02-2021.

| Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height |                                         |                                                                                   |           |                              |      |           |                              |         |           |                              |      |          |                              |         |          |                              |      |          |                              |      |     |
|--------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------------------------------------|-----------|------------------------------|------|-----------|------------------------------|---------|-----------|------------------------------|------|----------|------------------------------|---------|----------|------------------------------|------|----------|------------------------------|------|-----|
| Bar                                                                | Location                                | Shape                                                                             | 10' x 12' |                              |      | 10' x 11' |                              |         | 10' x 10' |                              |      | 10' x 9' |                              |         | 10' x 8' |                              |      | 10' x 7' |                              |      | Bar |
|                                                                    |                                         |                                                                                   | No.       | Length                       | Wt.  | No.       | Length                       | Wt.     | No.       | Length                       | Wt.  | No.      | Length                       | Wt.     | No.      | Length                       | Wt.  | No.      | Length                       | Wt.  |     |
| 5fa                                                                | Fence Anchor (Galv.)                    |  | 2         | 2'-10                        | 6    | 2         | 2'-10                        | 6       | 2         | 2'-10                        | 6    | 2        | 2'-10                        | 6       | 2        | 2'-10                        | 6    | 2        | 2'-10                        | 6    | 5fa |
| 4b1                                                                | Wingwall, B.F.H.                        |  | 2         | 41'-2                        | 58   | 2         | 38'-1                        | 51      | 2         | 35'-0                        | 47   | 2        | 31'-11                       | 43      | 2        | 28'-10                       | 39   | 2        | 25'-9                        | 34   | 4b1 |
| 4b2                                                                | Wingwall, B.F.H.                        |  | 20 Var.   | 2 Each<br>11'-11 to<br>39'-9 | 345  | 18 Var.   | 2 Each<br>11'-11 to<br>36'-8 | 292     | 16 Var.   | 2 Each<br>11'-11 to<br>33'-7 | 243  | 14 Var.  | 2 Each<br>11'-11 to<br>30'-6 | 198     | 12 Var.  | 2 Each<br>11'-11 to<br>27'-5 | 158  | 10 Var.  | 2 Each<br>11'-11 to<br>24'-4 | 121  | 4b2 |
| 5b3                                                                | Wingwall, F.F.H.                        |  | 2         | 41'-3                        | 91   | 2         | 38'-2                        | 80      | 2         | 35'-1                        | 73   | 2        | 32'-0                        | 67      | 2        | 28'-11                       | 60   | 2        | 25'-9                        | 54   | 5b3 |
| 5b4                                                                | Wingwall, F.F.H.                        |  | 22 Var.   | 2 Each<br>8'-10 to<br>39'-10 | 558  | 20 Var.   | 2 Each<br>8'-10 to<br>36'-9  | 475     | 18 Var.   | 2 Each<br>8'-11 to<br>33'-8  | 400  | 16 Var.  | 2 Each<br>8'-11 to<br>30'-7  | 330     | 14 Var.  | 2 Each<br>8'-11 to<br>27'-6  | 266  | 12 Var.  | 2 Each<br>8'-11 to<br>24'-4  | 208  | 5b4 |
| 5b5                                                                | Interior Wall, Both F.H.                |  | 42 Var.   | 2 Each<br>5'-2 to<br>27'-8   | 719  | 38 Var.   | 2 Each<br>5'-3 to<br>25'-8   | 613     | 34 Var.   | 2 Each<br>5'-3 to<br>23'-7   | 511  | 30 Var.  | 2 Each<br>5'-3 to<br>21'-7   | 420     | 26 Var.  | 2 Each<br>5'-4 to<br>19'-7   | 338  | 22 Var.  | 2 Each<br>5'-5 to<br>17'-7   | 264  | 5b5 |
| 4c1                                                                | Wingwall, F.F.V.                        |  | 76 Var.   | 2 Each<br>2'-9 to<br>14'-9   | 444  | 70 Var.   | 2 Each<br>2'-9 to<br>13'-9   | 386     | 64 Var.   | 2 Each<br>2'-9 to<br>12'-10  | 333  | 58 Var.  | 2 Each<br>2'-9 to<br>11'-10  | 283     | 52 Var.  | 2 Each<br>2'-9 to<br>10'-10  | 236  | 46 Var.  | 2 Each<br>2'-9 t<br>9'-11    | 195  | 4c1 |
| 4c2                                                                | Wingwall, F.F.V.                        |  | 36 Var.   | 2 Each<br>9'-5 to<br>14'-11  | 293  | 30 Var.   | 2 Each<br>9'-5 to<br>13'-11  | 234     | 24 Var.   | 2 Each<br>9'-5 to<br>13'-0   | 180  | 18 Var.  | 2 Each<br>9'-5 to<br>12'-0   | 129     | --       | --                           | --   | --       | --                           | --   | 4c2 |
| 4c3                                                                | Wingwall, F.F.V.                        |  | 4         | 13'-8                        | 37   | 4         | 12'-8                        | 34      | 2         | 11'-8                        | 16   | 2        | 10'-8                        | 14      | 2        | 9'-8                         | 13   | 2        | 8'-8                         | 12   | 4c3 |
| 4c4                                                                | Interior Wall, Both F.V.                |  | 4         | 4'-1                         | 11   | 4         | 4'-1                         | 11      | 4         | 4'-1                         | 11   | 4        | 4'-1                         | 11      | 4        | 4'-1                         | 11   | 4        | 4'-1                         | 11   | 4c4 |
| 4c5                                                                | Interior Wall, Both F.V.                |  | 100 Var.  | 2 Each<br>1'-11 to<br>12'-10 | 493  | 92 Var.   | 2 Each<br>1'-11 to<br>11'-10 | 423     | 84 Var.   | 2 Each<br>1'-11 to<br>10'-10 | 358  | 76 Var.  | 2 Each<br>1'-10 to<br>9'-10  | 296     | 68 Var.  | 2 Each<br>1'-10 to<br>8'-10  | 242  | 60 Var.  | 2 Each<br>1'-10 to<br>7'-9   | 192  | 4c5 |
| 5c6                                                                | Wingwall, B.F.V.                        |  | 12 Var.   | 2 Each<br>2'-9 to<br>4'-5    | 45   | 12 Var.   | 2 Each<br>2'-9 to<br>4'-5    | 45      | 12 Var.   | 2 Each<br>2'-9 to<br>4'-5    | 45   | 12 Var.  | 2 Each<br>2'-9 to<br>4'-5    | 45      | 12 Var.  | 2 Each<br>2'-9 to<br>4'-5    | 45   | 12 Var.  | 2 Each<br>2'-9 to<br>4'-5    | 45   | 5c6 |
| 5c7                                                                | Wingwall, B.F.V.                        |  | 64 Var.   | 2 Each<br>8'-9 to<br>18'-9   | 918  | 58 Var.   | 2 Each<br>8'-9 to<br>17'-9   | 802     | 52 Var.   | 2 Each<br>8'-9 to<br>16'-10  | 694  | 46 Var.  | 2 Each<br>8'-9 to<br>15'-10  | 590     | 40 Var.  | 2 Each<br>8'-9 to<br>14'-10  | 492  | 34 Var.  | 2 Each<br>8'-9 to<br>13'-11  | 402  | 5c7 |
| 5c8                                                                | Wingwall, B.F.V.                        |  | 50        | 10'-6                        | 548  | 44        | 10'-6                        | 482     | 38        | 10'-6                        | 416  | 32       | 10'-6                        | 350     | 26       | 10'-6                        | 285  | 20       | 10'-6                        | 219  | 5c8 |
| 5c9                                                                | Wingwall, B.F.V.                        |  | 4         | 17'-8                        | 74   | 4         | 16'-8                        | 70      | 2         | 15'-8                        | 33   | 2        | 14'-8                        | 31      | 2        | 13'-8                        | 29   | 2        | 12'-8                        | 26   | 5c9 |
| 4d1                                                                | Apron, Longit., Bott.                   |  | 21        | 27'-11                       | 392  | 21        | 25'-11                       | 364     | 21        | 23'-11                       | 336  | 21       | 21'-11                       | 307     | 21       | 19'-11                       | 279  | 21       | 17'-11                       | 251  | 4d1 |
| 4d2                                                                | Apron, Longit., Bott.                   |  | 6         | 36'-3                        | 145  | 6         | 33'-2                        | 133     | 6         | 30'-1                        | 121  | 6        | 27'-0                        | 108     | 6        | 23'-11                       | 96   | 6        | 20'-10                       | 84   | 4d2 |
| 6f1                                                                | Apron, Longit., Top                     |  | 31        | 27'-11                       | 1300 | 31        | 25'-11                       | 1207    | 31        | 23'-11                       | 1114 | 31       | 21'-11                       | 1020    | 31       | 19'-11                       | 927  | 31       | 17'-11                       | 834  | 6f1 |
| 6f2                                                                | Apron, Longit., Top                     |  | 16 Var.   | 2 Each<br>5'-10 to<br>24'-10 | 368  | 16 Var.   | 2 Each<br>3'-10 to<br>22'-10 | 320     | 14 Var.   | 2 Each<br>4'-6 to<br>20'-10  | 266  | 12 Var.  | 2 Each<br>5'-3 to<br>18'-10  | 217     | 10 Var.  | 2 Each<br>5'-11 to<br>16'-10 | 171  | 10 Var.  | 2 Each<br>3'-11 to<br>14'-10 | 141  | 6f2 |
| 6f3                                                                | Apron, Longit., Top                     |  | 2         | 41'-3                        | 131  | 2         | 38'-2                        | 115     | 2         | 35'-1                        | 105  | 2        | 32'-0                        | 96      | 2        | 28'-11                       | 87   | 2        | 25'-9                        | 77   | 6f3 |
| 4i1                                                                | Parapet, Vertical                       |  | 65        | 6'-1                         | 264  | 63        | 6'-1                         | 256     | 63        | 6'-1                         | 256  | 63       | 6'-1                         | 256     | 63       | 6'-1                         | 256  | 63       | 6'-1                         | 256  | 4i1 |
| 7j1                                                                | Parapet, Horizontal                     |  | 4         | 33'-8                        | 275  | 4         | 33'-4                        | 273     | 4         | 33'-0                        | 270  | 4        | 33'-0                        | 270     | 4        | 33'-0                        | 270  | 4        | 32'-8                        | 267  | 7j1 |
| 6m1                                                                | Apron, Trans., Top                      |  | 34 Var.   | 33'-10 to 46'-3              | 2107 | 31 Var.   | 33'-6 to 44'-9               | 1869    | 29 Var.   | 33'-2 to 43'-8               | 1710 | 26 Var.  | 33'-2 to 42'-7               | 1505    | 23 Var.  | 33'-2 to 41'-5               | 1303 | 21 Var.  | 32'-10 to 40'-4              | 1158 | 6m1 |
| 6m2                                                                | Apron, Trans., Bott.                    |  | 24 Var.   | 27'-9 to 39'-3               | 1208 | 22 Var.   | 27'-7 to 38'-1               | 1085    | 20 Var.   | 27'-5 to 36'-11              | 966  | 18 Var.  | 27'-5 to 35'-11              | 856     | 16 Var.  | 27'-5 to 34'-11              | 749  | 14 Var.  | 27'-3 to 33'-9               | 641  | 6m2 |
| 6p1                                                                | Curtain, Horizontal                     |  | 4         | 32'-3                        | 194  | 4         | 32'-1                        | 193     | 4         | 31'-11                       | 192  | 4        | 31'-11                       | 192     | 4        | 31'-11                       | 192  | 4        | 31'-9                        | 191  | 6p1 |
| 6p2                                                                | Curtain, Horizontal                     |  | 8         | 18'-7                        | 223  | 8         | 17'-4                        | 208     | 8         | 16'-1                        | 193  | 8        | 14'-10                       | 178     | 8        | 13'-7                        | 163  | 8        | 12'-4                        | 148  | 6p2 |
| 6s1                                                                | Wing Slope, Both F.                     |  | 4         | 7'-8                         | 46   | 4         | 7'-8                         | 46      | 4         | 7'-8                         | 46   | 4        | 7'-8                         | 46      | 4        | 7'-8                         | 46   | 4        | 7'-8                         | 46   | 6s1 |
| 6s2                                                                | Wing Slope, Both F.                     |  | 4         | 37'-1                        | 223  | 4         | 33'-10                       | 203     | 4         | 30'-7                        | 184  | 4        | 27'-4                        | 164     | 4        | 24'-1                        | 145  | 4        | 20'-10                       | 125  | 6s2 |
| 6s3                                                                | Wing Slope, F.F.                        |  | 2         | 43'-2                        | 137  | 2         | 39'-11                       | 120     | 2         | 36'-8                        | 110  | 2        | 33'-5                        | 100     | 2        | 30'-2                        | 91   | 2        | 26'-11                       | 81   | 6s3 |
| 6s4                                                                | Interior Wall, Both F.                  |  | 4         | 30'-3                        | 182  | 4         | 28'-0                        | 168     | 4         | 25'-9                        | 155  | 4        | 23'-6                        | 141     | 4        | 21'-4                        | 128  | 4        | 19'-1                        | 115  | 6s4 |
| 5t1                                                                | Curtain, Vertical                       |  | 47        | 8'-0                         | 392  | 45        | 7'-9                         | 364     | 43        | 7'-6                         | 336  | 41       | 7'-3                         | 310     | 39       | 7'-0                         | 285  | 37       | 6'-9                         | 260  | 5t1 |
|                                                                    | Estimated<br>Quantities<br>One Headwall | Reinf. Steel                                                                      | 12,227 LB |                              |      | 10,928 LB |                              |         | 9726 LB   |                              |      | 8579 LB  |                              |         | 7408 LB  |                              |      | 6464 LB  |                              |      |     |
|                                                                    |                                         |                                                                                   | Concrete  | Parapet Δ                    | 3.3  | 101.0 CY  | 3.2                          | 86.6 CY | 3.1       | 74.0 CY                      | 3.1  | 64.9 CY  | 3.1                          | 55.3 CY | 3.0      | 46.6 CY                      |      |          |                              |      |     |
|                                                                    |                                         | Wingwalls                                                                         |           | 34.0                         | 26.5 |           | 20.4                         |         | 16.9      |                              | 13.7 |          | 9.7                          |         |          |                              |      |          |                              |      |     |
|                                                                    |                                         | Apron *                                                                           |           | 63.7                         | 56.9 |           | 50.5                         |         | 44.9      |                              | 38.5 |          | 33.9                         |         |          |                              |      |          |                              |      |     |



Headwall Notes:

1. See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
5. Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
6. Concrete quantities are estimated from back of parapet.
7. Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1" and "6f3" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
8. Dimensions are in feet and inches unless otherwise noted.

Δ Includes top of wingwall quantities.  
\* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

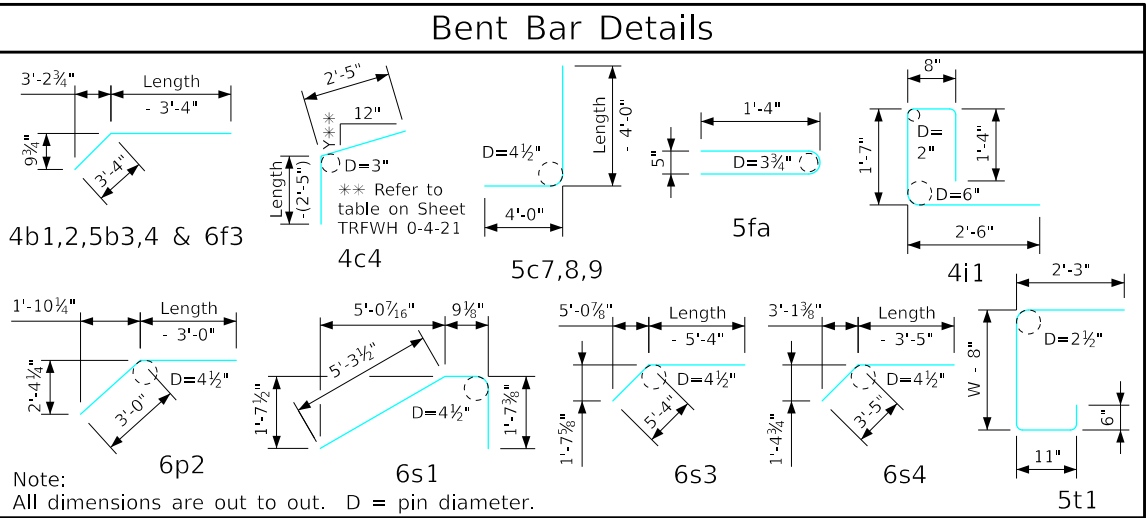
LATEST REVISION DATE

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Standard Design - Triple Reinforced Concrete Box Culverts  
**Flared Wing Headwalls**  
February, 2021  
Quantity Tabulation  
10'-0" Span  
0° Skew

TRFWH  
0-6-21  
Sheet 1 of 2

| Bill of Reinforcing for One Headwall 0° Skew Span x Culvert Height |                                         |                                                                                       |           |                              |         |          |                              |      |          |                              |     |     |  |
|--------------------------------------------------------------------|-----------------------------------------|---------------------------------------------------------------------------------------|-----------|------------------------------|---------|----------|------------------------------|------|----------|------------------------------|-----|-----|--|
| Bar                                                                | Location                                | Shape                                                                                 | 10' x 6'  |                              |         | 10' x 5' |                              |      | 10' x 4' |                              |     | Bar |  |
|                                                                    |                                         |                                                                                       | No.       | Length                       | Wt.     | No.      | Length                       | Wt.  | No.      | Length                       | Wt. |     |  |
| 5fa                                                                | Fence Anchor (Galv.)                    |    | 2         | 2'-10                        | 6       | 2        | 2'-10                        | 6    | 2        | 2'-10                        | 6   | 5fa |  |
| 4b1                                                                | Wingwall, B.F.H.                        |    | 2         | 22'-8                        | 30      | 2        | 19'-7                        | 26   | 2        | 16'-6                        | 22  | 4b1 |  |
| 4b2                                                                | Wingwall, B.F.H.                        |    | 8 Var.    | 2 Each<br>11'-11 to<br>21'-3 | 89      | 6 Var.   | 2 Each<br>11'-11 to<br>18'-2 | 60   | 4 Var.   | 2 Each<br>11'-11 to<br>15'-1 | 36  | 4b2 |  |
| 5b3                                                                | Wingwall, F.F.H.                        |    | 2         | 22'-8                        | 47      | 2        | 19'-7                        | 41   | 2        | 16'-6                        | 34  | 5b3 |  |
| 5b4                                                                | Wingwall, F.F.H.                        |    | 10 Var.   | 2 Each<br>8'-11 to<br>21'-3  | 157     | 8 Var.   | 2 Each<br>8'-11 to<br>18'-2  | 113  | 6 Var.   | 2 Each<br>8'-11 to<br>15'-1  | 75  | 5b4 |  |
| 5b5                                                                | Interior Wall, Both F.H.                |    | 18 Var.   | 2 Each<br>5'-5 to<br>15'-7   | 197     | 14 Var.  | 2 Each<br>5'-7 to<br>13'-7   | 140  | 10 Var.  | 2 Each<br>5'-9 to<br>11'-6   | 90  | 5b5 |  |
| 4c1                                                                | Wingwall, F.F.V.                        |    | 40 Var.   | 2 Each<br>2'-9 to<br>8'-11   | 156     | 32 Var.  | 2 Each<br>2'-9 to<br>7'-8    | 111  | 26 Var.  | 2 Each<br>2'-9 to<br>6'-8    | 82  | 4c1 |  |
| 4c2                                                                | Wingwall, F.F.V.                        |    | --        | --                           | --      | --       | --                           | --   | --       | --                           | --  | 4c2 |  |
| 4c3                                                                | Wingwall, F.F.V.                        |    | 2         | 7'-8                         | 10      | 4        | 6'-8                         | 18   | 4        | 5'-8                         | 15  | 4c3 |  |
| 4c4                                                                | Interior Wall, Both F.V.                |    | 4         | 4'-1                         | 11      | 4        | 4'-1                         | 11   | 4        | 4'-0                         | 11  | 4c4 |  |
| 4c5                                                                | Interior Wall, Both F.V.                |    | 52 Var.   | 2 Each<br>1'-10 to<br>6'-9   | 149     | 44 Var.  | 2 Each<br>1'-10 to<br>5'-9   | 111  | 36 Var.  | 2 Each<br>1'-10 to<br>4'-9   | 79  | 4c5 |  |
| 5c6                                                                | Wingwall, B.F.V.                        |    | 12 Var.   | 2 Each<br>2'-9 to<br>4'-5    | 45      | 12 Var.  | 2 Each<br>2'-9 to<br>4'-5    | 45   | 12 Var.  | 2 Each<br>2'-9 to<br>4'-5    | 45  | 5c6 |  |
| 5c7                                                                | Wingwall, B.F.V.                        |    | 28 Var.   | 2 Each<br>8'-9 to<br>12'-11  | 316     | 20 Var.  | 2 Each<br>8'-9 to<br>11'-8   | 213  | 14 Var.  | 2 Each<br>8'-9 to<br>10'-8   | 142 | 5c7 |  |
| 5c8                                                                | Wingwall, B.F.V.                        |    | 14        | 10'-6                        | 153     | --       | --                           | --   | --       | --                           | --  | 5c8 |  |
| 5c9                                                                | Wingwall, B.F.V.                        |    | 2         | 11'-8                        | 24      | 4        | 10'-8                        | 45   | 4        | 9'-8                         | 40  | 5c9 |  |
| 4d1                                                                | Apron, Longit., Bott.                   |    | 21        | 15'-11                       | 223     | 21       | 13'-11                       | 195  | 21       | 11'-11                       | 167 | 4d1 |  |
| 4d2                                                                | Apron, Longit., Bott.                   |    | 6         | 17'-8                        | 71      | 6        | 14'-7                        | 58   | 6        | 11'-6                        | 46  | 4d2 |  |
| 6f1                                                                | Apron, Longit., Top                     |    | 31        | 15'-11                       | 741     | 31       | 13'-11                       | 648  | 31       | 11'-11                       | 555 | 6f1 |  |
| 6f2                                                                | Apron, Longit., Top                     |  | 8 Var.    | 2 Each<br>4'-7 to<br>12'-10  | 105     | 6 Var.   | 2 Each<br>5'-4 to<br>10'-10  | 73   | 4 Var.   | 2 Each<br>6'-1 to<br>8'-10   | 45  | 6f2 |  |
| 6f3                                                                | Apron, Longit., Top                     |  | 2         | 22'-8                        | 68      | 2        | 19'-7                        | 59   | 2        | 16'-6                        | 50  | 6f3 |  |
| 4i1                                                                | Parapet, Vertical                       |  | 63        | 6'-1                         | 256     | 63       | 6'-1                         | 256  | 63       | 6'-1                         | 256 | 4i1 |  |
| 7j1                                                                | Parapet, Horizontal                     |  | 4         | 32'-8                        | 267     | 4        | 32'-8                        | 267  | 4        | 32'-8                        | 267 | 7j1 |  |
| 6m1                                                                | Apron, Trans., Top                      |  | 18 Var.   | 32'-10 to 39'-3              | 974     | 15 Var.  | 32'-10 to 38'-1              | 799  | 13 Var.  | 32'-10 to 37'-4              | 685 | 6m1 |  |
| 6m2                                                                | Apron, Trans., Bott.                    |  | 12 Var.   | 27'-3 to 32'-9               | 541     | 10 Var.  | 27'-3 to 31'-9               | 443  | 8 Var.   | 27'-3 to 30'-9               | 348 | 6m2 |  |
| 6p1                                                                | Curtain, Horizontal                     |  | 4         | 31'-9                        | 191     | 4        | 31'-9                        | 191  | 4        | 31'-9                        | 191 | 6p1 |  |
| 6p2                                                                | Curtain, Horizontal                     |  | 8         | 11'-1                        | 133     | 8        | 9'-10                        | 118  | 8        | 8'-7                         | 103 | 6p2 |  |
| 6s1                                                                | Wing Slope, Both F.                     |  | 4         | 7'-8                         | 46      | 4        | 7'-8                         | 46   | 4        | 7'-8                         | 46  | 6s1 |  |
| 6s2                                                                | Wing Slope, Both F.                     |  | 4         | 17'-7                        | 106     | 4        | 14'-4                        | 86   | 4        | 11'-1                        | 67  | 6s2 |  |
| 6s3                                                                | Wing Slope, F.F.                        |  | 2         | 23'-8                        | 71      | 2        | 20'-5                        | 61   | 2        | 17'-2                        | 52  | 6s3 |  |
| 6s4                                                                | Interior Wall, Both F.                  |  | 4         | 16'-10                       | 101     | 4        | 14'-7                        | 88   | 4        | 12'-4                        | 74  | 6s4 |  |
| 5t1                                                                | Curtain, Vertical                       |  | 35        | 6'-6                         | 237     | 33       | 6'-6                         | 224  | 31       | 6'-6                         | 210 | 5t1 |  |
|                                                                    | Estimated<br>Quantities<br>One Headwall | Reinf. Steel                                                                          |           | 5521 LB                      |         |          | 4552 LB                      |      |          | 3839 LB                      |     |     |  |
|                                                                    |                                         | Concrete                                                                              | Parapet Δ | 3.0                          | 39.4 CY | 3.0      | 33.2 CY                      | 3.0  | 27.4 CY  |                              |     |     |  |
|                                                                    |                                         |                                                                                       | Wingwalls | 7.4                          |         | 5.4      |                              | 3.7  |          |                              |     |     |  |
|                                                                    |                                         |                                                                                       | Apron *   | 29.0                         |         | 24.8     |                              | 20.7 |          |                              |     |     |  |



Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1" and "6f3" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

Δ Includes top of wingwall quantities.  
\* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

LATEST REVISION DATE

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Standard Design - Triple Reinforced Concrete Box Culverts

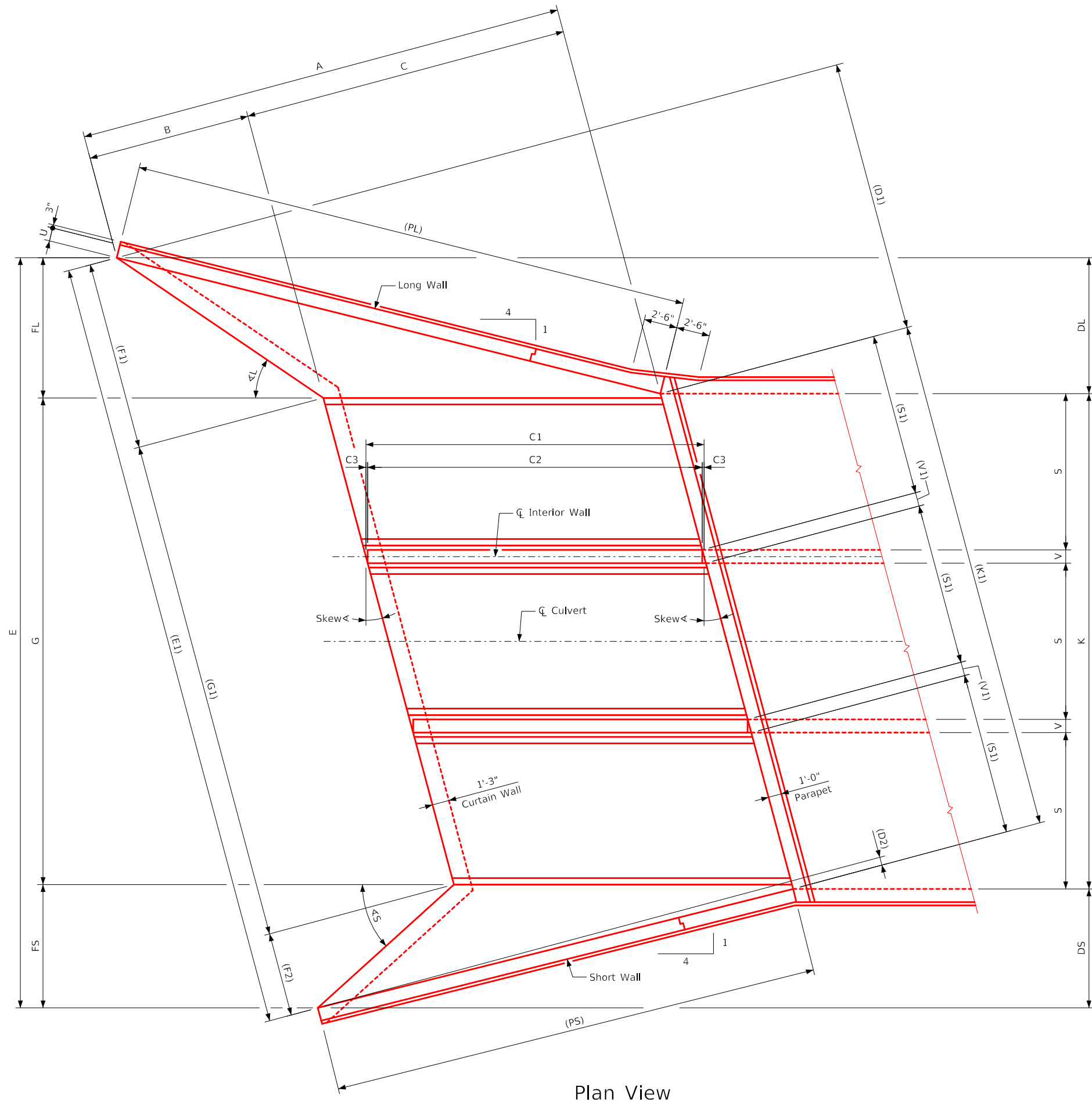
Flared Wing Headwalls

February, 2021

Quantity Tabulation  
10'-0" Span  
0° Skew

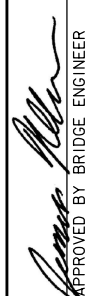
TRFWH  
0-6-21  
Sheet 2 of 2

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Notes:

1. See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet TRFWH 15-2-21 for dimensions table.
3. See Sheet TRFWH 15-5-21 for Angle L & Angle S.

|                                                                                                                      |  |                                                                                       |                  |
|----------------------------------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------|------------------|
| LATEST REVISION DATE                                                                                                 |  |  |                  |
| <br>APPROVED BY BRIDGE ENGINEER |  | Standard Design - Triple Reinforced Concrete Box Culverts                             |                  |
|                                                                                                                      |  | Flared Wing Headwalls                                                                 |                  |
|                                                                                                                      |  | February, 2021                                                                        |                  |
|                                                                                                                      |  | Dimension Plan<br>15° Skew                                                            | TRFWH<br>15-1-21 |

| Dimension Table |           |           |           |          |          |          |          |          |          |           |           |           |          |          |          |          |          |          |       |
|-----------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-------|
| S x H           | 12' x 12' | 12' x 11' | 12' x 10' | 12' x 9' | 12' x 8' | 12' x 7' | 12' x 6' | 12' x 5' | 12' x 4' | 10' x 12' | 10' x 11' | 10' x 10' | 10' x 9' | 10' x 8' | 10' x 7' | 10' x 6' | 10' x 5' | 10' x 4' | S x H |
| A               | 37'-0     | 34'-0     | 31'-0     | 28'-0    | 25'-0    | 22'-0    | 19'-0    | 16'-0    | 13'-0    | 37'-0     | 34'-0     | 31'-0     | 28'-0    | 25'-0    | 22'-0    | 19'-0    | 16'-0    | 13'-0    | A     |
| B               | 12'-4     | 11'-4     | 10'-4     | 9'-4     | 8'-4     | 7'-4     | 6'-4     | 5'-4     | 4'-4     | 12'-4     | 11'-4     | 10'-4     | 9'-4     | 8'-4     | 7'-4     | 6'-4     | 5'-4     | 4'-4     | B     |
| C               | 24'-8     | 22'-8     | 20'-8     | 18'-8    | 16'-8    | 14'-8    | 12'-8    | 10'-8    | 8'-8     | 24'-8     | 22'-8     | 20'-8     | 18'-8    | 16'-8    | 14'-8    | 12'-8    | 10'-8    | 8'-8     | C     |
| C1              | 25'-6½    | 23'-5⅝    | 21'-4¾    | 19'-3⅞   | 17'-3    | 15'-2¼   | 13'-1⅜   | 11'-0½   | 8'-11⅝   | 25'-6½    | 23'-5⅝    | 21'-4¾    | 19'-3⅞   | 17'-3    | 15'-2¼   | 13'-1⅜   | 11'-0½   | 8'-11⅝   | C1    |
| C2              | 25'-3¼    | 23'-2⅝    | 21'-2⅞    | 19'-1¾   | 17'-0⅞   | 14'-11¾  | 12'-11   | 10'-10⅞  | 8'-9¼    | 25'-3¼    | 23'-2⅝    | 21'-2⅞    | 19'-1¾   | 17'-0⅞   | 14'-11¾  | 12'-11   | 10'-10⅞  | 8'-9¼    | C2    |
| C3              | 1⅝        | 1½        | 1⅜        | 1⅝       | 1⅜       | 1¼       | 1¼       | 1¼       | 1¼       | 1⅝        | 1½        | 1⅜        | 1⅝       | 1⅜       | 1¼       | 1¼       | 1¼       | 1¼       | C3    |
| DL              | 10'-3⅝    | 9'-5⅝     | 8'-7¼     | 7'-9¼    | 6'-11¼   | 6'-1¼    | 5'-3¼    | 4'-5¼    | 3'-7¼    | 10'-3⅝    | 9'-5⅝     | 8'-7¼     | 7'-9¼    | 6'-11¼   | 6'-1¼    | 5'-3¼    | 4'-5¼    | 3'-7¼    | DL    |
| DS              | 8'-11¾    | 8'-3      | 7'-6¼     | 6'-9½    | 6'-0¾    | 5'-4     | 4'-7¼    | 3'-10⅝   | 3'-1⅞    | 8'-11¾    | 8'-3      | 7'-6¼     | 6'-9½    | 6'-0¾    | 5'-4     | 4'-7¼    | 3'-10⅝   | 3'-1⅞    | DS    |
| D1              | 20'-6½    | 18'-10½   | 17'-2½    | 15'-6½   | 13'-10½  | 12'-2½   | 10'-6⅝   | 8'-10⅝   | 7'-2⅝    | 20'-6½    | 18'-10½   | 17'-2½    | 15'-6½   | 13'-10½  | 12'-2½   | 10'-6⅝   | 8'-10⅝   | 7'-2⅝    | D1    |
| D2              | 7½        | 6⅝        | 6¼        | 5⅝       | 5        | 4½       | 3⅝       | 3¼       | 2⅝       | 7½        | 6⅝        | 6¼        | 5⅝       | 5        | 4½       | 3⅝       | 3¼       | 2⅝       | D2    |
| E               | 57'-2⅞    | 55'-6⅝    | 53'-9⅝    | 52'-2¾   | 50'-8    | 48'-11¼  | 47'-4½   | 45'-9⅞   | 44'-3⅝   | 51'-2⅞    | 49'-6⅝    | 47'-9⅞    | 46'-2¾   | 44'-8    | 42'-11¼  | 41'-4½   | 39'-9⅞   | 38'-3⅝   | E     |
| E1              | 59'-3⅝    | 57'-5⅝    | 55'-8¾    | 54'-0⅞   | 52'-5½   | 50'-8    | 49'-0⅞   | 47'-5¼   | 45'-9⅞   | 53'-0½    | 51'-3⅝    | 49'-5⅝    | 47'-10¼  | 46'-2⅞   | 44'-5½   | 42'-10⅞  | 41'-2¾   | 39'-7¼   | E1    |
| FL              | 10'-7⅝    | 9'-9⅝     | 8'-11¼    | 8'-1¼    | 7'-3¼    | 6'-5¼    | 5'-7¼    | 4'-9¼    | 3'-11¼   | 10'-7⅝    | 9'-9⅝     | 8'-11¼    | 8'-1¼    | 7'-3¼    | 6'-5¼    | 5'-7¼    | 4'-9¼    | 3'-11¼   | FL    |
| FS              | 9'-3¼     | 8'-7      | 7'-10¼    | 7'-1½    | 6'-4¾    | 5'-8     | 4'-11¼   | 4'-2⅝    | 3'-5⅝    | 9'-3¼     | 8'-7      | 7'-10¼    | 7'-1½    | 6'-4¾    | 5'-8     | 4'-11¼   | 4'-2⅝    | 3'-5⅝    | FS    |
| F1              | 14'-3¼    | 13'-1¾    | 12'-0¼    | 10'-10⅝  | 9'-9⅝    | 8'-7½    | 7'-6     | 6'-4⅝    | 5'-2⅝    | 14'-3¼    | 13'-1¾    | 12'-0¼    | 10'-10⅝  | 9'-9⅝    | 8'-7½    | 7'-6     | 6'-4⅝    | 5'-2⅝    | F1    |
| F2              | 6'-4      | 5'-10⅞    | 5'-4⅝     | 4'-10½   | 4'-4⅝    | 3'-10⅞   | 3'-5     | 2'-11¼   | 2'-5⅝    | 6'-4      | 5'-10⅞    | 5'-4⅝     | 4'-10½   | 4'-4⅝    | 3'-10⅞   | 3'-5     | 2'-11¼   | 2'-5⅝    | F2    |
| G               | 37'-4     | 37'-2     | 37'-0     | 37'-0    | 37'-0    | 36'-10   | 36'-10   | 36'-10   | 36'-10   | 31'-4     | 31'-2     | 31'-0     | 31'-0    | 31'-0    | 30'-10   | 30'-10   | 30'-10   | 30'-10   | G     |
| G1              | 38'-7¾    | 38'-5¾    | 38'-3⅝    | 38'-3⅝   | 38'-3⅝   | 38'-1⅝   | 38'-1⅝   | 38'-1⅝   | 38'-1⅝   | 32'-5¼    | 32'-3¼    | 32'-1⅝    | 32'-1⅝   | 32'-1⅝   | 31'-11   | 31'-11   | 31'-11   | 31'-11   | G1    |
| G2              | 39'-10½   | 39'-8½    | 39'-6⅝    | 39'-6¼   | 39'-6¼   | 39'-4⅝   | 39'-4    | 39'-3⅞   | 39'-3¾   | 33'-8     | 33'-5⅞    | 33'-3¾    | 33'-3¾   | 33'-3¼   | 33'-1⅝   | 33'-1½   | 33'-1⅝   | 33'-1¼   | G2    |
| G3              | 18'-10⅝   | 17'-4¼    | 15'-10⅝   | 14'-4⅝   | 12'-10   | 11'-3⅝   | 9'-9¾    | 8'-3⅝    | 6'-9⅝    | 18'-10⅝   | 17'-4¼    | 15'-10⅝   | 14'-4⅝   | 12'-10   | 11'-3⅝   | 9'-9¾    | 8'-3⅝    | 6'-9⅝    | G3    |
| G4              | 19'-6⅝    | 17'-9⅝    | 16'-0⅝    | 14'-6⅝   | 13'-0½   | 11'-3⅝   | 9'-9⅝    | 8'-3½    | 6'-9⅝    | 19'-6⅝    | 17'-9⅝    | 16'-0⅝    | 14'-6⅝   | 13'-0½   | 11'-3⅝   | 9'-9⅝    | 8'-3½    | 6'-9⅝    | G4    |
| G5              | 13'-10⅝   | 12'-9     | 11'-7¾    | 10'-6⅝   | 9'-5     | 8'-3¾    | 7'-2⅝    | 6'-1     | 4'-11¼   | 13'-10⅝   | 12'-9     | 11'-7¾    | 10'-6⅝   | 9'-5     | 8'-3¾    | 7'-2⅝    | 6'-1     | 4'-11¼   | G5    |
| G6              | 14'-11¼   | 13'-7⅞    | 12'-4⅝    | 11'-3⅝   | 10'-1¾   | 8'-10⅝   | 7'-9⅝    | 6'-7⅞    | 5'-6⅝    | 14'-11¼   | 13'-7⅞    | 12'-4⅝    | 11'-3⅝   | 10'-1¾   | 8'-10⅝   | 7'-9⅝    | 6'-7⅞    | 5'-6⅝    | G6    |
| G7              | 2⅝        | 5⅝        | 8⅝        | 8⅝       | 8⅝       | 10¾      | 10⅞      | 10⅝      | 10½      | 2⅝        | 5⅝        | 8⅝        | 8⅝       | 8⅝       | 10¾      | 10⅞      | 10⅝      | 10½      | G7    |
| G8              | 3¾        | 5⅝        | 7½        | 7½       | 7½       | 9¼       | 9¼       | 9¼       | 9⅞       | 3¾        | 5⅝        | 7½        | 7½       | 7½       | 9¼       | 9¼       | 9¼       | 9⅞       | G8    |
| K               | 38'-0     | 37'-10    | 37'-8     | 37'-8    | 37'-8    | 37'-6    | 37'-6    | 37'-6    | 37'-6    | 32'-0     | 31'-10    | 31'-8     | 31'-8    | 31'-8    | 31'-6    | 31'-6    | 31'-6    | 31'-6    | K     |
| K1              | 39'-4⅝    | 39'-2     | 39'-0     | 39'-0    | 39'-0    | 38'-9⅞   | 38'-9⅞   | 38'-9⅞   | 38'-9⅞   | 33'-1½    | 32'-11½   | 32'-9⅞    | 32'-9⅞   | 32'-9⅞   | 32'-7⅞   | 32'-7⅞   | 32'-7⅞   | 32'-7⅞   | K1    |
| PL              | 42'-3⅞    | 38'-10⅝   | 35'-5½    | 32'-0¼   | 28'-7⅝   | 25'-2    | 21'-8¾   | 18'-3⅝   | 14'-10⅝  | 42'-3⅞    | 38'-10⅝   | 35'-5½    | 32'-0¼   | 28'-7⅝   | 25'-2    | 21'-8¾   | 18'-3⅝   | 14'-10⅝  | PL    |
| PS              | 37'-0⅝    | 34'-0     | 31'-0     | 28'-0    | 25'-0    | 22'-0    | 19'-0    | 16'-0    | 13'-0    | 37'-0⅝    | 34'-0     | 31'-0     | 28'-0    | 25'-0    | 22'-0    | 19'-0    | 16'-0    | 13'-0    | PS    |
| RL              | 44'-1     | 40'-6⅝    | 36'-11⅝   | 33'-4¼   | 29'-9⅝   | 26'-2½   | 22'-7⅞   | 19'-0¾   | 15'-5⅝   | 44'-1     | 40'-6⅝    | 36'-11⅝   | 33'-4¼   | 29'-9⅝   | 26'-2½   | 22'-7⅞   | 19'-0¾   | 15'-5⅝   | RL    |
| RS              | 39'-0⅝    | 35'-10⅝   | 32'-8⅝    | 29'-6¼   | 26'-4¼   | 23'-2⅝   | 20'-0⅝   | 16'-10⅝  | 13'-8½   | 39'-0⅝    | 35'-10⅝   | 32'-8⅝    | 29'-6¼   | 26'-4¼   | 23'-2⅝   | 20'-0⅝   | 16'-10⅝  | 13'-8½   | RS    |
| R1              | 27'-6¾    | 25'-3⅝    | 23'-0⅝    | 20'-8½   | 18'-5    | 16'-1⅝   | 13'-10⅝  | 11'-6⅝   | 9'-3¼    | 27'-6¾    | 25'-3⅝    | 23'-0⅝    | 20'-8½   | 18'-5    | 16'-1⅝   | 13'-10⅝  | 11'-6⅝   | 9'-3¼    | R1    |
| S1              | 12'-5⅝    | 12'-5⅝    | 12'-5⅝    | 12'-5⅝   | 12'-5⅝   | 12'-5⅝   | 12'-5⅝   | 12'-5⅝   | 12'-5⅝   | 10'-4¼    | 10'-4¼    | 10'-4¼    | 10'-4¼   | 10'-4¼   | 10'-4¼   | 10'-4¼   | 10'-4¼   | 10'-4¼   | S1    |
| T               | 1'-2      | 1'-2      | 1'-2      | 1'-2     | 1'-2     | 1'-2     | 1'-2     | 1'-2     | 1'-2     | 1'-1      | 1'-1      | 1'-1      | 1'-1     | 1'-1     | 1'-1     | 1'-1     | 1'-1     | 1'-1     | T     |
| U               | 1'-0      | 11        | 10        | 10       | 10       | 9        | 9        | 9        | 9        | 1'-0      | 11        | 10        | 10       | 10       | 9        | 9        | 9        | 9        | U     |
| V               | 1'-0      | 11        | 10        | 10       | 10       | 9        | 9        | 9        | 9        | 1'-0      | 11        | 10        | 10       | 10       | 9        | 9        | 9        | 9        | V     |
| V1              | 1'-0⅝     | 11⅝       | 10⅝       | 10⅝      | 10⅝      | 9⅝       | 9⅝       | 9⅝       | 9⅝       | 1'-0⅝     | 11⅝       | 10⅝       | 10⅝      | 10⅝      | 9⅝       | 9⅝       | 9⅝       | 9⅝       | V1    |
| W               | 5'-0      | 4'-9      | 4'-6      | 4'-3     | 4'-0     | 3'-9     | 3'-6     | 3'-6     | 3'-6     | 5'-0      | 4'-9      | 4'-6      | 4'-3     | 4'-0     | 3'-9     | 3'-6     | 3'-6     | 3'-6     | W     |

- Notes:
- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
  - See Sheet TRFWH 15-1-21 and sheets TRFWH 15-3-21 thru TRFWH 15-6-21 for location of certain dimensions tabulated.
  - Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER



Standard Design - Triple Reinforced Concrete Box Culverts

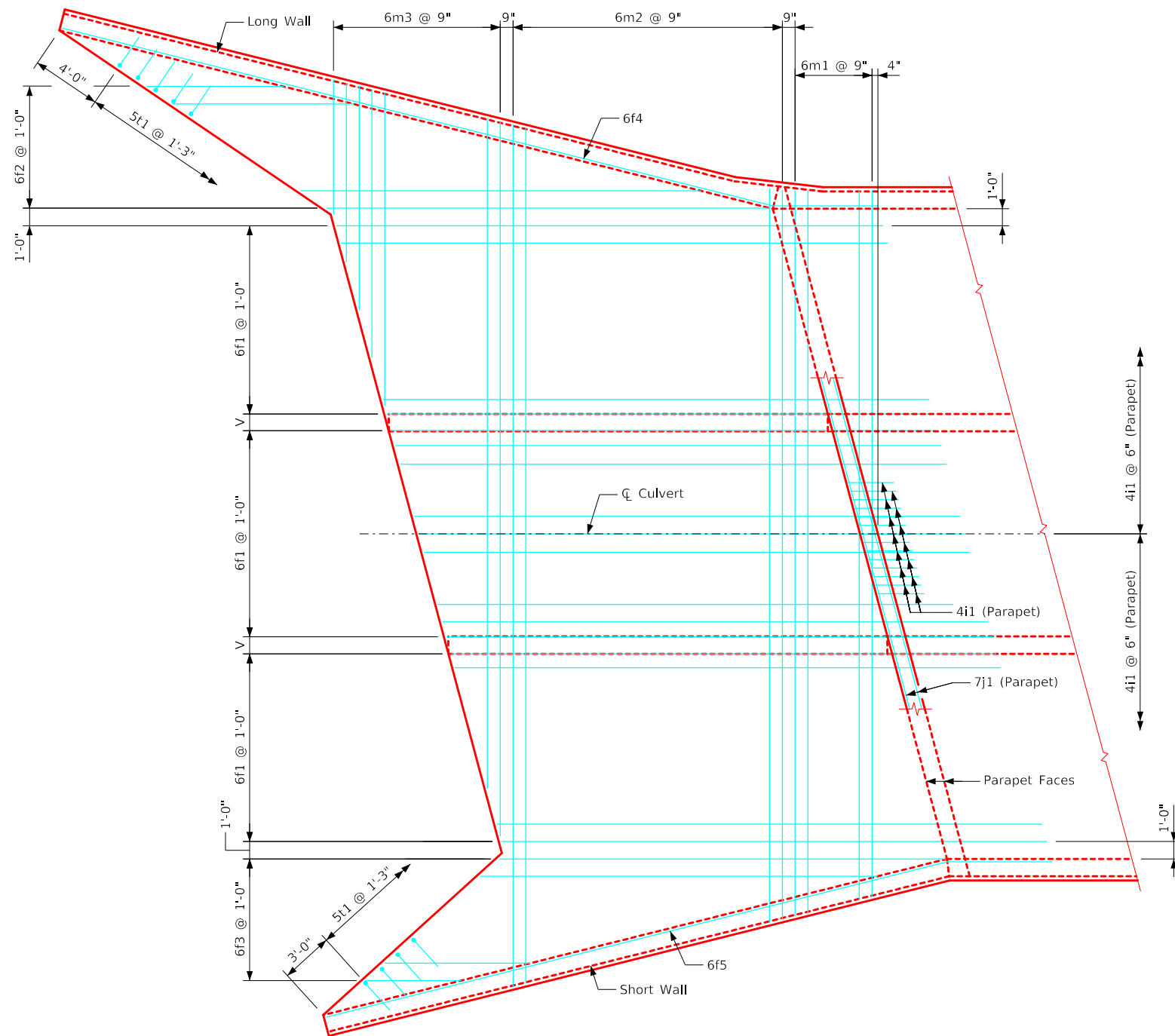
Flared Wing Headwalls

February, 2021

Dimension Table  
15° Skew

TRFWH  
15-2-21

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Plan View - Top of Apron Reinforcing

Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Top transverse floor bars are referenced approximately 4" from the back of the parapet for all headwalls.
3. For dimension table see Sheet TRFWH 15-2-21.
4. For reinforcing in curtain wall see Curtain Wall Details on Sheet TRFWH 15-5-21.

|                      |                                                                                                                      |                                                                                       |                  |
|----------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------|
| LATEST REVISION DATE | <br>APPROVED BY BRIDGE ENGINEER |  |                  |
|                      |                                                                                                                      | Standard Design - Triple Reinforced Concrete Box Culverts                             |                  |
|                      |                                                                                                                      | Flared Wing Headwalls                                                                 |                  |
|                      |                                                                                                                      | February, 2021                                                                        |                  |
|                      |                                                                                                                      | Top Apron Detail<br>15° Skew                                                          | TRFWH<br>15-3-21 |

End of Wing

24'-0" Δ

16'-0" \*

9'-6"

6"

5c9 @ 1'-0" B.F.V.

4c1 @ 1'-0" F.F.V.

4c3 @ 1'-0" F.F.V. Δ

6c13 @ 1'-0" B.F.V. \*

5c11 @ 1'-0" B.F.V.

Long Wall

Footing

Back Face Wingwall

Front Face Wingwall

6p2

4d2

5c14

6p1

Interior Wall Faces

Parapet Faces

CL Culvert

4d1 @ 1'-6"

4d1 @ 1'-6"

5c14

4d1

4d3

6p3

5t1 @ 1'-3"

3'-0"

6"

5c10 @ 1'-0" B.F.V.

6'-6"

14'-0" \*

1'-0"

1'-6"

2'-0"

Short Wall

5c12 @ 1'-0" B.F.V.

6c13 @ 1'-0" B.F.V. \*

4c2 @ 1'-0" F.F.V.

4c4 @ 1'-0" F.F.V. Δ

6m4 @ 1'-0"

21'-0" Δ

1'-10"

End of Apron

\* - See Note 3

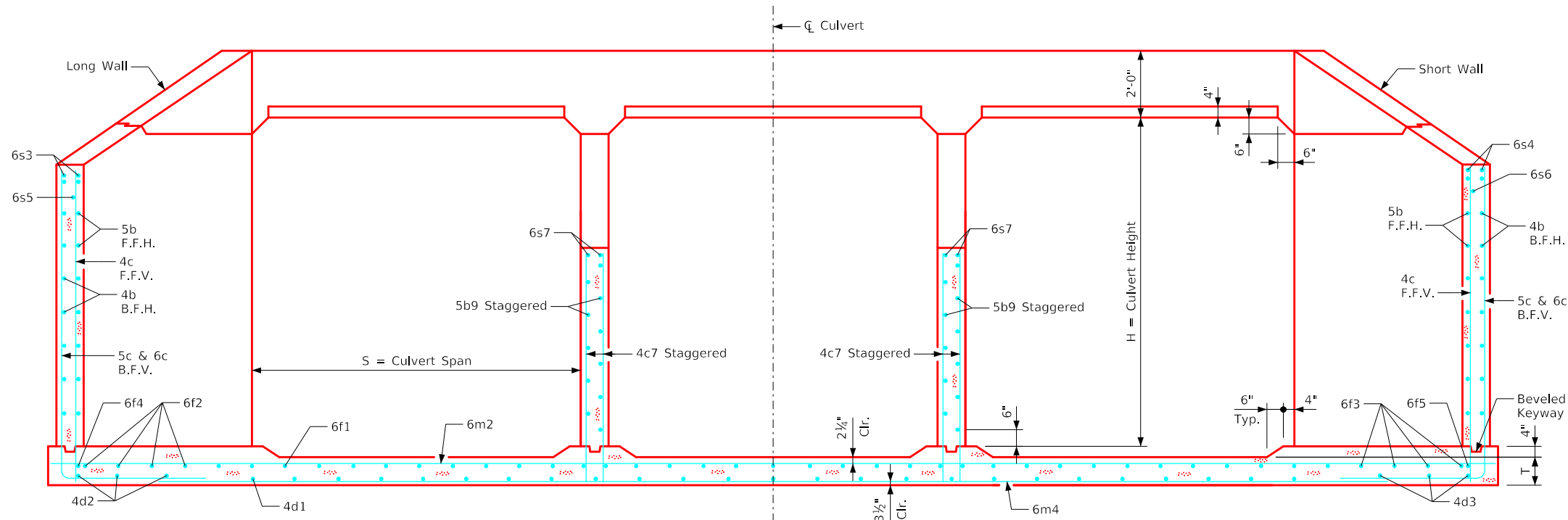
Δ - See Note 4

\* - See Note 3  
Δ - See Note 4

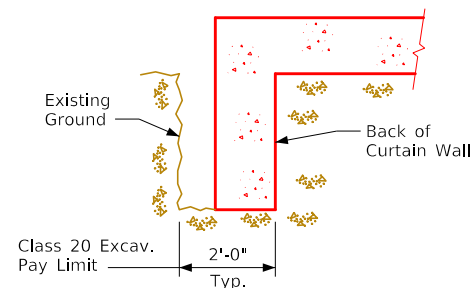
1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Wingwall bars consistently referenced from end of wing for all headwalls.
3. There are no 6c13 bars in the 4' & 5' height headwalls.
4. 4c3 & 4c4 bars used only in the 9', 10', 11' & 12' height headwalls.
5. For dimension table see Sheet TRFWH 15-2-21.
6. For reinforcing in curtain wall see Curtain Wall Details on Sheet TRFWH 15-5-21.

1/16/2021 5:26:26 PM bkloss W:\Highway\Bridge\Standards\Culverts\LRFD\EnglishLRFDSignedTripleCulvertsFWH.dgn TRFWH 15-4-21 11x17\_.pdf.pltcf

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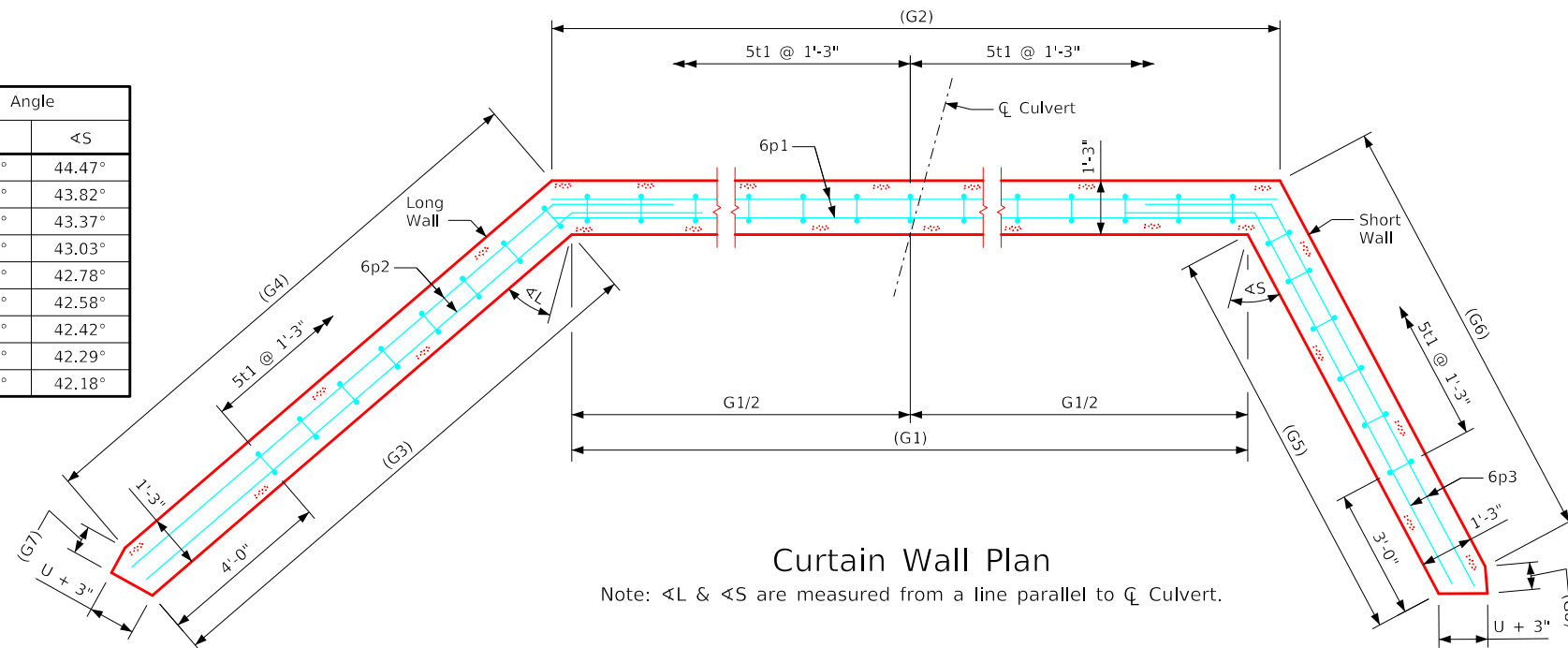


Typical Section - Near Center of Apron



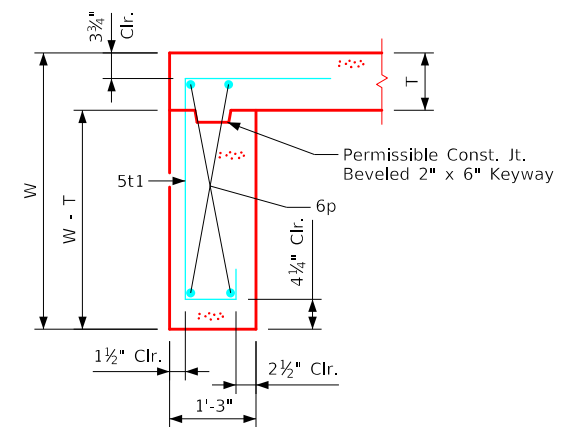
Curtain Wall  
Class 20 Excavation

| Culvert Height (H) | Angle  |        |
|--------------------|--------|--------|
|                    | <L     | <S     |
| 4'                 | 35.41° | 44.47° |
| 5'                 | 35.06° | 43.82° |
| 6'                 | 34.82° | 43.37° |
| 7'                 | 34.64° | 43.03° |
| 8'                 | 34.50° | 42.78° |
| 9'                 | 34.39° | 42.58° |
| 10'                | 34.31° | 42.42° |
| 11'                | 34.24° | 42.29° |
| 12'                | 34.18° | 42.18° |

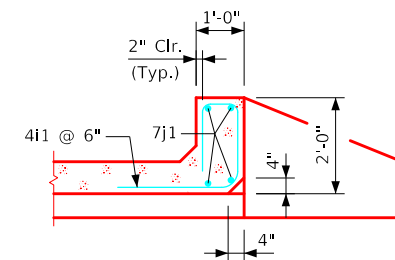


Curtain Wall Plan

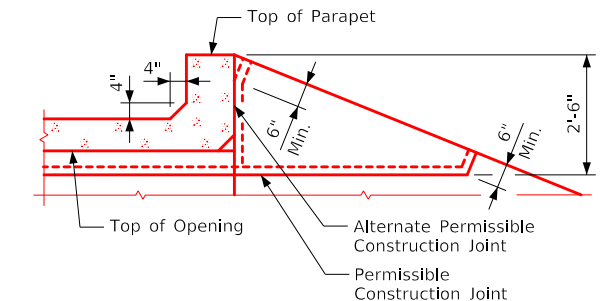
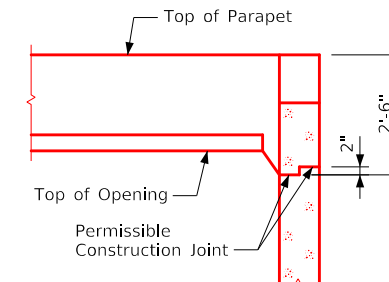
Note: <L & <S are measured from a line parallel to Q Culvert.



Section thru Curtain Wall



Section thru Parapet



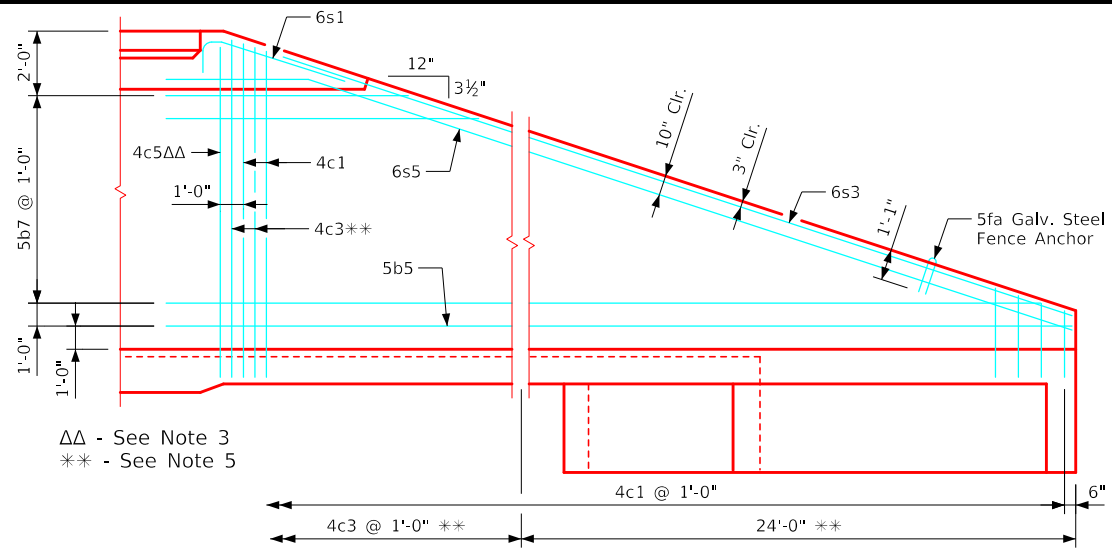
Top of Wingwall Details

Notes:

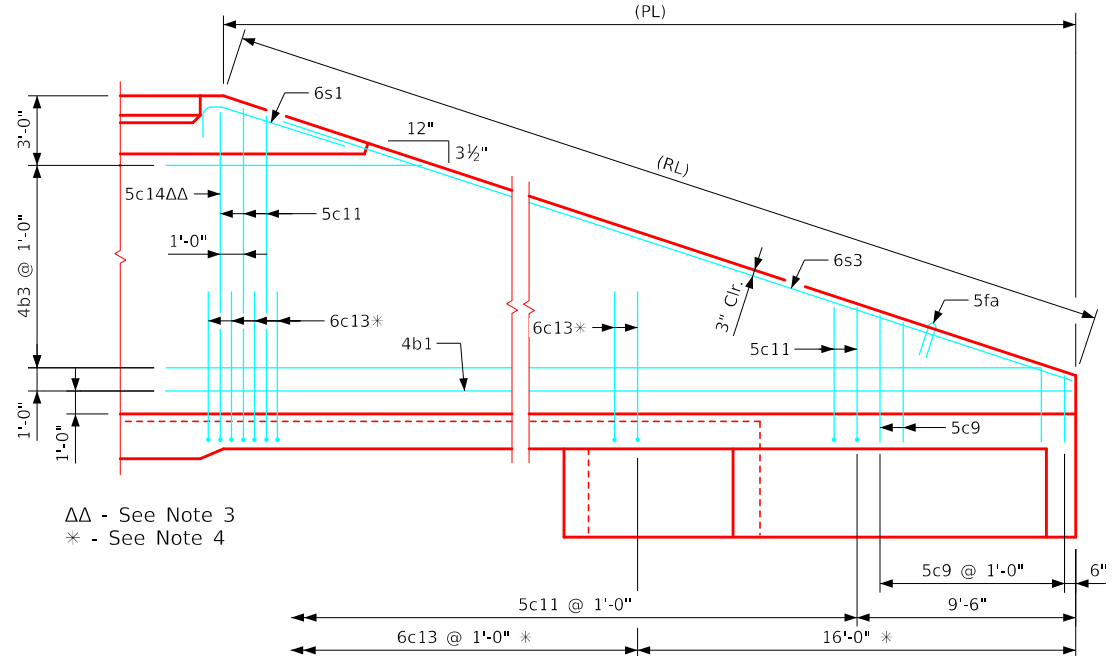
1. See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. For dimension table see Sheet TRFWH 15-2-21.

|                      |                                                                                       |                                                                                       |                  |
|----------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------|
| LATEST REVISION DATE |  |  |                  |
|                      |                                                                                       | Standard Design - Triple Reinforced Concrete Box Culverts                             |                  |
|                      |                                                                                       | Flared Wing Headwalls                                                                 |                  |
|                      |                                                                                       | February, 2021                                                                        |                  |
|                      |                                                                                       | Parapet & Curtain Wall Details<br>15° Skew                                            | TRFWH<br>15-5-21 |

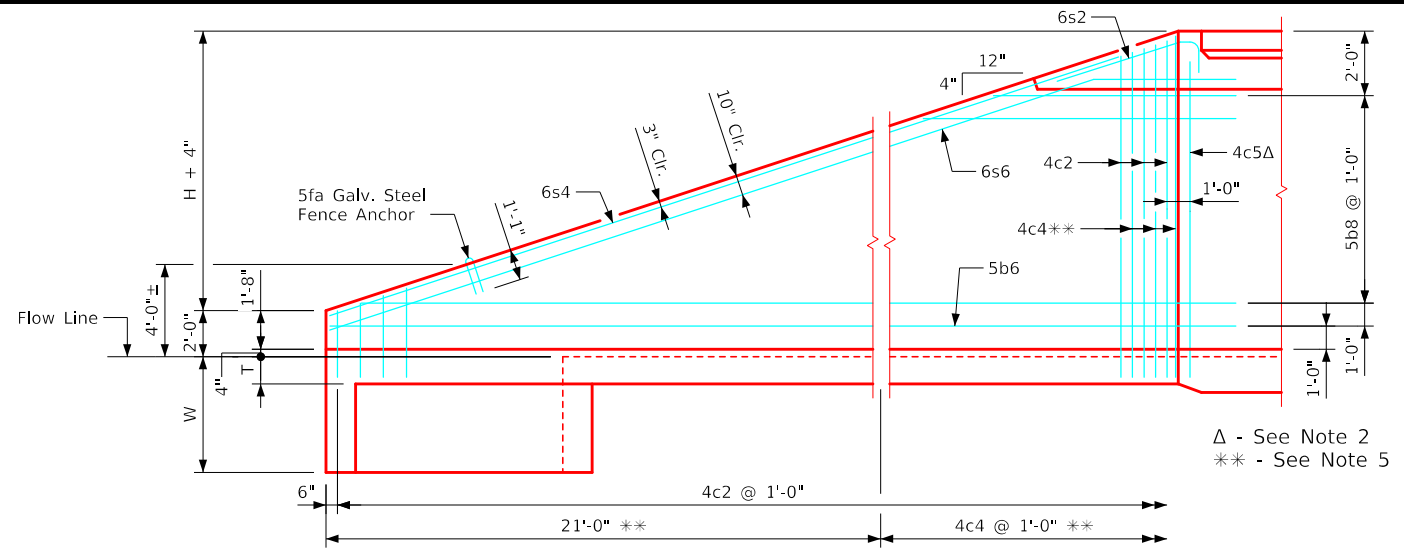
ENGLISHLRFDSIGNEDTRIPLECULVERTSFWH.DGN - TRFWH 15-6-21 - THIS SHEET ISSUED 02-2021.



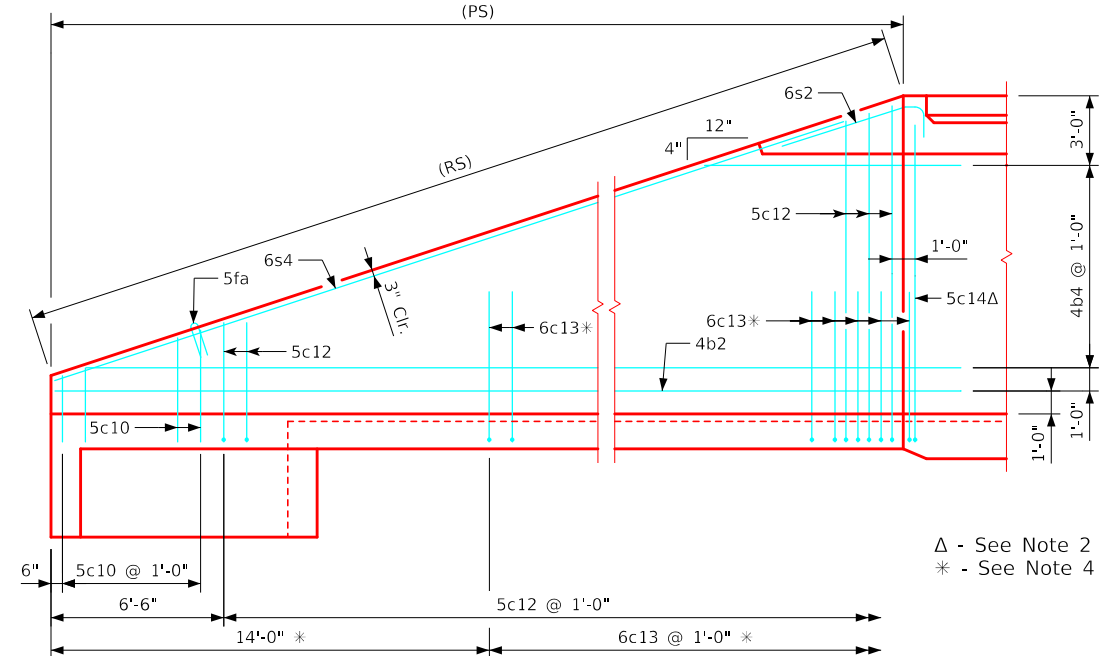
Typical View - Front Face Long Wingwall Reinforcing



Typical View - Back Face Long Wingwall Reinforcing

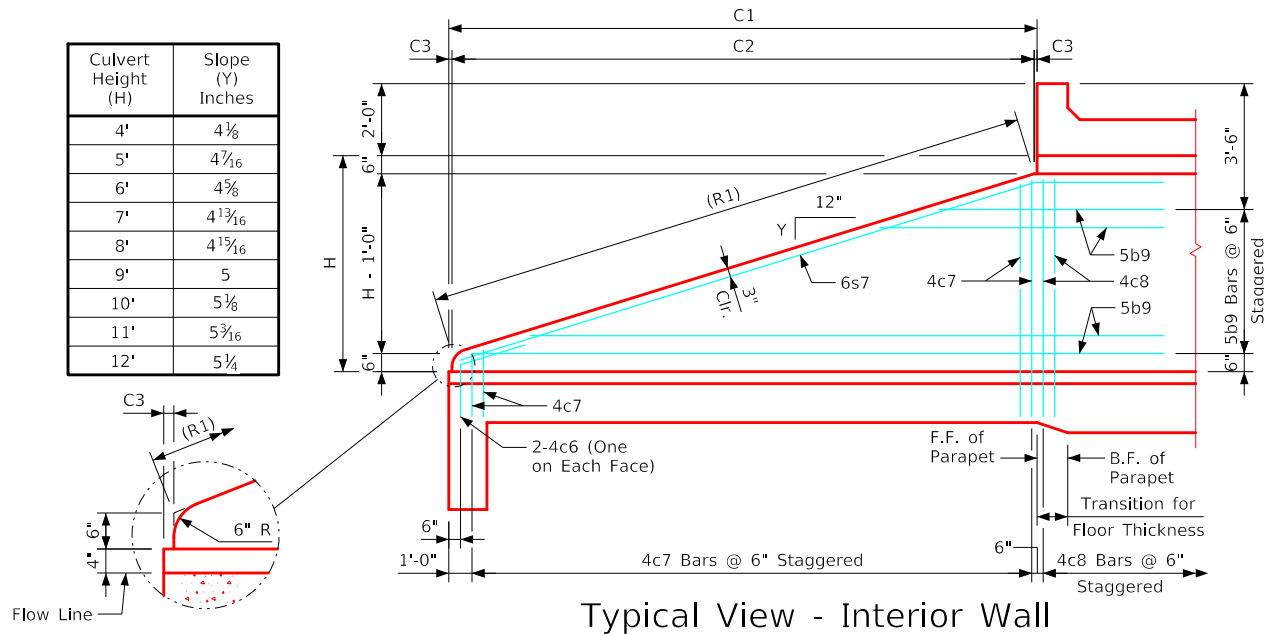


Typical View - Front Face Short Wingwall Reinforcing



Typical View - Back Face Short Wingwall Reinforcing

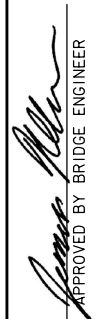
| Culvert Height (H) | Slope (Y) Inches |
|--------------------|------------------|
| 4'                 | 4 1/8            |
| 5'                 | 4 1/16           |
| 6'                 | 4 3/8            |
| 7'                 | 4 13/16          |
| 8'                 | 4 15/16          |
| 9'                 | 5                |
| 10'                | 5 1/8            |
| 11'                | 5 3/16           |
| 12'                | 5 1/4            |



Typical View - Interior Wall

#### Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Two 4c5 & two 5c14 bars for all headwalls.
3. Two 4c5 & two 5c14 for 5', 7', 9', 10' & 12' height headwalls. One 4c5 & one 5c14 bar for 4', 6', 8' & 11' height headwalls.
4. Not applicable for 4' & 5' height headwalls.
5. Not applicable for 4' thru 8' height headwalls.
6. For dimension table, see sheet TRFWH 15-2-21.
7. Top of wall slope may be rounded in some instances.

|                              |                                                                                                                      |                                                                                                                                                    |  |
|------------------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--|
| LATEST REVISION DATE         | <br>APPROVED BY BRIDGE ENGINEER | <br>Standard Design - Triple Reinforced Concrete Box Culverts |  |
|                              |                                                                                                                      | Flared Wing Headwalls                                                                                                                              |  |
|                              |                                                                                                                      | February, 2021                                                                                                                                     |  |
| Wingwall Details<br>15° Skew |                                                                                                                      | TRFWH<br>15-6-21                                                                                                                                   |  |

ENGLISHLRFDSignedTRIPLECulvertsFWH.DGN - TRFWH 15-7-21 S1 - THIS SHEET ISSUED 02-2021.

| Bill of Reinforcing for One Headwall 15° Skew Span x Culvert Height |                                   |                                                                                     |           |                         |      |           |                         |          |           |                         |      |           |                         |         |          |                         |      |      |  |  |  |  |
|---------------------------------------------------------------------|-----------------------------------|-------------------------------------------------------------------------------------|-----------|-------------------------|------|-----------|-------------------------|----------|-----------|-------------------------|------|-----------|-------------------------|---------|----------|-------------------------|------|------|--|--|--|--|
| Bar                                                                 | Location                          | Shape                                                                               | 12' x 12' |                         |      | 12' x 11' |                         |          | 12' x 10' |                         |      | 12' x 9'  |                         |         | 12' x 8' |                         |      | Bar  |  |  |  |  |
|                                                                     |                                   |                                                                                     | No.       | Length                  | Wt.  | No.       | Length                  | Wt.      | No.       | Length                  | Wt.  | No.       | Length                  | Wt.     | No.      | Length                  | Wt.  |      |  |  |  |  |
| 5fa                                                                 | Fence Anchor (Galv.)              |    | 2         | 2'-10                   | 6    | 2         | 2'-10                   | 6        | 2         | 2'-10                   | 6    | 2         | 2'-10                   | 6       | 2        | 2'-10                   | 6    | 5fa  |  |  |  |  |
| 4b1                                                                 | Wingwall, B.F.H. Long             |    | 1         | 45'-7                   | 32   | 1         | 42'-2                   | 30       | 1         | 38'-9                   | 26   | 1         | 35'-4                   | 24      | 1        | 31'-11                  | 21   | 4b1  |  |  |  |  |
| 4b2                                                                 | Wingwall, B.F.H. Short            |    | 1         | 40'-4                   | 29   | 1         | 37'-4                   | 25       | 1         | 34'-4                   | 23   | 1         | 31'-4                   | 21      | 1        | 28'-4                   | 19   | 4b2  |  |  |  |  |
| 4b3                                                                 | Wingwall, B.F.H. Long             |    | 10 Var.   | 13'-2 to 44'-0          | 194  | 9 Var.    | 13'-2 to 40'-7          | 163      | 8 Var.    | 13'-2 to 37'-2          | 134  | 7 Var.    | 13'-2 to 33'-9          | 110     | 6 Var.   | 13'-2 to 30'-4          | 87   | 4b3  |  |  |  |  |
| 4b4                                                                 | Wingwall, B.F.H. Short            |    | 10 Var.   | 11'-11 to 38'-11        | 170  | 9 Var.    | 11'-11 to 35'-11        | 144      | 8 Var.    | 11'-11 to 32'-11        | 120  | 7 Var.    | 11'-11 to 29'-11        | 98      | 6 Var.   | 11'-11 to 26'-11        | 78   | 4b4  |  |  |  |  |
| 5b5                                                                 | Wingwall, F.F.H. Long             |    | 1         | 45'-8                   | 50   | 1         | 42'-3                   | 47       | 1         | 38'-10                  | 41   | 1         | 35'-5                   | 37      | 1        | 31'-11                  | 33   | 5b5  |  |  |  |  |
| 5b6                                                                 | Wingwall, F.F.H. Short            |    | 1         | 40'-4                   | 45   | 1         | 37'-4                   | 39       | 1         | 34'-4                   | 36   | 1         | 31'-4                   | 33      | 1        | 28'-4                   | 30   | 5b6  |  |  |  |  |
| 5b7                                                                 | Wingwall, F.F.H. Long             |    | 11 Var.   | 9'-10 to 44'-1          | 314  | 10 Var.   | 9'-10 to 40'-8          | 266      | 9 Var.    | 9'-10 to 37'-3          | 221  | 8 Var.    | 9'-10 to 33'-10         | 182     | 7 Var.   | 9'-10 to 30'-5          | 147  | 5b7  |  |  |  |  |
| 5b8                                                                 | Wingwall, F.F.H. Short            |    | 11 Var.   | 9'-0 to 39'-0           | 275  | 10 Var.   | 9'-0 to 36'-0           | 235      | 9 Var.    | 9'-0 to 33'-0           | 197  | 8 Var.    | 9'-0 to 30'-0           | 163     | 7 Var.   | 9'-0 to 27'-0           | 131  | 5b8  |  |  |  |  |
| 5b9                                                                 | Interior Wall, Both F.H.          |    | 42 Var.   | 2 Each<br>5'-6 to 28'-6 | 745  | 38 Var.   | 2 Each<br>5'-6 to 26'-5 | 632      | 34 Var.   | 2 Each<br>5'-6 to 24'-4 | 529  | 30 Var.   | 2 Each<br>5'-7 to 22'-3 | 435     | 26 Var.  | 2 Each<br>5'-7 to 20'-2 | 349  | 5b9  |  |  |  |  |
| 4c1                                                                 | Wingwall, F.F.V. Long             |    | 42 Var.   | 2'-10 to 14'-10         | 248  | 39 Var.   | 2'-10 to 13'-11         | 218      | 35 Var.   | 2'-10 to 12'-9          | 182  | 32 Var.   | 2'-10 to 11'-11         | 158     | 29 Var.  | 2'-10 to 11'-0          | 134  | 4c1  |  |  |  |  |
| 4c2                                                                 | Wingwall, F.F.V. Short            |    | 37 Var.   | 2'-10 to 14'-10         | 218  | 34 Var.   | 2'-10 to 13'-10         | 189      | 31 Var.   | 2'-10 to 12'-10         | 162  | 28 Var.   | 2'-10 to 11'-10         | 137     | 25 Var.  | 2'-10 to 10'-10         | 114  | 4c2  |  |  |  |  |
| 4c3                                                                 | Wingwall, F.F.V. Long             |    | 19 Var.   | 9'-8 to 14'-11          | 156  | 16 Var.   | 9'-8 to 14'-1           | 127      | 12 Var.   | 9'-8 to 12'-11          | 91   | 9 Var.    | 9'-8 to 12'-0           | 65      | --       | --                      | --   | 4c3  |  |  |  |  |
| 4c4                                                                 | Wingwall, F.F.V. Short            |    | 17 Var.   | 9'-8 to 15'-0           | 140  | 14 Var.   | 9'-8 to 14'-0           | 111      | 11 Var.   | 9'-8 to 13'-0           | 83   | 8 Var.    | 9'-8 to 12'-0           | 58      | --       | --                      | --   | 4c4  |  |  |  |  |
| 4c5                                                                 | Wingwall, F.F.V. Long             |    | 2         | 13'-9                   | 18   | 1         | 12'-9                   | 9        | 2         | 11'-9                   | 16   | 2         | 10'-9                   | 14      | 1        | 9'-9                    | 7    | 4c5  |  |  |  |  |
| 4c5                                                                 | Wingwall, F.F.V. Short            |    | 2         | 13'-9                   | 18   | 2         | 12'-9                   | 17       | 2         | 11'-9                   | 16   | 2         | 10'-9                   | 14      | 2        | 9'-9                    | 13   | 4c5  |  |  |  |  |
| 4c6                                                                 | Interior Wall, Both F.V.          |    | 4         | 4'-2                    | 11   | 4         | 4'-2                    | 11       | 4         | 4'-2                    | 11   | 4         | 4'-2                    | 11      | 4        | 4'-2                    | 11   | 4c6  |  |  |  |  |
| 4c7                                                                 | Interior Wall, Both F.V.          |    | 98 Var.   | 2 Each<br>2'-0 to 12'-5 | 472  | 90 Var.   | 1'-11 to 11'-5          | 401      | 82 Var.   | 1'-11 to 10'-5          | 338  | 74 Var.   | 1'-11 to 9'-6           | 282     | 66 Var.  | 1'-11 to 8'-6           | 230  | 4c7  |  |  |  |  |
| 4c8                                                                 | Interior Wall, Both F.V.          |    | 4         | 12'-7                   | 34   | 4         | 11'-7                   | 31       | 4         | 10'-7                   | 28   | 4         | 9'-7                    | 26      | 4        | 8'-7                    | 23   | 4c8  |  |  |  |  |
| 5c9                                                                 | Wingwall, B.F.V. Long             |    | 9 Var.    | 2'-10 to 5'-2           | 38   | 9 Var.    | 2'-10 to 5'-2           | 38       | 9 Var.    | 2'-10 to 5'-2           | 38   | 9 Var.    | 2'-10 to 5'-2           | 38      | 9 Var.   | 2'-10 to 5'-2           | 38   | 5c9  |  |  |  |  |
| 5c10                                                                | Wingwall, B.F.V. Short            |    | 6 Var.    | 2'-10 to 4'-6           | 23   | 6 Var.    | 2'-10 to 4'-6           | 23       | 6 Var.    | 2'-10 to 4'-6           | 23   | 6 Var.    | 2'-10 to 4'-6           | 23      | 6 Var.   | 2'-10 to 4'-6           | 23   | 5c10 |  |  |  |  |
| 5c11                                                                | Wingwall, B.F.V. Long             |    | 33 Var.   | 9'-6 to 18'-10          | 488  | 30 Var.   | 9'-6 to 17'-11          | 429      | 26 Var.   | 9'-6 to 16'-9           | 356  | 23 Var.   | 9'-6 to 15'-11          | 305     | 20 Var.  | 9'-6 to 15'-0           | 256  | 5c11 |  |  |  |  |
| 5c12                                                                | Wingwall, B.F.V. Short            |    | 31 Var.   | 8'-10 to 18'-10         | 447  | 28 Var.   | 8'-10 to 17'-10         | 389      | 25 Var.   | 8'-10 to 16'-10         | 335  | 22 Var.   | 8'-10 to 15'-10         | 283     | 19 Var.  | 8'-10 to 14'-10         | 235  | 5c12 |  |  |  |  |
| 6c13                                                                | Wingwall, B.F.V. Long             |    | 27        | 10'-6                   | 426  | 24        | 10'-6                   | 379      | 20        | 10'-6                   | 315  | 17        | 10'-6                   | 268     | 14       | 10'-6                   | 221  | 6c13 |  |  |  |  |
| 6c13                                                                | Wingwall, B.F.V. Short            |    | 24        | 10'-6                   | 379  | 21        | 10'-6                   | 331      | 18        | 10'-6                   | 284  | 15        | 10'-6                   | 237     | 12       | 10'-6                   | 189  | 6c13 |  |  |  |  |
| 5c14                                                                | Wingwall, B.F.V. Long             |    | 2         | 17'-9                   | 37   | 1         | 16'-9                   | 17       | 2         | 15'-9                   | 33   | 2         | 14'-9                   | 31      | 1        | 13'-9                   | 14   | 5c14 |  |  |  |  |
| 5c14                                                                | Wingwall, B.F.V. Short            |    | 2         | 17'-9                   | 37   | 2         | 16'-9                   | 35       | 2         | 15'-9                   | 33   | 2         | 14'-9                   | 31      | 2        | 13'-9                   | 29   | 5c14 |  |  |  |  |
| 4d1                                                                 | Apron, Longit., Bott.             |    | 25        | 28'-10                  | 482  | 25        | 26'-9                   | 447      | 25        | 24'-9                   | 413  | 25        | 22'-8                   | 379     | 25       | 20'-7                   | 344  | 4d1  |  |  |  |  |
| 4d2                                                                 | Apron, Longit., Bott. Long        |  | 3         | 40'-3                   | 86   | 3         | 36'-10                  | 74       | 3         | 33'-5                   | 67   | 3         | 30'-0                   | 60      | 3        | 26'-7                   | 53   | 4d2  |  |  |  |  |
| 4d3                                                                 | Apron, Longit., Bott. Short       |  | 3         | 35'-6                   | 71   | 3         | 32'-5                   | 65       | 3         | 29'-5                   | 59   | 3         | 26'-5                   | 53      | 3        | 23'-5                   | 47   | 4d3  |  |  |  |  |
| 6f1                                                                 | Apron, Longit., Top               |  | 37        | 28'-10                  | 1602 | 37        | 26'-9                   | 1487     | 37        | 24'-9                   | 1375 | 37        | 22'-8                   | 1260    | 37       | 20'-7                   | 1144 | 6f1  |  |  |  |  |
| 6f2                                                                 | Apron, Longit., Top Long          |  | 9 Var.    | 5'-5 to 25'-7           | 210  | 8 Var.    | 5'-10 to 23'-6          | 176      | 7 Var.    | 6'-3 to 21'-5           | 145  | 6 Var.    | 6'-8 to 19'-5           | 118     | 5 Var.   | 7'-2 to 17'-4           | 92   | 6f2  |  |  |  |  |
| 6f3                                                                 | Apron, Longit., Top Short         |  | 8 Var.    | 5'-5 to 25'-8           | 187  | 7 Var.    | 6'-3 to 23'-8           | 157      | 6 Var.    | 7'-0 to 21'-7           | 129  | 6 Var.    | 4'-11 to 19'-6          | 110     | 5 Var.   | 5'-9 to 17'-5           | 87   | 6f3  |  |  |  |  |
| 6f4                                                                 | Apron, Longit., Top Long          |  | 1         | 45'-8                   | 72   | 1         | 42'-3                   | 67       | 1         | 38'-10                  | 58   | 1         | 35'-5                   | 53      | 1        | 31'-11                  | 48   | 6f4  |  |  |  |  |
| 6f5                                                                 | Apron, Longit., Top Short         |  | 1         | 40'-4                   | 64   | 1         | 37'-4                   | 56       | 1         | 34'-4                   | 52   | 1         | 31'-4                   | 47      | 1        | 28'-4                   | 43   | 6f5  |  |  |  |  |
| 4i1                                                                 | Parapet, Vertical                 |  | 77        | 6'-2                    | 317  | 75        | 6'-2                    | 309      | 75        | 6'-2                    | 309  | 75        | 6'-2                    | 309     | 75       | 6'-2                    | 309  | 4i1  |  |  |  |  |
| 7j1                                                                 | Parapet, Horizontal               |  | 4         | 41'-0                   | 355  | 4         | 40'-8                   | 352      | 4         | 40'-4                   | 350  | 4         | 40'-4                   | 350     | 4        | 40'-4                   | 350  | 7j1  |  |  |  |  |
| 6m1                                                                 | Apron, Trans., Top                |  | 8 Var.    | 41'-3 to 42'-7          | 533  | 8 Var.    | 40'-11 to 42'-3         | 529      | 8 Var.    | 40'-7 to 41'-11         | 525  | 8 Var.    | 40'-7 to 41'-11         | 525     | 8 Var.   | 40'-7 to 41'-11         | 525  | 6m1  |  |  |  |  |
| 6m2                                                                 | Apron, Trans., Top                |  | 21 Var.   | 42'-10 to 50'-4         | 1546 | 18 Var.   | 42'-6 to 48'-11         | 1301     | 15 Var.   | 42'-2 to 47'-5          | 1064 | 12 Var.   | 42'-2 to 46'-3          | 840     | 10 Var.  | 42'-2 to 45'-6          | 695  | 6m2  |  |  |  |  |
| 6m3                                                                 | Apron, Trans., Top                |  | 13 Var.   | 8'-10 to 40'-2          | 482  | 13 Var.   | 8'-9 to 40'-1           | 480      | 14 Var.   | 6'-1 to 40'-1           | 489  | 14 Var.   | 6'-3 to 40'-2           | 492     | 13 Var.  | 6'-4 to 37'-8           | 430  | 6m3  |  |  |  |  |
| 6m4                                                                 | Apron, Trans., Bott.              |  | 24 Var.   | 34'-11 to 47'-4         | 1533 | 22 Var.   | 34'-9 to 46'-1          | 1379     | 20 Var.   | 34'-7 to 44'-10         | 1225 | 18 Var.   | 34'-7 to 43'-9          | 1084    | 16 Var.  | 34'-7 to 42'-8          | 947  | 6m4  |  |  |  |  |
| 6p1                                                                 | Curtain, Horizontal               |  | 4         | 39'-7                   | 238  | 4         | 39'-5                   | 237      | 4         | 39'-3                   | 236  | 4         | 39'-3                   | 236     | 4        | 39'-3                   | 236  | 6p1  |  |  |  |  |
| 6p2                                                                 | Curtain, Horizontal, Long         |  | 4         | 21'-9                   | 131  | 4         | 20'-3                   | 122      | 4         | 18'-9                   | 113  | 4         | 17'-3                   | 104     | 4        | 15'-9                   | 95   | 6p2  |  |  |  |  |
| 6p3                                                                 | Curtain, Horizontal, Short        |  | 4         | 16'-10                  | 101  | 4         | 15'-9                   | 95       | 4         | 14'-7                   | 88   | 4         | 13'-6                   | 81      | 4        | 12'-5                   | 75   | 6p3  |  |  |  |  |
| 6s1                                                                 | Wing Slope, Both F., Long         |  | 2         | 6'-11                   | 21   | 2         | 6'-11                   | 21       | 2         | 6'-11                   | 21   | 2         | 6'-11                   | 21      | 2        | 6'-11                   | 21   | 6s1  |  |  |  |  |
| 6s2                                                                 | Wing Slope, Both F., Short        |  | 2         | 6'-6                    | 20   | 2         | 6'-6                    | 20       | 2         | 6'-6                    | 20   | 2         | 6'-6                    | 20      | 2        | 6'-6                    | 20   | 6s2  |  |  |  |  |
| 6s3                                                                 | Wing Slope, Both F., Long         |  | 2         | 41'-3                   | 131  | 2         | 37'-9                   | 113      | 2         | 34'-2                   | 103  | 2         | 30'-7                   | 92      | 2        | 27'-0                   | 81   | 6s3  |  |  |  |  |
| 6s4                                                                 | Wing Slope, Both F., Short        |  | 2         | 36'-11                  | 111  | 2         | 33'-9                   | 101      | 2         | 30'-7                   | 92   | 2         | 27'-5                   | 82      | 2        | 24'-3                   | 73   | 6s4  |  |  |  |  |
| 6s5                                                                 | Wing Slope, F.F. Long             |  | 1         | 46'-5                   | 73   | 1         | 42'-10                  | 68       | 1         | 39'-3                   | 59   | 1         | 35'-8                   | 54      | 1        | 32'-1                   | 48   | 6s5  |  |  |  |  |
| 6s6                                                                 | Wing Slope, F.F. Short            |  | 1         | 41'-8                   | 66   | 1         | 38'-6                   | 58       | 1         | 35'-4                   | 53   | 1         | 32'-2                   | 48      | 1        | 29'-0                   | 44   | 6s6  |  |  |  |  |
| 6s7                                                                 | Interior Wall, Both F.H.          |  | 4         | 30'-9                   | 185  | 4         | 28'-6                   | 171      | 4         | 26'-3                   | 158  | 4         | 23'-11                  | 144     | 4        | 21'-8                   | 130  | 6s7  |  |  |  |  |
| 5t1                                                                 | Curtain, Vertical                 |  | 52        | 7'-11                   | 429  | 50        | 7'-8                    | 400      | 48        | 7'-5                    | 371  | 47        | 7'-2                    | 351     | 45       | 6'-11                   | 325  | 5t1  |  |  |  |  |
|                                                                     | Estimated Quantities One Headwall | Reinf. Steel                                                                        | 14,096 LB |                         |      | 12,627 LB |                         |          | 11,251 LB |                         |      | 10,003 LB |                         |         | 8700 LB  |                         |      |      |  |  |  |  |
|                                                                     |                                   |                                                                                     | Concrete  | Parapet Δ               | 4.0  | 117.6 CY  | 3.9                     | 101.9 CY | 3.8       | 87.6 CY                 | 3.8  | 77.0 CY   | 3.8                     | 67.1 CY |          |                         |      |      |  |  |  |  |
|                                                                     |                                   | Wingwalls                                                                           |           | 35.6                    | 28.0 |           | 21.5                    |          | 17.8      |                         | 14.4 |           |                         |         |          |                         |      |      |  |  |  |  |
|                                                                     |                                   | Apron *                                                                             |           | 78.0                    | 70.0 |           | 62.3                    |          | 55.4      |                         | 48.9 |           |                         |         |          |                         |      |      |  |  |  |  |

Δ Includes top of wingwall quantities.

\* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall  
"Long" Denotes Long Wingwall

### Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER



Standard Design - Triple Reinforced Concrete Box Culverts

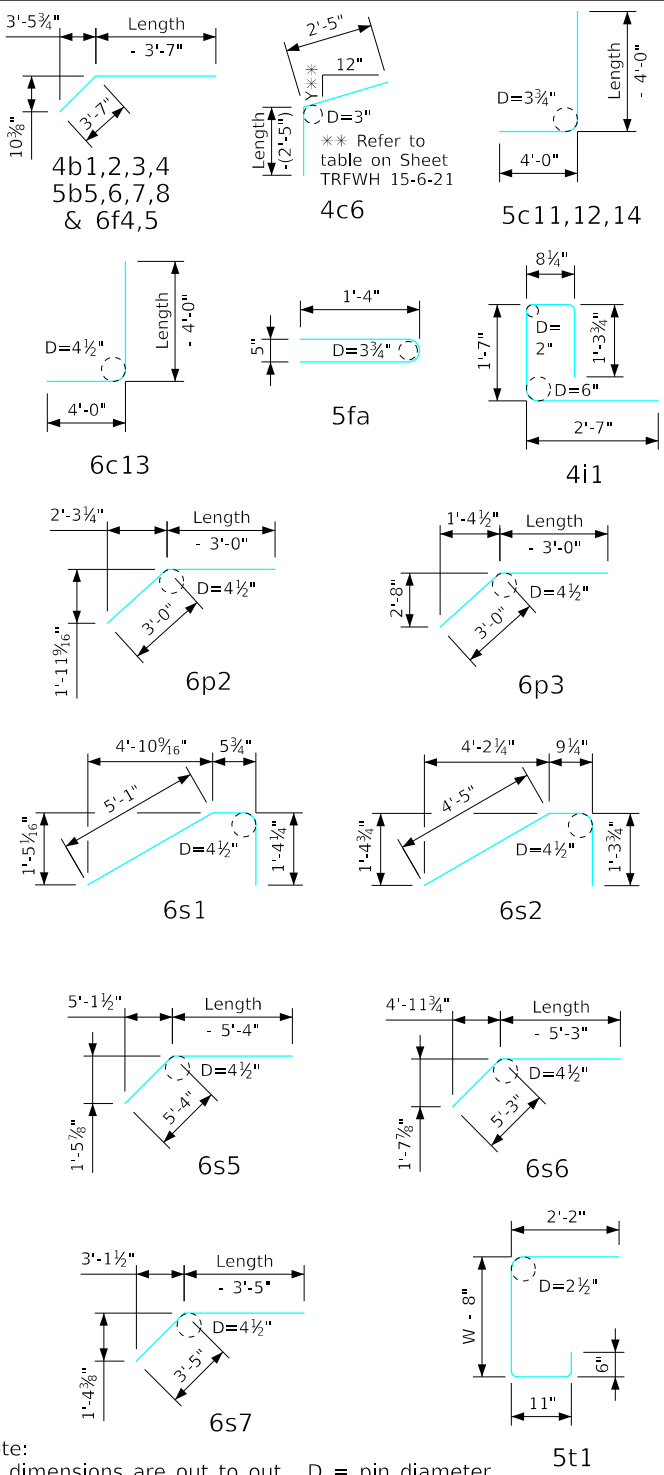
### Flared Wing Headwalls

February, 2021

Quantity Tabulation  
12'-0" Span  
15° Skew

TRFWH  
15-7-21  
Sheet 1 of 2

Note:  
All dimensions are out to out. D = pin diameter.



| Bill of Reinforcing for One Headwall 15° Skew Span x Culvert Height |                                   |                                                                                      |           |                         |         |          |                         |      |          |                          |         |          |                          |     |      |  |
|---------------------------------------------------------------------|-----------------------------------|--------------------------------------------------------------------------------------|-----------|-------------------------|---------|----------|-------------------------|------|----------|--------------------------|---------|----------|--------------------------|-----|------|--|
| Bar                                                                 | Location                          | Shape                                                                                | 12' x 7'  |                         |         | 12' x 6' |                         |      | 12' x 5' |                          |         | 12' x 4' |                          |     | Bar  |  |
|                                                                     |                                   |                                                                                      | No.       | Length                  | Wt.     | No.      | Length                  | Wt.  | No.      | Length                   | Wt.     | No.      | Length                   | Wt. |      |  |
| 5fa                                                                 | Fence Anchor (Galv.)              |    | 2         | 2'-10                   | 6       | 2        | 2'-10                   | 6    | 2        | 2'-10                    | 6       | 2        | 2'-10                    | 6   | 5fa  |  |
| 4b1                                                                 | Wingwall, B.F.H. Long             |    | 1         | 28'-6                   | 19      | 1        | 25'-1                   | 17   | 1        | 21'-7                    | 14      | 1        | 18'-2                    | 12  | 4b1  |  |
| 4b2                                                                 | Wingwall, B.F.H. Short            |    | 1         | 25'-4                   | 17      | 1        | 22'-4                   | 15   | 1        | 19'-4                    | 13      | 1        | 16'-4                    | 11  | 4b2  |  |
| 4b3                                                                 | Wingwall, B.F.H. Long             |    | 5 Var.    | 13'-2 to 26'-11         | 67      | 4 Var.   | 13'-2 to 23'-6          | 49   | 3 Var.   | 13'-2 to 20'-1           | 33      | 2 Var.   | 13'-2 to 16'-7           | 20  | 4b3  |  |
| 4b4                                                                 | Wingwall, B.F.H. Short            |    | 5 Var.    | 11'-11 to 23'-11        | 60      | 4 Var.   | 11'-11 to 20'-11        | 44   | 3 Var.   | 11'-11 to 17'-11         | 30      | 2 Var.   | 11'-11 to 14'-11         | 18  | 4b4  |  |
| 5b5                                                                 | Wingwall, F.F.H. Long             |    | 1         | 28'-6                   | 30      | 1        | 25'-1                   | 26   | 1        | 21'-8                    | 23      | 1        | 18'-3                    | 19  | 5b5  |  |
| 5b6                                                                 | Wingwall, F.F.H. Short            |    | 1         | 25'-4                   | 26      | 1        | 22'-4                   | 23   | 1        | 19'-4                    | 20      | 1        | 16'-4                    | 17  | 5b6  |  |
| 5b7                                                                 | Wingwall, F.F.H. Long             |    | 6 Var.    | 9'-10 to 26'-11         | 115     | 5 Var.   | 9'-10 to 23'-6          | 87   | 4 Var.   | 9'-10 to 20'-1           | 62      | 3 Var.   | 9'-9 to 16'-8            | 41  | 5b7  |  |
| 5b8                                                                 | Wingwall, F.F.H. Short            |    | 6 Var.    | 9'-0 to 24'-0           | 103     | 5 Var.   | 9'-0 to 21'-0           | 78   | 4 Var.   | 9'-0 to 18'-0            | 56      | 3 Var.   | 9'-0 to 15'-0            | 38  | 5b8  |  |
| 5b9                                                                 | Interior Wall, Both F.H.          |    | 22 Var.   | 2 Each<br>5'-8 to 18'-2 | 273     | 18 Var.  | 2 Each<br>5'-9 to 16'-1 | 205  | 14 Var.  | 2 Each<br>5'-10 to 14'-0 | 145     | 10 Var.  | 2 Each<br>6'-0 to 11'-10 | 93  | 5b9  |  |
| 4c1                                                                 | Wingwall, F.F.V. Long             |    | 25 Var.   | 2'-10 to 9'-10          | 106     | 22 Var.  | 2'-10 to 9'-0           | 87   | 18 Var.  | 2'-10 to 7'-10           | 64      | 15 Var.  | 2'-10 to 6'-11           | 49  | 4c1  |  |
| 4c2                                                                 | Wingwall, F.F.V. Short            |    | 22 Var.   | 2'-10 to 9'-10          | 93      | 19 Var.  | 2'-10 to 8'-10          | 74   | 16 Var.  | 2'-10 to 7'-10           | 57      | 13 Var.  | 2'-10 to 6'-10           | 42  | 4c2  |  |
| 4c3                                                                 | Wingwall, F.F.V. Long             |    | --        | --                      | --      | --       | --                      | --   | --       | --                       | --      | --       | --                       | --  | 4c3  |  |
| 4c4                                                                 | Wingwall, F.F.V. Short            |    | --        | --                      | --      | --       | --                      | --   | --       | --                       | --      | --       | --                       | --  | 4c4  |  |
| 4c5                                                                 | Wingwall, F.F.V. Long             |    | 2         | 8'-9                    | 12      | 1        | 7'-9                    | 5    | 2        | 6'-9                     | 9       | 1        | 5'-9                     | 4   | 4c5  |  |
| 4c5                                                                 | Wingwall, F.F.V. Short            |    | 2         | 8'-9                    | 12      | 2        | 7'-9                    | 10   | 2        | 6'-9                     | 9       | 2        | 5'-9                     | 8   | 4c5  |  |
| 4c6                                                                 | Interior Wall, Both F.V.          |    | 4         | 4'-2                    | 11      | 4        | 4'-2                    | 11   | 4        | 4'-2                     | 11      | 4        | 4'-1                     | 11  | 4c6  |  |
| 4c7                                                                 | Interior Wall, Both F.V.          |    | 56 Var.   | 2 Each<br>1'-11 to 7'-4 | 173     | 48 Var.  | 2 Each<br>1'-11 to 6'-4 | 132  | 40 Var.  | 2 Each<br>1'-11 to 5'-5  | 98      | 32 Var.  | 2 Each<br>1'-10 to 4'-5  | 67  | 4c7  |  |
| 4c8                                                                 | Interior Wall, Both F.V.          |    | 4         | 7'-7                    | 20      | 4        | 6'-7                    | 18   | 4        | 5'-7                     | 15      | 4        | 4'-7                     | 12  | 4c8  |  |
| 5c9                                                                 | Wingwall, B.F.V. Long             |    | 9 Var.    | 2'-10 to 5'-2           | 38      | 9 Var.   | 2'-10 to 5'-2           | 38   | 9 Var.   | 2'-10 to 5'-2            | 38      | 9 Var.   | 2'-10 to 5'-2            | 38  | 5c9  |  |
| 5c10                                                                | Wingwall, B.F.V. Short            |    | 6 Var.    | 2'-10 to 4'-6           | 23      | 6 Var.   | 2'-10 to 4'-6           | 23   | 6 Var.   | 2'-10 to 4'-6            | 23      | 6 Var.   | 2'-10 to 4'-6            | 23  | 5c10 |  |
| 5c11                                                                | Wingwall, B.F.V. Long             |    | 16 Var.   | 9'-6 to 13'-10          | 195     | 13 Var.  | 9'-6 to 13'-0           | 153  | 9 Var.   | 9'-6 to 11'-10           | 100     | 6 Var.   | 9'-6 to 10'-11           | 64  | 5c11 |  |
| 5c12                                                                | Wingwall, B.F.V. Short            |    | 16 Var.   | 8'-10 to 13'-10         | 189     | 13 Var.  | 8'-10 to 12'-10         | 147  | 10 Var.  | 8'-10 to 11'-10          | 108     | 7 Var.   | 8'-10 to 10'-10          | 72  | 5c12 |  |
| 6c13                                                                | Wingwall, B.F.V. Long             |    | 10        | 10'-6                   | 158     | 7        | 10'-6                   | 110  | --       | --                       | --      | --       | --                       | --  | 6c13 |  |
| 6c13                                                                | Wingwall, B.F.V. Short            |    | 9         | 10'-6                   | 142     | 6        | 10'-6                   | 95   | --       | --                       | --      | --       | --                       | --  | 6c13 |  |
| 5c14                                                                | Wingwall, B.F.V. Long             |    | 2         | 12'-9                   | 27      | 1        | 11'-9                   | 12   | 2        | 10'-9                    | 22      | 1        | 9'-9                     | 10  | 5c14 |  |
| 5c14                                                                | Wingwall, B.F.V. Short            |    | 2         | 12'-9                   | 27      | 2        | 11'-9                   | 25   | 2        | 10'-9                    | 22      | 2        | 9'-9                     | 20  | 5c14 |  |
| 4d1                                                                 | Apron, Longit., Bott.             |    | 25        | 18'-6                   | 309     | 25       | 16'-5                   | 274  | 25       | 14'-4                    | 239     | 25       | 12'-4                    | 206 | 4d1  |  |
| 4d2                                                                 | Apron, Longit., Bott. Long        |    | 3         | 23'-1                   | 46      | 3        | 19'-8                   | 39   | 3        | 16'-3                    | 33      | 3        | 12'-10                   | 26  | 4d2  |  |
| 4d3                                                                 | Apron, Longit., Bott. Short       |    | 3         | 20'-5                   | 41      | 3        | 17'-5                   | 35   | 3        | 14'-5                    | 29      | 3        | 11'-5                    | 23  | 4d3  |  |
| 6f1                                                                 | Apron, Longit., Top               |   | 37        | 18'-6                   | 1028    | 37       | 16'-5                   | 912  | 37       | 14'-4                    | 797     | 37       | 12'-4                    | 685 | 6f1  |  |
| 6f2                                                                 | Apron, Longit., Top Long          |  | 4 Var.    | 7'-7 to 15'-3           | 69      | 4 Var.   | 5'-6 to 13'-2           | 56   | 3 Var.   | 5'-11 to 11'-1           | 38      | 2 Var.   | 6'-5 to 9'-0             | 23  | 6f2  |  |
| 6f3                                                                 | Apron, Longit., Top Short         |  | 4 Var.    | 6'-7 to 15'-4           | 66      | 4 Var.   | 4'-5 to 13'-3           | 53   | 3 Var.   | 5'-3 to 11'-2            | 37      | 2 Var.   | 6'-2 to 9'-1             | 23  | 6f3  |  |
| 6f4                                                                 | Apron, Longit., Top Long          |  | 1         | 28'-6                   | 43      | 1        | 25'-1                   | 38   | 1        | 21'-8                    | 33      | 1        | 18'-3                    | 27  | 6f4  |  |
| 6f5                                                                 | Apron, Longit., Top Short         |  | 1         | 25'-4                   | 38      | 1        | 22'-4                   | 34   | 1        | 19'-4                    | 29      | 1        | 16'-4                    | 25  | 6f5  |  |
| 4i1                                                                 | Parapet, Vertical                 |  | 75        | 6'-2                    | 309     | 75       | 6'-2                    | 309  | 75       | 6'-2                     | 309     | 75       | 6'-2                     | 309 | 4i1  |  |
| 7j1                                                                 | Parapet, Horizontal               |  | 4         | 40'-0                   | 327     | 4        | 40'-0                   | 327  | 4        | 40'-0                    | 327     | 4        | 40'-0                    | 327 | 7j1  |  |
| 6m1                                                                 | Apron, Trans., Top                |  | 8 Var.    | 40'-3 to 41'-7          | 521     | 8 Var.   | 40'-3 to 41'-7          | 521  | 8 Var.   | 40'-3 to 41'-7           | 521     | 7 Var.   | 40'-3 to 41'-4           | 454 | 6m1  |  |
| 6m2                                                                 | Apron, Trans., Top                |  | 7 Var.    | 41'-10 to 44'-1         | 477     | 4 Var.   | 41'-10 to 42'-11        | 269  | 1        | 41'-10                   | 66      | 1        | 35'-5                    | 53  | 6m2  |  |
| 6m3                                                                 | Apron, Trans., Top                |  | 13 Var.   | 6'-3 to 37'-7           | 428     | 14 Var.  | 3'-9 to 37'-9           | 436  | 14 Var.  | 3'-10 to 37'-10          | 438     | 12 Var.  | 4'-0 to 32'-8            | 330 | 6m3  |  |
| 6m4                                                                 | Apron, Trans., Bott.              |  | 14 Var.   | 34'-5 to 41'-5          | 808     | 12 Var.  | 34'-5 to 40'-4          | 677  | 10 Var.  | 34'-5 to 39'-3           | 553     | 8 Var.   | 34'-5 to 38'-2           | 436 | 6m4  |  |
| 6p1                                                                 | Curtain, Horizontal               |  | 4         | 39'-1                   | 235     | 4        | 39'-1                   | 235  | 4        | 39'-0                    | 234     | 4        | 39'-0                    | 234 | 6p1  |  |
| 6p2                                                                 | Curtain, Horizontal, Long         |  | 4         | 14'-2                   | 85      | 4        | 12'-8                   | 76   | 4        | 11'-2                    | 67      | 4        | 9'-8                     | 58  | 6p2  |  |
| 6p3                                                                 | Curtain, Horizontal, Short        |  | 4         | 11'-3                   | 68      | 4        | 10'-2                   | 61   | 4        | 9'-1                     | 55      | 4        | 7'-11                    | 48  | 6p3  |  |
| 6s1                                                                 | Wing Slope, Both F., Long         |  | 2         | 6'-11                   | 21      | 2        | 6'-11                   | 21   | 2        | 6'-11                    | 21      | 2        | 6'-11                    | 21  | 6s1  |  |
| 6s2                                                                 | Wing Slope, Both F., Short        |  | 2         | 6'-6                    | 20      | 2        | 6'-6                    | 20   | 2        | 6'-6                     | 20      | 2        | 6'-6                     | 20  | 6s2  |  |
| 6s3                                                                 | Wing Slope, Both F., Long         |  | 2         | 23'-5                   | 70      | 2        | 19'-10                  | 60   | 2        | 16'-3                    | 49      | 2        | 12'-8                    | 38  | 6s3  |  |
| 6s4                                                                 | Wing Slope, Both F., Short        |  | 2         | 21'-1                   | 63      | 2        | 17'-11                  | 54   | 2        | 14'-9                    | 44      | 2        | 11'-7                    | 35  | 6s4  |  |
| 6s5                                                                 | Wing Slope, F.F. Long             |  | 1         | 28'-7                   | 43      | 1        | 25'-0                   | 38   | 1        | 21'-5                    | 32      | 1        | 17'-10                   | 27  | 6s5  |  |
| 6s6                                                                 | Wing Slope, F.F. Short            |  | 1         | 25'-10                  | 39      | 1        | 22'-8                   | 34   | 1        | 19'-6                    | 29      | 1        | 16'-4                    | 25  | 6s6  |  |
| 6s7                                                                 | Interior Wall, Both F.H.          |  | 4         | 19'-4                   | 116     | 4        | 17'-1                   | 103  | 4        | 14'-9                    | 89      | 4        | 12'-6                    | 75  | 6s7  |  |
| 5t1                                                                 | Curtain, Vertical                 |  | 42        | 6'-8                    | 292     | 40       | 6'-5                    | 268  | 38       | 6'-5                     | 254     | 36       | 6'-5                     | 241 | 5t1  |  |
|                                                                     | Estimated Quantities One Headwall | Reinf. Steel                                                                         |           | 7504 LB                 |         |          | 6440 LB                 |      |          | 5321 LB                  |         |          | 4464 LB                  |     |      |  |
|                                                                     |                                   | Concrete                                                                             | Parapet Δ | 3.7                     | 55.8 CY | 3.7      | 47.7 CY                 | 3.7  | 40.4 CY  | 3.7                      | 33.5 CY |          |                          |     |      |  |
|                                                                     |                                   |                                                                                      | Wingwalls | 10.3                    |         | 7.9      |                         | 5.8  |          | 3.9                      |         |          |                          |     |      |  |
|                                                                     |                                   |                                                                                      | Apron *   | 41.8                    |         | 36.1     |                         | 30.9 |          | 25.9                     |         |          |                          |     |      |  |

Δ Includes top of wingwall quantities.

\* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

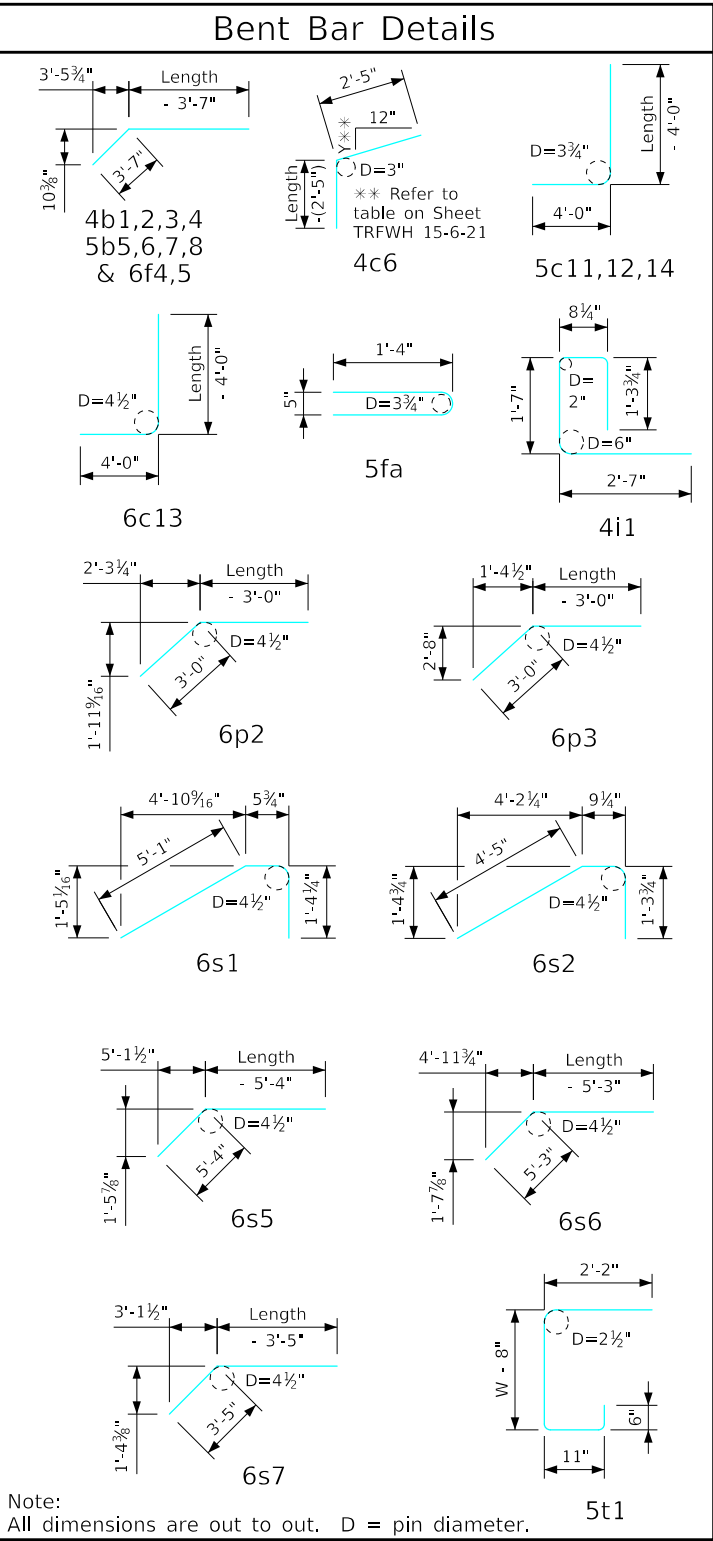
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall

"Long" Denotes Long Wingwall

### Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.



LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER



Standard Design - Triple Reinforced Concrete Box Culverts

### Flared Wing Headwalls

February, 2021

Quantity Tabulation  
12'-0" Span  
15° Skew

TRFWH  
15-7-21  
Sheet 2 of 2

ENGLISHLRFDSignedTRIPLECulvertsFWH.DGN - TRFWH 15-8-21 S1 - THIS SHEET ISSUED 02-2021.

| Bill of Reinforcing for One Headwall 15° Skew Span x Culvert Height |                                   |                                                                                     |           |                          |          |           |                          |      |           |                          |      |          |                         |      |          |                         |     |      |
|---------------------------------------------------------------------|-----------------------------------|-------------------------------------------------------------------------------------|-----------|--------------------------|----------|-----------|--------------------------|------|-----------|--------------------------|------|----------|-------------------------|------|----------|-------------------------|-----|------|
| Bar                                                                 | Location                          | Shape                                                                               | 10' x 12' |                          |          | 10' x 11' |                          |      | 10' x 10' |                          |      | 10' x 9' |                         |      | 10' x 8' |                         |     | Bar  |
|                                                                     |                                   |                                                                                     | No.       | Length                   | Wt.      | No.       | Length                   | Wt.  | No.       | Length                   | Wt.  | No.      | Length                  | Wt.  | No.      | Length                  | Wt. |      |
| 5fa                                                                 | Fence Anchor (Galv.)              |    | 2         | 2'-10                    | 6        | 2         | 2'-10                    | 6    | 2         | 2'-10                    | 6    | 2        | 2'-10                   | 6    | 2        | 2'-10                   | 6   | 5fa  |
| 4b1                                                                 | Wingwall, B.F.H. Long             |    | 1         | 45'-7                    | 32       | 1         | 42'-2                    | 30   | 1         | 38'-9                    | 26   | 1        | 35'-4                   | 24   | 1        | 31'-11                  | 21  | 4b1  |
| 4b2                                                                 | Wingwall, B.F.H. Short            |    | 1         | 40'-4                    | 29       | 1         | 37'-4                    | 25   | 1         | 34'-4                    | 23   | 1        | 31'-4                   | 21   | 1        | 28'-4                   | 19  | 4b2  |
| 4b3                                                                 | Wingwall, B.F.H. Long             |    | 10 Var.   | 13'-2 to 44'-0           | 194      | 9 Var.    | 13'-2 to 40'-7           | 163  | 8 Var.    | 13'-2 to 37'-2           | 134  | 7 Var.   | 13'-2 to 33'-9          | 110  | 6 Var.   | 13'-2 to 30'-4          | 87  | 4b3  |
| 4b4                                                                 | Wingwall, B.F.H. Short            |    | 10 Var.   | 11'-11 to 38'-11         | 170      | 9 Var.    | 11'-11 to 35'-11         | 144  | 8 Var.    | 11'-11 to 32'-11         | 120  | 7 Var.   | 11'-11 to 29'-11        | 98   | 6 Var.   | 11'-11 to 26'-11        | 78  | 4b4  |
| 5b5                                                                 | Wingwall, F.F.H. Long             |    | 1         | 45'-8                    | 50       | 1         | 42'-3                    | 47   | 1         | 38'-10                   | 41   | 1        | 35'-5                   | 37   | 1        | 31'-11                  | 33  | 5b5  |
| 5b6                                                                 | Wingwall, F.F.H. Short            |    | 1         | 40'-4                    | 45       | 1         | 37'-4                    | 39   | 1         | 34'-4                    | 36   | 1        | 31'-4                   | 33   | 1        | 28'-4                   | 30  | 5b6  |
| 5b7                                                                 | Wingwall, F.F.H. Long             |    | 11 Var.   | 9'-10 to 44'-1           | 314      | 10 Var.   | 9'-10 to 40'-8           | 266  | 9 Var.    | 9'-10 to 37'-3           | 221  | 8 Var.   | 9'-10 to 33'-10         | 182  | 7 Var.   | 9'-10 to 30'-5          | 147 | 5b7  |
| 5b8                                                                 | Wingwall, F.F.H. Short            |    | 11 Var.   | 9'-0 to 39'-0            | 275      | 10 Var.   | 9'-0 to 36'-0            | 235  | 9 Var.    | 9'-0 to 33'-0            | 197  | 8 Var.   | 9'-0 to 30'-0           | 163  | 7 Var.   | 9'-0 to 27'-0           | 131 | 5b8  |
| 5b9                                                                 | Interior Wall, Both F.H.          |    | 42 Var.   | 2 Each<br>5'-6 to 28'-6  | 745      | 38 Var.   | 2 Each<br>5'-6 to 26'-5  | 632  | 34 Var.   | 2 Each<br>5'-6 to 24'-4  | 529  | 30 Var.  | 2 Each<br>5'-7 to 22'-3 | 435  | 26 Var.  | 2 Each<br>5'-7 to 20'-2 | 349 | 5b9  |
| 4c1                                                                 | Wingwall, F.F.V. Long             |    | 42 Var.   | 2'-9 to 14'-9            | 245      | 39 Var.   | 2'-9 to 13'-10           | 216  | 35 Var.   | 2'-9 to 12'-8            | 180  | 32 Var.  | 2'-9 to 11'-10          | 156  | 29 Var.  | 2'-9 to 10'-11          | 132 | 4c1  |
| 4c2                                                                 | Wingwall, F.F.V. Short            |    | 37 Var.   | 2'-9 to 14'-9            | 216      | 34 Var.   | 2'-9 to 13'-9            | 187  | 31 Var.   | 2'-9 to 12'-9            | 160  | 28 Var.  | 2'-9 to 11'-9           | 136  | 25 Var.  | 2'-9 to 10'-9           | 113 | 4c2  |
| 4c3                                                                 | Wingwall, F.F.V. Long             |    | 19 Var.   | 9'-7 to 14'-10           | 155      | 16 Var.   | 9'-7 to 14'-0            | 126  | 12 Var.   | 9'-7 to 12'-10           | 90   | 9 Var.   | 9'-7 to 11'-11          | 65   | --       | --                      | --  | 4c3  |
| 4c4                                                                 | Wingwall, F.F.V. Short            |    | 17 Var.   | 9'-7 to 14'-11           | 139      | 14 Var.   | 9'-7 to 13'-11           | 110  | 11 Var.   | 9'-7 to 12'-11           | 83   | 8 Var.   | 9'-7 to 11'-11          | 57   | --       | --                      | --  | 4c4  |
| 4c5                                                                 | Wingwall, F.F.V. Long             |    | 2         | 13'-8                    | 18       | 1         | 12'-8                    | 8    | 2         | 11'-8                    | 16   | 2        | 10'-8                   | 14   | 1        | 9'-8                    | 6   | 4c5  |
| 4c5                                                                 | Wingwall, F.F.V. Short            |    | 2         | 13'-8                    | 18       | 2         | 12'-8                    | 17   | 2         | 11'-8                    | 16   | 2        | 10'-8                   | 14   | 2        | 9'-8                    | 13  | 4c5  |
| 4c6                                                                 | Interior Wall, Both F.V.          |    | 4         | 4'-1                     | 11       | 4         | 4'-1                     | 11   | 4         | 4'-1                     | 11   | 4        | 4'-1                    | 11   | 4        | 4'-1                    | 11  | 4c6  |
| 4c7                                                                 | Interior Wall, Both F.V.          |    | 98 Var.   | 2 Each<br>1'-11 to 12'-4 | 466      | 90 Var.   | 2 Each<br>1'-10 to 11'-4 | 396  | 82 Var.   | 2 Each<br>1'-10 to 10'-4 | 333  | 74 Var.  | 2 Each<br>1'-10 to 9'-5 | 278  | 66 Var.  | 2 Each<br>1'-10 to 8'-5 | 226 | 4c7  |
| 4c8                                                                 | Interior Wall, Both F.V.          |    | 4         | 12'-6                    | 33       | 4         | 11'-6                    | 31   | 4         | 10'-6                    | 28   | 4        | 9'-6                    | 25   | 4        | 8'-6                    | 23  | 4c8  |
| 5c9                                                                 | Wingwall, B.F.V. Long             |    | 9 Var.    | 2'-9 to 5'-1             | 37       | 9 Var.    | 2'-9 to 5'-1             | 37   | 9 Var.    | 2'-9 to 5'-1             | 37   | 9 Var.   | 2'-9 to 5'-1            | 37   | 9 Var.   | 2'-9 to 5'-1            | 37  | 5c9  |
| 5c10                                                                | Wingwall, B.F.V. Short            |    | 6 Var.    | 2'-9 to 4'-5             | 22       | 6 Var.    | 2'-9 to 4'-5             | 22   | 6 Var.    | 2'-9 to 4'-5             | 22   | 6 Var.   | 2'-9 to 4'-5            | 22   | 6 Var.   | 2'-9 to 4'-5            | 22  | 5c10 |
| 5c11                                                                | Wingwall, B.F.V. Long             |    | 33 Var.   | 9'-5 to 18'-9            | 485      | 30 Var.   | 9'-5 to 17'-10           | 426  | 26 Var.   | 9'-5 to 16'-8            | 354  | 23 Var.  | 9'-5 to 15'-10          | 303  | 20 Var.  | 9'-5 to 14'-11          | 254 | 5c11 |
| 5c12                                                                | Wingwall, B.F.V. Short            |    | 31 Var.   | 8'-9 to 18'-9            | 445      | 28 Var.   | 8'-9 to 17'-9            | 387  | 25 Var.   | 8'-9 to 16'-9            | 332  | 22 Var.  | 8'-9 to 15'-9           | 281  | 19 Var.  | 8'-9 to 14'-9           | 233 | 5c12 |
| 6c13                                                                | Wingwall, B.F.V. Long             |    | 27        | 10'-6                    | 426      | 24        | 10'-6                    | 379  | 20        | 10'-6                    | 315  | 17       | 10'-6                   | 268  | 14       | 10'-6                   | 221 | 6c13 |
| 6c13                                                                | Wingwall, B.F.V. Short            |    | 24        | 10'-6                    | 379      | 21        | 10'-6                    | 331  | 18        | 10'-6                    | 284  | 15       | 10'-6                   | 237  | 12       | 10'-6                   | 189 | 6c13 |
| 5c14                                                                | Wingwall, B.F.V. Long             |    | 2         | 17'-8                    | 37       | 1         | 16'-8                    | 17   | 2         | 15'-8                    | 33   | 2        | 14'-8                   | 31   | 1        | 13'-8                   | 14  | 5c14 |
| 5c14                                                                | Wingwall, B.F.V. Short            |    | 2         | 17'-8                    | 37       | 2         | 16'-8                    | 35   | 2         | 15'-8                    | 33   | 2        | 14'-8                   | 31   | 2        | 13'-8                   | 29  | 5c14 |
| 4d1                                                                 | Apron, Longit., Bott.             |    | 21        | 28'-10                   | 404      | 21        | 26'-9                    | 375  | 21        | 24'-9                    | 347  | 21       | 22'-8                   | 318  | 21       | 20'-7                   | 289 | 4d1  |
| 4d2                                                                 | Apron, Longit., Bott. Long        |    | 3         | 40'-3                    | 86       | 3         | 36'-10                   | 74   | 3         | 33'-5                    | 67   | 3        | 30'-0                   | 60   | 3        | 26'-7                   | 53  | 4d2  |
| 4d3                                                                 | Apron, Longit., Bott. Short       |   | 3         | 35'-6                    | 71       | 3         | 32'-5                    | 65   | 3         | 29'-5                    | 59   | 3        | 26'-5                   | 53   | 3        | 23'-5                   | 47  | 4d3  |
| 6f1                                                                 | Apron, Longit., Top               |  | 31        | 28'-10                   | 1343     | 31        | 26'-9                    | 1246 | 31        | 24'-9                    | 1152 | 31       | 22'-8                   | 1055 | 31       | 20'-7                   | 958 | 6f1  |
| 6f2                                                                 | Apron, Longit., Top Long          |  | 9 Var.    | 5'-5 to 25'-7            | 210      | 8 Var.    | 5'-10 to 23'-6           | 176  | 7 Var.    | 6'-3 to 21'-5            | 145  | 6 Var.   | 6'-8 to 19'-5           | 118  | 5 Var.   | 7'-2 to 17'-4           | 92  | 6f2  |
| 6f3                                                                 | Apron, Longit., Top Short         |  | 8 Var.    | 5'-5 to 25'-8            | 187      | 7 Var.    | 6'-3 to 23'-8            | 157  | 6 Var.    | 7'-0 to 21'-7            | 129  | 6 Var.   | 4'-11 to 19'-6          | 110  | 5 Var.   | 5'-9 to 17'-5           | 87  | 6f3  |
| 6f4                                                                 | Apron, Longit., Top Long          |  | 1         | 45'-8                    | 72       | 1         | 42'-3                    | 67   | 1         | 38'-10                   | 58   | 1        | 35'-5                   | 53   | 1        | 31'-11                  | 48  | 6f4  |
| 6f5                                                                 | Apron, Longit., Top Short         |  | 1         | 40'-4                    | 64       | 1         | 37'-4                    | 56   | 1         | 34'-4                    | 52   | 1        | 31'-4                   | 47   | 1        | 28'-4                   | 43  | 6f5  |
| 4i1                                                                 | Parapet, Vertical                 |  | 65        | 6'-2                     | 268      | 63        | 6'-2                     | 260  | 63        | 6'-2                     | 260  | 63       | 6'-2                    | 260  | 63       | 6'-2                    | 260 | 4i1  |
| 7j1                                                                 | Parapet, Horizontal               |  | 4         | 34'-10                   | 285      | 4         | 34'-6                    | 282  | 4         | 34'-1                    | 279  | 4        | 34'-1                   | 279  | 4        | 34'-1                   | 279 | 7j1  |
| 6m1                                                                 | Apron, Trans., Top                |  | 7 Var.    | 35'-1 to 36'-2           | 375      | 7 Var.    | 34'-9 to 35'-10          | 371  | 7 Var.    | 34'-4 to 35'-6           | 367  | 7 Var.   | 34'-4 to 35'-6          | 367  | 7 Var.   | 34'-4 to 35'-6          | 367 | 6m1  |
| 6m2                                                                 | Apron, Trans., Top                |  | 23 Var.   | 36'-6 to 44'-9           | 1451     | 20 Var.   | 36'-2 to 43'-3           | 1225 | 17 Var.   | 35'-9 to 41'-9           | 1008 | 14 Var.  | 35'-9 to 40'-8          | 811  | 12 Var.  | 35'-9 to 39'-11         | 682 | 6m2  |
| 6m3                                                                 | Apron, Trans., Top                |  | 11 Var.   | 8'-8 to 34'-9            | 359      | 11 Var.   | 8'-7 to 34'-8            | 357  | 12 Var.   | 5'-11 to 34'-8           | 366  | 12 Var.  | 6'-0 to 34'-9           | 367  | 11 Var.  | 6'-2 to 32'-3           | 317 | 6m3  |
| 6m4                                                                 | Apron, Trans., Bott.              |  | 24 Var.   | 28'-8 to 41'-1           | 1268     | 22 Var.   | 28'-6 to 39'-10          | 1129 | 20 Var.   | 28'-4 to 38'-7           | 1005 | 18 Var.  | 28'-4 to 37'-6          | 890  | 16 Var.  | 28'-4 to 36'-5          | 778 | 6m4  |
| 6p1                                                                 | Curtain, Horizontal               |  | 4         | 33'-5                    | 201      | 4         | 33'-2                    | 199  | 4         | 33'-0                    | 198  | 4        | 33'-0                   | 198  | 4        | 33'-0                   | 198 | 6p1  |
| 6p2                                                                 | Curtain, Horizontal, Long         |  | 4         | 21'-9                    | 131      | 4         | 20'-3                    | 122  | 4         | 18'-9                    | 113  | 4        | 17'-3                   | 104  | 4        | 15'-9                   | 95  | 6p2  |
| 6p3                                                                 | Curtain, Horizontal, Short        |  | 4         | 16'-10                   | 101      | 4         | 15'-9                    | 95   | 4         | 14'-7                    | 88   | 4        | 13'-6                   | 81   | 4        | 12'-5                   | 75  | 6p3  |
| 6s1                                                                 | Wing Slope, Both F., Long         |  | 2         | 6'-11                    | 21       | 2         | 6'-11                    | 21   | 2         | 6'-11                    | 21   | 2        | 6'-11                   | 21   | 2        | 6'-11                   | 21  | 6s1  |
| 6s2                                                                 | Wing Slope, Both F., Short        |  | 2         | 6'-6                     | 20       | 2         | 6'-6                     | 20   | 2         | 6'-6                     | 20   | 2        | 6'-6                    | 20   | 2        | 6'-6                    | 20  | 6s2  |
| 6s3                                                                 | Wing Slope, Both F., Long         |  | 2         | 41'-3                    | 131      | 2         | 37'-9                    | 113  | 2         | 34'-2                    | 103  | 2        | 30'-7                   | 92   | 2        | 27'-0                   | 81  | 6s3  |
| 6s4                                                                 | Wing Slope, Both F., Short        |  | 2         | 36'-11                   | 111      | 2         | 33'-9                    | 101  | 2         | 30'-7                    | 92   | 2        | 27'-5                   | 82   | 2        | 24'-3                   | 73  | 6s4  |
| 6s5                                                                 | Wing Slope, F.F. Long             |  | 1         | 46'-5                    | 73       | 1         | 42'-10                   | 68   | 1         | 39'-3                    | 59   | 1        | 35'-8                   | 54   | 1        | 32'-1                   | 48  | 6s5  |
| 6s6                                                                 | Wing Slope, F.F. Short            |  | 1         | 41'-8                    | 66       | 1         | 38'-6                    | 58   | 1         | 35'-4                    | 53   | 1        | 32'-2                   | 48   | 1        | 29'-0                   | 44  | 6s6  |
| 6s7                                                                 | Interior Wall, Both F.H.          |  | 4         | 30'-9                    | 185      | 4         | 28'-6                    | 171  | 4         | 26'-3                    | 158  | 4        | 23'-11                  | 144  | 4        | 21'-8                   | 130 | 6s7  |
| 5t1                                                                 | Curtain, Vertical                 |  | 46        | 7'-11                    | 380      | 44        | 7'-8                     | 352  | 42        | 7'-5                     | 325  | 41       | 7'-2                    | 306  | 39       | 6'-11                   | 281 | 5t1  |
|                                                                     | Estimated Quantities One Headwall | Reinf. Steel<br>Concrete                                                            | 12,892 LB |                          |          | 11,483 LB |                          |      | 10,184 LB |                          |      | 9013 LB  |                         |      | 7790 LB  |                         |     |      |
|                                                                     |                                   |                                                                                     | Parapet Δ | 3.5                      | 105.6 CY | 3.4       | 90.9 CY                  |      | 3.3       | 77.6 CY                  |      | 3.3      | 68.0 CY                 |      | 3.3      |                         |     |      |

Δ Includes top of wingwall quantities.

\* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall  
"Long" Denotes Long Wingwall

### Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

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Standard Design - Triple Reinforced Concrete Box Culverts

| Bill of Reinforcing for One Headwall 15° Skew Span x Culvert Height |                             |       |              |                         |     |          |                         |         |          |                          |      |          |                          |     |      |
|---------------------------------------------------------------------|-----------------------------|-------|--------------|-------------------------|-----|----------|-------------------------|---------|----------|--------------------------|------|----------|--------------------------|-----|------|
| Bar                                                                 | Location                    | Shape | 10' x 7'     |                         |     | 10' x 6' |                         |         | 10' x 5' |                          |      | 10' x 4' |                          |     | Bar  |
|                                                                     |                             |       | No.          | Length                  | Wt. | No.      | Length                  | Wt.     | No.      | Length                   | Wt.  | No.      | Length                   | Wt. |      |
| 5fa                                                                 | Fence Anchor (Galv.)        |       | 2            | 2'-10                   | 6   | 2        | 2'-10                   | 6       | 2        | 2'-10                    | 6    | 2        | 2'-10                    | 6   | 5fa  |
| 4b1                                                                 | Wingwall, B.F.H. Long       |       | 1            | 28'-6                   | 19  | 1        | 25'-1                   | 17      | 1        | 21'-7                    | 14   | 1        | 18'-2                    | 12  | 4b1  |
| 4b2                                                                 | Wingwall, B.F.H. Short      |       | 1            | 25'-4                   | 17  | 1        | 22'-4                   | 15      | 1        | 19'-4                    | 13   | 1        | 16'-4                    | 11  | 4b2  |
| 4b3                                                                 | Wingwall, B.F.H. Long       |       | 5 Var.       | 13'-2 to 26'-11         | 67  | 4 Var.   | 13'-2 to 23'-6          | 49      | 3 Var.   | 13'-2 to 20'-1           | 33   | 2 Var.   | 13'-2 to 16'-7           | 20  | 4b3  |
| 4b4                                                                 | Wingwall, B.F.H. Short      |       | 5 Var.       | 11'-11 to 23'-11        | 60  | 4 Var.   | 11'-11 to 20'-11        | 44      | 3 Var.   | 11'-11 to 17'-11         | 30   | 2 Var.   | 11'-11 to 14'-11         | 18  | 4b4  |
| 5b5                                                                 | Wingwall, F.F.H. Long       |       | 1            | 28'-6                   | 30  | 1        | 25'-1                   | 26      | 1        | 21'-8                    | 23   | 1        | 18'-3                    | 19  | 5b5  |
| 5b6                                                                 | Wingwall, F.F.H. Short      |       | 1            | 25'-4                   | 26  | 1        | 22'-4                   | 23      | 1        | 19'-4                    | 20   | 1        | 16'-4                    | 17  | 5b6  |
| 5b7                                                                 | Wingwall, F.F.H. Long       |       | 6 Var.       | 9'-10 to 26'-11         | 115 | 5 Var.   | 9'-10 to 23'-6          | 87      | 4 Var.   | 9'-10 to 20'-1           | 62   | 3 Var.   | 9'-9 to 16'-8            | 41  | 5b7  |
| 5b8                                                                 | Wingwall, F.F.H. Short      |       | 6 Var.       | 9'-0 to 24'-0           | 103 | 5 Var.   | 9'-0 to 21'-0           | 78      | 4 Var.   | 9'-0 to 18'-0            | 56   | 3 Var.   | 9'-0 to 15'-0            | 38  | 5b8  |
| 5b9                                                                 | Interior Wall, Both F.H.    |       | 22 Var.      | 2 Each<br>5'-8 to 18'-2 | 273 | 18 Var.  | 2 Each<br>5'-9 to 16'-1 | 205     | 14 Var.  | 2 Each<br>5'-10 to 14'-0 | 145  | 10 Var.  | 2 Each<br>6'-0 to 11'-10 | 93  | 5b9  |
| 4c1                                                                 | Wingwall, F.F.V. Long       |       | 25 Var.      | 2'-9 to 9'-9            | 104 | 22 Var.  | 2'-9 to 8'-11           | 86      | 18 Var.  | 2'-9 to 7'-9             | 63   | 15 Var.  | 2'-9 to 6'-10            | 48  | 4c1  |
| 4c2                                                                 | Wingwall, F.F.V. Short      |       | 22 Var.      | 2'-9 to 9'-9            | 92  | 19 Var.  | 2'-9 to 8'-9            | 73      | 16 Var.  | 2'-9 to 7'-9             | 56   | 13 Var.  | 2'-9 to 6'-9             | 41  | 4c2  |
| 4c3                                                                 | Wingwall, F.F.V. Long       |       | --           | --                      | --  | --       | --                      | --      | --       | --                       | --   | --       | --                       | --  | 4c3  |
| 4c4                                                                 | Wingwall, F.F.V. Short      |       | --           | --                      | --  | --       | --                      | --      | --       | --                       | --   | --       | --                       | --  | 4c4  |
| 4c5                                                                 | Wingwall, F.F.V. Long       |       | 2            | 8'-8                    | 12  | 1        | 7'-8                    | 5       | 2        | 6'-8                     | 9    | 1        | 5'-8                     | 4   | 4c5  |
| 4c5                                                                 | Wingwall, F.F.V. Short      |       | 2            | 8'-8                    | 12  | 2        | 7'-8                    | 10      | 2        | 6'-8                     | 9    | 2        | 5'-8                     | 8   | 4c5  |
| 4c6                                                                 | Interior Wall, Both F.V.    |       | 4            | 4'-1                    | 11  | 4        | 4'-1                    | 11      | 4        | 4'-1                     | 11   | 4        | 4'-0                     | 11  | 4c6  |
| 4c7                                                                 | Interior Wall, Both F.V.    |       | 56 Var.      | 2 Each<br>1'-10 to 7'-3 | 170 | 48 Var.  | 2 Each<br>1'-10 to 6'-3 | 130     | 40 Var.  | 2 Each<br>1'-10 to 5'-4  | 96   | 32 Var.  | 2 Each<br>1'-9 to 4'-4   | 65  | 4c7  |
| 4c8                                                                 | Interior Wall, Both F.V.    |       | 4            | 7'-6                    | 20  | 4        | 6'-6                    | 17      | 4        | 5'-6                     | 15   | 4        | 4'-6                     | 12  | 4c8  |
| 5c9                                                                 | Wingwall, B.F.V. Long       |       | 9 Var.       | 2'-9 to 5'-1            | 37  | 9 Var.   | 2'-9 to 5'-1            | 37      | 9 Var.   | 2'-9 to 5'-1             | 37   | 9 Var.   | 2'-9 to 5'-1             | 37  | 5c9  |
| 5c10                                                                | Wingwall, B.F.V. Short      |       | 6 Var.       | 2'-9 to 4'-5            | 22  | 6 Var.   | 2'-9 to 4'-5            | 22      | 6 Var.   | 2'-9 to 4'-5             | 22   | 6 Var.   | 2'-9 to 4'-5             | 22  | 5c10 |
| 5c11                                                                | Wingwall, B.F.V. Long       |       | 16 Var.      | 9'-5 to 13'-9           | 193 | 13 Var.  | 9'-5 to 12'-11          | 151     | 9 Var.   | 9'-5 to 11'-9            | 99   | 6 Var.   | 9'-5 to 10'-10           | 63  | 5c11 |
| 5c12                                                                | Wingwall, B.F.V. Short      |       | 16 Var.      | 8'-9 to 13'-9           | 188 | 13 Var.  | 8'-9 to 12'-9           | 146     | 10 Var.  | 8'-9 to 11'-9            | 107  | 7 Var.   | 8'-9 to 10'-9            | 71  | 5c12 |
| 6c13                                                                | Wingwall, B.F.V. Long       |       | 10           | 10'-6                   | 158 | 7        | 10'-6                   | 110     | --       | --                       | --   | --       | --                       | --  | 6c13 |
| 6c13                                                                | Wingwall, B.F.V. Short      |       | 9            | 10'-6                   | 142 | 6        | 10'-6                   | 95      | --       | --                       | --   | --       | --                       | --  | 6c13 |
| 5c14                                                                | Wingwall, B.F.V. Long       |       | 2            | 12'-8                   | 26  | 1        | 11'-8                   | 12      | 2        | 10'-8                    | 22   | 1        | 9'-8                     | 10  | 5c14 |
| 5c14                                                                | Wingwall, B.F.V. Short      |       | 2            | 12'-8                   | 26  | 2        | 11'-8                   | 24      | 2        | 10'-8                    | 22   | 2        | 9'-8                     | 20  | 5c14 |
| 4d1                                                                 | Apron, Longit., Bott.       |       | 21           | 18'-6                   | 260 | 21       | 16'-5                   | 230     | 21       | 14'-4                    | 201  | 21       | 12'-4                    | 173 | 4d1  |
| 4d2                                                                 | Apron, Longit., Bott. Long  |       | 3            | 23'-1                   | 46  | 3        | 19'-8                   | 39      | 3        | 16'-3                    | 33   | 3        | 12'-10                   | 26  | 4d2  |
| 4d3                                                                 | Apron, Longit., Bott. Short |       | 3            | 20'-5                   | 41  | 3        | 17'-5                   | 35      | 3        | 14'-5                    | 29   | 3        | 11'-5                    | 23  | 4d3  |
| 6f1                                                                 | Apron, Longit., Top         |       | 31           | 18'-6                   | 861 | 31       | 16'-5                   | 764     | 31       | 14'-4                    | 667  | 31       | 12'-4                    | 574 | 6f1  |
| 6f2                                                                 | Apron, Longit., Top Long    |       | 4 Var.       | 7'-7 to 15'-3           | 69  | 4 Var.   | 5'-6 to 13'-2           | 56      | 3 Var.   | 5'-11 to 11'-1           | 38   | 2 Var.   | 6'-5 to 9'-0             | 23  | 6f2  |
| 6f3                                                                 | Apron, Longit., Top Short   |       | 4 Var.       | 6'-7 to 15'-4           | 66  | 4 Var.   | 4'-5 to 13'-3           | 53      | 3 Var.   | 5'-3 to 11'-2            | 37   | 2 Var.   | 6'-2 to 9'-1             | 23  | 6f3  |
| 6f4                                                                 | Apron, Longit., Top Long    |       | 1            | 28'-6                   | 43  | 1        | 25'-1                   | 38      | 1        | 21'-8                    | 33   | 1        | 18'-3                    | 27  | 6f4  |
| 6f5                                                                 | Apron, Longit., Top Short   |       | 1            | 25'-4                   | 38  | 1        | 22'-4                   | 34      | 1        | 19'-4                    | 29   | 1        | 16'-4                    | 25  | 6f5  |
| 4i1                                                                 | Parapet, Vertical           |       | 63           | 6'-2                    | 260 | 63       | 6'-2                    | 260     | 63       | 6'-2                     | 260  | 63       | 6'-2                     | 260 | 4i1  |
| 7j1                                                                 | Parapet, Horizontal         |       | 4            | 33'-9                   | 276 | 4        | 33'-9                   | 276     | 4        | 33'-9                    | 276  | 4        | 33'-9                    | 276 | 7j1  |
| 6m1                                                                 | Apron, Trans., Top          |       | 7 Var.       | 34'-0 to 35'-2          | 364 | 7 Var.   | 34'-0 to 35'-2          | 364     | 7 Var.   | 34'-0 to 35'-2           | 364  | 7 Var.   | 34'-0 to 35'-2           | 364 | 6m1  |
| 6m2                                                                 | Apron, Trans., Top          |       | 9 Var.       | 35'-5 to 38'-5          | 499 | 6 Var.   | 35'-5 to 37'-4          | 328     | 3 Var.   | 35'-5 to 36'-2           | 161  | 1        | 35'-5                    | 53  | 6m2  |
| 6m3                                                                 | Apron, Trans., Top          |       | 11 Var.      | 6'-1 to 32'-2           | 316 | 11 Var.  | 6'-2 to 32'-4           | 318     | 12 Var.  | 3'-8 to 32'-5            | 325  | 11 Var.  | 3'-9 to 29'-11           | 278 | 6m3  |
| 6m4                                                                 | Apron, Trans., Bott.        |       | 14 Var.      | 28'-2 to 35'-2          | 666 | 12 Var.  | 28'-2 to 34'-1          | 561     | 10 Var.  | 28'-2 to 33'-1           | 460  | 8 Var.   | 28'-2 to 31'-11          | 361 | 6m4  |
| 6p1                                                                 | Curtain, Horizontal         |       | 4            | 32'-10                  | 197 | 4        | 32'-10                  | 197     | 4        | 32'-10                   | 197  | 4        | 32'-10                   | 197 | 6p1  |
| 6p2                                                                 | Curtain, Horizontal, Long   |       | 4            | 14'-2                   | 85  | 4        | 12'-8                   | 76      | 4        | 11'-2                    | 67   | 4        | 9'-8                     | 58  | 6p2  |
| 6p3                                                                 | Curtain, Horizontal, Short  |       | 4            | 11'-3                   | 68  | 4        | 10'-2                   | 61      | 4        | 9'-1                     | 55   | 4        | 7'-11                    | 48  | 6p3  |
| 6s1                                                                 | Wing Slope, Both F., Long   |       | 2            | 6'-11                   | 21  | 2        | 6'-11                   | 21      | 2        | 6'-11                    | 21   | 2        | 6'-11                    | 21  | 6s1  |
| 6s2                                                                 | Wing Slope, Both F., Short  |       | 2            | 6'-6                    | 20  | 2        | 6'-6                    | 20      | 2        | 6'-6                     | 20   | 2        | 6'-6                     | 20  | 6s2  |
| 6s3                                                                 | Wing Slope, Both F., Long   |       | 2            | 23'-5                   | 70  | 2        | 19'-10                  | 60      | 2        | 16'-3                    | 49   | 2        | 12'-8                    | 38  | 6s3  |
| 6s4                                                                 | Wing Slope, Both F., Short  |       | 2            | 21'-1                   | 63  | 2        | 17'-11                  | 54      | 2        | 14'-9                    | 44   | 2        | 11'-7                    | 35  | 6s4  |
| 6s5                                                                 | Wing Slope, F.F. Long       |       | 1            | 28'-7                   | 43  | 1        | 25'-0                   | 38      | 1        | 21'-5                    | 32   | 1        | 17'-10                   | 27  | 6s5  |
| 6s6                                                                 | Wing Slope, F.F. Short      |       | 1            | 25'-10                  | 39  | 1        | 22'-8                   | 34      | 1        | 19'-6                    | 29   | 1        | 16'-4                    | 25  | 6s6  |
| 6s7                                                                 | Interior Wall, Both F.H.    |       | 4            | 19'-4                   | 116 | 4        | 17'-1                   | 103     | 4        | 14'-9                    | 89   | 4        | 12'-6                    | 75  | 6s7  |
| 5t1                                                                 | Curtain, Vertical           |       | 36           | 6'-8                    | 250 | 34       | 6'-5                    | 228     | 32       | 6'-5                     | 214  | 30       | 6'-5                     | 201 | 5t1  |
| Estimated Quantities One Headwall                                   |                             |       | Reinf. Steel | 6706 LB                 |     |          | 5727 LB                 |         |          | 4700 LB                  |      |          | 3918 LB                  |     |      |
|                                                                     |                             |       | Concrete     | 48.9 CY                 |     |          | 3.2                     | 41.3 CY |          |                          | 3.2  | 34.8 CY  |                          |     |      |
|                                                                     |                             |       | Parapet Δ    |                         |     |          | 7.9                     |         |          |                          | 5.8  |          |                          |     |      |
|                                                                     |                             |       | Wingwalls    |                         |     |          | 30.2                    |         |          |                          | 25.8 |          |                          |     |      |
|                                                                     |                             |       | Apron *      | 35.4                    |     |          |                         |         |          |                          |      |          |                          |     |      |

Δ Includes top of wingwall quantities.

\* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall

"Long" Denotes Long Wingwall

### Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

### Bent Bar Details

Note: All dimensions are out to out. D = pin diameter.

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Standard Design - Triple Reinforced Concrete Box Culverts

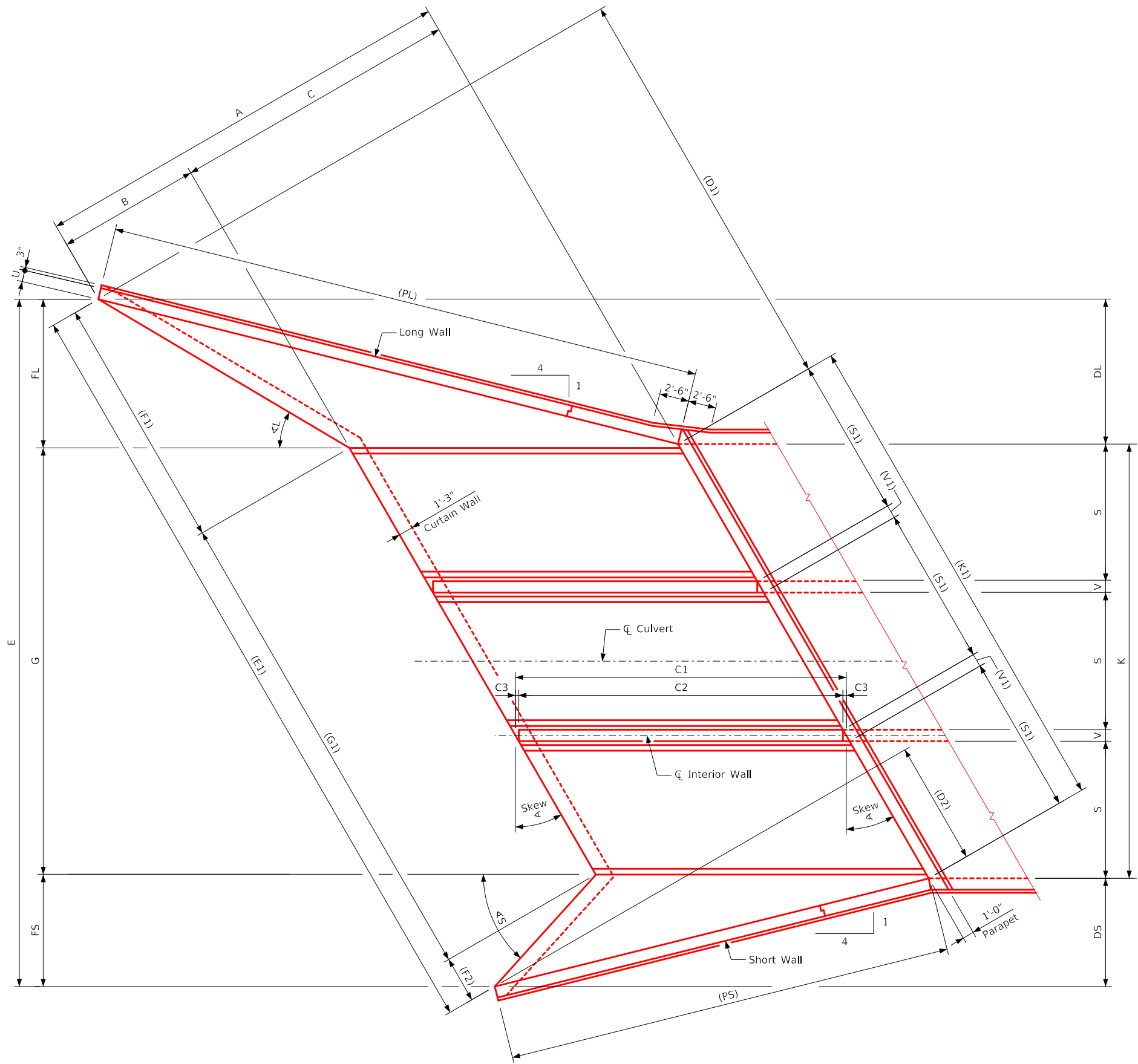
### Flared Wing Headwalls

February, 2021

Quantity Tabulation  
10'-0" Span  
15° Skew

TRFWH  
15-8-21  
Sheet 2 of 2

ENGLISHLRFDDESIGNEDTRIPLECULVERTSFHW.DGN - TRFWH 30-1-21 - THIS SHEET ISSUED 02-2021.



Plan View

- Notes:
1. See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
  2. See Sheet TRFWH 30-2-21 for dimensions table.
  3. See Sheet TRFWH 30-5-21 for Angle L & Angle S.

|                      |                                                                                                                      |                                                                                       |                  |
|----------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------|
| LATEST REVISION DATE | <br>APPROVED BY BRIDGE ENGINEER |  |                  |
|                      |                                                                                                                      | Standard Design - Triple Reinforced Concrete Box Culverts                             |                  |
|                      |                                                                                                                      | Flared Wing Headwalls                                                                 |                  |
|                      |                                                                                                                      | February, 2021                                                                        |                  |
|                      |                                                                                                                      | Dimension Plan<br>30° Skew                                                            | TRFWH<br>30-1-21 |

ENGLISHLRFDDESIGNEDTRIPLECULVERTSFWH.DGN - TRFWH 30-2-21 - THIS SHEET ISSUED 02-2021.

| Dimension Table |           |           |           |          |          |          |          |          |          |           |           |           |          |          |          |          |          |          |       |  |
|-----------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-------|--|
| S x H           | 12' x 12' | 12' x 11' | 12' x 10' | 12' x 9' | 12' x 8' | 12' x 7' | 12' x 6' | 12' x 5' | 12' x 4' | 10' x 12' | 10' x 11' | 10' x 10' | 10' x 9' | 10' x 8' | 10' x 7' | 10' x 6' | 10' x 5' | 10' x 4' | S x H |  |
| A               | 37'-0     | 34'-0     | 31'-0     | 28'-0    | 25'-0    | 22'-0    | 19'-0    | 16'-0    | 13'-0    | 37'-0     | 34'-0     | 31'-0     | 28'-0    | 25'-0    | 22'-0    | 19'-0    | 16'-0    | 13'-0    | A     |  |
| B               | 12'-4     | 11'-4     | 10'-4     | 9'-4     | 8'-4     | 7'-4     | 6'-4     | 5'-4     | 4'-4     | 12'-4     | 11'-4     | 10'-4     | 9'-4     | 8'-4     | 7'-4     | 6'-4     | 5'-4     | 4'-4     | B     |  |
| C               | 24'-8     | 22'-8     | 20'-8     | 18'-8    | 16'-8    | 14'-8    | 12'-8    | 10'-8    | 8'-8     | 24'-8     | 22'-8     | 20'-8     | 18'-8    | 16'-8    | 14'-8    | 12'-8    | 10'-8    | 8'-8     | C     |  |
| C1              | 28'-5¼    | 26'-2½    | 23'-10⅔   | 21'-6⅝   | 19'-3    | 16'-11¼  | 14'-7½   | 12'-3¾   | 10'-0⅞   | 28'-5¼    | 26'-2½    | 23'-10⅔   | 21'-6⅝   | 19'-3    | 16'-11¼  | 14'-7½   | 12'-3¾   | 10'-0⅞   | C1    |  |
| C2              | 27'-10⅞   | 25'-7¾    | 23'-4⅞    | 21'-0⅞   | 18'-9⅞   | 16'-6    | 14'-2⅞   | 11'-10⅞  | 9'-6⅞    | 27'-10⅞   | 25'-7¾    | 23'-4⅞    | 21'-0⅞   | 18'-9⅞   | 16'-6    | 14'-2⅞   | 11'-10⅞  | 9'-6⅞    | C2    |  |
| C3              | 3½        | 3⅞        | 2⅞        | 2⅞       | 2⅞       | 2⅞       | 2⅞       | 2⅞       | 2⅞       | 3½        | 3⅞        | 2⅞        | 2⅞       | 2⅞       | 2⅞       | 2⅞       | 2⅞       | 2⅞       | C3    |  |
| DL              | 12'-5¾    | 11'-5⅞    | 10'-5½    | 9'-5⅝    | 8'-5¼    | 7'-5⅞    | 6'-4⅞    | 5'-4¾    | 4'-4⅞    | 12'-5¾    | 11'-5⅞    | 10'-5½    | 9'-5⅝    | 8'-5¼    | 7'-5⅞    | 6'-4⅞    | 5'-4¾    | 4'-4⅞    | DL    |  |
| DS              | 9'-4      | 8'-6⅞     | 7'-9⅞     | 7'-0¾    | 6'-3⅞    | 5'-6⅞    | 4'-9½    | 4'-0⅞    | 3'-3⅞    | 9'-4      | 8'-6⅞     | 7'-9⅞     | 7'-0¾    | 6'-3⅞    | 5'-6⅞    | 4'-9½    | 4'-0⅞    | 3'-3⅞    | DS    |  |
| D1              | 35'-9¼    | 32'-10½   | 29'-11¾   | 27'-0⅞   | 24'-2⅞   | 21'-3¼   | 18'-4½   | 15'-5⅞   | 12'-6⅞   | 35'-9¼    | 32'-10½   | 29'-11¾   | 27'-0⅞   | 24'-2⅞   | 21'-3¼   | 18'-4½   | 15'-5⅞   | 12'-6⅞   | D1    |  |
| D2              | 10'-7     | 9'-8¾     | 8'-10⅞    | 8'-0⅞    | 7'-1⅞    | 6'-3½    | 5'-5¼    | 4'-6⅞    | 3'-8⅞    | 10'-7     | 9'-8¾     | 8'-10⅞    | 8'-0⅞    | 7'-1⅞    | 6'-3½    | 5'-5¼    | 4'-6⅞    | 3'-8⅞    | D2    |  |
| E               | 59'-9¾    | 57'-10⅞   | 55'-11⅞   | 54'-2⅞   | 52'-4⅞   | 50'-5⅞   | 48'-8⅞   | 46'-11¼  | 45'-2    | 53'-9¾    | 51'-10⅞   | 49'-11⅞   | 48'-2⅞   | 46'-4⅞   | 44'-5⅞   | 42'-8⅞   | 40'-11¼  | 39'-2    | E     |  |
| E1              | 69'-0⅞    | 66'-10    | 64'-7¼    | 62'-6¾   | 60'-6⅞   | 58'-3⅞   | 56'-2⅞   | 54'-2⅞   | 52'-1⅞   | 62'-1¾    | 59'-10⅞   | 57'-8⅞    | 55'-7½   | 53'-7    | 51'-4¼   | 49'-3¾   | 47'-3¼   | 45'-2¾   | E1    |  |
| FL              | 12'-9¾    | 11'-9⅞    | 10'-9½    | 9'-9⅞    | 8'-9¼    | 7'-9⅞    | 6'-8⅞    | 5'-8¾    | 4'-8⅞    | 12'-9¾    | 11'-9⅞    | 10'-9½    | 9'-9⅞    | 8'-9¼    | 7'-9⅞    | 6'-8⅞    | 5'-8¾    | 4'-8⅞    | FL    |  |
| FS              | 9'-8      | 8'-10⅞    | 8'-1⅞     | 7'-4¾    | 6'-7⅞    | 5'-10⅞   | 5'-1½    | 4'-4⅞    | 3'-7⅞    | 9'-8      | 8'-10⅞    | 8'-1⅞     | 7'-4¾    | 6'-7⅞    | 5'-10⅞   | 5'-1½    | 4'-4⅞    | 3'-7⅞    | FS    |  |
| F1              | 21'-11    | 20'-2⅞    | 18'-5⅞    | 16'-8⅞   | 14'-11¼  | 13'-2¼   | 11'-5⅞   | 9'-8⅞    | 7'-11⅞   | 21'-11    | 20'-2⅞    | 18'-5⅞    | 16'-8⅞   | 14'-11¼  | 13'-2¼   | 11'-5⅞   | 9'-8⅞    | 7'-11⅞   | F1    |  |
| F2              | 4'-0½     | 3'-9      | 3'-5⅞     | 3'-1⅞    | 2'-10¼   | 2'-6¾    | 2'-3⅞    | 1'-11⅞   | 1'-8     | 4'-0½     | 3'-9      | 3'-5⅞     | 3'-1⅞    | 2'-10¼   | 2'-6¾    | 2'-3⅞    | 1'-11⅞   | 1'-8     | F2    |  |
| G               | 37'-4     | 37'-2     | 37'-0     | 37'-0    | 37'-0    | 36'-10   | 36'-10   | 36'-10   | 36'-10   | 31'-4     | 31'-2     | 31'-0     | 31'-0    | 31'-0    | 30'-10   | 30'-10   | 30'-10   | 30'-10   | G     |  |
| G1              | 43'-1¼    | 42'-11    | 42'-8⅞    | 42'-8⅞   | 42'-8⅞   | 42'-6⅞   | 42'-6⅞   | 42'-6⅞   | 42'-6⅞   | 36'-2⅞    | 35'-11⅞   | 35'-9½    | 35'-9½   | 35'-9½   | 35'-7¼   | 35'-7¼   | 35'-7¼   | 35'-7¼   | G1    |  |
| G2              | 44'-4⅞    | 44'-1¾    | 43'-11⅞   | 43'-11⅞  | 43'-11¼  | 43'-8⅞   | 43'-8⅞   | 43'-8⅞   | 43'-8½   | 37'-5     | 37'-2⅞    | 37'-0¼    | 37'-0¼   | 37'-0⅞   | 36'-9¾   | 36'-9⅞   | 36'-9½   | 36'-9⅞   | G2    |  |
| G3              | 25'-1¾    | 23'-1⅞    | 21'-1½    | 19'-1⅞   | 17'-1¼   | 15'-1⅞   | 13'-1    | 11'-0¾   | 9'-0⅞    | 25'-1¾    | 23'-1⅞    | 21'-1½    | 19'-1⅞   | 17'-1¼   | 15'-1⅞   | 13'-1    | 11'-0¾   | 9'-0⅞    | G3    |  |
| G4              | 25'-7⅞    | 23'-4¼    | 21'-0⅞    | 19'-0½   | 17'-0⅞   | 14'-8⅞   | 12'-8¾   | 10'-8¾   | 8'-8¾    | 25'-7⅞    | 23'-4¼    | 21'-0⅞    | 19'-0½   | 17'-0⅞   | 14'-8⅞   | 12'-8¾   | 10'-8¾   | 8'-8¾    | G4    |  |
| G5              | 12'-11¾   | 11'-11¼   | 10'-10¾   | 9'-10¼   | 8'-9¾    | 7'-9¼    | 6'-8¾    | 5'-8¼    | 4'-7¾    | 12'-11¾   | 11'-11¼   | 10'-10¾   | 9'-10¼   | 8'-9¾    | 7'-9¼    | 6'-8¾    | 5'-8¼    | 4'-7¾    | G5    |  |
| G6              | 14'-3¼    | 13'-0⅞    | 11'-10⅞   | 10'-10⅞  | 9'-9⅞    | 8'-7⅞    | 7'-7     | 6'-6½    | 5'-6⅞    | 14'-3¼    | 13'-0⅞    | 11'-10⅞   | 10'-10⅞  | 9'-9⅞    | 8'-7⅞    | 7'-7     | 6'-6½    | 5'-6⅞    | G6    |  |
| G7              | 2¼        | 5½        | 8⅞        | 8⅞       | 8⅞       | 1'-0⅞    | 1'-0     | 1'-0     | 11⅞      | 2¼        | 5½        | 8⅞        | 8⅞       | 8⅞       | 1'-0⅞    | 1'-0     | 1'-0     | 11⅞      | G7    |  |
| G8              | 4⅞        | 6⅞        | 7⅞        | 7⅞       | 7⅞       | 9        | 9        | 9        | 9        | 4⅞        | 6⅞        | 7⅞        | 7⅞       | 7⅞       | 9        | 9        | 9        | 9        | G8    |  |
| K               | 38'-0     | 37'-10    | 37'-8     | 37'-8    | 37'-8    | 37'-6    | 37'-6    | 37'-6    | 37'-6    | 32'-0     | 31'-10    | 31'-8     | 31'-8    | 31'-8    | 31'-6    | 31'-6    | 31'-6    | 31'-6    | K     |  |
| K1              | 43'-10½   | 43'-8¼    | 43'-5⅞    | 43'-5⅞   | 43'-5⅞   | 43'-3⅞   | 43'-3⅞   | 43'-3⅞   | 43'-3⅞   | 36'-11⅞   | 36'-9⅞    | 36'-6¾    | 36'-6¾   | 36'-6¾   | 36'-4½   | 36'-4½   | 36'-4½   | 36'-4½   | K1    |  |
| PL              | 51'-5⅞    | 47'-3½    | 43'-1½    | 38'-11⅞  | 34'-9¼   | 30'-7¼   | 26'-5⅞   | 22'-3⅞   | 18'-1    | 51'-5⅞    | 47'-3½    | 43'-1½    | 38'-11⅞  | 34'-9¼   | 30'-7¼   | 26'-5⅞   | 22'-3⅞   | 18'-1    | PL    |  |
| PS              | 38'-5¾    | 35'-4⅞    | 32'-2⅞    | 29'-1½   | 26'-0    | 22'-10⅞  | 19'-9⅞   | 16'-7¾   | 13'-6¼   | 38'-5¾    | 35'-4⅞    | 32'-2⅞    | 29'-1½   | 26'-0    | 22'-10⅞  | 19'-9⅞   | 16'-7¾   | 13'-6¼   | PS    |  |
| RL              | 52'-11⅞   | 48'-7⅞    | 44'-4⅞    | 40'-0⅞   | 35'-9⅞   | 31'-5⅞   | 27'-2⅞   | 22'-10⅞  | 18'-7⅞   | 52'-11⅞   | 48'-7⅞    | 44'-4⅞    | 40'-0⅞   | 35'-9⅞   | 31'-5⅞   | 27'-2⅞   | 22'-10⅞  | 18'-7⅞   | RL    |  |
| RS              | 40'-5     | 37'-1⅞    | 33'-10¼   | 30'-7    | 27'-3⅞   | 24'-0⅞   | 20'-9    | 17'-5¾   | 14'-2⅞   | 40'-5     | 37'-1⅞    | 33'-10¼   | 30'-7    | 27'-3⅞   | 24'-0⅞   | 20'-9    | 17'-5¾   | 14'-2⅞   | RS    |  |
| R1              | 30'-0     | 27'-6¼    | 25'-0⅞    | 22'-6½   | 20'-0⅞   | 17'-6¾   | 15'-0⅞   | 12'-6½   | 10'-0⅞   | 30'-0     | 27'-6¼    | 25'-0⅞    | 22'-6½   | 20'-0⅞   | 17'-6¾   | 15'-0⅞   | 12'-6½   | 10'-0⅞   | R1    |  |
| S1              | 13'-10¼   | 13'-10¼   | 13'-10¼   | 13'-10¼  | 13'-10¼  | 13'-10¼  | 13'-10¼  | 13'-10¼  | 13'-10¼  | 11'-6⅞    | 11'-6⅞    | 11'-6⅞    | 11'-6⅞   | 11'-6⅞   | 11'-6⅞   | 11'-6⅞   | 11'-6⅞   | 11'-6⅞   | S1    |  |
| T               | 1'-2      | 1'-2      | 1'-2      | 1'-2     | 1'-2     | 1'-2     | 1'-2     | 1'-2     | 1'-2     | 1'-1      | 1'-1      | 1'-1      | 1'-1     | 1'-1     | 1'-1     | 1'-1     | 1'-1     | 1'-1     | T     |  |
| U               | 1'-0      | 11        | 10        | 10       | 10       | 9        | 9        | 9        | 9        | 1'-0      | 11        | 10        | 10       | 10       | 9        | 9        | 9        | 9        | U     |  |
| V               | 1'-0      | 11        | 10        | 10       | 10       | 9        | 9        | 9        | 9        | 1'-0      | 11        | 10        | 10       | 10       | 9        | 9        | 9        | 9        | V     |  |
| V1              | 1'-1⅞     | 1'-0¾     | 11½       | 11½      | 11½      | 10⅞      | 10⅞      | 10⅞      | 10⅞      | 1'-1⅞     | 1'-0¾     | 11½       | 11½      | 11½      | 10⅞      | 10⅞      | 10⅞      | 10⅞      | V1    |  |
| W               | 5'-0      | 4'-9      | 4'-6      | 4'-3     | 4'-0     | 3'-9     | 3'-6     | 3'-6     | 3'-6     | 5'-0      | 4'-9      | 4'-6      | 4'-3     | 4'-0     | 3'-9     | 3'-6     | 3'-6     | 3'-6     | W     |  |

- Notes:
- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
  - See Sheet TRFWH 30-1-21 and sheets TRFWH 30-3-21 thru TRFWH 30-6-21 for location of certain dimensions tabulated.
  - Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

  
APPROVED BY BRIDGE ENGINEER

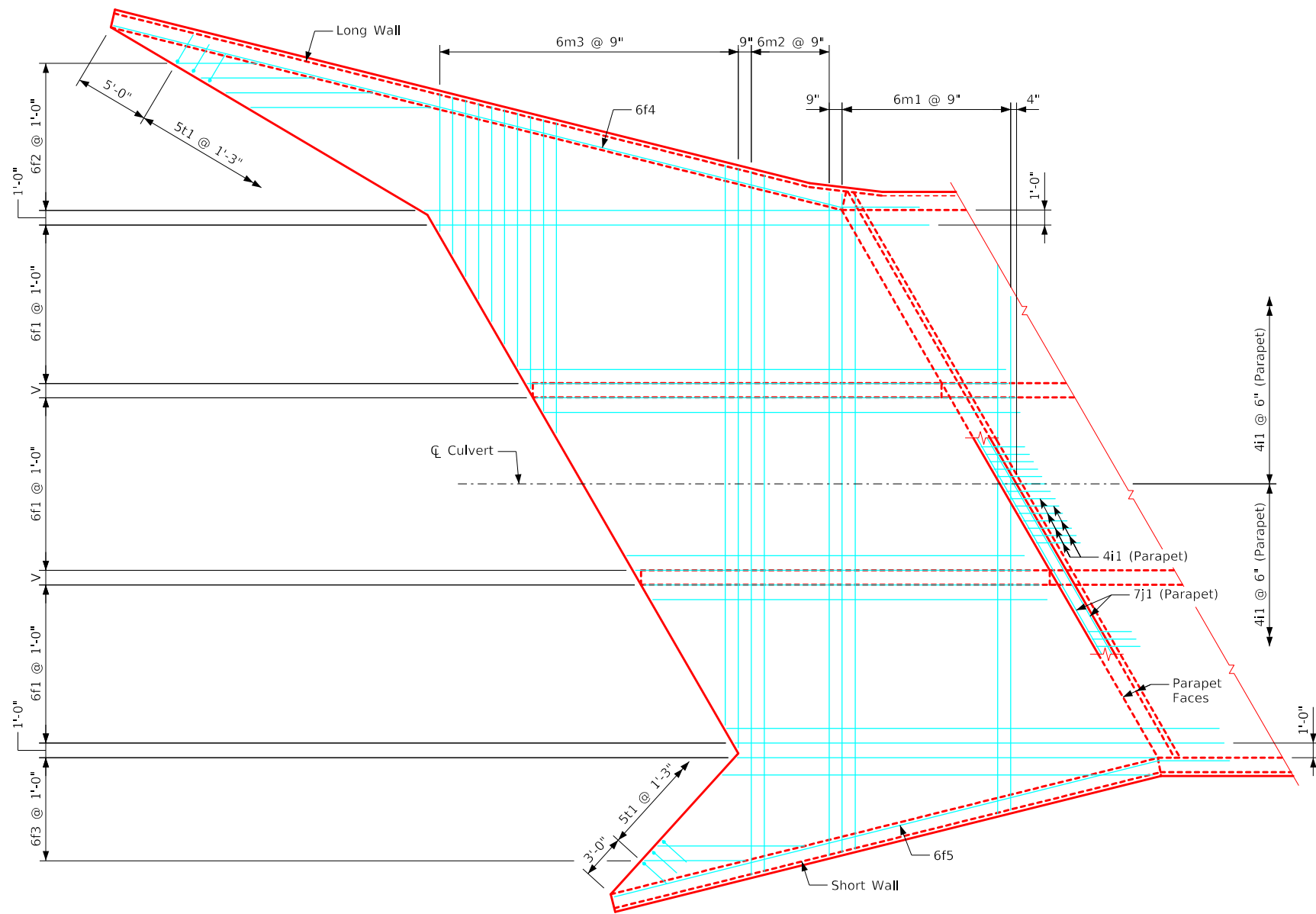
  
Standard Design - Triple Reinforced Concrete Box Culverts

Flared Wing Headwalls  
February, 2021

Dimension Table  
30° Skew

TRFWH  
30-2-21

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Plan View - Top of Apron Reinforcing

Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Top transverse floor bars are referenced approximately 4" from the back of the parapet for all headwalls.
3. For dimension table see Sheet TRFWH 30-2-21.
4. For reinforcing in curtain wall see Curtain Wall Details on Sheet TRFWH 30-5-21.

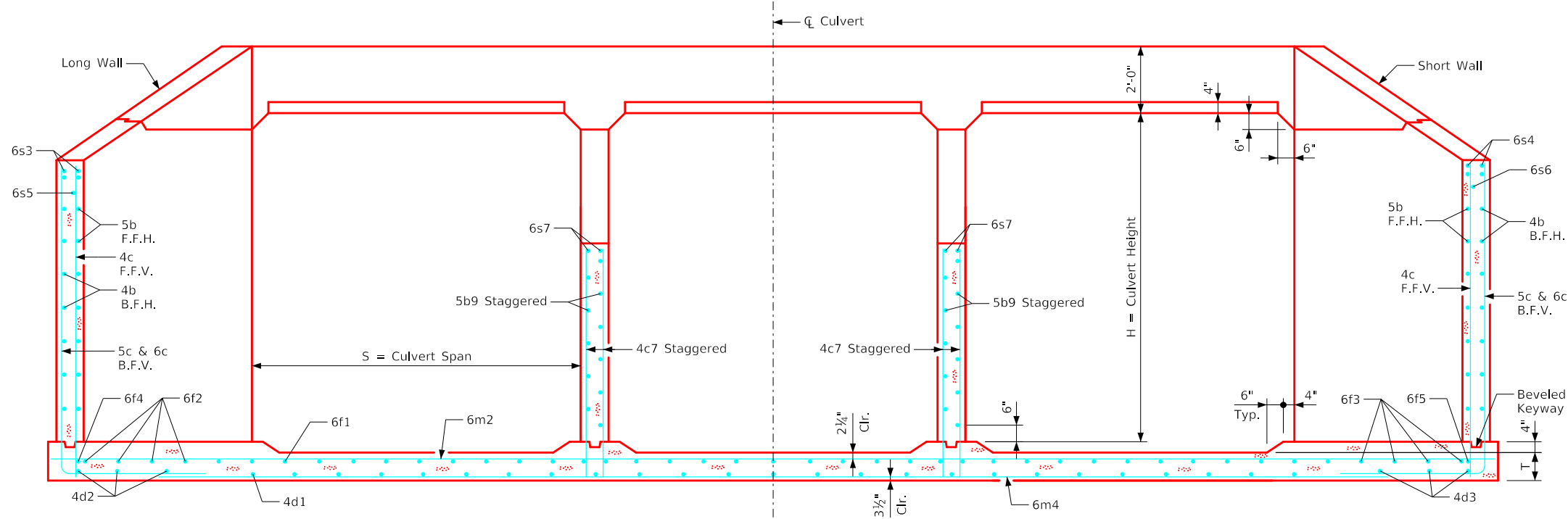
|                      |                                                                                                                      |                                                                                       |                  |
|----------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------|
| LATEST REVISION DATE | <br>APPROVED BY BRIDGE ENGINEER |  |                  |
|                      |                                                                                                                      | Standard Design - Triple Reinforced Concrete Box Culverts                             |                  |
|                      |                                                                                                                      | Flared Wing Headwalls                                                                 |                  |
|                      |                                                                                                                      | February, 2021                                                                        |                  |
|                      |                                                                                                                      | Top Apron Detail<br>30° Skew                                                          | TRFWH<br>30-3-21 |

\* - See Note 3  
Δ - See Note 4

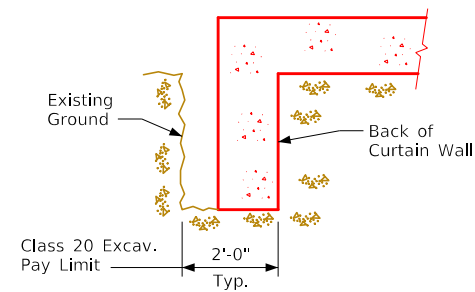
1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Wingwall bars consistently referenced from end of wing for all headwalls.
3. There are no 6c13 bars in the 4' & 5' height headwalls.
4. 4c3 & 4c4 bars used only in the 9', 10', 11' & 12' height headwalls.
5. For dimension table see Sheet TRFWH 30-2-21.
6. For reinforcing in curtain wall see Curtain Wall Details on Sheet TRFWH 30-5-21.

1/16/2021 5:27:12 PM bkloss W:\Highway\Bridge\Standards\Culverts\LRFD\EnglishLRFDSignedTripleCulvertsFWH.dgn TRFWH 30-4-21 11x17\_.pdf.pltcf

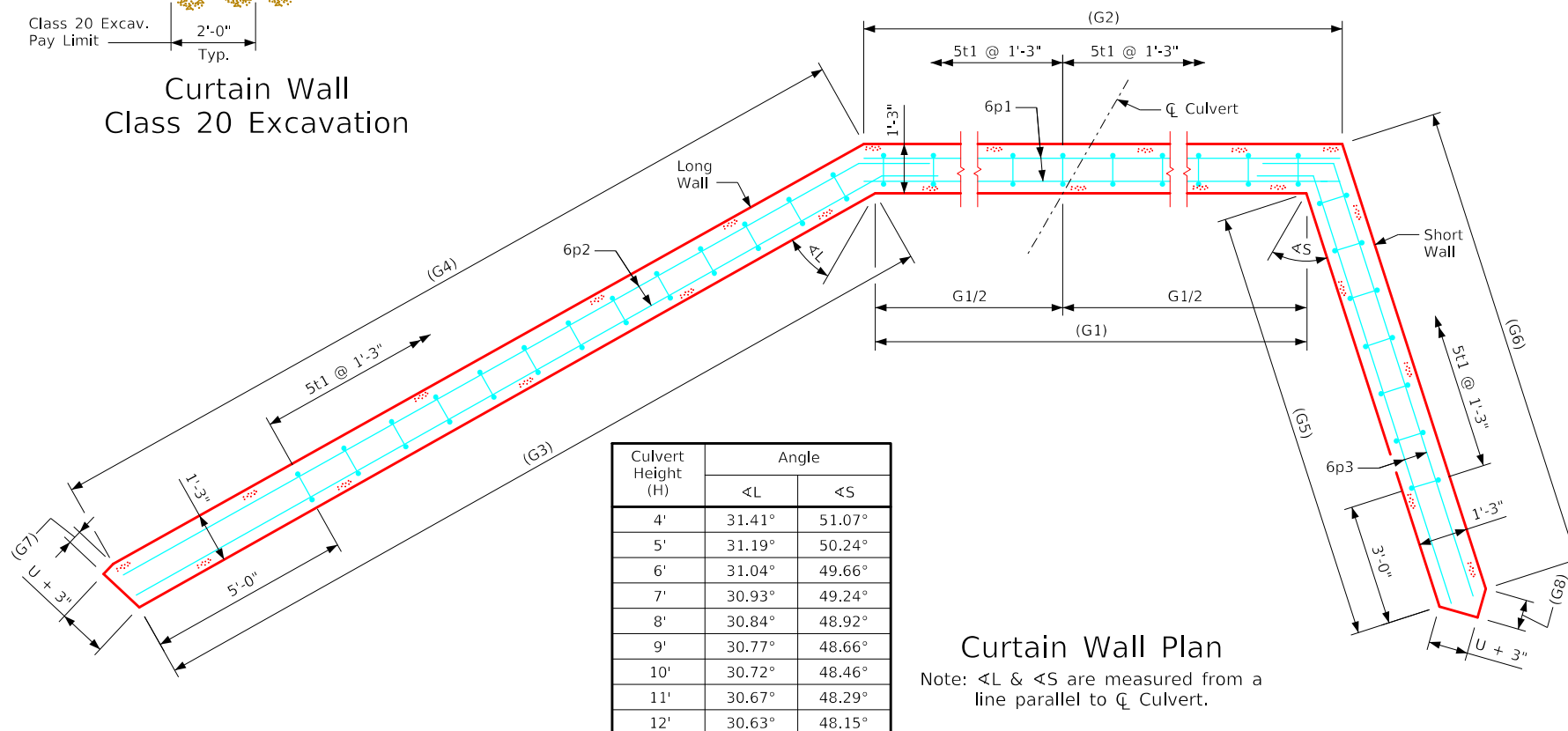
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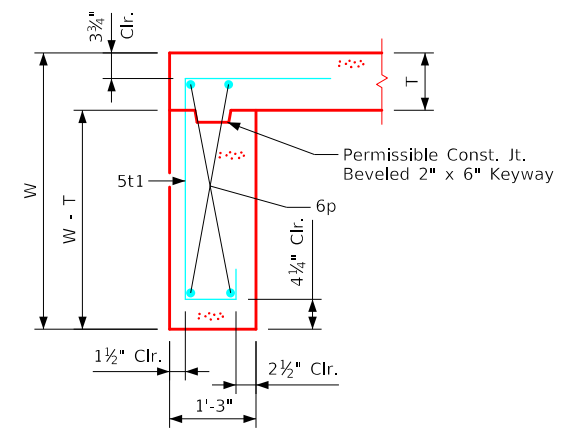
Typical Section - Near Center of Apron



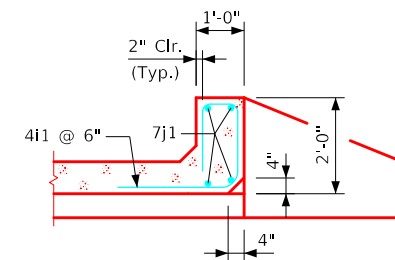
Curtain Wall  
Class 20 Excavation



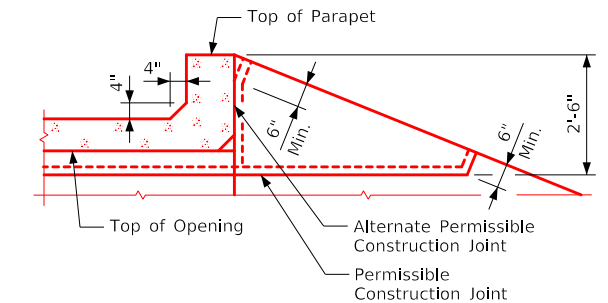
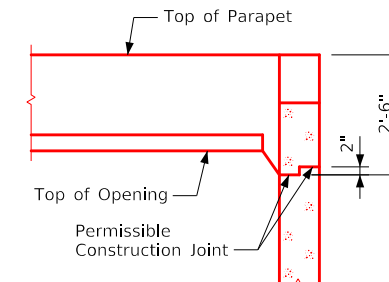
Curtain Wall Plan



Section thru Curtain Wall



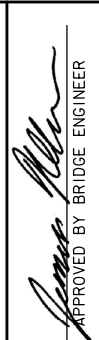
Section thru Parapet



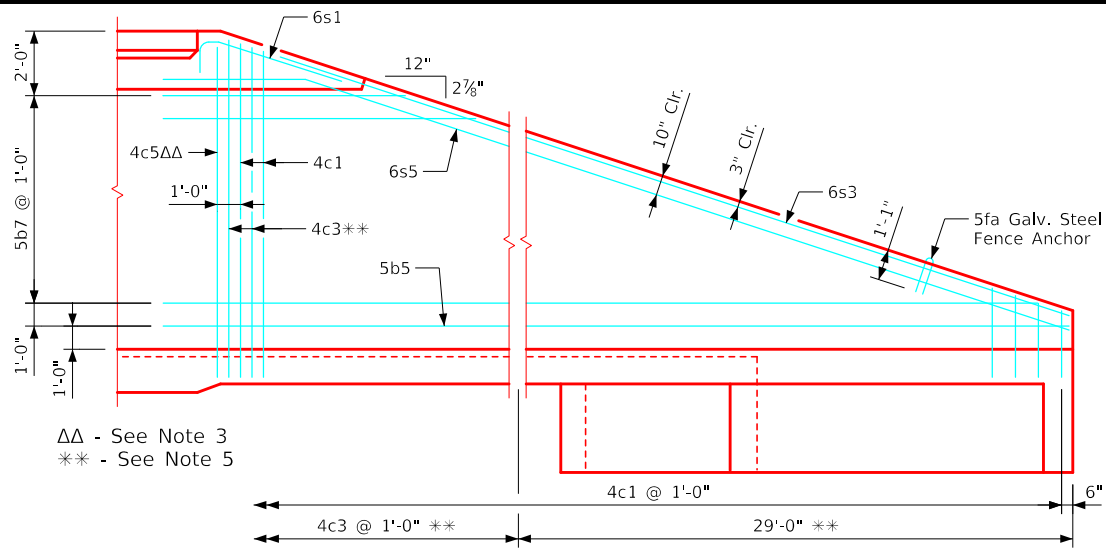
Top of Wingwall Details

Notes:

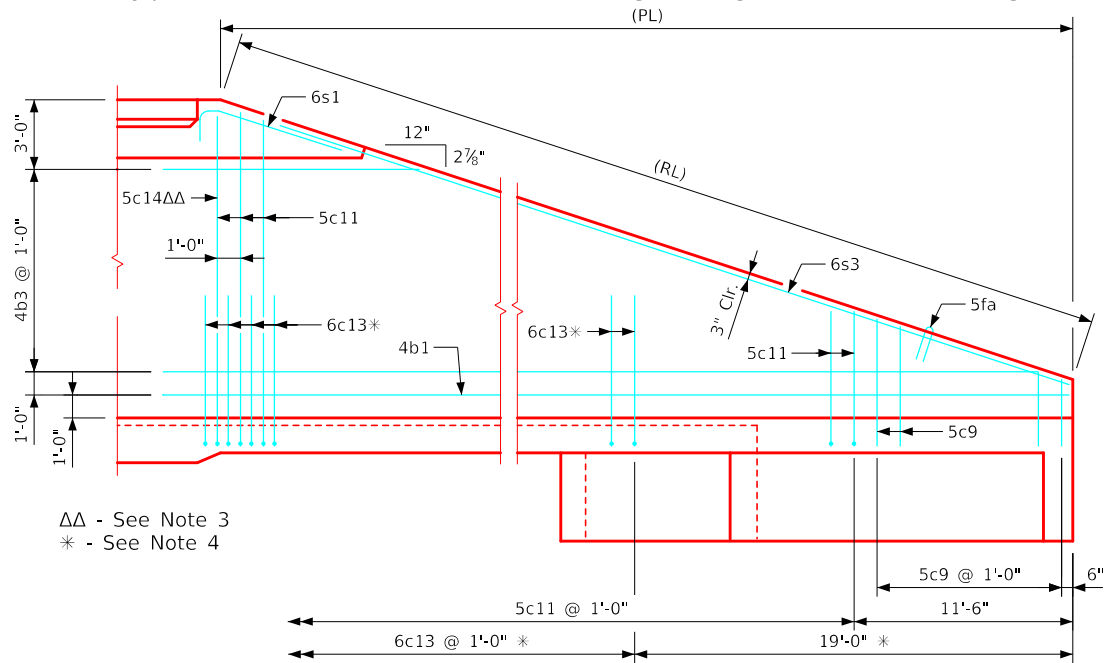
1. See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. For dimension table see Sheet TRFWH 30-2-21.

|                      |                                                                                                                      |                                                                                                                                                    |                  |
|----------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| LATEST REVISION DATE | <br>APPROVED BY BRIDGE ENGINEER | <br>Standard Design - Triple Reinforced Concrete Box Culverts |                  |
|                      |                                                                                                                      | Flared Wing Headwalls                                                                                                                              |                  |
|                      |                                                                                                                      | February, 2021                                                                                                                                     |                  |
|                      |                                                                                                                      | Parapet & Curtain Wall Details<br>30° Skew                                                                                                         | TRFWH<br>30-5-21 |

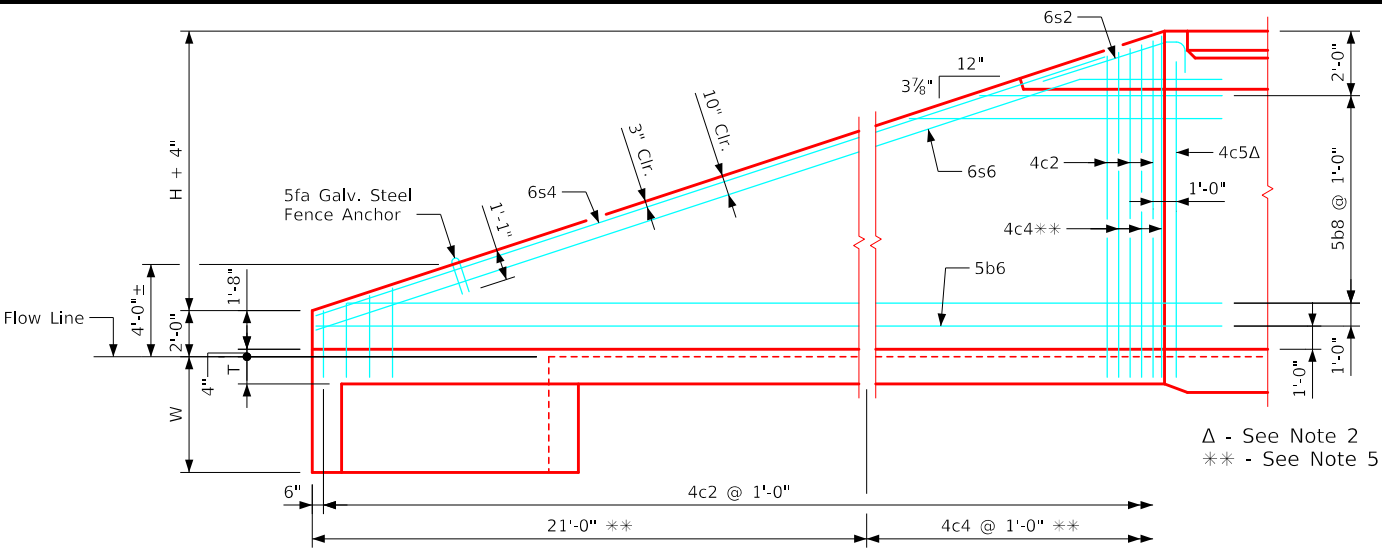
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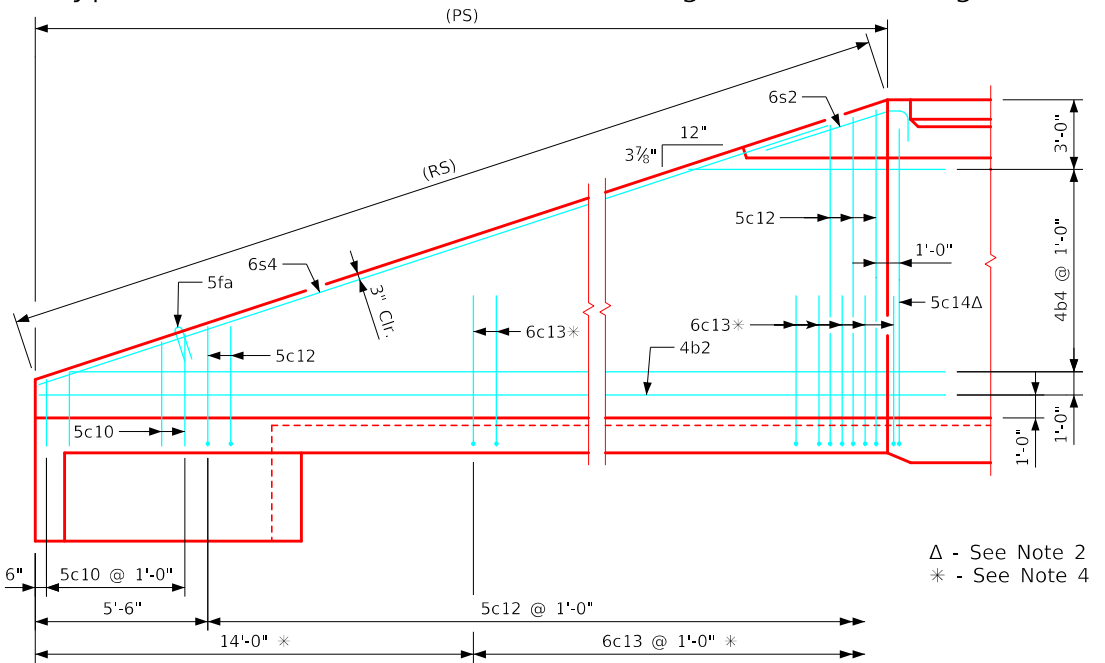
Typical View - Front Face Long Wingwall Reinforcing



Typical View - Back Face Long Wingwall Reinforcing

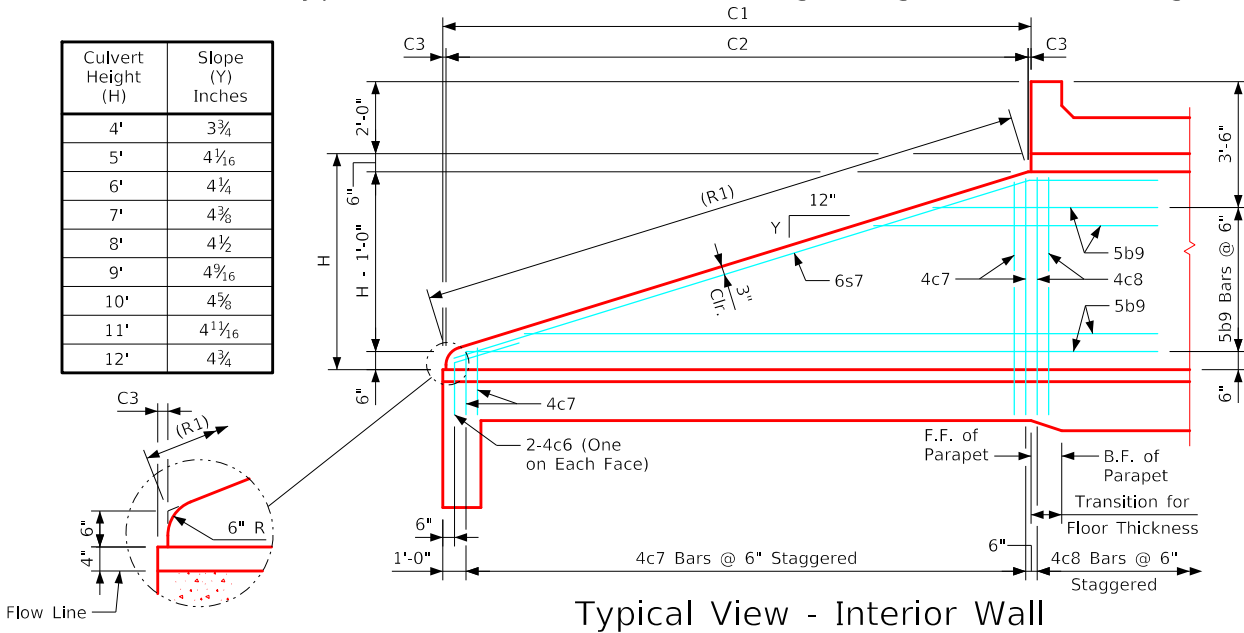


Typical View - Front Face Short Wingwall Reinforcing



Typical View - Back Face Short Wingwall Reinforcing

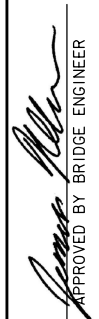
| Culvert Height (H) | Slope (Y) Inches |
|--------------------|------------------|
| 4'                 | 3 3/4            |
| 5'                 | 4 1/16           |
| 6'                 | 4 1/4            |
| 7'                 | 4 3/8            |
| 8'                 | 4 1/2            |
| 9'                 | 4 5/16           |
| 10'                | 4 3/8            |
| 11'                | 4 1 1/16         |
| 12'                | 4 3/4            |



Typical View - Interior Wall

Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Two 4c5 & two 5c14 bars for 8', 9', 10', 11' & 12' height headwalls. One 4c5 & one 5c14 bar for 4', 5', 6' & 7' height headwalls.
3. Two 4c5 & two 5c14 for 4', 5', 6', 10', 11' & 12' height headwalls. One 4c5 & one 5c14 bar for 7', 8' & 9' height headwalls.
4. Not applicable for 4' & 5' height headwalls.
5. Not applicable for 4' thru 8' height headwalls.
6. For dimension table, see sheet TRFWH 30-2-21.
7. Top of wall slope may be rounded in some instances.

|                              |                                                                                                                      |                                                                                                                                                    |  |
|------------------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--|
| LATEST REVISION DATE         | <br>APPROVED BY BRIDGE ENGINEER | <br>Standard Design - Triple Reinforced Concrete Box Culverts |  |
|                              |                                                                                                                      | Flared Wing Headwalls                                                                                                                              |  |
|                              |                                                                                                                      | February, 2021                                                                                                                                     |  |
| Wingwall Details<br>30° Skew |                                                                                                                      | TRFWH<br>30-6-21                                                                                                                                   |  |

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| Bill of Reinforcing for One Headwall 30° Skew Span x Culvert Height |                                   |                                                                                     |           |                          |          |           |                          |      |           |                          |      |          |                         |      |          |                         |      |      |  |
|---------------------------------------------------------------------|-----------------------------------|-------------------------------------------------------------------------------------|-----------|--------------------------|----------|-----------|--------------------------|------|-----------|--------------------------|------|----------|-------------------------|------|----------|-------------------------|------|------|--|
| Bar                                                                 | Location                          | Shape                                                                               | 12' x 12' |                          |          | 12' x 11' |                          |      | 12' x 10' |                          |      | 12' x 9' |                         |      | 12' x 8' |                         |      | Bar  |  |
|                                                                     |                                   |                                                                                     | No.       | Length                   | Wt.      | No.       | Length                   | Wt.  | No.       | Length                   | Wt.  | No.      | Length                  | Wt.  | No.      | Length                  | Wt.  |      |  |
| 5fa                                                                 | Fence Anchor (Galv.)              |    | 2         | 2'-10                    | 6        | 2         | 2'-10                    | 6    | 2         | 2'-10                    | 6    | 2        | 2'-10                   | 6    | 2        | 2'-10                   | 6    | 5fa  |  |
| 4b1                                                                 | Wingwall, B.F.H. Long             |    | 1         | 55'-2                    | 38       | 1         | 51'-0                    | 36   | 1         | 46'-10                   | 33   | 1        | 42'-8                   | 30   | 1        | 38'-6                   | 26   | 4b1  |  |
| 4b2                                                                 | Wingwall, B.F.H. Short            |    | 1         | 42'-2                    | 30       | 1         | 39'-1                    | 26   | 1         | 36'-0                    | 24   | 1        | 32'-10                  | 22   | 1        | 29'-9                   | 20   | 4b2  |  |
| 4b3                                                                 | Wingwall, B.F.H. Long             |    | 10 Var.   | 15'-8 to 53'-3           | 237      | 9 Var.    | 15'-8 to 49'-1           | 199  | 8 Var.    | 15'-8 to 44'-11          | 165  | 7 Var.   | 15'-8 to 40'-9          | 134  | 6 Var.   | 15'-8 to 36'-7          | 105  | 4b3  |  |
| 4b4                                                                 | Wingwall, B.F.H. Short            |    | 10 Var.   | 12'-11 to 40'-9          | 181      | 9 Var.    | 12'-11 to 37'-8          | 152  | 8 Var.    | 12'-11 to 34'-7          | 127  | 7 Var.   | 12'-10 to 31'-5         | 103  | 6 Var.   | 12'-10 to 28'-4         | 82   | 4b4  |  |
| 5b5                                                                 | Wingwall, F.F.H. Long             |    | 1         | 55'-3                    | 60       | 1         | 51'-1                    | 56   | 1         | 46'-11                   | 51   | 1        | 42'-9                   | 47   | 1        | 38'-7                   | 40   | 5b5  |  |
| 5b6                                                                 | Wingwall, F.F.H. Short            |    | 1         | 42'-3                    | 46       | 1         | 39'-2                    | 41   | 1         | 36'-0                    | 38   | 1        | 32'-11                  | 34   | 1        | 29'-9                   | 31   | 5b6  |  |
| 5b7                                                                 | Wingwall, F.F.H. Long             |    | 11 Var.   | 11'-7 to 53'-4           | 382      | 10 Var.   | 11'-7 to 49'-1           | 324  | 9 Var.    | 11'-7 to 44'-11          | 270  | 8 Var.   | 11'-7 to 40'-9          | 221  | 7 Var.   | 11'-7 to 36'-7          | 176  | 5b7  |  |
| 5b8                                                                 | Wingwall, F.F.H. Short            |    | 11 Var.   | 9'-10 to 40'-10          | 293      | 10 Var.   | 9'-10 to 37'-9           | 248  | 9 Var.    | 9'-10 to 34'-7           | 208  | 8 Var.   | 9'-10 to 31'-6          | 172  | 7 Var.   | 9'-9 to 28'-4           | 139  | 5b8  |  |
| 5b9                                                                 | Interior Wall, Both F.H.          |    | 42 Var.   | 2 Each<br>6'-0 to 31'-4  | 818      | 38 Var.   | 2 Each<br>6'-0 to 29'-1  | 695  | 34 Var.   | 2 Each<br>6'-0 to 26'-9  | 581  | 30 Var.  | 2 Each<br>6'-0 to 24'-5 | 476  | 26 Var.  | 2 Each<br>6'-1 to 22'-2 | 383  | 5b9  |  |
| 4c1                                                                 | Wingwall, F.F.V. Long             |    | 51 Var.   | 2'-10 to 14'-10          | 301      | 47 Var.   | 2'-10 to 13'-10          | 262  | 43 Var.   | 2'-10 to 12'-11          | 226  | 39 Var.  | 2'-10 to 11'-11         | 192  | 35 Var.  | 2'-10 to 11'-0          | 162  | 4c1  |  |
| 4c2                                                                 | Wingwall, F.F.V. Short            |    | 38 Var.   | 2'-10 to 14'-9           | 223      | 35 Var.   | 2'-10 to 13'-9           | 194  | 32 Var.   | 2'-10 to 12'-10          | 167  | 29 Var.  | 2'-10 to 11'-10         | 142  | 26 Var.  | 2'-10 to 10'-10         | 119  | 4c2  |  |
| 4c3                                                                 | Wingwall, F.F.V. Long             |    | 23 Var.   | 9'-8 to 14'-11           | 189      | 19 Var.   | 9'-8 to 14'-0            | 150  | 15 Var.   | 9'-8 to 13'-0            | 114  | 11 Var.  | 9'-8 to 12'-1           | 80   | --       | --                      | --   | 4c3  |  |
| 4c4                                                                 | Wingwall, F.F.V. Short            |    | 18 Var.   | 9'-5 to 14'-11           | 146      | 15 Var.   | 9'-5 to 13'-11           | 117  | 12 Var.   | 9'-5 to 12'-11           | 90   | 9 Var.   | 9'-5 to 12'-0           | 64   | --       | --                      | --   | 4c4  |  |
| 4c5                                                                 | Wingwall, F.F.V. Long             |    | 2         | 13'-9                    | 18       | 2         | 12'-9                    | 17   | 2         | 11'-9                    | 16   | 1        | 10'-9                   | 7    | 1        | 9'-9                    | 7    | 4c5  |  |
| 4c5                                                                 | Wingwall, F.F.V. Short            |    | 2         | 13'-9                    | 18       | 2         | 12'-9                    | 17   | 2         | 11'-9                    | 16   | 2        | 10'-9                   | 14   | 2        | 9'-9                    | 13   | 4c5  |  |
| 4c6                                                                 | Interior Wall, Both F.V.          |    | 4         | 4'-2                     | 11       | 4         | 4'-2                     | 11   | 4         | 4'-2                     | 11   | 4        | 4'-2                    | 11   | 4        | 4'-2                    | 11   | 4c6  |  |
| 4c7                                                                 | Interior Wall, Both F.V.          |    | 108 Var.  | 2 Each<br>1'-11 to 12'-4 | 514      | 100 Var.  | 2 Each<br>1'-11 to 11'-6 | 448  | 90 Var.   | 2 Each<br>1'-11 to 10'-5 | 371  | 82 Var.  | 2 Each<br>1'-11 to 9'-6 | 313  | 72 Var.  | 2 Each<br>1'-11 to 8'-5 | 248  | 4c7  |  |
| 4c8                                                                 | Interior Wall, Both F.V.          |    | 4         | 12'-7                    | 34       | 4         | 11'-7                    | 31   | 4         | 10'-7                    | 28   | 4        | 9'-7                    | 26   | 4        | 8'-7                    | 23   | 4c8  |  |
| 5c9                                                                 | Wingwall, B.F.V. Long             |    | 11 Var.   | 2'-10 to 5'-3            | 46       | 11 Var.   | 2'-10 to 5'-3            | 46   | 11 Var.   | 2'-10 to 5'-3            | 46   | 11 Var.  | 2'-10 to 5'-3           | 46   | 11 Var.  | 2'-10 to 5'-3           | 46   | 5c9  |  |
| 5c10                                                                | Wingwall, B.F.V. Short            |    | 5 Var.    | 2'-10 to 4'-2            | 18       | 5 Var.    | 2'-10 to 4'-2            | 18   | 5 Var.    | 2'-10 to 4'-2            | 18   | 5 Var.   | 2'-10 to 4'-2           | 18   | 5 Var.   | 2'-10 to 4'-2           | 18   | 5c10 |  |
| 5c11                                                                | Wingwall, B.F.V. Long             |    | 40 Var.   | 9'-6 to 18'-10           | 591      | 36 Var.   | 9'-6 to 17'-10           | 513  | 32 Var.   | 9'-6 to 16'-11           | 441  | 28 Var.  | 9'-6 to 15'-11          | 371  | 24 Var.  | 9'-6 to 15'-0           | 307  | 5c11 |  |
| 5c12                                                                | Wingwall, B.F.V. Short            |    | 33 Var.   | 8'-6 to 18'-9            | 469      | 30 Var.   | 8'-6 to 17'-9            | 411  | 27 Var.   | 8'-6 to 16'-10           | 357  | 24 Var.  | 8'-6 to 15'-10          | 305  | 21 Var.  | 8'-6 to 14'-10          | 256  | 5c12 |  |
| 6c13                                                                | Wingwall, B.F.V. Long             |    | 33        | 10'-6                    | 520      | 29        | 10'-6                    | 457  | 25        | 10'-6                    | 394  | 21       | 10'-6                   | 331  | 17       | 10'-6                   | 268  | 6c13 |  |
| 6c13                                                                | Wingwall, B.F.V. Short            |    | 25        | 10'-6                    | 394      | 22        | 10'-6                    | 347  | 19        | 10'-6                    | 300  | 16       | 10'-6                   | 252  | 13       | 10'-6                   | 205  | 6c13 |  |
| 5c14                                                                | Wingwall, B.F.V. Long             |    | 2         | 17'-9                    | 37       | 2         | 16'-9                    | 35   | 2         | 15'-9                    | 33   | 1        | 14'-9                   | 15   | 1        | 13'-9                   | 14   | 5c14 |  |
| 5c14                                                                | Wingwall, B.F.V. Short            |    | 2         | 17'-9                    | 37       | 2         | 16'-9                    | 35   | 2         | 15'-9                    | 33   | 2        | 14'-9                   | 31   | 2        | 13'-9                   | 29   | 5c14 |  |
| 4d1                                                                 | Apron, Longit., Bott.             |    | 25        | 31'-11                   | 533      | 25        | 29'-7                    | 494  | 25        | 27'-3                    | 455  | 25       | 25'-0                   | 418  | 25       | 22'-8                   | 379  | 4d1  |  |
| 4d2                                                                 | Apron, Longit., Bott. Long        |    | 3         | 48'-9                    | 102      | 3         | 44'-7                    | 94   | 3         | 40'-5                    | 86   | 3        | 36'-3                   | 73   | 3        | 32'-1                   | 64   | 4d2  |  |
| 4d3                                                                 | Apron, Longit., Bott. Short       |    | 3         | 37'-3                    | 75       | 3         | 34'-2                    | 68   | 3         | 31'-0                    | 62   | 3        | 27'-11                  | 56   | 3        | 24'-9                   | 50   | 4d3  |  |
| 6f1                                                                 | Apron, Longit., Top               |    | 37        | 31'-11                   | 1774     | 37        | 29'-7                    | 1644 | 37        | 27'-3                    | 1514 | 37       | 25'-0                   | 1389 | 37       | 22'-8                   | 1260 | 6f1  |  |
| 6f2                                                                 | Apron, Longit., Top Long          |    | 11 Var.   | 5'-4 to 28'-6            | 279      | 10 Var.   | 5'-4 to 26'-2            | 237  | 9 Var.    | 5'-4 to 23'-10           | 197  | 8 Var.   | 5'-4 to 21'-7           | 162  | 7 Var.   | 5'-3 to 19'-3           | 129  | 6f2  |  |
| 6f3                                                                 | Apron, Longit., Top Short         |   | 8 Var.    | 7'-0 to 28'-8            | 214      | 7 Var.    | 7'-9 to 26'-5            | 180  | 7 Var.    | 5'-5 to 24'-1            | 155  | 6 Var.   | 6'-2 to 21'-9           | 126  | 5 Var.   | 6'-11 to 19'-6          | 99   | 6f3  |  |
| 6f4                                                                 | Apron, Longit., Top Long          |  | 1         | 55'-3                    | 86       | 1         | 51'-1                    | 80   | 1         | 46'-11                   | 74   | 1        | 42'-9                   | 68   | 1        | 38'-7                   | 58   | 6f4  |  |
| 6f5                                                                 | Apron, Longit., Top Short         |  | 1         | 42'-3                    | 67       | 1         | 39'-2                    | 59   | 1         | 36'-0                    | 54   | 1        | 32'-11                  | 49   | 1        | 29'-9                   | 45   | 6f5  |  |
| 4i1                                                                 | Parapet, Vertical                 |  | 77        | 6'-4                     | 326      | 75        | 6'-4                     | 317  | 75        | 6'-4                     | 317  | 75       | 6'-4                    | 317  | 75       | 6'-4                    | 317  | 4i1  |  |
| 7j1                                                                 | Parapet, Horizontal               |  | 4         | 45'-9                    | 392      | 4         | 45'-5                    | 390  | 4         | 45'-0                    | 386  | 4        | 45'-0                   | 386  | 4        | 45'-0                   | 386  | 7j1  |  |
| 6m1                                                                 | Apron, Trans., Top                |  | 16 Var.   | 42'-8 to 45'-6           | 1117     | 16 Var.   | 42'-4 to 45'-2           | 1109 | 16 Var.   | 42'-0 to 44'-10          | 1101 | 15 Var.  | 42'-0 to 44'-7          | 1030 | 13 Var.  | 42'-0 to 44'-3          | 889  | 6m1  |  |
| 6m2                                                                 | Apron, Trans., Top                |  | 9 Var.    | 45'-9 to 48'-9           | 671      | 6 Var.    | 45'-5 to 47'-4           | 440  | 3 Var.    | 45'-1 to 45'-10          | 216  | 1        | 44'-9                   | 71   | 3 Var.   | 34'-8 to 37'-3          | 162  | 6m2  |  |
| 6m3                                                                 | Apron, Trans., Top                |  | 29 Var.   | 8'-8 to 39'-9            | 1054     | 29 Var.   | 7'-10 to 38'-11          | 1018 | 29 Var.   | 7'-0 to 38'-1            | 982  | 29 Var.  | 6'-4 to 37'-5           | 953  | 25 Var.  | 6'-9 to 33'-5           | 754  | 6m3  |  |
| 6m4                                                                 | Apron, Trans., Bott.              |  | 24 Var.   | 38'-10 to 54'-6          | 1762     | 22 Var.   | 38'-8 to 53'-0           | 1587 | 20 Var.   | 38'-6 to 51'-5           | 1412 | 18 Var.  | 38'-6 to 50'-1          | 1252 | 16 Var.  | 38'-6 to 48'-8          | 1094 | 6m4  |  |
| 6p1                                                                 | Curtain, Horizontal               |  | 4         | 44'-1                    | 278      | 4         | 43'-10                   | 277  | 4         | 43'-8                    | 276  | 4        | 43'-8                   | 276  | 4        | 43'-8                   | 276  | 6p1  |  |
| 6p2                                                                 | Curtain, Horizontal, Long         |  | 4         | 28'-0                    | 168      | 4         | 26'-0                    | 156  | 4         | 24'-0                    | 144  | 4        | 22'-0                   | 132  | 4        | 20'-0                   | 120  | 6p2  |  |
| 6p3                                                                 | Curtain, Horizontal, Short        |  | 4         | 15'-11                   | 96       | 4         | 14'-11                   | 90   | 4         | 13'-10                   | 83   | 4        | 12'-10                  | 77   | 4        | 11'-9                   | 71   | 6p3  |  |
| 6s1                                                                 | Wing Slope, Both F., Long         |  | 2         | 8'-0                     | 24       | 2         | 8'-0                     | 24   | 2         | 8'-0                     | 24   | 2        | 8'-0                    | 24   | 2        | 8'-0                    | 24   | 6s1  |  |
| 6s2                                                                 | Wing Slope, Both F., Short        |  | 2         | 6'-11                    | 21       | 2         | 6'-11                    | 21   | 2         | 6'-11                    | 21   | 2        | 6'-11                   | 21   | 2        | 6'-11                   | 21   | 6s2  |  |
| 6s3                                                                 | Wing Slope, Both F., Long         |  | 2         | 48'-11                   | 154      | 2         | 44'-7                    | 141  | 2         | 40'-4                    | 128  | 2        | 36'-0                   | 108  | 2        | 31'-9                   | 95   | 6s3  |  |
| 6s4                                                                 | Wing Slope, Both F., Short        |  | 2         | 38'-0                    | 114      | 2         | 34'-9                    | 104  | 2         | 31'-6                    | 95   | 2        | 28'-2                   | 85   | 2        | 24'-11                  | 75   | 6s4  |  |
| 6s5                                                                 | Wing Slope, F.F. Long             |  | 1         | 55'-0                    | 86       | 1         | 50'-9                    | 80   | 1         | 46'-5                    | 73   | 1        | 42'-2                   | 67   | 1        | 37'-10                  | 57   | 6s5  |  |
| 6s6                                                                 | Wing Slope, F.F. Short            |  | 1         | 43'-4                    | 68       | 1         | 40'-1                    | 64   | 1         | 36'-9                    | 55   | 1        | 33'-6                   | 50   | 1        | 30'-3                   | 45   | 6s6  |  |
| 6s7                                                                 | Interior Wall, Both F.H.          |  | 4         | 33'-3                    | 200      | 4         | 30'-10                   | 185  | 4         | 28'-4                    | 170  | 4        | 25'-10                  | 155  | 4        | 23'-4                   | 140  | 6s7  |  |
| 5t1                                                                 | Curtain, Vertical                 |  | 60        | 7'-11                    | 495      | 58        | 7'-8                     | 464  | 55        | 7'-5                     | 425  | 53       | 7'-2                    | 396  | 50       | 6'-11                   | 361  | 5t1  |  |
|                                                                     | Estimated Quantities One Headwall | Reinf. Steel                                                                        |           | 15,813 LB                |          |           | 14,215 LB                |      |           | 12,669 LB                |      |          | 11,204 LB               |      |          | 9705 LB                 |      |      |  |
|                                                                     |                                   | Concrete                                                                            | Parapet Δ | 4.4                      | 133.9 CY | 4.3       | 115.9 CY                 |      | 4.2       | 99.4 CY                  |      | 4.2      | 87.4 CY                 |      | 4.2      | 76.1 CY                 |      |      |  |
|                                                                     |                                   |                                                                                     | Wingwalls | 40.1                     |          | 31.5      |                          |      | 24.1      |                          |      | 20.0     |                         |      | 16.3     |                         |      |      |  |
|                                                                     |                                   |                                                                                     | Apron *   | 89.4                     |          | 80.1      |                          |      | 71.1      |                          |      | 63.2     |                         |      | 55.6     |                         |      |      |  |

Δ Includes top of wingwall quantities.

\* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall  
"Long" Denotes Long Wingwall

### Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER



Standard Design - Triple Reinforced Concrete Box Culverts

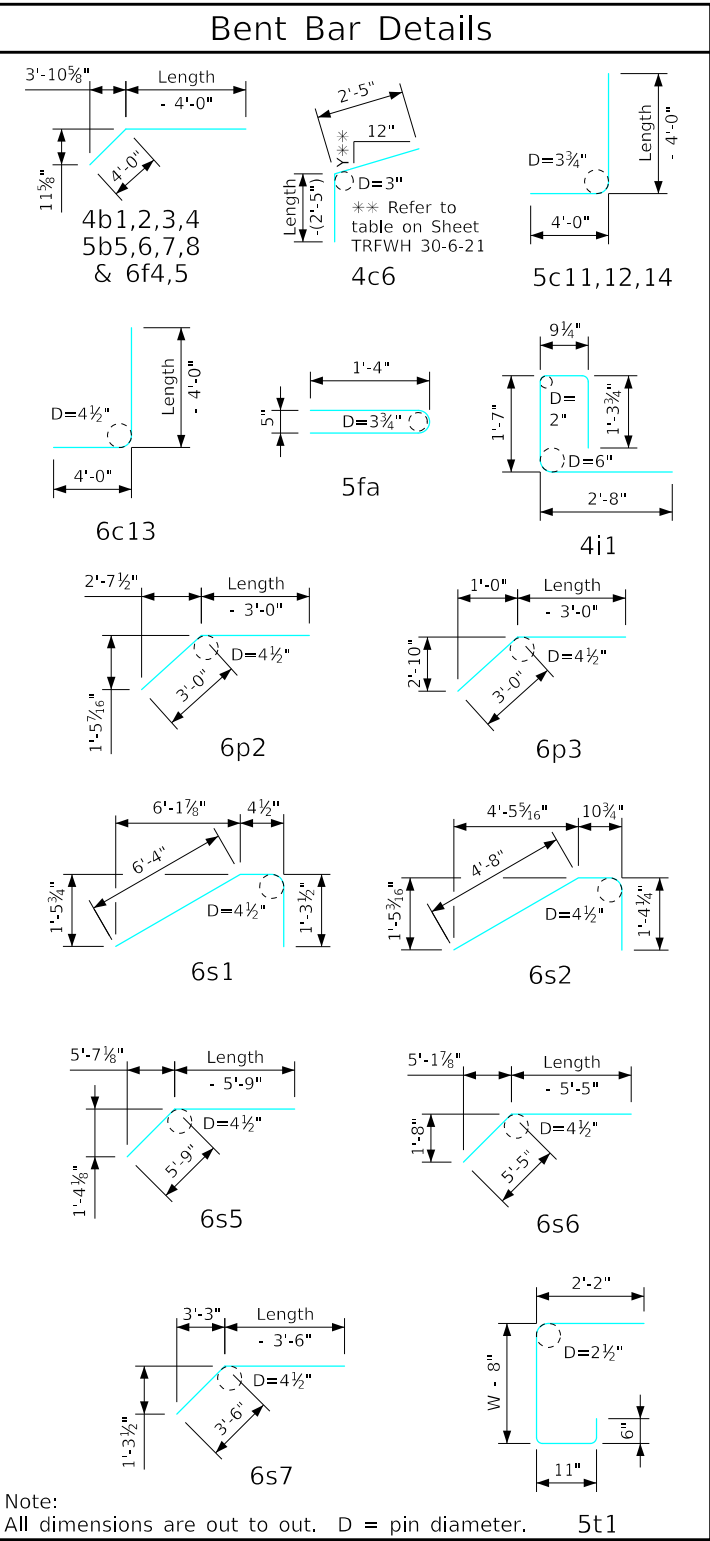
### Flared Wing Headwalls

February, 2021

Quantity Tabulation  
12'-0" Span  
30° Skew

TRFWH  
30-7-21  
Sheet 1 of 2

Note:  
All dimensions are out to out. D = pin diameter.



| Bill of Reinforcing for One Headwall 30° Skew Span x Culvert Height |                                   |              |           |                          |         |          |                         |         |          |                         |         |          |                          |     |      |
|---------------------------------------------------------------------|-----------------------------------|--------------|-----------|--------------------------|---------|----------|-------------------------|---------|----------|-------------------------|---------|----------|--------------------------|-----|------|
| Bar                                                                 | Location                          | Shape        | 12' x 7'  |                          |         | 12' x 6' |                         |         | 12' x 5' |                         |         | 12' x 4' |                          |     | Bar  |
|                                                                     |                                   |              | No.       | Length                   | Wt.     | No.      | Length                  | Wt.     | No.      | Length                  | Wt.     | No.      | Length                   | Wt. |      |
| 5fa                                                                 | Fence Anchor (Galv.)              |              | 2         | 2'-10                    | 6       | 2        | 2'-10                   | 6       | 2        | 2'-10                   | 6       | 2        | 2'-10                    | 6   | 5fa  |
| 4b1                                                                 | Wingwall, B.F.H. Long             |              | 1         | 34'-4                    | 23      | 1        | 30'-2                   | 20      | 1        | 26'-0                   | 17      | 1        | 21'-10                   | 15  | 4b1  |
| 4b2                                                                 | Wingwall, B.F.H. Short            |              | 1         | 26'-7                    | 18      | 1        | 23'-6                   | 16      | 1        | 20'-5                   | 14      | 1        | 17'-3                    | 12  | 4b2  |
| 4b3                                                                 | Wingwall, B.F.H. Long             |              | 5 Var.    | 15'-8 to 32'-5           | 80      | 4 Var.   | 15'-8 to 28'-3          | 59      | 3 Var.   | 15'-8 to 24'-1          | 40      | 2 Var.   | 15'-8 to 19'-10          | 24  | 4b3  |
| 4b4                                                                 | Wingwall, B.F.H. Short            |              | 5 Var.    | 12'-10 to 25'-3          | 64      | 4 Var.   | 12'-10 to 22'-1         | 47      | 3 Var.   | 12'-9 to 19'-0          | 32      | 2 Var.   | 12'-9 to 15'-10          | 19  | 4b4  |
| 5b5                                                                 | Wingwall, F.F.H. Long             |              | 1         | 34'-5                    | 36      | 1        | 30'-2                   | 31      | 1        | 26'-0                   | 27      | 1        | 21'-10                   | 23  | 5b5  |
| 5b6                                                                 | Wingwall, F.F.H. Short            |              | 1         | 26'-8                    | 28      | 1        | 23'-6                   | 25      | 1        | 20'-5                   | 21      | 1        | 17'-4                    | 18  | 5b6  |
| 5b7                                                                 | Wingwall, F.F.H. Long             |              | 6 Var.    | 11'-7 to 32'-5           | 138     | 5 Var.   | 11'-7 to 28'-3          | 104     | 4 Var.   | 11'-7 to 24'-1          | 74      | 3 Var.   | 11'-7 to 19'-11          | 49  | 5b7  |
| 5b8                                                                 | Wingwall, F.F.H. Short            |              | 6 Var.    | 9'-9 to 25'-3            | 110     | 5 Var.   | 9'-9 to 22'-1           | 83      | 4 Var.   | 9'-9 to 19'-0           | 60      | 3 Var.   | 9'-8 to 15'-11           | 40  | 5b8  |
| 5b9                                                                 | Interior Wall, Both F.H.          |              | 22 Var.   | 2 Each<br>6'-1 to 19'-10 | 297     | 18 Var.  | 2 Each<br>6'-2 to 17'-6 | 222     | 14 Var.  | 2 Each<br>6'-3 to 15'-2 | 156     | 10 Var.  | 2 Each<br>6'-6 to 12'-10 | 101 | 5b9  |
| 4c1                                                                 | Wingwall, F.F.V. Long             |              | 31 Var.   | 2'-10 to 10'-0           | 133     | 26 Var.  | 2'-10 to 8'-10          | 101     | 22 Var.  | 2'-10 to 7'-10          | 78      | 18 Var.  | 2'-10 to 6'-11           | 59  | 4c1  |
| 4c2                                                                 | Wingwall, F.F.V. Short            |              | 23 Var.   | 2'-10 to 9'-11           | 98      | 20 Var.  | 2'-10 to 8'-11          | 78      | 17 Var.  | 2'-10 to 8'-0           | 62      | 14 Var.  | 2'-10 to 7'-0            | 46  | 4c2  |
| 4c3                                                                 | Wingwall, F.F.V. Long             |              | --        | --                       | --      | --       | --                      | --      | --       | --                      | --      | --       | --                       | --  | 4c3  |
| 4c4                                                                 | Wingwall, F.F.V. Short            |              | --        | --                       | --      | --       | --                      | --      | --       | --                      | --      | --       | --                       | --  | 4c4  |
| 4c5                                                                 | Wingwall, F.F.V. Long             |              | 1         | 8'-9                     | 6       | 2        | 7'-9                    | 10      | 2        | 6'-9                    | 9       | 2        | 5'-9                     | 8   | 4c5  |
| 4c5                                                                 | Wingwall, F.F.V. Short            |              | 1         | 8'-9                     | 6       | 1        | 7'-9                    | 5       | 1        | 6'-9                    | 5       | 1        | 5'-9                     | 4   | 4c5  |
| 4c6                                                                 | Interior Wall, Both F.V.          |              | 4         | 4'-2                     | 11      | 4        | 4'-1                    | 11      | 4        | 4'-1                    | 11      | 4        | 4'-1                     | 11  | 4c6  |
| 4c7                                                                 | Interior Wall, Both F.V.          |              | 64 Var.   | 2 Each<br>1'-11 to 7'-6  | 201     | 54 Var.  | 2 Each<br>1'-11 to 6'-6 | 152     | 44 Var.  | 2 Each<br>1'-10 to 5'-5 | 107     | 36 Var.  | 2 Each<br>1'-10 to 4'-6  | 76  | 4c7  |
| 4c8                                                                 | Interior Wall, Both F.V.          |              | 4         | 7'-7                     | 20      | 4        | 6'-7                    | 18      | 4        | 5'-7                    | 15      | 4        | 4'-7                     | 12  | 4c8  |
| 5c9                                                                 | Wingwall, B.F.V. Long             |              | 11 Var.   | 2'-10 to 5'-3            | 46      | 11 Var.  | 2'-10 to 5'-3           | 46      | 11 Var.  | 2'-10 to 5'-3           | 46      | 11 Var.  | 2'-10 to 5'-3            | 46  | 5c9  |
| 5c10                                                                | Wingwall, B.F.V. Short            |              | 5 Var.    | 2'-10 to 4'-2            | 18      | 5 Var.   | 2'-10 to 4'-2           | 18      | 5 Var.   | 2'-10 to 4'-2           | 18      | 5 Var.   | 2'-10 to 4'-2            | 18  | 5c10 |
| 5c11                                                                | Wingwall, B.F.V. Long             |              | 20 Var.   | 9'-6 to 14'-0            | 245     | 15 Var.  | 9'-6 to 12'-10          | 175     | 11 Var.  | 9'-6 to 11'-10          | 122     | 7 Var.   | 9'-6 to 10'-11           | 75  | 5c11 |
| 5c12                                                                | Wingwall, B.F.V. Short            |              | 18 Var.   | 8'-6 to 13'-11           | 210     | 15 Var.  | 8'-6 to 12'-11          | 168     | 12 Var.  | 8'-6 to 12'-0           | 128     | 9 Var.   | 8'-6 to 11'-0            | 92  | 5c12 |
| 6c13                                                                | Wingwall, B.F.V. Long             |              | 13        | 10'-6                    | 205     | 8        | 10'-6                   | 126     | --       | --                      | --      | --       | --                       | --  | 6c13 |
| 6c13                                                                | Wingwall, B.F.V. Short            |              | 10        | 10'-6                    | 158     | 7        | 10'-6                   | 110     | --       | --                      | --      | --       | --                       | --  | 6c13 |
| 5c14                                                                | Wingwall, B.F.V. Long             |              | 1         | 12'-9                    | 13      | 2        | 11'-9                   | 25      | 2        | 10'-9                   | 22      | 2        | 9'-9                     | 20  | 5c14 |
| 5c14                                                                | Wingwall, B.F.V. Short            |              | 1         | 12'-9                    | 13      | 1        | 11'-9                   | 12      | 1        | 10'-9                   | 11      | 1        | 9'-9                     | 10  | 5c14 |
| 4d1                                                                 | Apron, Longit., Bott.             |              | 25        | 20'-4                    | 340     | 25       | 18'-1                   | 302     | 25       | 15'-9                   | 263     | 25       | 13'-5                    | 224 | 4d1  |
| 4d2                                                                 | Apron, Longit., Bott. Long        |              | 3         | 27'-11                   | 56      | 3        | 23'-9                   | 48      | 3        | 19'-7                   | 39      | 3        | 15'-4                    | 31  | 4d2  |
| 4d3                                                                 | Apron, Longit., Bott. Short       |              | 3         | 21'-8                    | 43      | 3        | 18'-7                   | 37      | 3        | 15'-5                   | 31      | 3        | 12'-4                    | 25  | 4d3  |
| 6f1                                                                 | Apron, Longit., Top               |              | 37        | 20'-4                    | 1130    | 37       | 18'-1                   | 1005    | 37       | 15'-9                   | 875     | 37       | 13'-5                    | 746 | 6f1  |
| 6f2                                                                 | Apron, Longit., Top Long          |              | 6 Var.    | 5'-3 to 16'-11           | 100     | 5 Var.   | 5'-3 to 14'-7           | 74      | 4 Var.   | 5'-3 to 12'-4           | 53      | 3 Var.   | 5'-3 to 10'-0            | 34  | 6f2  |
| 6f3                                                                 | Apron, Longit., Top Short         |              | 4 Var.    | 7'-9 to 17'-2            | 75      | 4 Var.   | 5'-5 to 14'-10          | 61      | 3 Var.   | 6'-2 to 12'-6           | 42      | 2 Var.   | 7'-0 to 10'-3            | 26  | 6f3  |
| 6f4                                                                 | Apron, Longit., Top Long          |              | 1         | 34'-5                    | 52      | 1        | 30'-2                   | 45      | 1        | 26'-0                   | 39      | 1        | 21'-10                   | 33  | 6f4  |
| 6f5                                                                 | Apron, Longit., Top Short         |              | 1         | 26'-8                    | 40      | 1        | 23'-6                   | 35      | 1        | 20'-5                   | 31      | 1        | 17'-4                    | 26  | 6f5  |
| 4i1                                                                 | Parapet, Vertical                 |              | 75        | 6'-4                     | 317     | 75       | 6'-4                    | 317     | 75       | 6'-4                    | 317     | 75       | 6'-4                     | 317 | 4i1  |
| 7j1                                                                 | Parapet, Horizontal               |              | 4         | 44'-7                    | 383     | 4        | 44'-7                   | 383     | 4        | 44'-7                   | 383     | 4        | 44'-7                    | 383 | 7j1  |
| 6m1                                                                 | Apron, Trans., Top                |              | 10 Var.   | 41'-8 to 43'-4           | 675     | 7 Var.   | 41'-8 to 42'-9          | 469     | 4 Var.   | 41'-8 to 42'-3          | 267     | 1        | 41'-8                    | 66  | 6m1  |
| 6m2                                                                 | Apron, Trans., Top                |              | 6 Var.    | 30'-6 to 37'-0           | 304     | 9 Var.   | 26'-6 to 36'-10         | 428     | 12 Var.  | 22'-6 to 36'-9          | 534     | 15 Var.  | 18'-6 to 36'-8           | 621 | 6m2  |
| 6m3                                                                 | Apron, Trans., Top                |              | 22 Var.   | 5'-11 to 29'-4           | 582     | 19 Var.  | 5'-3 to 25'-4           | 436     | 16 Var.  | 4'-7 to 21'-4           | 311     | 13 Var.  | 3'-11 to 17'-4           | 207 | 6m3  |
| 6m4                                                                 | Apron, Trans., Bott.              |              | 14 Var.   | 38'-3 to 47'-2           | 938     | 12 Var.  | 38'-3 to 45'-9          | 790     | 10 Var.  | 38'-3 to 44'-5          | 646     | 8 Var.   | 38'-3 to 43'-1           | 507 | 6m4  |
| 6p1                                                                 | Curtain, Horizontal               |              | 4         | 43'-5                    | 274     | 4        | 43'-5                   | 274     | 4        | 43'-5                   | 274     | 4        | 43'-5                    | 274 | 6p1  |
| 6p2                                                                 | Curtain, Horizontal, Long         |              | 4         | 18'-0                    | 108     | 4        | 16'-0                   | 96      | 4        | 13'-11                  | 84      | 4        | 11'-11                   | 72  | 6p2  |
| 6p3                                                                 | Curtain, Horizontal, Short        |              | 4         | 10'-9                    | 65      | 4        | 9'-8                    | 58      | 4        | 8'-8                    | 52      | 4        | 7'-7                     | 46  | 6p3  |
| 6s1                                                                 | Wing Slope, Both F., Long         |              | 2         | 8'-0                     | 24      | 2        | 8'-0                    | 24      | 2        | 8'-0                    | 24      | 2        | 8'-0                     | 24  | 6s1  |
| 6s2                                                                 | Wing Slope, Both F., Short        |              | 2         | 6'-11                    | 21      | 2        | 6'-11                   | 21      | 2        | 6'-11                   | 21      | 2        | 6'-11                    | 21  | 6s2  |
| 6s3                                                                 | Wing Slope, Both F., Long         |              | 2         | 27'-5                    | 82      | 2        | 23'-2                   | 70      | 2        | 18'-10                  | 57      | 2        | 14'-7                    | 44  | 6s3  |
| 6s4                                                                 | Wing Slope, Both F., Short        |              | 2         | 21'-8                    | 65      | 2        | 18'-4                   | 55      | 2        | 15'-1                   | 45      | 2        | 11'-10                   | 36  | 6s4  |
| 6s5                                                                 | Wing Slope, F.F. Long             |              | 1         | 33'-7                    | 50      | 1        | 29'-3                   | 44      | 1        | 25'-0                   | 38      | 1        | 20'-8                    | 31  | 6s5  |
| 6s6                                                                 | Wing Slope, F.F. Short            |              | 1         | 26'-11                   | 40      | 1        | 23'-8                   | 36      | 1        | 20'-5                   | 31      | 1        | 17'-1                    | 26  | 6s6  |
| 6s7                                                                 | Interior Wall, Both F.H.          |              | 4         | 20'-10                   | 125     | 4        | 18'-4                   | 110     | 4        | 15'-10                  | 95      | 4        | 13'-4                    | 80  | 6s7  |
| 5t1                                                                 | Curtain, Vertical                 |              | 48        | 6'-8                     | 334     | 45       | 6'-5                    | 301     | 43       | 6'-5                    | 288     | 41       | 6'-5                     | 274 | 5t1  |
|                                                                     | Estimated Quantities One Headwall | Reinf. Steel |           | 8406 LB                  |         | 7187 LB  |                         | 5921 LB |          | 4958 LB                 |         |          |                          |     |      |
|                                                                     |                                   | Concrete     | Parapet Δ | 4.1                      | 63.5 CY | 4.1      | 53.9 CY                 | 4.1     | 45.5 CY  | 4.1                     | 37.7 CY |          |                          |     |      |
|                                                                     |                                   |              | Wingwalls | 11.6                     |         | 8.9      |                         | 6.5     |          | 4.4                     |         |          |                          |     |      |
|                                                                     |                                   |              | Apron *   | 47.8                     |         | 40.9     |                         | 34.9    |          | 29.2                    |         |          |                          |     |      |

Δ Includes top of wingwall quantities.

\* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

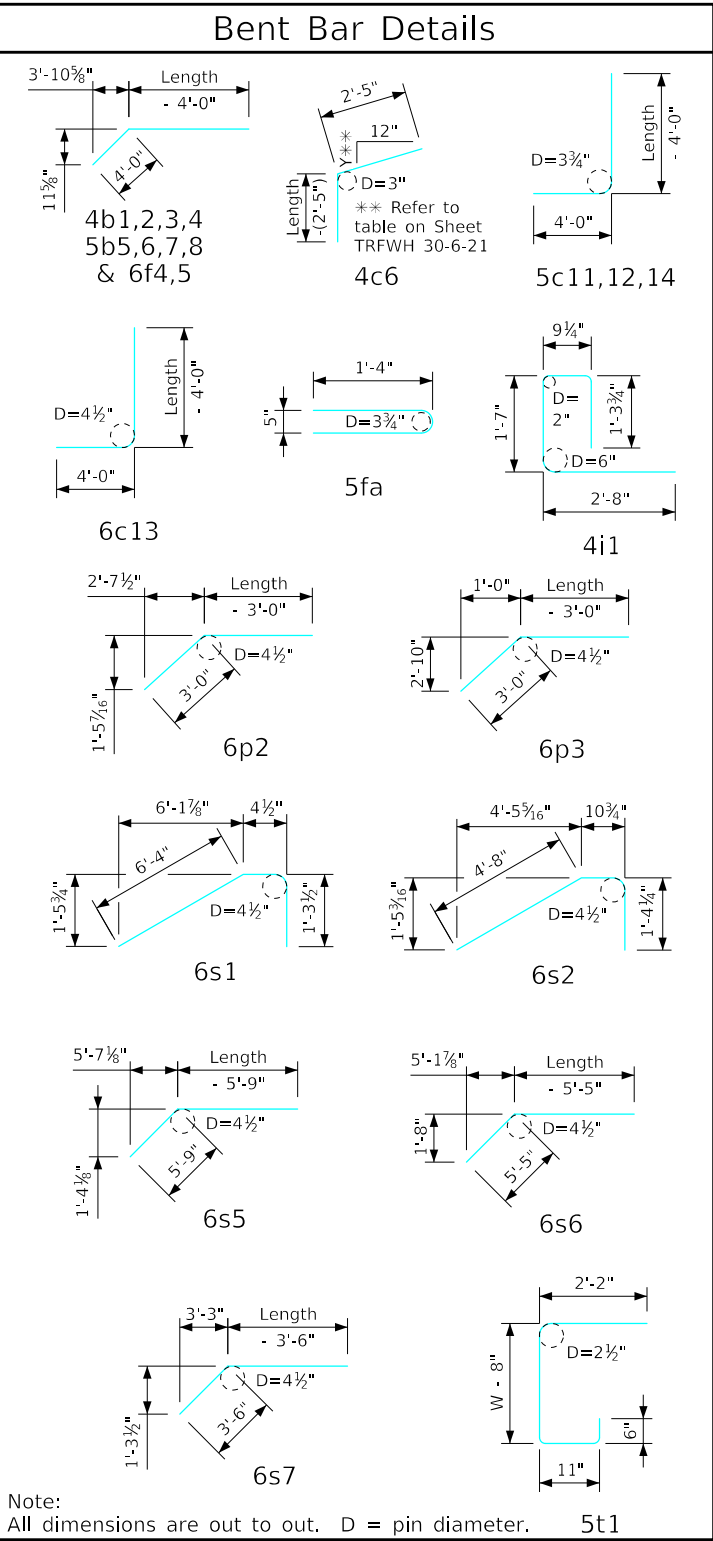
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall

"Long" Denotes Long Wingwall

### Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.



LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER



Standard Design - Triple Reinforced Concrete Box Culverts

### Flared Wing Headwalls

February, 2021

Quantity Tabulation  
12'-0" Span  
30° Skew

TRFWH  
30-7-21  
Sheet 2 of 2

ENGLISHRFD(S)IGNEDTRIPLECULVERTSFWH.DGN - TRFWH 30-8-21 S1 - THIS SHEET ISSUED 02-2021.

| Bill of Reinforcing for One Headwall 30° Skew Span x Culvert Height |                                   |                                                                                     |           |                          |          |           |                          |      |           |                          |      |          |                         |      |          |                         |      |      |  |
|---------------------------------------------------------------------|-----------------------------------|-------------------------------------------------------------------------------------|-----------|--------------------------|----------|-----------|--------------------------|------|-----------|--------------------------|------|----------|-------------------------|------|----------|-------------------------|------|------|--|
| Bar                                                                 | Location                          | Shape                                                                               | 10' x 12' |                          |          | 10' x 11' |                          |      | 10' x 10' |                          |      | 10' x 9' |                         |      | 10' x 8' |                         |      | Bar  |  |
|                                                                     |                                   |                                                                                     | No.       | Length                   | Wt.      | No.       | Length                   | Wt.  | No.       | Length                   | Wt.  | No.      | Length                  | Wt.  | No.      | Length                  | Wt.  |      |  |
| 5fa                                                                 | Fence Anchor (Galv.)              |    | 2         | 2'-10                    | 6        | 2         | 2'-10                    | 6    | 2         | 2'-10                    | 6    | 2        | 2'-10                   | 6    | 2        | 2'-10                   | 6    | 5fa  |  |
| 4b1                                                                 | Wingwall, B.F.H. Long             |    | 1         | 55'-2                    | 38       | 1         | 51'-0                    | 36   | 1         | 46'-10                   | 33   | 1        | 42'-8                   | 30   | 1        | 38'-6                   | 26   | 4b1  |  |
| 4b2                                                                 | Wingwall, B.F.H. Short            |    | 1         | 42'-2                    | 30       | 1         | 39'-1                    | 26   | 1         | 36'-0                    | 24   | 1        | 32'-10                  | 22   | 1        | 29'-9                   | 20   | 4b2  |  |
| 4b3                                                                 | Wingwall, B.F.H. Long             |    | 10 Var.   | 15'-8 to 53'-3           | 237      | 9 Var.    | 15'-8 to 49'-1           | 199  | 8 Var.    | 15'-8 to 44'-11          | 165  | 7 Var.   | 15'-8 to 40'-9          | 134  | 6 Var.   | 15'-8 to 36'-7          | 105  | 4b3  |  |
| 4b4                                                                 | Wingwall, B.F.H. Short            |    | 10 Var.   | 12'-11 to 40'-9          | 181      | 9 Var.    | 12'-11 to 37'-8          | 152  | 8 Var.    | 12'-11 to 34'-7          | 127  | 7 Var.   | 12'-10 to 31'-5         | 103  | 6 Var.   | 12'-10 to 28'-4         | 82   | 4b4  |  |
| 5b5                                                                 | Wingwall, F.F.H. Long             |    | 1         | 55'-3                    | 60       | 1         | 51'-1                    | 56   | 1         | 46'-11                   | 51   | 1        | 42'-9                   | 47   | 1        | 38'-7                   | 40   | 5b5  |  |
| 5b6                                                                 | Wingwall, F.F.H. Short            |    | 1         | 42'-3                    | 46       | 1         | 39'-2                    | 41   | 1         | 36'-0                    | 38   | 1        | 32'-11                  | 34   | 1        | 29'-9                   | 31   | 5b6  |  |
| 5b7                                                                 | Wingwall, F.F.H. Long             |    | 11 Var.   | 11'-7 to 53'-4           | 382      | 10 Var.   | 11'-7 to 49'-1           | 324  | 9 Var.    | 11'-7 to 44'-11          | 270  | 8 Var.   | 11'-7 to 40'-9          | 221  | 7 Var.   | 11'-7 to 36'-7          | 176  | 5b7  |  |
| 5b8                                                                 | Wingwall, F.F.H. Short            |    | 11 Var.   | 9'-10 to 40'-10          | 293      | 10 Var.   | 9'-10 to 37'-9           | 248  | 9 Var.    | 9'-10 to 34'-7           | 208  | 8 Var.   | 9'-10 to 31'-6          | 172  | 7 Var.   | 9'-9 to 28'-4           | 139  | 5b8  |  |
| 5b9                                                                 | Interior Wall, Both F.H.          |    | 42 Var.   | 2 Each<br>6'-0 to 31'-4  | 818      | 38 Var.   | 2 Each<br>6'-0 to 29'-1  | 695  | 34 Var.   | 6'-0 to 26'-9            | 581  | 30 Var.  | 2 Each<br>6'-0 to 24'-5 | 476  | 26 Var.  | 2 Each<br>6'-1 to 22'-2 | 383  | 5b9  |  |
| 4c1                                                                 | Wingwall, F.F.V. Long             |    | 51 Var.   | 2'-9 to 14'-9            | 298      | 47 Var.   | 2'-9 to 13'-9            | 259  | 43 Var.   | 2'-9 to 12'-10           | 224  | 39 Var.  | 2'-9 to 11'-10          | 190  | 35 Var.  | 2'-9 to 10'-11          | 160  | 4c1  |  |
| 4c2                                                                 | Wingwall, F.F.V. Short            |    | 38 Var.   | 2'-9 to 14'-8            | 221      | 35 Var.   | 2'-9 to 13'-8            | 192  | 32 Var.   | 2'-9 to 12'-9            | 166  | 29 Var.  | 2'-9 to 11'-9           | 140  | 26 Var.  | 2'-9 to 10'-9           | 117  | 4c2  |  |
| 4c3                                                                 | Wingwall, F.F.V. Long             |    | 23 Var.   | 9'-7 to 14'-10           | 188      | 19 Var.   | 9'-7 to 13'-11           | 149  | 15 Var.   | 9'-7 to 12'-11           | 113  | 11 Var.  | 9'-7 to 12'-0           | 79   | --       | --                      | --   | 4c3  |  |
| 4c4                                                                 | Wingwall, F.F.V. Short            |    | 18 Var.   | 9'-4 to 14'-10           | 145      | 15 Var.   | 9'-4 to 13'-10           | 116  | 12 Var.   | 9'-4 to 12'-10           | 89   | 9 Var.   | 9'-4 to 11'-11          | 64   | --       | --                      | --   | 4c4  |  |
| 4c5                                                                 | Wingwall, F.F.V. Long             |    | 2         | 13'-8                    | 18       | 2         | 12'-8                    | 17   | 2         | 11'-8                    | 16   | 1        | 10'-8                   | 7    | 1        | 9'-8                    | 6    | 4c5  |  |
| 4c5                                                                 | Wingwall, F.F.V. Short            |    | 2         | 13'-8                    | 18       | 2         | 12'-8                    | 17   | 2         | 11'-8                    | 16   | 2        | 10'-8                   | 14   | 2        | 9'-8                    | 13   | 4c5  |  |
| 4c6                                                                 | Interior Wall, Both F.V.          |    | 4         | 4'-1                     | 11       | 4         | 4'-1                     | 11   | 4         | 4'-1                     | 11   | 4        | 4'-1                    | 11   | 4        | 4'-1                    | 11   | 4c6  |  |
| 4c7                                                                 | Interior Wall, Both F.V.          |    | 108 Var.  | 2 Each<br>1'-10 to 12'-3 | 508      | 100 Var.  | 2 Each<br>1'-10 to 11'-5 | 443  | 90 Var.   | 2 Each<br>1'-10 to 10'-4 | 366  | 82 Var.  | 2 Each<br>1'-10 to 9'-5 | 308  | 72 Var.  | 2 Each<br>1'-10 to 8'-4 | 244  | 4c7  |  |
| 4c8                                                                 | Interior Wall, Both F.V.          |    | 4         | 12'-6                    | 33       | 4         | 11'-6                    | 31   | 4         | 10'-6                    | 28   | 4        | 9'-6                    | 25   | 4        | 8'-6                    | 23   | 4c8  |  |
| 5c9                                                                 | Wingwall, B.F.V. Long             |    | 11 Var.   | 2'-9 to 5'-2             | 45       | 11 Var.   | 2'-9 to 5'-2             | 45   | 11 Var.   | 2'-9 to 5'-2             | 45   | 11 Var.  | 2'-9 to 5'-2            | 45   | 11 Var.  | 2'-9 to 5'-2            | 45   | 5c9  |  |
| 5c10                                                                | Wingwall, B.F.V. Short            |    | 5 Var.    | 2'-9 to 4'-1             | 18       | 5 Var.    | 2'-9 to 4'-1             | 18   | 5 Var.    | 2'-9 to 4'-1             | 18   | 5 Var.   | 2'-9 to 4'-1            | 18   | 5 Var.   | 2'-9 to 4'-1            | 18   | 5c10 |  |
| 5c11                                                                | Wingwall, B.F.V. Long             |    | 40 Var.   | 9'-5 to 18'-9            | 588      | 36 Var.   | 9'-5 to 17'-9            | 510  | 32 Var.   | 9'-5 to 16'-10           | 438  | 28 Var.  | 9'-5 to 15'-10          | 369  | 24 Var.  | 9'-5 to 14'-11          | 305  | 5c11 |  |
| 5c12                                                                | Wingwall, B.F.V. Short            |    | 33 Var.   | 8'-5 to 18'-8            | 466      | 30 Var.   | 8'-5 to 17'-8            | 408  | 27 Var.   | 8'-5 to 16'-9            | 354  | 24 Var.  | 8'-5 to 15'-9           | 302  | 21 Var.  | 8'-5 to 14'-9           | 254  | 5c12 |  |
| 6c13                                                                | Wingwall, B.F.V. Long             |    | 33        | 10'-6                    | 520      | 29        | 10'-6                    | 457  | 25        | 10'-6                    | 394  | 21       | 10'-6                   | 331  | 17       | 10'-6                   | 268  | 6c13 |  |
| 6c13                                                                | Wingwall, B.F.V. Short            |    | 25        | 10'-6                    | 394      | 22        | 10'-6                    | 347  | 19        | 10'-6                    | 300  | 16       | 10'-6                   | 252  | 13       | 10'-6                   | 205  | 6c13 |  |
| 5c14                                                                | Wingwall, B.F.V. Long             |    | 2         | 17'-8                    | 37       | 2         | 16'-8                    | 35   | 2         | 15'-8                    | 33   | 1        | 14'-8                   | 15   | 1        | 13'-8                   | 14   | 5c14 |  |
| 5c14                                                                | Wingwall, B.F.V. Short            |    | 2         | 17'-8                    | 37       | 2         | 16'-8                    | 35   | 2         | 15'-8                    | 33   | 2        | 14'-8                   | 31   | 2        | 13'-8                   | 29   | 5c14 |  |
| 4d1                                                                 | Apron, Longit., Bott.             |    | 21        | 31'-11                   | 448      | 21        | 29'-7                    | 415  | 21        | 27'-3                    | 382  | 21       | 25'-0                   | 351  | 21       | 22'-8                   | 318  | 4d1  |  |
| 4d2                                                                 | Apron, Longit., Bott. Long        |    | 3         | 48'-9                    | 102      | 3         | 44'-7                    | 94   | 3         | 40'-5                    | 86   | 3        | 36'-3                   | 73   | 3        | 32'-1                   | 64   | 4d2  |  |
| 4d3                                                                 | Apron, Longit., Bott. Short       |    | 3         | 37'-3                    | 75       | 3         | 34'-2                    | 68   | 3         | 31'-0                    | 62   | 3        | 27'-11                  | 56   | 3        | 24'-9                   | 50   | 4d3  |  |
| 6f1                                                                 | Apron, Longit., Top               |    | 31        | 31'-11                   | 1486     | 31        | 29'-7                    | 1377 | 31        | 27'-3                    | 1269 | 31       | 25'-0                   | 1164 | 31       | 22'-8                   | 1055 | 6f1  |  |
| 6f2                                                                 | Apron, Longit., Top Long          |   | 11 Var.   | 5'-4 to 28'-6            | 279      | 10 Var.   | 5'-4 to 26'-2            | 237  | 9 Var.    | 5'-4 to 23'-10           | 197  | 8 Var.   | 5'-4 to 21'-7           | 162  | 7 Var.   | 5'-3 to 19'-3           | 129  | 6f2  |  |
| 6f3                                                                 | Apron, Longit., Top Short         |  | 8 Var.    | 7'-0 to 28'-8            | 214      | 7 Var.    | 7'-9 to 26'-5            | 180  | 7 Var.    | 5'-5 to 24'-1            | 155  | 6 Var.   | 6'-2 to 21'-9           | 126  | 5 Var.   | 6'-11 to 19'-6          | 99   | 6f3  |  |
| 6f4                                                                 | Apron, Longit., Top Long          |  | 1         | 55'-3                    | 86       | 1         | 51'-1                    | 80   | 1         | 46'-11                   | 74   | 1        | 42'-9                   | 68   | 1        | 38'-7                   | 58   | 6f4  |  |
| 6f5                                                                 | Apron, Longit., Top Short         |  | 1         | 42'-3                    | 67       | 1         | 39'-2                    | 59   | 1         | 36'-0                    | 54   | 1        | 32'-11                  | 49   | 1        | 29'-9                   | 45   | 6f5  |  |
| 4i1                                                                 | Parapet, Vertical                 |  | 65        | 6'-4                     | 275      | 63        | 6'-4                     | 267  | 63        | 6'-4                     | 267  | 63       | 6'-4                    | 267  | 63       | 6'-4                    | 267  | 4i1  |  |
| 7j1                                                                 | Parapet, Horizontal               |  | 4         | 38'-10                   | 318      | 4         | 38'-5                    | 314  | 4         | 38'-1                    | 311  | 4        | 38'-1                   | 311  | 4        | 38'-1                   | 311  | 7j1  |  |
| 6m1                                                                 | Apron, Trans., Top                |  | 14 Var.   | 36'-3 to 38'-8           | 788      | 14 Var.   | 35'-11 to 38'-4          | 781  | 14 Var.   | 35'-7 to 38'-0           | 774  | 13 Var.  | 35'-7 to 37'-10         | 717  | 14 Var.  | 35'-7 to 38'-0          | 774  | 6m1  |  |
| 6m2                                                                 | Apron, Trans., Top                |  | 13 Var.   | 39'-0 to 43'-6           | 842      | 10 Var.   | 38'-8 to 42'-1           | 628  | 7 Var.    | 38'-4 to 40'-7           | 422  | 5 Var.   | 38'-0 to 39'-6          | 291  | 1        | 38'-4                   | 58   | 6m2  |  |
| 6m3                                                                 | Apron, Trans., Top                |  | 25 Var.   | 8'-4 to 35'-0            | 814      | 24 Var.   | 8'-7 to 34'-2            | 771  | 24 Var.   | 7'-9 to 33'-4            | 740  | 24 Var.  | 7'-1 to 32'-8           | 716  | 24 Var.  | 6'-5 to 32'-0           | 692  | 6m3  |  |
| 6m4                                                                 | Apron, Trans., Bott.              |  | 24 Var.   | 31'-11 to 47'-7          | 1476     | 22 Var.   | 31'-9 to 46'-0           | 1317 | 20 Var.   | 31'-7 to 44'-6           | 1168 | 18 Var.  | 31'-7 to 43'-1          | 1027 | 16 Var.  | 31'-7 to 41'-9          | 892  | 6m4  |  |
| 6p1                                                                 | Curtain, Horizontal               |  | 4         | 37'-2                    | 223      | 4         | 36'-11                   | 222  | 4         | 36'-9                    | 221  | 4        | 36'-9                   | 221  | 4        | 36'-9                   | 221  | 6p1  |  |
| 6p2                                                                 | Curtain, Horizontal, Long         |  | 4         | 28'-0                    | 168      | 4         | 26'-0                    | 156  | 4         | 24'-0                    | 144  | 4        | 22'-0                   | 132  | 4        | 20'-0                   | 120  | 6p2  |  |
| 6p3                                                                 | Curtain, Horizontal, Short        |  | 4         | 15'-11                   | 96       | 4         | 14'-11                   | 90   | 4         | 13'-10                   | 83   | 4        | 12'-10                  | 77   | 4        | 11'-9                   | 71   | 6p3  |  |
| 6s1                                                                 | Wing Slope, Both F., Long         |  | 2         | 8'-0                     | 24       | 2         | 8'-0                     | 24   | 2         | 8'-0                     | 24   | 2        | 8'-0                    | 24   | 2        | 8'-0                    | 24   | 6s1  |  |
| 6s2                                                                 | Wing Slope, Both F., Short        |  | 2         | 6'-11                    | 21       | 2         | 6'-11                    | 21   | 2         | 6'-11                    | 21   | 2        | 6'-11                   | 21   | 2        | 6'-11                   | 21   | 6s2  |  |
| 6s3                                                                 | Wing Slope, Both F., Long         |  | 2         | 48'-11                   | 154      | 2         | 44'-7                    | 141  | 2         | 40'-4                    | 128  | 2        | 36'-0                   | 108  | 2        | 31'-9                   | 95   | 6s3  |  |
| 6s4                                                                 | Wing Slope, Both F., Short        |  | 2         | 38'-0                    | 114      | 2         | 34'-9                    | 104  | 2         | 31'-6                    | 95   | 2        | 28'-2                   | 85   | 2        | 24'-11                  | 75   | 6s4  |  |
| 6s5                                                                 | Wing Slope, F.F. Long             |  | 1         | 55'-0                    | 86       | 1         | 50'-9                    | 80   | 1         | 46'-5                    | 73   | 1        | 42'-2                   | 67   | 1        | 37'-10                  | 57   | 6s5  |  |
| 6s6                                                                 | Wing Slope, F.F. Short            |  | 1         | 43'-4                    | 68       | 1         | 40'-1                    | 64   | 1         | 36'-9                    | 55   | 1        | 33'-6                   | 50   | 1        | 30'-3                   | 45   | 6s6  |  |
| 6s7                                                                 | Interior Wall, Both F.H.          |  | 4         | 33'-3                    | 200      | 4         | 30'-10                   | 185  | 4         | 28'-4                    | 170  | 4        | 25'-10                  | 155  | 4        | 23'-4                   | 140  | 6s7  |  |
| 5t1                                                                 | Curtain, Vertical                 |  | 54        | 7'-11                    | 446      | 52        | 7'-8                     | 416  | 49        | 7'-5                     | 379  | 47       | 7'-2                    | 351  | 44       | 6'-11                   | 317  | 5t1  |  |
|                                                                     | Estimated Quantities One Headwall | Reinf. Steel                                                                        |           | 14,506 LB                |          |           | 12,964 LB                |      |           | 11,501 LB                |      |          | 10,115 LB               |      |          | 8718 LB                 |      |      |  |
|                                                                     |                                   | Concrete                                                                            | Parapet Δ | 3.9                      | 120.5 CY | 3.8       | 103.6 CY                 |      | 3.7       | 88.3 CY                  |      | 3.7      | 77.3 CY                 |      | 3.7      | 67.0 CY                 |      |      |  |
|                                                                     |                                   |                                                                                     | Wingwalls | 40.1                     |          | 31.5      |                          |      | 24.1      |                          |      | 20.0     |                         |      | 16.3     |                         |      |      |  |
|                                                                     |                                   |                                                                                     | Apron *   | 76.5                     |          | 68.3      |                          |      | 60.5      |                          |      | 53.6     |                         |      | 47.0     |                         |      |      |  |

Δ Includes top of wingwall quantities.

\* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall  
"Long" Denotes Long Wingwall

### Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

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Standard Design - Triple Reinforced Concrete Box Culverts

### Flared Wing Headwalls

February, 2021

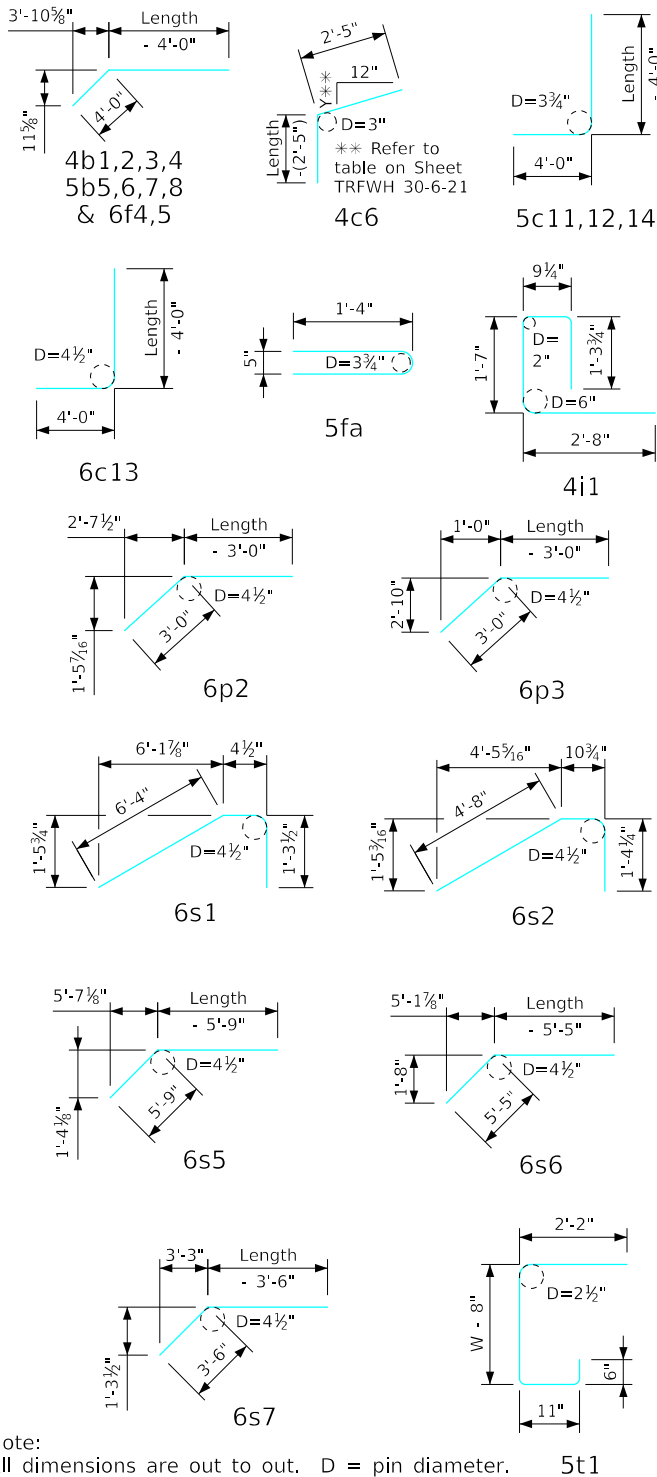
Quantity Tabulation  
10'-0" Span  
30° Skew

TRFWH  
30-8-21  
Sheet 1 of 2

Note:

All dimensions are out to out. D = pin diameter.

### Bent Bar Details



| Bill of Reinforcing for One Headwall 30° Skew Span x Culvert Height |                                   |              |           |                             |         |          |                            |         |          |                            |         |          |                             |     |      |
|---------------------------------------------------------------------|-----------------------------------|--------------|-----------|-----------------------------|---------|----------|----------------------------|---------|----------|----------------------------|---------|----------|-----------------------------|-----|------|
| Bar                                                                 | Location                          | Shape        | 10' x 7'  |                             |         | 10' x 6' |                            |         | 10' x 5' |                            |         | 10' x 4' |                             |     | Bar  |
|                                                                     |                                   |              | No.       | Length                      | Wt.     | No.      | Length                     | Wt.     | No.      | Length                     | Wt.     | No.      | Length                      | Wt. |      |
| 5fa                                                                 | Fence Anchor (Galv.)              |              | 2         | 2'-10                       | 6       | 2        | 2'-10                      | 6       | 2        | 2'-10                      | 6       | 2        | 2'-10                       | 6   | 5fa  |
| 4b1                                                                 | Wingwall, B.F.H. Long             |              | 1         | 34'-4                       | 23      | 1        | 30'-2                      | 20      | 1        | 26'-0                      | 17      | 1        | 21'-10                      | 15  | 4b1  |
| 4b2                                                                 | Wingwall, B.F.H. Short            |              | 1         | 26'-7                       | 18      | 1        | 23'-6                      | 16      | 1        | 20'-5                      | 14      | 1        | 17'-3                       | 12  | 4b2  |
| 4b3                                                                 | Wingwall, B.F.H. Long             |              | 5 Var.    | 15'-8 to 32'-5              | 80      | 4 Var.   | 15'-8 to 28'-3             | 59      | 3 Var.   | 15'-8 to 24'-1             | 40      | 2 Var.   | 15'-8 to 19'-10             | 24  | 4b3  |
| 4b4                                                                 | Wingwall, B.F.H. Short            |              | 5 Var.    | 12'-10 to 25'-3             | 64      | 4 Var.   | 12'-10 to 22'-1            | 47      | 3 Var.   | 12'-9 to 19'-0             | 32      | 2 Var.   | 12'-9 to 15'-10             | 19  | 4b4  |
| 5b5                                                                 | Wingwall, F.F.H. Long             |              | 1         | 34'-5                       | 36      | 1        | 30'-2                      | 31      | 1        | 26'-0                      | 27      | 1        | 21'-10                      | 23  | 5b5  |
| 5b6                                                                 | Wingwall, F.F.H. Short            |              | 1         | 26'-8                       | 28      | 1        | 23'-6                      | 25      | 1        | 20'-5                      | 21      | 1        | 17'-4                       | 18  | 5b6  |
| 5b7                                                                 | Wingwall, F.F.H. Long             |              | 6 Var.    | 11'-7 to 32'-5              | 138     | 5 Var.   | 11'-7 to 28'-3             | 104     | 4 Var.   | 11'-7 to 24'-1             | 74      | 3 Var.   | 11'-7 to 19'-11             | 49  | 5b7  |
| 5b8                                                                 | Wingwall, F.F.H. Short            |              | 6 Var.    | 9'-9 to 25'-3               | 110     | 5 Var.   | 9'-9 to 22'-1              | 83      | 4 Var.   | 9'-9 to 19'-0              | 60      | 3 Var.   | 9'-8 to 15'-11              | 40  | 5b8  |
| 5b9                                                                 | Interior Wall, Both F.H.          |              | 22 Var.   | 2 Each<br>6'-1 to<br>19'-10 | 297     | 18 Var.  | 2 Each<br>6'-2 to<br>17'-6 | 222     | 14 Var.  | 2 Each<br>6'-3 to<br>15'-2 | 156     | 10 Var.  | 2 Each<br>6'-6 to<br>12'-10 | 101 | 5b9  |
| 4c1                                                                 | Wingwall, F.F.V. Long             |              | 31 Var.   | 2'-9 to 9'-11               | 131     | 26 Var.  | 2'-9 to 8'-9               | 100     | 22 Var.  | 2'-9 to 7'-9               | 77      | 18 Var.  | 2'-9 to 6'-10               | 58  | 4c1  |
| 4c2                                                                 | Wingwall, F.F.V. Short            |              | 23 Var.   | 2'-9 to 9'-10               | 97      | 20 Var.  | 2'-9 to 8'-10              | 77      | 17 Var.  | 2'-9 to 7'-11              | 61      | 14 Var.  | 2'-9 to 6'-11               | 45  | 4c2  |
| 4c3                                                                 | Wingwall, F.F.V. Long             |              | --        | --                          | --      | --       | --                         | --      | --       | --                         | --      | --       | --                          | --  | 4c3  |
| 4c4                                                                 | Wingwall, F.F.V. Short            |              | --        | --                          | --      | --       | --                         | --      | --       | --                         | --      | --       | --                          | --  | 4c4  |
| 4c5                                                                 | Wingwall, F.F.V. Long             |              | 1         | 8'-8                        | 6       | 2        | 7'-8                       | 10      | 2        | 6'-8                       | 9       | 2        | 5'-8                        | 8   | 4c5  |
| 4c5                                                                 | Wingwall, F.F.V. Short            |              | 1         | 8'-8                        | 6       | 1        | 7'-8                       | 5       | 1        | 6'-8                       | 4       | 1        | 5'-8                        | 4   | 4c5  |
| 4c6                                                                 | Interior Wall, Both F.V.          |              | 4         | 4'-1                        | 11      | 4        | 4'-0                       | 11      | 4        | 4'-0                       | 11      | 4        | 4'-0                        | 11  | 4c6  |
| 4c7                                                                 | Interior Wall, Both F.V.          |              | 64 Var.   | 2 Each<br>1'-10 to<br>7'-5  | 198     | 54 Var.  | 2 Each<br>1'-10 to<br>6'-5 | 149     | 44 Var.  | 2 Each<br>1'-9 to<br>5'-4  | 104     | 36 Var.  | 2 Each<br>1'-9 to<br>4'-5   | 74  | 4c7  |
| 4c8                                                                 | Interior Wall, Both F.V.          |              | 4         | 7'-6                        | 20      | 4        | 6'-6                       | 17      | 4        | 5'-6                       | 15      | 4        | 4'-6                        | 12  | 4c8  |
| 5c9                                                                 | Wingwall, B.F.V. Long             |              | 11 Var.   | 2'-9 to 5'-2                | 45      | 11 Var.  | 2'-9 to 5'-2               | 45      | 11 Var.  | 2'-9 to 5'-2               | 45      | 11 Var.  | 2'-9 to 5'-2                | 45  | 5c9  |
| 5c10                                                                | Wingwall, B.F.V. Short            |              | 5 Var.    | 2'-9 to 4'-1                | 18      | 5 Var.   | 2'-9 to 4'-1               | 18      | 5 Var.   | 2'-9 to 4'-1               | 18      | 5 Var.   | 2'-9 to 4'-1                | 18  | 5c10 |
| 5c11                                                                | Wingwall, B.F.V. Long             |              | 20 Var.   | 9'-5 to 13'-11              | 243     | 15 Var.  | 9'-5 to 12'-9              | 173     | 11 Var.  | 9'-5 to 11'-9              | 121     | 7 Var.   | 9'-5 to 10'-10              | 74  | 5c11 |
| 5c12                                                                | Wingwall, B.F.V. Short            |              | 18 Var.   | 8'-5 to 13'-10              | 209     | 15 Var.  | 8'-5 to 12'-10             | 166     | 12 Var.  | 8'-5 to 11'-11             | 127     | 9 Var.   | 8'-5 to 10'-11              | 91  | 5c12 |
| 6c13                                                                | Wingwall, B.F.V. Long             |              | 13        | 10'-6                       | 205     | 8        | 10'-6                      | 126     | --       | --                         | --      | --       | --                          | --  | 6c13 |
| 6c13                                                                | Wingwall, B.F.V. Short            |              | 10        | 10'-6                       | 158     | 7        | 10'-6                      | 110     | --       | --                         | --      | --       | --                          | --  | 6c13 |
| 5c14                                                                | Wingwall, B.F.V. Long             |              | 1         | 12'-8                       | 13      | 2        | 11'-8                      | 24      | 2        | 10'-8                      | 22      | 2        | 9'-8                        | 20  | 5c14 |
| 5c14                                                                | Wingwall, B.F.V. Short            |              | 1         | 12'-8                       | 13      | 1        | 11'-8                      | 12      | 1        | 10'-8                      | 11      | 1        | 9'-8                        | 10  | 5c14 |
| 4d1                                                                 | Apron, Longit., Bott.             |              | 21        | 20'-4                       | 285     | 21       | 18'-1                      | 254     | 21       | 15'-9                      | 221     | 21       | 13'-5                       | 188 | 4d1  |
| 4d2                                                                 | Apron, Longit., Bott. Long        |              | 3         | 27'-11                      | 56      | 3        | 23'-9                      | 48      | 3        | 19'-7                      | 39      | 3        | 15'-4                       | 31  | 4d2  |
| 4d3                                                                 | Apron, Longit., Bott. Short       |              | 3         | 21'-8                       | 43      | 3        | 18'-7                      | 37      | 3        | 15'-5                      | 31      | 3        | 12'-4                       | 25  | 4d3  |
| 6f1                                                                 | Apron, Longit., Top               |              | 31        | 20'-4                       | 947     | 31       | 18'-1                      | 842     | 31       | 15'-9                      | 733     | 31       | 13'-5                       | 625 | 6f1  |
| 6f2                                                                 | Apron, Longit., Top Long          |              | 6 Var.    | 5'-3 to 16'-11              | 100     | 5 Var.   | 5'-3 to 14'-7              | 74      | 4 Var.   | 5'-3 to 12'-4              | 53      | 3 Var.   | 5'-3 to 10'-0               | 34  | 6f2  |
| 6f3                                                                 | Apron, Longit., Top Short         |              | 4 Var.    | 7'-9 to 17'-2               | 75      | 4 Var.   | 5'-5 to 14'-10             | 61      | 3 Var.   | 6'-2 to 12'-6              | 42      | 2 Var.   | 7'-0 to 10'-3               | 26  | 6f3  |
| 6f4                                                                 | Apron, Longit., Top Long          |              | 1         | 34'-5                       | 52      | 1        | 30'-2                      | 45      | 1        | 26'-0                      | 39      | 1        | 21'-10                      | 33  | 6f4  |
| 6f5                                                                 | Apron, Longit., Top Short         |              | 1         | 26'-8                       | 40      | 1        | 23'-6                      | 35      | 1        | 20'-5                      | 31      | 1        | 17'-4                       | 26  | 6f5  |
| 4i1                                                                 | Parapet, Vertical                 |              | 63        | 6'-4                        | 267     | 63       | 6'-4                       | 267     | 63       | 6'-4                       | 267     | 63       | 6'-4                        | 267 | 4i1  |
| 7j1                                                                 | Parapet, Horizontal               |              | 4         | 37'-8                       | 308     | 4        | 37'-8                      | 308     | 4        | 37'-8                      | 308     | 4        | 37'-8                       | 308 | 7j1  |
| 6m1                                                                 | Apron, Trans., Top                |              | 12 Var.   | 35'-3 to 37'-3              | 653     | 9 Var.   | 35'-3 to 36'-9             | 487     | 6 Var.   | 35'-3 to 36'-2             | 322     | 3 Var.   | 35'-3 to 35'-7              | 160 | 6m1  |
| 6m2                                                                 | Apron, Trans., Top                |              | 2 Var.    | 30'-1 to 31'-5              | 92      | 5 Var.   | 26'-1 to 31'-3             | 215     | 8 Var.   | 22'-1 to 31'-2             | 320     | 11 Var.  | 18'-1 to 31'-1              | 406 | 6m2  |
| 6m3                                                                 | Apron, Trans., Top                |              | 22 Var.   | 5'-7 to 28'-11              | 570     | 19 Var.  | 4'-11 to 24'-11            | 426     | 16 Var.  | 4'-3 to 20'-11             | 302     | 13 Var.  | 3'-7 to 16'-11              | 200 | 6m3  |
| 6m4                                                                 | Apron, Trans., Bott.              |              | 14 Var.   | 31'-4 to 40'-3              | 756     | 12 Var.  | 31'-4 to 38'-10            | 632     | 10 Var.  | 31'-4 to 37'-6             | 517     | 8 Var.   | 31'-4 to 36'-2              | 406 | 6m4  |
| 6p1                                                                 | Curtain, Horizontal               |              | 4         | 36'-6                       | 219     | 4        | 36'-6                      | 219     | 4        | 36'-6                      | 219     | 4        | 36'-6                       | 219 | 6p1  |
| 6p2                                                                 | Curtain, Horizontal, Long         |              | 4         | 18'-0                       | 108     | 4        | 16'-0                      | 96      | 4        | 13'-11                     | 84      | 4        | 11'-11                      | 72  | 6p2  |
| 6p3                                                                 | Curtain, Horizontal, Short        |              | 4         | 10'-9                       | 65      | 4        | 9'-8                       | 58      | 4        | 8'-8                       | 52      | 4        | 7'-7                        | 46  | 6p3  |
| 6s1                                                                 | Wing Slope, Both F., Long         |              | 2         | 8'-0                        | 24      | 2        | 8'-0                       | 24      | 2        | 8'-0                       | 24      | 2        | 8'-0                        | 24  | 6s1  |
| 6s2                                                                 | Wing Slope, Both F., Short        |              | 2         | 6'-11                       | 21      | 2        | 6'-11                      | 21      | 2        | 6'-11                      | 21      | 2        | 6'-11                       | 21  | 6s2  |
| 6s3                                                                 | Wing Slope, Both F., Long         |              | 2         | 27'-5                       | 82      | 2        | 23'-2                      | 70      | 2        | 18'-10                     | 57      | 2        | 14'-7                       | 44  | 6s3  |
| 6s4                                                                 | Wing Slope, Both F., Short        |              | 2         | 21'-8                       | 65      | 2        | 18'-4                      | 55      | 2        | 15'-1                      | 45      | 2        | 11'-10                      | 36  | 6s4  |
| 6s5                                                                 | Wing Slope, F.F. Long             |              | 1         | 33'-7                       | 50      | 1        | 29'-3                      | 44      | 1        | 25'-0                      | 38      | 1        | 20'-8                       | 31  | 6s5  |
| 6s6                                                                 | Wing Slope, F.F. Short            |              | 1         | 26'-11                      | 40      | 1        | 23'-8                      | 36      | 1        | 20'-5                      | 31      | 1        | 17'-1                       | 26  | 6s6  |
| 6s7                                                                 | Interior Wall, Both F.H.          |              | 4         | 20'-10                      | 125     | 4        | 18'-4                      | 110     | 4        | 15'-10                     | 95      | 4        | 13'-4                       | 80  | 6s7  |
| 5t1                                                                 | Curtain, Vertical                 |              | 42        | 6'-8                        | 292     | 39       | 6'-5                       | 261     | 37       | 6'-5                       | 248     | 35       | 6'-5                        | 234 | 5t1  |
|                                                                     | Estimated Quantities One Headwall | Reinf. Steel |           | 7508 LB                     |         | 6381 LB  |                            | 5211 LB |          | 4345 LB                    |         |          |                             |     |      |
|                                                                     |                                   | Concrete     | Parapet Δ | 3.6                         | 55.5 CY | 3.6      | 46.8 CY                    | 3.6     | 39.3 CY  | 3.6                        | 32.4 CY |          |                             |     |      |
|                                                                     |                                   |              | Wingwalls | 11.6                        |         | 8.9      |                            | 6.5     |          | 4.4                        |         |          |                             |     |      |
|                                                                     |                                   |              | Apron *   | 40.3                        |         | 34.3     |                            | 29.2    |          | 24.4                       |         |          |                             |     |      |

Δ Includes top of wingwall quantities.

\* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

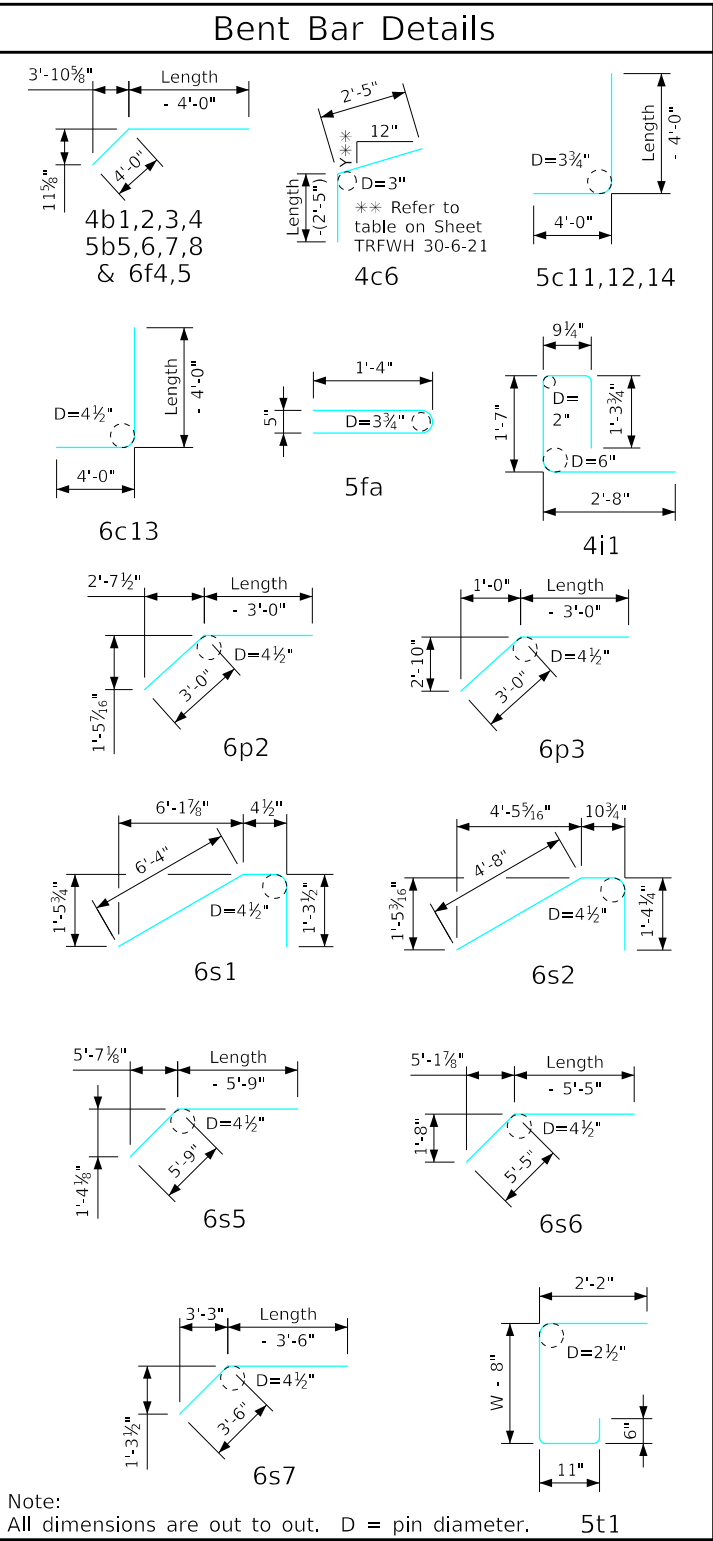
Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall

"Long" Denotes Long Wingwall

### Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.



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Standard Design - Triple Reinforced Concrete Box Culverts

### Flared Wing Headwalls

February, 2021

Quantity Tabulation  
10'-0" Span  
30° Skew

TRFWH  
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Sheet 2 of 2

[illegible]

Plan View

1. See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. See Sheet TRFWH 45-2-21 for dimensions table.
3. See Sheet TRFWH 45-5-21 for Angle L & Angle S.



Standard Design - Triple Reinforced Concrete Box Culverts

## Flared Wing Headwalls

February, 2021

Dimension Plan  
45° Skew

TRFWH  
45-1-21

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| Dimension Table |           |           |           |          |          |          |          |          |          |           |           |           |          |          |          |          |          |          |       |  |
|-----------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-------|--|
| S x H           | 12' x 12' | 12' x 11' | 12' x 10' | 12' x 9' | 12' x 8' | 12' x 7' | 12' x 6' | 12' x 5' | 12' x 4' | 10' x 12' | 10' x 11' | 10' x 10' | 10' x 9' | 10' x 8' | 10' x 7' | 10' x 6' | 10' x 5' | 10' x 4' | S x H |  |
| A               | 37'-0     | 34'-0     | 31'-0     | 28'-0    | 25'-0    | 22'-0    | 19'-0    | 16'-0    | 13'-0    | 37'-0     | 34'-0     | 31'-0     | 28'-0    | 25'-0    | 22'-0    | 19'-0    | 16'-0    | 13'-0    | A     |  |
| B               | 12'-4     | 11'-4     | 10'-4     | 9'-4     | 8'-4     | 7'-4     | 6'-4     | 5'-4     | 4'-4     | 12'-4     | 11'-4     | 10'-4     | 9'-4     | 8'-4     | 7'-4     | 6'-4     | 5'-4     | 4'-4     | B     |  |
| C               | 24'-8     | 22'-8     | 20'-8     | 18'-8    | 16'-8    | 14'-8    | 12'-8    | 10'-8    | 8'-8     | 24'-8     | 22'-8     | 20'-8     | 18'-8    | 16'-8    | 14'-8    | 12'-8    | 10'-8    | 8'-8     | C     |  |
| C1              | 34'-10½   | 32'-0½    | 29'-2¾    | 26'-4¾   | 23'-6¾   | 20'-8¾   | 17'-11   | 15'-1    | 12'-3½   | 34'-10½   | 32'-0½    | 29'-2¾    | 26'-4¾   | 23'-6¾   | 20'-8¾   | 17'-11   | 15'-1    | 12'-3½   | C1    |  |
| C2              | 33'-10½   | 31'-1½    | 28'-4¾    | 25'-6¾   | 22'-8¾   | 19'-11½  | 17'-2    | 14'-4    | 11'-6½   | 33'-10½   | 31'-1½    | 28'-4¾    | 25'-6¾   | 22'-8¾   | 19'-11½  | 17'-2    | 14'-4    | 11'-6½   | C2    |  |
| C3              | 6         | 5½        | 5         | 5        | 5        | 4½       | 4½       | 4½       | 4½       | 6         | 5½        | 5         | 5        | 5        | 4½       | 4½       | 4½       | 4½       | C3    |  |
| DL              | 17'-5¼    | 16'-0¾    | 14'-7¾    | 13'-2¾   | 11'-9¾   | 10'-4½   | 8'-11½   | 7'-6½    | 6'-1½    | 17'-5¼    | 16'-0¾    | 14'-7¾    | 13'-2¾   | 11'-9¾   | 10'-4½   | 8'-11½   | 7'-6½    | 6'-1½    | DL    |  |
| DS              | 10'-5½    | 9'-7¾     | 8'-9¼     | 7'-11    | 7'-0¾    | 6'-2¾    | 5'-4½    | 4'-6¼    | 3'-8½    | 10'-5½    | 9'-7¾     | 8'-9¼     | 7'-11    | 7'-0¾    | 6'-2¾    | 5'-4½    | 4'-6¼    | 3'-8½    | DS    |  |
| D1              | 61'-8     | 56'-8     | 51'-8     | 46'-8    | 41'-8    | 36'-8    | 31'-8    | 26'-8    | 21'-8    | 61'-8     | 56'-8     | 51'-8     | 46'-8    | 41'-8    | 36'-8    | 31'-8    | 26'-8    | 21'-8    | D1    |  |
| D2              | 22'-2¾    | 20'-4¾    | 18'-7¼    | 16'-9¾   | 15'-0    | 13'-2¾   | 11'-4¾   | 9'-7¼    | 7'-9¾    | 22'-2¾    | 20'-4¾    | 18'-7¼    | 16'-9¾   | 15'-0    | 13'-2¾   | 11'-4¾   | 9'-7¼    | 7'-9¾    | D2    |  |
| E               | 65'-10¾   | 63'-5¾    | 61'-0¾    | 58'-9¾   | 56'-6¼   | 54'-1½   | 51'-10   | 49'-6¾   | 47'-3¾   | 59'-10¾   | 57'-5¾    | 55'-0¾    | 52'-9¾   | 50'-6¼   | 48'-1½   | 45'-10   | 43'-6¾   | 41'-3¾   | E     |  |
| E1              | 93'-2½    | 89'-9¼    | 86'-4     | 83'-1¾   | 79'-11¼  | 76'-6    | 73'-3¾   | 70'-1¼   | 66'-10¾  | 84'-8¾    | 81'-3¾    | 77'-10¼   | 74'-7¾   | 71'-5¾   | 68'-0¾   | 64'-9¾   | 61'-7¾   | 58'-5    | E1    |  |
| FL              | 17'-9¼    | 16'-4¾    | 14'-11¾   | 13'-6¾   | 12'-1¾   | 10'-8½   | 9'-3½    | 7'-10½   | 6'-5½    | 17'-9¼    | 16'-4¾    | 14'-11¾   | 13'-6¾   | 12'-1¾   | 10'-8½   | 9'-3½    | 7'-10½   | 6'-5½    | FL    |  |
| FS              | 10'-9½    | 9'-11¾    | 9'-1¼     | 8'-3     | 7'-4¾    | 6'-6¾    | 5'-8½    | 4'-10¼   | 4'-0¾    | 10'-9½    | 9'-11¾    | 9'-1¼     | 8'-3     | 7'-4¾    | 6'-6¾    | 5'-8½    | 4'-10¼   | 4'-0¾    | FS    |  |
| F1              | 37'-5½    | 34'-5½    | 31'-5½    | 28'-5½   | 25'-5½   | 22'-5½   | 19'-5½   | 16'-5½   | 13'-5½   | 37'-5½    | 34'-5½    | 31'-5½    | 28'-5½   | 25'-5½   | 22'-5½   | 19'-5½   | 16'-5½   | 13'-5½   | F1    |  |
| F2              | 2'-11¼    | 2'-8¾     | 2'-6½     | 2'-4     | 2'-1¾    | 1'-11¼   | 1'-8¾    | 1'-6½    | 1'-4     | 2'-11¼    | 2'-8¾     | 2'-6½     | 2'-4     | 2'-1¾    | 1'-11¼   | 1'-8¾    | 1'-6½    | 1'-4     | F2    |  |
| G               | 37'-4     | 37'-2     | 37'-0     | 37'-0    | 37'-0    | 36'-10   | 36'-10   | 36'-10   | 36'-10   | 31'-4     | 31'-2     | 31'-0     | 31'-0    | 31'-0    | 30'-10   | 30'-10   | 30'-10   | 30'-10   | G     |  |
| G1              | 52'-9¾    | 52'-6¾    | 52'-3¾    | 52'-3¾   | 52'-3¾   | 52'-1½   | 52'-1½   | 52'-1½   | 52'-1½   | 44'-3¾    | 44'-0¾    | 43'-10¾   | 43'-10¾  | 43'-10¾  | 43'-7¼   | 43'-7¼   | 43'-7¼   | 43'-7¼   | G1    |  |
| G2              | 53'-11¾   | 53'-9     | 53'-6½    | 53'-6    | 53'-6    | 53'-3    | 53'-2¾   | 53'-2¾   | 53'-2½   | 45'-6     | 45'-3½    | 45'-0¼    | 45'-0¼   | 45'-0¾   | 44'-9¼   | 44'-9¾   | 44'-8¾   | 44'-8¾   | G2    |  |
| G3              | 39'-5¾    | 36'-3½    | 33'-1½    | 29'-11½  | 26'-9¾   | 23'-7¾   | 20'-5¾   | 17'-3¾   | 14'-1¾   | 39'-5¾    | 36'-3½    | 33'-1½    | 29'-11½  | 26'-9¾   | 23'-7¾   | 20'-5¾   | 17'-3¾   | 14'-1¾   | G3    |  |
| G4              | 39'-9½    | 36'-3     | 32'-8½    | 29'-6¾   | 26'-4¾   | 22'-10¼  | 19'-8¾   | 16'-6½   | 13'-4¾   | 39'-9½    | 36'-3     | 32'-8½    | 29'-6¾   | 26'-4¾   | 22'-10¼  | 19'-8¾   | 16'-6½   | 13'-4¾   | G4    |  |
| G5              | 12'-8¾    | 11'-7¾    | 10'-7¾    | 9'-7½    | 8'-7¼    | 7'-7     | 6'-6¾    | 5'-6¾    | 4'-6¾    | 12'-8¾    | 11'-7¾    | 10'-7¾    | 9'-7½    | 8'-7¼    | 7'-7     | 6'-6¾    | 5'-6¾    | 4'-6¾    | G5    |  |
| G6              | 14'-2½    | 13'-0½    | 11'-10¾   | 10'-10½  | 9'-10¾   | 8'-8¾    | 7'-8½    | 6'-8¾    | 5'-8¾    | 14'-2½    | 13'-0½    | 11'-10¾   | 10'-10½  | 9'-10¾   | 8'-8¾    | 7'-8½    | 6'-8¾    | 5'-8¾    | G6    |  |
| G7              | 1¾        | 6¾        | 10½       | 10½      | 10½      | 1'-2¾    | 1'-2¾    | 1'-2¾    | 1'-2¾    | 1¾        | 6¾        | 10½       | 10½      | 10½      | 1'-2¾    | 1'-2¾    | 1'-2¾    | 1'-2¾    | G7    |  |
| G8              | 6¾        | 7¾        | 8¼        | 8¼       | 8¼       | 9¼       | 9¼       | 9¾       | 9¾       | 6¾        | 7¾        | 8¼        | 8¼       | 8¼       | 9¼       | 9¼       | 9¾       | 9¾       | G8    |  |
| K               | 38'-0     | 37'-10    | 37'-8     | 37'-8    | 37'-8    | 37'-6    | 37'-6    | 37'-6    | 37'-6    | 32'-0     | 31'-10    | 31'-8     | 31'-8    | 31'-8    | 31'-6    | 31'-6    | 31'-6    | 31'-6    | K     |  |
| K1              | 53'-8¾    | 53'-6     | 53'-3¾    | 53'-3¾   | 53'-3¾   | 53'-0¾   | 53'-0¾   | 53'-0¾   | 53'-0¾   | 45'-3     | 45'-0¼    | 44'-9¾    | 44'-9¾   | 44'-9¾   | 44'-6¾   | 44'-6¾   | 44'-6¾   | 44'-6¾   | K1    |  |
| PL              | 71'-11    | 66'-1     | 60'-3     | 54'-5½   | 48'-7½   | 42'-9¾   | 36'-11½  | 31'-1½   | 25'-3¼   | 71'-11    | 66'-1     | 60'-3     | 54'-5½   | 48'-7½   | 42'-9¾   | 36'-11½  | 31'-1½   | 25'-3¼   | PL    |  |
| PS              | 43'-1¾    | 39'-7¾    | 36'-1¾    | 32'-7¾   | 29'-1¾   | 25'-7¾   | 22'-1¾   | 18'-7¾   | 15'-1¾   | 43'-1¾    | 39'-7¾    | 36'-1¾    | 32'-7¾   | 29'-1¾   | 25'-7¾   | 22'-1¾   | 18'-7¾   | 15'-1¾   | PS    |  |
| RL              | 72'-11¾   | 67'-0¾    | 61'-1¾    | 55'-2¾   | 49'-3¾   | 43'-4¾   | 37'-5¾   | 31'-6¾   | 25'-7¾   | 72'-11¾   | 67'-0¾    | 61'-1¾    | 55'-2¾   | 49'-3¾   | 43'-4¾   | 37'-5¾   | 31'-6¾   | 25'-7¾   | RL    |  |
| RS              | 44'-10½   | 41'-2¾    | 37'-7¼    | 33'-11½  | 30'-3¾   | 26'-8¾   | 23'-0½   | 19'-4¾   | 15'-9¼   | 44'-10½   | 41'-2¾    | 37'-7¼    | 33'-11½  | 30'-3¾   | 26'-8¾   | 23'-0½   | 19'-4¾   | 15'-9¼   | RS    |  |
| R1              | 35'-7½    | 32'-8½    | 29'-9¾    | 26'-9½   | 23'-9½   | 20'-10½  | 17'-10½  | 14'-10¾  | 11'-10¾  | 35'-7½    | 32'-8½    | 29'-9¾    | 26'-9½   | 23'-9½   | 20'-10½  | 17'-10½  | 14'-10¾  | 11'-10¾  | R1    |  |
| S1              | 16'-11¾   | 16'-11¾   | 16'-11¾   | 16'-11¾  | 16'-11¾  | 16'-11¾  | 16'-11¾  | 16'-11¾  | 16'-11¾  | 14'-1¾    | 14'-1¾    | 14'-1¾    | 14'-1¾   | 14'-1¾   | 14'-1¾   | 14'-1¾   | 14'-1¾   | 14'-1¾   | S1    |  |
| T               | 1'-2      | 1'-2      | 1'-2      | 1'-2     | 1'-2     | 1'-2     | 1'-2     | 1'-2     | 1'-2     | 1'-1      | 1'-1      | 1'-1      | 1'-1     | 1'-1     | 1'-1     | 1'-1     | 1'-1     | 1'-1     | T     |  |
| U               | 1'-0      | 11        | 10        | 10       | 10       | 9        | 9        | 9        | 9        | 1'-0      | 11        | 10        | 10       | 10       | 9        | 9        | 9        | 9        | U     |  |
| V               | 1'-0      | 11        | 10        | 10       | 10       | 9        | 9        | 9        | 9        | 1'-0      | 11        | 10        | 10       | 10       | 9        | 9        | 9        | 9        | V     |  |
| V1              | 1'-5      | 1'-3½     | 1'-2¾     | 1'-2¾    | 1'-2¾    | 1'-0¾    | 1'-0¾    | 1'-0¾    | 1'-0¾    | 1'-5      | 1'-3½     | 1'-2¾     | 1'-2¾    | 1'-2¾    | 1'-0¾    | 1'-0¾    | 1'-0¾    | 1'-0¾    | V1    |  |
| W               | 5'-0      | 4'-9      | 4'-6      | 4'-3     | 4'-0     | 3'-9     | 3'-6     | 3'-6     | 3'-6     | 5'-0      | 4'-9      | 4'-6      | 4'-3     | 4'-0     | 3'-9     | 3'-6     | 3'-6     | 3'-6     | W     |  |

- Notes:
- 1. See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
  - 2. See Sheet TRFWH 45-1-21 and sheets TRFWH 45-3-21 thru TRFWH 45-6-21 for location of certain dimensions tabulated.
  - 3. Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

  
APPROVED BY BRIDGE ENGINEER

  
Standard Design - Triple Reinforced Concrete Box Culverts

Flared Wing Headwalls  
February, 2021

Dimension Table  
45° Skew

TRFWH  
45-2-21

Notes:

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Top transverse floor bars are referenced approximately 4" from the back of the parapet for all headwalls.
3. For dimension table see Sheet TRFWH 45-2-21.
4. For reinforcing in curtain wall see Curtain Wall Details on Sheet TRFWH 45-5-21.

|                      |                                                                                                                      |                                                                                       |                  |
|----------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------|
| LATEST REVISION DATE | <br>APPROVED BY BRIDGE ENGINEER |  |                  |
|                      |                                                                                                                      | Standard Design - Triple Reinforced Concrete Box Culverts                             |                  |
|                      |                                                                                                                      | Flared Wing Headwalls<br>February, 2021                                               |                  |
|                      |                                                                                                                      | Top Apron Detail<br>45° Skew                                                          | TRFWH<br>45-3-21 |

1. Bar spacings and positions shown are similar for all sizes of headwalls in this standard.
2. Wingwall bars consistently referenced from end of wing for all headwalls.
3. There are no 6c13 bars in the 4' & 5' height headwalls.
4. 4c3 & 4c4 bars used only in the 9', 10', 11' & 12' height headwalls.
5. For dimensioning table see Sheet TRFWH 45-2-21.
6. For reinforcing in curtain wall see Curtain Wall Details on Sheet TRFWH 45-5-21.

LATEST REVISION DATE

APPROVED BY BRIDGE ENGINEER



Standard Design - Triple Reinforced Concrete Box Culverts

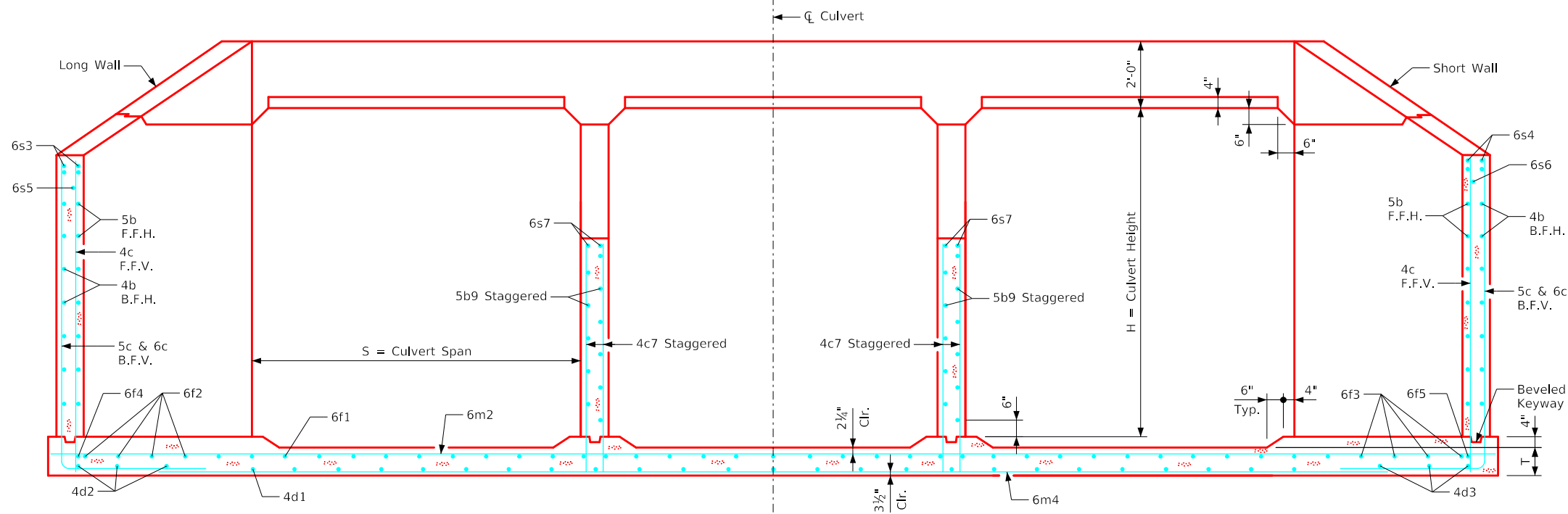
## Flared Wing Headwalls

February, 2021

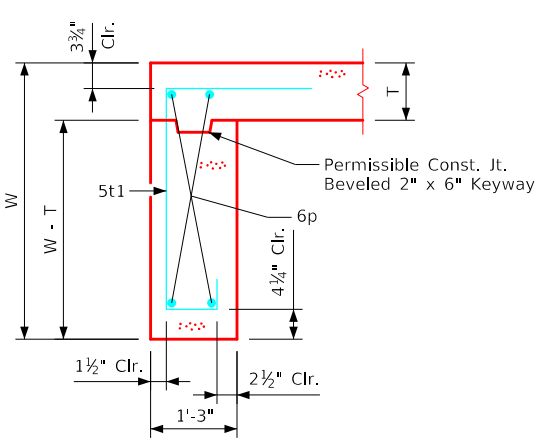
Bottom Apron Detail  
45° Skew

TRFWH  
45-4-21

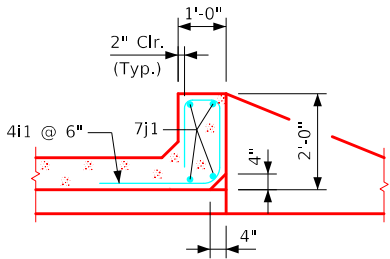
ENGLISHLRFDDESIGNEDTRIPLECULVERTSFHW.DGN - TRFWH 45-5-21 - THIS SHEET ISSUED 02-2021.



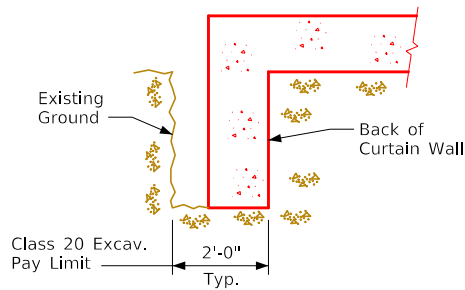
Typical Section - Near Center of Apron



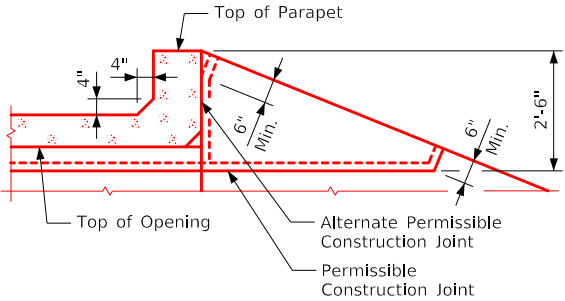
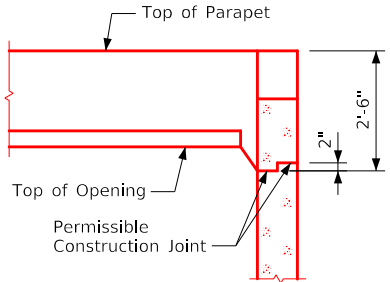
Section thru Curtain Wall



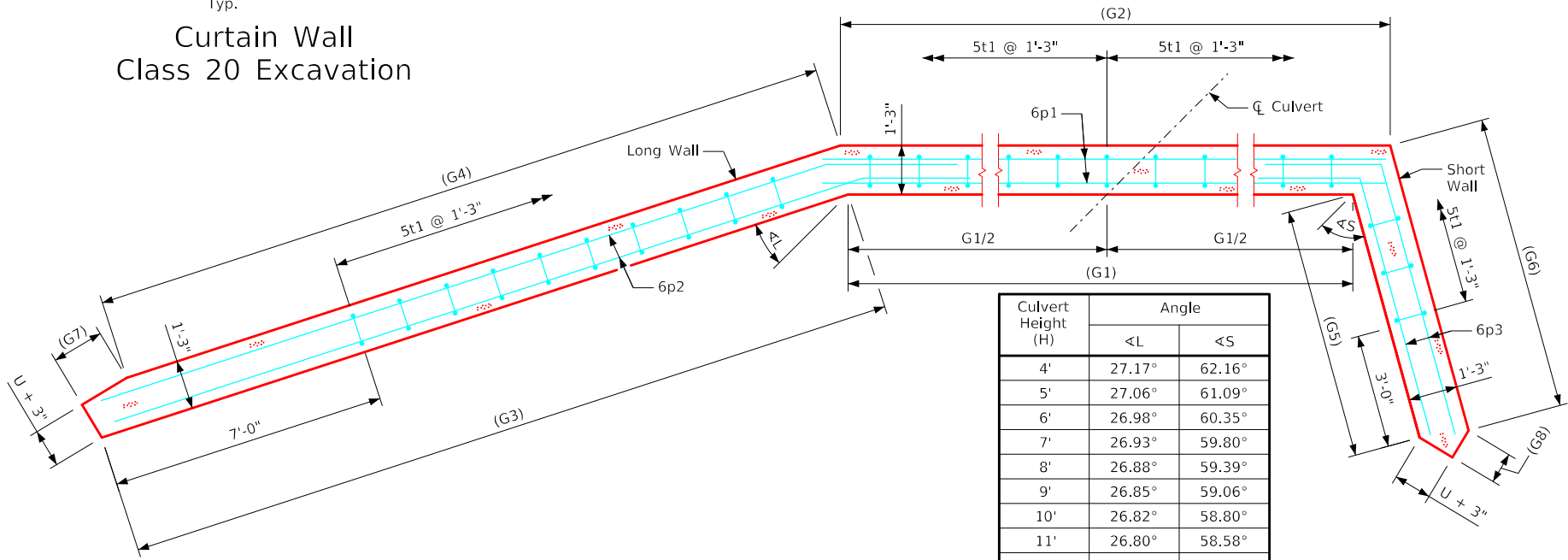
Section thru Parapet



Curtain Wall  
Class 20 Excavation



Top of Wingwall Details



| Culvert Height (H) | Angle  |        |
|--------------------|--------|--------|
|                    | <L     | <S     |
| 4'                 | 27.17° | 62.16° |
| 5'                 | 27.06° | 61.09° |
| 6'                 | 26.98° | 60.35° |
| 7'                 | 26.93° | 59.80° |
| 8'                 | 26.88° | 59.39° |
| 9'                 | 26.85° | 59.06° |
| 10'                | 26.82° | 58.80° |
| 11'                | 26.80° | 58.58° |
| 12'                | 26.78° | 58.40° |

Curtain Wall Plan

Note: <L & <S are measured from a line parallel to  $\mathcal{Q}$  Culvert.

Notes:

1. See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. For dimension table see Sheet TRFWH 45-2-21.

|                                            |                                                                                                                      |                                                                                                                                                    |  |
|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--|
| LATEST REVISION DATE                       | <br>APPROVED BY BRIDGE ENGINEER | <br>Standard Design - Triple Reinforced Concrete Box Culverts |  |
|                                            |                                                                                                                      | Flared Wing Headwalls                                                                                                                              |  |
|                                            |                                                                                                                      | February, 2021                                                                                                                                     |  |
| Parapet & Curtain Wall Details<br>45° Skew |                                                                                                                      | TRFWH<br>45-5-21                                                                                                                                   |  |



| Bill of Reinforcing for One Headwall 45° Skew Span x Culvert Height |                                   |                                                                                     |           |                          |          |           |                           |      |           |                          |          |          |                          |      |          |                         |      |      |  |
|---------------------------------------------------------------------|-----------------------------------|-------------------------------------------------------------------------------------|-----------|--------------------------|----------|-----------|---------------------------|------|-----------|--------------------------|----------|----------|--------------------------|------|----------|-------------------------|------|------|--|
| Bar                                                                 | Location                          | Shape                                                                               | 12' x 12' |                          |          | 12' x 11' |                           |      | 12' x 10' |                          |          | 12' x 9' |                          |      | 12' x 8' |                         |      | Bar  |  |
|                                                                     |                                   |                                                                                     | No.       | Length                   | Wt.      | No.       | Length                    | Wt.  | No.       | Length                   | Wt.      | No.      | Length                   | Wt.  | No.      | Length                  | Wt.  |      |  |
| 5fa                                                                 | Fence Anchor (Galv.)              |    | 2         | 2'-10                    | 6        | 2         | 2'-10                     | 6    | 2         | 2'-10                    | 6        | 2        | 2'-10                    | 6    | 2        | 2'-10                   | 6    | 5fa  |  |
| 4b1                                                                 | Wingwall, B.F.H. Long             |    | 1         | 76'-3                    | 53       | 1         | 70'-6                     | 49   | 1         | 64'-8                    | 45       | 1        | 58'-10                   | 41   | 1        | 53'-0                   | 37   | 4b1  |  |
| 4b2                                                                 | Wingwall, B.F.H. Short            |    | 1         | 47'-6                    | 33       | 1         | 44'-0                     | 31   | 1         | 40'-7                    | 29       | 1        | 37'-1                    | 25   | 1        | 33'-7                   | 22   | 4b2  |  |
| 4b3                                                                 | Wingwall, B.F.H. Long             |    | 10 Var.   | 21'-2 to 73'-6           | 326      | 9 Var.    | 21'-2 to 67'-8            | 275  | 8 Var.    | 21'-2 to 61'-11          | 228      | 7 Var.   | 21'-2 to 56'-1           | 185  | 6 Var.   | 21'-2 to 50'-3          | 146  | 4b3  |  |
| 4b4                                                                 | Wingwall, B.F.H. Short            |    | 10 Var.   | 14'-6 to 45'-11          | 205      | 9 Var.    | 14'-6 to 42'-5            | 173  | 8 Var.    | 14'-6 to 38'-11          | 143      | 7 Var.   | 14'-6 to 35'-5           | 117  | 6 Var.   | 14'-6 to 31'-11         | 93   | 4b4  |  |
| 5b5                                                                 | Wingwall, F.F.H. Long             |    | 1         | 76'-4                    | 82       | 1         | 70'-6                     | 76   | 1         | 64'-8                    | 70       | 1        | 58'-10                   | 64   | 1        | 53'-0                   | 58   | 5b5  |  |
| 5b6                                                                 | Wingwall, F.F.H. Short            |    | 1         | 47'-7                    | 52       | 1         | 44'-1                     | 48   | 1         | 40'-7                    | 45       | 1        | 37'-1                    | 39   | 1        | 33'-7                   | 35   | 5b6  |  |
| 5b7                                                                 | Wingwall, F.F.H. Long             |    | 11 Var.   | 15'-5 to 73'-7           | 526      | 10 Var.   | 15'-5 to 67'-9            | 446  | 9 Var.    | 15'-5 to 61'-11          | 373      | 8 Var.   | 15'-5 to 56'-1           | 306  | 7 Var.   | 15'-4 to 50'-3          | 244  | 5b7  |  |
| 5b8                                                                 | Wingwall, F.F.H. Short            |    | 11 Var.   | 11'-1 to 46'-0           | 333      | 10 Var.   | 11'-1 to 42'-6            | 282  | 9 Var.    | 11'-1 to 39'-0           | 235      | 8 Var.   | 11'-1 to 35'-6           | 194  | 7 Var.   | 11'-1 to 32'-0          | 157  | 5b8  |  |
| 5b9                                                                 | Interior Wall, Both F.H.          |    | 42 Var.   | 2 Each<br>6'-11 to 37'-9 | 978      | 38 Var.   | 2 Each<br>6'-11 to 34'-11 | 829  | 34 Var.   | 2 Each<br>6'-11 to 32'-2 | 693      | 30 Var.  | 2 Each<br>6'-11 to 29'-4 | 567  | 26 Var.  | 2 Each<br>7'-0 to 26'-6 | 454  | 5b9  |  |
| 4c1                                                                 | Wingwall, F.F.V. Long             |    | 72 Var.   | 2'-9 to 15'-0            | 427      | 66 Var.   | 2'-9 to 13'-11            | 367  | 60 Var.   | 2'-9 to 12'-11           | 314      | 54 Var.  | 2'-9 to 11'-11           | 265  | 49 Var.  | 2'-9 to 11'-0           | 225  | 4c1  |  |
| 4c2                                                                 | Wingwall, F.F.V. Short            |    | 43 Var.   | 2'-10 to 14'-10          | 254      | 40 Var.   | 2'-10 to 14'-0            | 225  | 36 Var.   | 2'-10 to 12'-10          | 188      | 33 Var.  | 2'-10 to 12'-0           | 163  | 29 Var.  | 2'-10 to 10'-10         | 132  | 4c2  |  |
| 4c3                                                                 | Wingwall, F.F.V. Long             |    | 33 Var.   | 9'-7 to 15'-1            | 272      | 27 Var.   | 9'-7 to 14'-0             | 213  | 21 Var.   | 9'-7 to 13'-0            | 158      | 15 Var.  | 9'-7 to 12'-0            | 108  | --       | --                      | --   | 4c3  |  |
| 4c4                                                                 | Wingwall, F.F.V. Short            |    | 20 Var.   | 9'-7 to 15'-0            | 164      | 17 Var.   | 9'-7 to 14'-1             | 134  | 13 Var.   | 9'-7 to 13'-0            | 98       | 10 Var.  | 9'-7 to 12'-1            | 72   | --       | --                      | --   | 4c4  |  |
| 4c5                                                                 | Wingwall, F.F.V. Long             |    | 1         | 13'-9                    | 9        | 2         | 12'-9                     | 17   | 2         | 11'-9                    | 16       | 2        | 10'-9                    | 14   | 1        | 9'-9                    | 7    | 4c5  |  |
| 4c5                                                                 | Wingwall, F.F.V. Short            |    | 2         | 13'-9                    | 18       | 1         | 12'-9                     | 9    | 2         | 11'-9                    | 16       | 1        | 10'-9                    | 7    | 2        | 9'-9                    | 13   | 4c5  |  |
| 4c6                                                                 | Interior Wall, Both F.V.          |    | 4         | 4'-1                     | 11       | 4         | 4'-1                      | 11   | 4         | 4'-1                     | 11       | 4        | 4'-1                     | 11   | 4        | 4'-1                    | 11   | 4c6  |  |
| 4c7                                                                 | Interior Wall, Both F.V.          |    | 132 Var.  | 2 Each<br>1'-10 to 12'-5 | 628      | 122 Var.  | 2 Each<br>1'-10 to 11'-6  | 543  | 110 Var.  | 2 Each<br>1'-10 to 10'-5 | 450      | 100 Var. | 2 Each<br>1'-10 to 9'-6  | 379  | 88 Var.  | 2 Each<br>1'-10 to 8'-6 | 304  | 4c7  |  |
| 4c8                                                                 | Interior Wall, Both F.V.          |    | 6         | 12'-7                    | 50       | 6         | 11'-7                     | 46   | 6         | 10'-7                    | 42       | 6        | 9'-7                     | 38   | 6        | 8'-7                    | 34   | 4c8  |  |
| 5c9                                                                 | Wingwall, B.F.V. Long             |    | 15 Var.   | 2'-9 to 5'-2             | 62       | 15 Var.   | 2'-9 to 5'-2              | 62   | 15 Var.   | 2'-9 to 5'-2             | 62       | 15 Var.  | 2'-9 to 5'-2             | 62   | 15 Var.  | 2'-9 to 5'-2            | 62   | 5c9  |  |
| 5c10                                                                | Wingwall, B.F.V. Short            |    | 4 Var.    | 2'-10 to 3'-8            | 14       | 4 Var.    | 2'-10 to 3'-8             | 14   | 4 Var.    | 2'-10 to 3'-8            | 14       | 4 Var.   | 2'-10 to 3'-8            | 14   | 4 Var.   | 2'-10 to 3'-8           | 14   | 5c10 |  |
| 5c11                                                                | Wingwall, B.F.V. Long             |    | 57 Var.   | 9'-4 to 19'-0            | 842      | 51 Var.   | 9'-4 to 17'-11            | 725  | 45 Var.   | 9'-4 to 16'-11           | 616      | 39 Var.  | 9'-4 to 15'-11           | 514  | 34 Var.  | 9'-4 to 15'-0           | 431  | 5c11 |  |
| 5c12                                                                | Wingwall, B.F.V. Short            |    | 39 Var.   | 8'-0 to 18'-10           | 546      | 36 Var.   | 8'-0 to 18'-0             | 488  | 32 Var.   | 8'-0 to 16'-10           | 414      | 29 Var.  | 8'-0 to 16'-0            | 363  | 25 Var.  | 8'-0 to 14'-10          | 298  | 5c12 |  |
| 6c13                                                                | Wingwall, B.F.V. Long             |    | 47        | 10'-6                    | 741      | 41        | 10'-6                     | 647  | 35        | 10'-6                    | 552      | 29       | 10'-6                    | 457  | 24       | 10'-6                   | 379  | 6c13 |  |
| 6c13                                                                | Wingwall, B.F.V. Short            |    | 28        | 10'-6                    | 442      | 25        | 10'-6                     | 394  | 21        | 10'-6                    | 331      | 18       | 10'-6                    | 284  | 14       | 10'-6                   | 221  | 6c13 |  |
| 5c14                                                                | Wingwall, B.F.V. Long             |    | 1         | 17'-9                    | 19       | 2         | 16'-9                     | 35   | 2         | 15'-9                    | 33       | 2        | 14'-9                    | 31   | 1        | 13'-9                   | 14   | 5c14 |  |
| 5c14                                                                | Wingwall, B.F.V. Short            |    | 2         | 17'-9                    | 37       | 1         | 16'-9                     | 17   | 2         | 15'-9                    | 33       | 1        | 14'-9                    | 15   | 2        | 13'-9                   | 29   | 5c14 |  |
| 4d1                                                                 | Apron, Longit., Bott.             |    | 25        | 38'-6                    | 643      | 25        | 35'-8                     | 596  | 25        | 32'-10                   | 548      | 25       | 30'-0                    | 501  | 25       | 27'-2                   | 454  | 4d1  |  |
| 4d2                                                                 | Apron, Longit., Bott. Long        |    | 3         | 68'-10                   | 143      | 3         | 63'-0                     | 131  | 3         | 57'-2                    | 119      | 3        | 51'-5                    | 108  | 3        | 45'-7                   | 96   | 4d2  |  |
| 4d3                                                                 | Apron, Longit., Bott. Short       |    | 3         | 42'-7                    | 90       | 3         | 39'-1                     | 78   | 3         | 35'-7                    | 71       | 3        | 32'-1                    | 64   | 3        | 28'-7                   | 57   | 4d3  |  |
| 6f1                                                                 | Apron, Longit., Top               |   | 37        | 38'-6                    | 2140     | 37        | 35'-8                     | 1982 | 37        | 32'-10                   | 1825     | 37       | 30'-0                    | 1667 | 37       | 27'-2                   | 1510 | 6f1  |  |
| 6f2                                                                 | Apron, Longit., Top Long          |  | 15 Var.   | 6'-7 to 34'-10           | 467      | 14 Var.   | 5'-8 to 32'-0             | 396  | 12 Var.   | 6'-11 to 29'-2           | 325      | 11 Var.  | 6'-1 to 26'-4            | 268  | 9 Var.   | 7'-3 to 23'-6           | 208  | 6f2  |  |
| 6f3                                                                 | Apron, Longit., Top Short         |  | 9 Var.    | 8'-1 to 35'-2            | 292      | 8 Var.    | 8'-8 to 32'-4             | 246  | 8 Var.    | 5'-9 to 29'-6            | 212      | 7 Var.   | 6'-4 to 26'-8            | 173  | 6 Var.   | 6'-10 to 23'-10         | 138  | 6f3  |  |
| 6f4                                                                 | Apron, Longit., Top Long          |  | 1         | 76'-4                    | 118      | 1         | 70'-6                     | 110  | 1         | 64'-8                    | 101      | 1        | 58'-10                   | 92   | 1        | 53'-0                   | 83   | 6f4  |  |
| 6f5                                                                 | Apron, Longit., Top Short         |  | 1         | 47'-7                    | 75       | 1         | 44'-1                     | 70   | 1         | 40'-7                    | 65       | 1        | 37'-1                    | 56   | 1        | 33'-7                   | 50   | 6f5  |  |
| 4i1                                                                 | Parapet, Vertical                 |  | 77        | 6'-8                     | 343      | 75        | 6'-8                      | 334  | 75        | 6'-8                     | 334      | 75       | 6'-8                     | 334  | 75       | 6'-8                    | 334  | 4i1  |  |
| 7j1                                                                 | Parapet, Horizontal               |  | 4         | 56'-1                    | 478      | 4         | 55'-7                     | 474  | 4         | 55'-1                    | 470      | 4        | 55'-1                    | 470  | 4        | 55'-1                   | 470  | 7j1  |  |
| 6m1                                                                 | Apron, Trans., Top                |  | 23 Var.   | 44'-8 to 48'-9           | 1697     | 20 Var.   | 44'-3 to 47'-10           | 1456 | 16 Var.   | 43'-11 to 46'-9          | 1148     | 12 Var.  | 43'-11 to 46'-0          | 854  | 9 Var.   | 43'-11 to 45'-5         | 636  | 6m1  |  |
| 6m2                                                                 | Apron, Trans., Top                |  | 4 Var.    | 36'-3 to 38'-6           | 225      | 7 Var.    | 33'-3 to 37'-9            | 373  | 11 Var.   | 30'-3 to 37'-9           | 562      | 15 Var.  | 27'-5 to 37'-11          | 736  | 18 Var.  | 24'-7 to 37'-4          | 837  | 6m2  |  |
| 6m3                                                                 | Apron, Trans., Top                |  | 46 Var.   | 10'-3 to 35'-7           | 1583     | 42 Var.   | 9'-7 to 32'-7             | 1330 | 39 Var.   | 8'-3 to 29'-8            | 1111     | 35 Var.  | 7'-8 to 26'-10           | 907  | 31 Var.  | 7'-1 to 24'-0           | 724  | 6m3  |  |
| 6m4                                                                 | Apron, Trans., Bott.              |  | 24 Var.   | 47'-4 to 71'-10          | 2235     | 22 Var.   | 47'-1 to 69'-6            | 2006 | 20 Var.   | 46'-10 to 67'-1          | 1784     | 18 Var.  | 46'-10 to 65'-0          | 1577 | 16 Var.  | 46'-10 to 62'-10        | 1376 | 6m4  |  |
| 6p1                                                                 | Curtain, Horizontal               |  | 4         | 53'-8                    | 337      | 4         | 53'-6                     | 336  | 4         | 53'-3                    | 334      | 4        | 53'-3                    | 334  | 4        | 53'-3                   | 334  | 6p1  |  |
| 6p2                                                                 | Curtain, Horizontal, Long         |  | 4         | 42'-4                    | 269      | 4         | 39'-2                     | 235  | 4         | 36'-0                    | 216      | 4        | 32'-10                   | 197  | 4        | 29'-8                   | 178  | 6p2  |  |
| 6p3                                                                 | Curtain, Horizontal, Short        |  | 4         | 15'-8                    | 94       | 4         | 14'-7                     | 88   | 4         | 13'-7                    | 82       | 4        | 12'-7                    | 76   | 4        | 11'-7                   | 70   | 6p3  |  |
| 6s1                                                                 | Wing Slope, Both F., Long         |  | 2         | 8'-4                     | 25       | 2         | 8'-4                      | 25   | 2         | 8'-4                     | 25       | 2        | 8'-4                     | 25   | 2        | 8'-4                    | 25   | 6s1  |  |
| 6s2                                                                 | Wing Slope, Both F., Short        |  | 2         | 7'-11                    | 24       | 2         | 7'-11                     | 24   | 2         | 7'-11                    | 24       | 2        | 7'-11                    | 24   | 2        | 7'-11                   | 24   | 6s2  |  |
| 6s3                                                                 | Wing Slope, Both F., Long         |  | 2         | 68'-7                    | 213      | 2         | 62'-8                     | 196  | 2         | 56'-9                    | 178      | 2        | 50'-10                   | 160  | 2        | 44'-11                  | 142  | 6s3  |  |
| 6s4                                                                 | Wing Slope, Both F., Short        |  | 2         | 41'-8                    | 132      | 2         | 38'-0                     | 114  | 2         | 34'-5                    | 103      | 2        | 30'-9                    | 92   | 2        | 27'-1                   | 81   | 6s4  |  |
| 6s5                                                                 | Wing Slope, F.F. Long             |  | 1         | 74'-8                    | 116      | 1         | 68'-9                     | 107  | 1         | 62'-10                   | 98       | 1        | 56'-11                   | 89   | 1        | 51'-0                   | 80   | 6s5  |  |
| 6s6                                                                 | Wing Slope, F.F. Short            |  | 1         | 47'-8                    | 75       | 1         | 44'-0                     | 70   | 1         | 40'-4                    | 64       | 1        | 36'-9                    | 55   | 1        | 33'-1                   | 50   | 6s6  |  |
| 6s7                                                                 | Interior Wall, Both F.H.          |  | 4         | 39'-1                    | 235      | 4         | 36'-2                     | 217  | 4         | 33'-3                    | 200      | 4        | 30'-3                    | 182  | 4        | 27'-3                   | 164  | 6s7  |  |
| 5t1                                                                 | Curtain, Vertical                 |  | 77        | 7'-11                    | 636      | 74        | 7'-8                      | 592  | 69        | 7'-5                     | 534      | 66       | 7'-2                     | 493  | 62       | 6'-11                   | 447  | 5t1  |  |
|                                                                     | Estimated Quantities One Headwall | Reinf. Steel                                                                        |           | 19,815 LB                |          |           | 17,748 LB                 |      |           | 15,748 LB                |          |          | 13,875 LB                |      |          | 11,994 LB               |      |      |  |
|                                                                     |                                   | Concrete                                                                            | Parapet Δ | 5.4                      | 172.5 CY | 5.3       | 149.0 CY                  | 5.2  | 127.7 CY  | 5.2                      | 112.0 CY | 5.2      | 97.0 CY                  |      |          |                         |      |      |  |
|                                                                     |                                   |                                                                                     | Wingwalls | 50.5                     |          | 39.6      |                           | 30.3 |           | 25.2                     |          | 20.4     |                          |      |          |                         |      |      |  |
|                                                                     |                                   |                                                                                     | Apron *   | 116.6                    |          | 104.1     |                           | 92.2 |           | 81.6                     |          | 71.4     |                          |      |          |                         |      |      |  |

Δ Includes top of wingwall quantities.  
\* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap.  
Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall  
"Long" Denotes Long Wingwall

## Headwall Notes:

1. See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
2. This headwall is based on a 3:1 slope normal to centerline of roadway.
3. The sides of the apron are to be formed to ensure correct line and grade.
4. All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
5. Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
6. Concrete quantities are estimated from back of parapet.
7. Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
8. Dimensions are in feet and inches unless otherwise noted.

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# Bent Bar Details

4b1, 2, 3, 4  
5b5, 6, 7, 8  
& 6f4, 5

4c6

5c11, 12, 14

6c13

4i1

6p2

6p3

6s1

6s2

6s5

6s6

6s7

5t1

Note:  
All dimensions are out to out. D = pin diameter.

| Bill of Reinforcing for One Headwall 45° Skew Span x Culvert Height |                                   |              |           |                            |         |          |                             |         |          |                            |         |          |                            |     |      |
|---------------------------------------------------------------------|-----------------------------------|--------------|-----------|----------------------------|---------|----------|-----------------------------|---------|----------|----------------------------|---------|----------|----------------------------|-----|------|
| Bar                                                                 | Location                          | Shape        | 12' x 7'  |                            |         | 12' x 6' |                             |         | 12' x 5' |                            |         | 12' x 4' |                            |     | Bar  |
|                                                                     |                                   |              | No.       | Length                     | Wt.     | No.      | Length                      | Wt.     | No.      | Length                     | Wt.     | No.      | Length                     | Wt. |      |
| 5fa                                                                 | Fence Anchor (Galv.)              |              | 2         | 2'-10                      | 6       | 2        | 2'-10                       | 6       | 2        | 2'-10                      | 6       | 2        | 2'-10                      | 6   | 5fa  |
| 4b1                                                                 | Wingwall, B.F.H. Long             |              | 1         | 47'-2                      | 33      | 1        | 41'-4                       | 29      | 1        | 35'-6                      | 24      | 1        | 29'-8                      | 20  | 4b1  |
| 4b2                                                                 | Wingwall, B.F.H. Short            |              | 1         | 30'-1                      | 20      | 1        | 26'-7                       | 18      | 1        | 23'-1                      | 15      | 1        | 19'-7                      | 13  | 4b2  |
| 4b3                                                                 | Wingwall, B.F.H. Long             |              | 5 Var.    | 21'-2 to 44'-5             | 111     | 4 Var.   | 21'-1 to 38'-7              | 80      | 3 Var.   | 21'-1 to 32'-9             | 54      | 2 Var.   | 21'-1 to 26'-11            | 32  | 4b3  |
| 4b4                                                                 | Wingwall, B.F.H. Short            |              | 5 Var.    | 14'-6 to 28'-5             | 72      | 4 Var.   | 14'-6 to 24'-11             | 53      | 3 Var.   | 14'-6 to 21'-5             | 36      | 2 Var.   | 14'-6 to 17'-11            | 22  | 4b4  |
| 5b5                                                                 | Wingwall, F.F.H. Long             |              | 1         | 47'-2                      | 52      | 1        | 41'-4                       | 46      | 1        | 35'-6                      | 37      | 1        | 29'-9                      | 31  | 5b5  |
| 5b6                                                                 | Wingwall, F.F.H. Short            |              | 1         | 30'-1                      | 31      | 1        | 26'-7                       | 28      | 1        | 23'-1                      | 24      | 1        | 19'-7                      | 20  | 5b6  |
| 5b7                                                                 | Wingwall, F.F.H. Long             |              | 6 Var.    | 15'-4 to 44'-5             | 189     | 5 Var.   | 15'-4 to 38'-7              | 141     | 4 Var.   | 15'-4 to 32'-9             | 100     | 3 Var.   | 15'-4 to 26'-11            | 66  | 5b7  |
| 5b8                                                                 | Wingwall, F.F.H. Short            |              | 6 Var.    | 11'-0 to 28'-6             | 124     | 5 Var.   | 11'-0 to 25'-0              | 94      | 4 Var.   | 11'-0 to 21'-6             | 68      | 3 Var.   | 11'-0 to 18'-0             | 45  | 5b8  |
| 5b9                                                                 | Interior Wall, Both F.H.          |              | 22 Var.   | 2 Each<br>7'-0 to<br>23'-8 | 352     | 18 Var.  | 2 Each<br>7'-1 to<br>20'-10 | 262     | 14 Var.  | 2 Each<br>7'-3 to<br>18'-0 | 184     | 10 Var.  | 2 Each<br>7'-5 to<br>15'-1 | 117 | 5b9  |
| 4c1                                                                 | Wingwall, F.F.V. Long             |              | 43 Var.   | 2'-9 to 10'-0              | 183     | 37 Var.  | 2'-9 to 9'-0                | 145     | 31 Var.  | 2'-9 to 7'-11              | 110     | 25 Var.  | 2'-9 to 6'-11              | 81  | 4c1  |
| 4c2                                                                 | Wingwall, F.F.V. Short            |              | 26 Var.   | 2'-10 to 10'-0             | 111     | 22 Var.  | 2'-10 to 8'-10              | 86      | 19 Var.  | 2'-10 to 8'-0              | 69      | 15 Var.  | 2'-10 to 6'-10             | 48  | 4c2  |
| 4c3                                                                 | Wingwall, F.F.V. Long             |              | --        | --                         | --      | --       | --                          | --      | --       | --                         | --      | --       | --                         | --  | 4c3  |
| 4c4                                                                 | Wingwall, F.F.V. Short            |              | --        | --                         | --      | --       | --                          | --      | --       | --                         | --      | --       | --                         | --  | 4c4  |
| 4c5                                                                 | Wingwall, F.F.V. Long             |              | 1         | 8'-9                       | 6       | 1        | 7'-9                        | 5       | 2        | 6'-9                       | 9       | 2        | 5'-9                       | 8   | 4c5  |
| 4c5                                                                 | Wingwall, F.F.V. Short            |              | 1         | 8'-9                       | 6       | 2        | 7'-9                        | 10      | 1        | 6'-9                       | 5       | 2        | 5'-9                       | 8   | 4c5  |
| 4c6                                                                 | Interior Wall, Both F.V.          |              | 4         | 4'-1                       | 11      | 4        | 4'-1                        | 11      | 4        | 4'-1                       | 11      | 4        | 4'-1                       | 11  | 4c6  |
| 4c7                                                                 | Interior Wall, Both F.V.          |              | 76 Var.   | 2 Each<br>1'-10 to<br>7'-5 | 235     | 66 Var.  | 2 Each<br>1'-10 to<br>6'-6  | 184     | 54 Var.  | 2 Each<br>1'-10 to<br>5'-5 | 131     | 44 Var.  | 2 Each<br>1'-10 to<br>4'-6 | 93  | 4c7  |
| 4c8                                                                 | Interior Wall, Both F.V.          |              | 6         | 7'-7                       | 30      | 6        | 6'-7                        | 26      | 6        | 5'-7                       | 22      | 6        | 4'-7                       | 18  | 4c8  |
| 5c9                                                                 | Wingwall, B.F.V. Long             |              | 15 Var.   | 2'-9 to 5'-2               | 62      | 15 Var.  | 2'-9 to 5'-2                | 62      | 15 Var.  | 2'-9 to 5'-2               | 62      | 15 Var.  | 2'-9 to 5'-2               | 62  | 5c9  |
| 5c10                                                                | Wingwall, B.F.V. Short            |              | 4 Var.    | 2'-10 to 3'-8              | 14      | 4 Var.   | 2'-10 to 3'-8               | 14      | 4 Var.   | 2'-10 to 3'-8              | 14      | 4 Var.   | 2'-10 to 3'-8              | 14  | 5c10 |
| 5c11                                                                | Wingwall, B.F.V. Long             |              | 28 Var.   | 9'-4 to 14'-0              | 341     | 22 Var.  | 9'-4 to 13'-0               | 256     | 16 Var.  | 9'-4 to 11'-11             | 177     | 10 Var.  | 9'-4 to 10'-11             | 106 | 5c11 |
| 5c12                                                                | Wingwall, B.F.V. Short            |              | 22 Var.   | 8'-0 to 14'-0              | 252     | 18 Var.  | 8'-0 to 12'-10              | 196     | 15 Var.  | 8'-0 to 12'-0              | 156     | 11 Var.  | 8'-0 to 10'-10             | 108 | 5c12 |
| 6c13                                                                | Wingwall, B.F.V. Long             |              | 18        | 10'-6                      | 284     | 12       | 10'-6                       | 189     | --       | --                         | --      | --       | --                         | --  | 6c13 |
| 6c13                                                                | Wingwall, B.F.V. Short            |              | 11        | 10'-6                      | 173     | 7        | 10'-6                       | 110     | --       | --                         | --      | --       | --                         | --  | 6c13 |
| 5c14                                                                | Wingwall, B.F.V. Long             |              | 1         | 12'-9                      | 13      | 1        | 11'-9                       | 12      | 2        | 10'-9                      | 22      | 2        | 9'-9                       | 20  | 5c14 |
| 5c14                                                                | Wingwall, B.F.V. Short            |              | 1         | 12'-9                      | 13      | 2        | 11'-9                       | 25      | 1        | 10'-9                      | 11      | 2        | 9'-9                       | 20  | 5c14 |
| 4d1                                                                 | Apron, Longit., Bott.             |              | 25        | 24'-5                      | 408     | 25       | 21'-7                       | 360     | 25       | 18'-9                      | 313     | 25       | 15'-11                     | 266 | 4d1  |
| 4d2                                                                 | Apron, Longit., Bott. Long        |              | 3         | 39'-9                      | 80      | 3        | 33'-11                      | 68      | 3        | 28'-1                      | 56      | 3        | 22'-3                      | 45  | 4d2  |
| 4d3                                                                 | Apron, Longit., Bott. Short       |              | 3         | 25'-1                      | 50      | 3        | 21'-7                       | 43      | 3        | 18'-1                      | 36      | 3        | 14'-7                      | 29  | 4d3  |
| 6f1                                                                 | Apron, Longit., Top               |              | 37        | 24'-5                      | 1357    | 37       | 21'-7                       | 1199    | 37       | 18'-9                      | 1042    | 37       | 15'-11                     | 885 | 6f1  |
| 6f2                                                                 | Apron, Longit., Top Long          |              | 8 Var.    | 6'-5 to 20'-8              | 163     | 7 Var.   | 5'-7 to 17'-10              | 123     | 5 Var.   | 6'-10 to 15'-0             | 82      | 4 Var.   | 6'-0 to 12'-2              | 55  | 6f2  |
| 6f3                                                                 | Apron, Longit., Top Short         |              | 5 Var.    | 7'-4 to 21'-0              | 106     | 4 Var.   | 7'-11 to 18'-2              | 78      | 3 Var.   | 8'-6 to 15'-4              | 54      | 2 Var.   | 9'-1 to 12'-6              | 32  | 6f3  |
| 6f4                                                                 | Apron, Longit., Top Long          |              | 1         | 47'-2                      | 74      | 1        | 41'-4                       | 66      | 1        | 35'-6                      | 53      | 1        | 29'-9                      | 45  | 6f4  |
| 6f5                                                                 | Apron, Longit., Top Short         |              | 1         | 30'-1                      | 45      | 1        | 26'-7                       | 40      | 1        | 23'-1                      | 35      | 1        | 19'-7                      | 29  | 6f5  |
| 4i1                                                                 | Parapet, Vertical                 |              | 75        | 6'-8                       | 334     | 75       | 6'-8                        | 334     | 75       | 6'-8                       | 334     | 75       | 6'-8                       | 334 | 4i1  |
| 7j1                                                                 | Parapet, Horizontal               |              | 4         | 54'-8                      | 467     | 4        | 54'-8                       | 467     | 4        | 54'-8                      | 467     | 4        | 54'-8                      | 467 | 7j1  |
| 6m1                                                                 | Apron, Trans., Top                |              | 5 Var.    | 43'-7 to 44'-4             | 348     | 1        | 43'-7                       | 69      | 27 Var.  | 16'-0 to 35'-6             | 1044    | 27 Var.  | 13'-2 to 32'-8             | 929 | 6m1  |
| 6m2                                                                 | Apron, Trans., Top                |              | 22 Var.   | 21'-8 to 37'-5             | 976     | 26 Var.  | 18'-10 to 37'-7             | 1102    | 20 Var.  | 4'-8 to 15'-4              | 300     | 16 Var.  | 4'-1 to 12'-6              | 199 | 6m2  |
| 6m3                                                                 | Apron, Trans., Top                |              | 27 Var.   | 6'-5 to 21'-0              | 556     | 23 Var.  | 5'-10 to 18'-2              | 415     | --       | --                         | --      | --       | --                         | --  | 6m3  |
| 6m4                                                                 | Apron, Trans., Bott.              |              | 14 Var.   | 46'-7 to 60'-6             | 1177    | 12 Var.  | 46'-7 to 58'-4              | 989     | 10 Var.  | 46'-7 to 56'-2             | 808     | 8 Var.   | 46'-7 to 54'-1             | 634 | 6m4  |
| 6p1                                                                 | Curtain, Horizontal               |              | 4         | 53'-0                      | 333     | 4        | 52'-11                      | 332     | 4        | 52'-11                     | 332     | 4        | 52'-11                     | 332 | 6p1  |
| 6p2                                                                 | Curtain, Horizontal, Long         |              | 4         | 26'-6                      | 159     | 4        | 23'-4                       | 140     | 4        | 20'-2                      | 121     | 4        | 17'-0                      | 102 | 6p2  |
| 6p3                                                                 | Curtain, Horizontal, Short        |              | 4         | 10'-7                      | 64      | 4        | 9'-6                        | 57      | 4        | 8'-6                       | 51      | 4        | 7'-6                       | 45  | 6p3  |
| 6s1                                                                 | Wing Slope, Both F., Long         |              | 2         | 8'-4                       | 25      | 2        | 8'-4                        | 25      | 2        | 8'-4                       | 25      | 2        | 8'-4                       | 25  | 6s1  |
| 6s2                                                                 | Wing Slope, Both F., Short        |              | 2         | 7'-11                      | 24      | 2        | 7'-11                       | 24      | 2        | 7'-11                      | 24      | 2        | 7'-11                      | 24  | 6s2  |
| 6s3                                                                 | Wing Slope, Both F., Long         |              | 2         | 39'-0                      | 117     | 2        | 33'-1                       | 99      | 2        | 27'-2                      | 82      | 2        | 21'-3                      | 64  | 6s3  |
| 6s4                                                                 | Wing Slope, Both F., Short        |              | 2         | 23'-6                      | 71      | 2        | 19'-10                      | 60      | 2        | 16'-2                      | 49      | 2        | 12'-7                      | 38  | 6s4  |
| 6s5                                                                 | Wing Slope, F.F. Long             |              | 1         | 45'-1                      | 71      | 1        | 39'-2                       | 59      | 1        | 33'-3                      | 50      | 1        | 27'-5                      | 41  | 6s5  |
| 6s6                                                                 | Wing Slope, F.F. Short            |              | 1         | 29'-5                      | 44      | 1        | 25'-10                      | 39      | 1        | 22'-2                      | 33      | 1        | 18'-6                      | 28  | 6s6  |
| 6s7                                                                 | Interior Wall, Both F.H.          |              | 4         | 24'-4                      | 146     | 4        | 21'-4                       | 128     | 4        | 18'-4                      | 110     | 4        | 15'-4                      | 92  | 6s7  |
| 5t1                                                                 | Curtain, Vertical                 |              | 59        | 6'-8                       | 410     | 55       | 6'-5                        | 368     | 53       | 6'-5                       | 355     | 49       | 6'-5                       | 328 | 5t1  |
|                                                                     | Estimated Quantities One Headwall | Reinf. Steel |           | 10,329 LB                  |         | 8772 LB  |                             | 7203 LB |          | 6037 LB                    |         |          |                            |     |      |
|                                                                     |                                   | Concrete     | Parapet Δ | 5.1                        | 80.9 CY | 5.1      | 68.2 CY                     | 5.1     | 57.4 CY  | 5.1                        | 47.3 CY |          |                            |     |      |
|                                                                     |                                   |              | Wingwalls | 14.6                       |         | 11.1     |                             | 8.1     |          | 5.5                        |         |          |                            |     |      |
|                                                                     |                                   |              | Apron *   | 61.2                       |         | 52.0     |                             | 44.2    |          | 36.7                       |         |          |                            |     |      |

Δ Includes top of wingwall quantities.

\* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall

"Long" Denotes Long Wingwall

### Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

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Standard Design - Triple Reinforced Concrete Box Culverts

### Flared Wing Headwalls

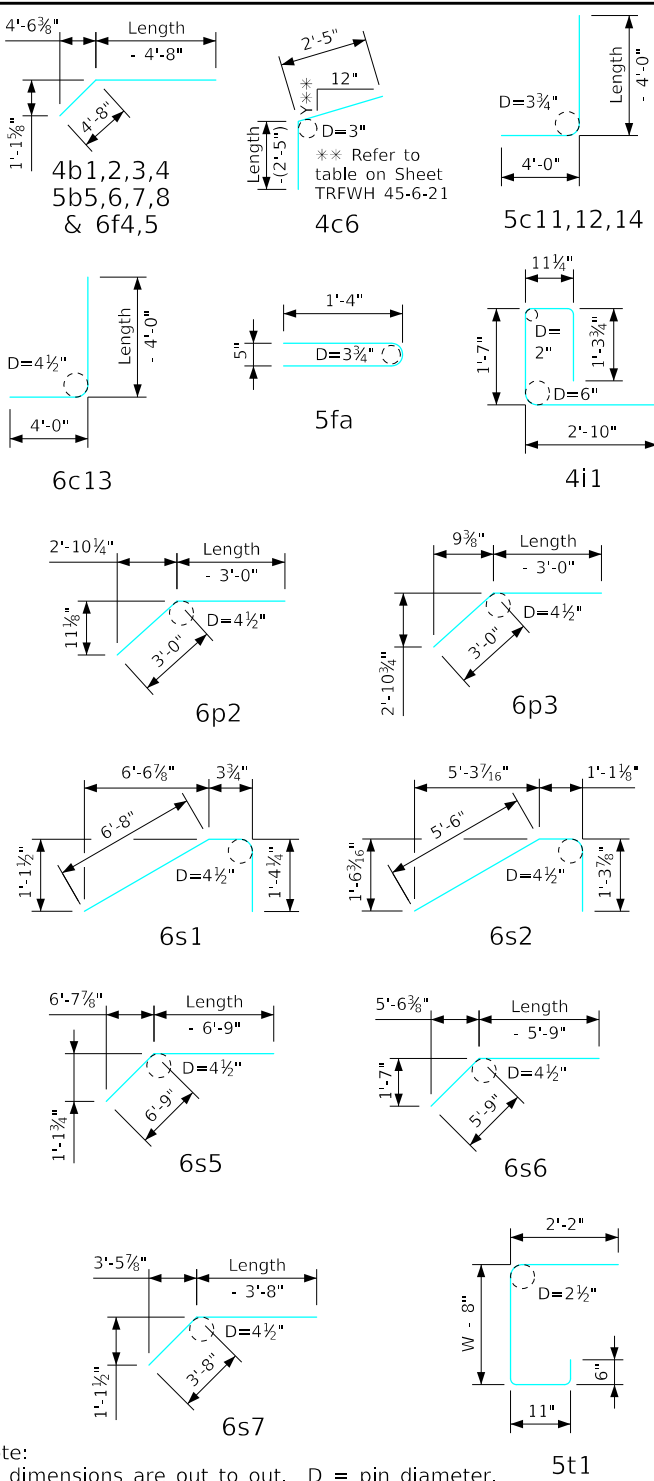
February, 2021

Quantity Tabulation  
12'-0" Span  
45° Skew

TRFWH  
45-7-21  
Sheet 2 of 2

Note:  
All dimensions are out to out. D = pin diameter.

### Bent Bar Details



ENGLISHLRFD5IGNEDTRIPLECULVERTSFWH.DGN - TRFWH 45-8-21 S1 - THIS SHEET ISSUED 02-2021.

| Bill of Reinforcing for One Headwall 45° Skew Span x Culvert Height |                                   |              |           |                          |      |           |                           |          |           |                          |      |           |                          |         |           |                         |      |      |  |
|---------------------------------------------------------------------|-----------------------------------|--------------|-----------|--------------------------|------|-----------|---------------------------|----------|-----------|--------------------------|------|-----------|--------------------------|---------|-----------|-------------------------|------|------|--|
| Bar                                                                 | Location                          | Shape        | 10' x 12' |                          |      | 10' x 11' |                           |          | 10' x 10' |                          |      | 10' x 9'  |                          |         | 10' x 8'  |                         |      | Bar  |  |
|                                                                     |                                   |              | No.       | Length                   | Wt.  | No.       | Length                    | Wt.      | No.       | Length                   | Wt.  | No.       | Length                   | Wt.     | No.       | Length                  | Wt.  |      |  |
| 5fa                                                                 | Fence Anchor (Galv.)              |              | 2         | 2'-10                    | 6    | 2         | 2'-10                     | 6        | 2         | 2'-10                    | 6    | 2         | 2'-10                    | 6       | 2         | 2'-10                   | 6    | 5fa  |  |
| 4b1                                                                 | Wingwall, B.F.H. Long             |              | 1         | 76'-3                    | 53   | 1         | 70'-6                     | 49       | 1         | 64'-8                    | 45   | 1         | 58'-10                   | 41      | 1         | 53'-0                   | 37   | 4b1  |  |
| 4b2                                                                 | Wingwall, B.F.H. Short            |              | 1         | 47'-6                    | 33   | 1         | 44'-0                     | 31       | 1         | 40'-7                    | 29   | 1         | 37'-1                    | 25      | 1         | 33'-7                   | 22   | 4b2  |  |
| 4b3                                                                 | Wingwall, B.F.H. Long             |              | 10 Var.   | 21'-2 to 73'-6           | 326  | 9 Var.    | 21'-2 to 67'-8            | 275      | 8 Var.    | 21'-2 to 61'-11          | 228  | 7 Var.    | 21'-2 to 56'-1           | 185     | 6 Var.    | 21'-2 to 50'-3          | 146  | 4b3  |  |
| 4b4                                                                 | Wingwall, B.F.H. Short            |              | 10 Var.   | 14'-6 to 45'-11          | 205  | 9 Var.    | 14'-6 to 42'-5            | 173      | 8 Var.    | 14'-6 to 38'-11          | 143  | 7 Var.    | 14'-6 to 35'-5           | 117     | 6 Var.    | 14'-6 to 31'-11         | 93   | 4b4  |  |
| 5b5                                                                 | Wingwall, F.F.H. Long             |              | 1         | 76'-4                    | 82   | 1         | 70'-6                     | 76       | 1         | 64'-8                    | 70   | 1         | 58'-10                   | 64      | 1         | 53'-0                   | 58   | 5b5  |  |
| 5b6                                                                 | Wingwall, F.F.H. Short            |              | 1         | 47'-7                    | 52   | 1         | 44'-1                     | 48       | 1         | 40'-7                    | 45   | 1         | 37'-1                    | 39      | 1         | 33'-7                   | 35   | 5b6  |  |
| 5b7                                                                 | Wingwall, F.F.H. Long             |              | 11 Var.   | 15'-5 to 73'-7           | 526  | 10 Var.   | 15'-5 to 67'-9            | 446      | 9 Var.    | 15'-5 to 61'-11          | 373  | 8 Var.    | 15'-5 to 56'-1           | 306     | 7 Var.    | 15'-4 to 50'-3          | 244  | 5b7  |  |
| 5b8                                                                 | Wingwall, F.F.H. Short            |              | 11 Var.   | 11'-1 to 46'-0           | 333  | 10 Var.   | 11'-1 to 42'-6            | 282      | 9 Var.    | 11'-1 to 39'-0           | 235  | 8 Var.    | 11'-1 to 35'-6           | 194     | 7 Var.    | 11'-1 to 32'-0          | 157  | 5b8  |  |
| 5b9                                                                 | Interior Wall, Both F.H.          |              | 42 Var.   | 2 Each<br>6'-11 to 37'-9 | 978  | 38 Var.   | 2 Each<br>6'-11 to 34'-11 | 829      | 34 Var.   | 2 Each<br>6'-11 to 32'-2 | 693  | 30 Var.   | 2 Each<br>6'-11 to 29'-4 | 567     | 26 Var.   | 2 Each<br>7'-0 to 26'-6 | 454  | 5b9  |  |
| 4c1                                                                 | Wingwall, F.F.V. Long             |              | 72 Var.   | 2'-8 to 14'-11           | 423  | 66 Var.   | 2'-8 to 13'-10            | 364      | 60 Var.   | 2'-8 to 12'-10           | 311  | 54 Var.   | 2'-8 to 11'-10           | 262     | 49 Var.   | 2'-8 to 10'-11          | 222  | 4c1  |  |
| 4c2                                                                 | Wingwall, F.F.V. Short            |              | 43 Var.   | 2'-9 to 14'-9            | 251  | 40 Var.   | 2'-9 to 13'-11            | 223      | 36 Var.   | 2'-9 to 12'-9            | 186  | 33 Var.   | 2'-9 to 11'-11           | 162     | 29 Var.   | 2'-9 to 10'-9           | 131  | 4c2  |  |
| 4c3                                                                 | Wingwall, F.F.V. Long             |              | 33 Var.   | 9'-6 to 15'-0            | 270  | 27 Var.   | 9'-6 to 13'-11            | 211      | 21 Var.   | 9'-6 to 12'-11           | 157  | 15 Var.   | 9'-6 to 11'-11           | 107     | --        | --                      | --   | 4c3  |  |
| 4c4                                                                 | Wingwall, F.F.V. Short            |              | 20 Var.   | 9'-6 to 14'-11           | 163  | 17 Var.   | 9'-6 to 14'-0             | 133      | 13 Var.   | 9'-6 to 12'-11           | 97   | 10 Var.   | 9'-6 to 12'-0            | 72      | --        | --                      | --   | 4c4  |  |
| 4c5                                                                 | Wingwall, F.F.V. Long             |              | 1         | 13'-8                    | 9    | 2         | 12'-8                     | 17       | 2         | 11'-8                    | 16   | 2         | 10'-8                    | 14      | 1         | 9'-8                    | 6    | 4c5  |  |
| 4c5                                                                 | Wingwall, F.F.V. Short            |              | 2         | 13'-8                    | 18   | 1         | 12'-8                     | 8        | 2         | 11'-8                    | 16   | 1         | 10'-8                    | 7       | 2         | 9'-8                    | 13   | 4c5  |  |
| 4c6                                                                 | Interior Wall, Both F.V.          |              | 4         | 4'-0                     | 11   | 4         | 4'-0                      | 11       | 4         | 4'-0                     | 11   | 4         | 4'-0                     | 11      | 4         | 4'-0                    | 11   | 4c6  |  |
| 4c7                                                                 | Interior Wall, Both F.V.          |              | 132 Var.  | 2 Each<br>1'-9 to 12'-4  | 621  | 122 Var.  | 2 Each<br>1'-9 to 11'-5   | 537      | 110 Var.  | 2 Each<br>1'-9 to 10'-4  | 444  | 100 Var.  | 2 Each<br>1'-9 to 9'-5   | 373     | 88 Var.   | 2 Each<br>1'-9 to 8'-5  | 299  | 4c7  |  |
| 4c8                                                                 | Interior Wall, Both F.V.          |              | 6         | 12'-6                    | 50   | 6         | 11'-6                     | 46       | 6         | 10'-6                    | 42   | 6         | 9'-6                     | 38      | 6         | 8'-6                    | 34   | 4c8  |  |
| 5c9                                                                 | Wingwall, B.F.V. Long             |              | 15 Var.   | 2'-8 to 5'-1             | 61   | 15 Var.   | 2'-8 to 5'-1              | 61       | 15 Var.   | 2'-8 to 5'-1             | 61   | 15 Var.   | 2'-8 to 5'-1             | 61      | 15 Var.   | 2'-8 to 5'-1            | 61   | 5c9  |  |
| 5c10                                                                | Wingwall, B.F.V. Short            |              | 4 Var.    | 2'-9 to 3'-7             | 13   | 4 Var.    | 2'-9 to 3'-7              | 13       | 4 Var.    | 2'-9 to 3'-7             | 13   | 4 Var.    | 2'-9 to 3'-7             | 13      | 4 Var.    | 2'-9 to 3'-7            | 13   | 5c10 |  |
| 5c11                                                                | Wingwall, B.F.V. Long             |              | 57 Var.   | 9'-3 to 18'-11           | 837  | 51 Var.   | 9'-3 to 17'-10            | 720      | 45 Var.   | 9'-3 to 16'-10           | 612  | 39 Var.   | 9'-3 to 15'-10           | 510     | 34 Var.   | 9'-3 to 14'-11          | 428  | 5c11 |  |
| 5c12                                                                | Wingwall, B.F.V. Short            |              | 39 Var.   | 7'-11 to 18'-9           | 542  | 36 Var.   | 7'-11 to 17'-11           | 485      | 32 Var.   | 7'-11 to 16'-9           | 412  | 29 Var.   | 7'-11 to 15'-11          | 360     | 25 Var.   | 7'-11 to 14'-9          | 296  | 5c12 |  |
| 6c13                                                                | Wingwall, B.F.V. Long             |              | 47        | 10'-6                    | 741  | 41        | 10'-6                     | 647      | 35        | 10'-6                    | 552  | 29        | 10'-6                    | 457     | 24        | 10'-6                   | 379  | 6c13 |  |
| 6c13                                                                | Wingwall, B.F.V. Short            |              | 28        | 10'-6                    | 442  | 25        | 10'-6                     | 394      | 21        | 10'-6                    | 331  | 18        | 10'-6                    | 284     | 14        | 10'-6                   | 221  | 6c13 |  |
| 5c14                                                                | Wingwall, B.F.V. Long             |              | 1         | 17'-8                    | 18   | 2         | 16'-8                     | 35       | 2         | 15'-8                    | 33   | 2         | 14'-8                    | 31      | 1         | 13'-8                   | 14   | 5c14 |  |
| 5c14                                                                | Wingwall, B.F.V. Short            |              | 2         | 17'-8                    | 37   | 1         | 16'-8                     | 17       | 2         | 15'-8                    | 33   | 1         | 14'-8                    | 15      | 2         | 13'-8                   | 29   | 5c14 |  |
| 4d1                                                                 | Apron, Longit., Bott.             |              | 21        | 38'-6                    | 540  | 21        | 35'-8                     | 500      | 21        | 32'-10                   | 461  | 21        | 30'-0                    | 421     | 21        | 27'-2                   | 381  | 4d1  |  |
| 4d2                                                                 | Apron, Longit., Bott. Long        |              | 3         | 68'-10                   | 143  | 3         | 63'-0                     | 131      | 3         | 57'-2                    | 119  | 3         | 51'-5                    | 108     | 3         | 45'-7                   | 96   | 4d2  |  |
| 4d3                                                                 | Apron, Longit., Bott. Short       |              | 3         | 42'-7                    | 90   | 3         | 39'-1                     | 78       | 3         | 35'-7                    | 71   | 3         | 32'-1                    | 64      | 3         | 28'-7                   | 57   | 4d3  |  |
| 6f1                                                                 | Apron, Longit., Top               |              | 31        | 38'-6                    | 1793 | 31        | 35'-8                     | 1661     | 31        | 32'-10                   | 1529 | 31        | 30'-0                    | 1397    | 31        | 27'-2                   | 1265 | 6f1  |  |
| 6f2                                                                 | Apron, Longit., Top Long          |              | 15 Var.   | 6'-7 to 34'-10           | 467  | 14 Var.   | 5'-8 to 32'-0             | 396      | 12 Var.   | 6'-11 to 29'-2           | 325  | 11 Var.   | 6'-1 to 26'-4            | 268     | 9 Var.    | 7'-3 to 23'-6           | 208  | 6f2  |  |
| 6f3                                                                 | Apron, Longit., Top Short         |              | 9 Var.    | 8'-1 to 35'-2            | 292  | 8 Var.    | 8'-8 to 32'-4             | 246      | 8 Var.    | 5'-9 to 29'-6            | 212  | 7 Var.    | 6'-4 to 26'-8            | 173     | 6 Var.    | 6'-10 to 23'-10         | 138  | 6f3  |  |
| 6f4                                                                 | Apron, Longit., Top Long          |              | 1         | 76'-4                    | 118  | 1         | 70'-6                     | 110      | 1         | 64'-8                    | 101  | 1         | 58'-10                   | 92      | 1         | 53'-0                   | 83   | 6f4  |  |
| 6f5                                                                 | Apron, Longit., Top Short         |              | 1         | 47'-7                    | 75   | 1         | 44'-1                     | 70       | 1         | 40'-7                    | 65   | 1         | 37'-1                    | 56      | 1         | 33'-7                   | 50   | 6f5  |  |
| 4i1                                                                 | Parapet, Vertical                 |              | 65        | 6'-8                     | 289  | 63        | 6'-8                      | 281      | 63        | 6'-8                     | 281  | 63        | 6'-8                     | 281     | 63        | 6'-8                    | 281  | 4i1  |  |
| 7j1                                                                 | Parapet, Horizontal               |              | 4         | 47'-7                    | 409  | 4         | 47'-1                     | 405      | 4         | 46'-8                    | 401  | 4         | 46'-8                    | 401     | 4         | 46'-8                   | 401  | 7j1  |  |
| 6m1                                                                 | Apron, Trans., Top                |              | 23 Var.   | 37'-11 to 42'-0          | 1420 | 23 Var.   | 37'-6 to 41'-8            | 1400     | 20 Var.   | 37'-2 to 40'-9           | 1185 | 16 Var.   | 37'-2 to 40'-0           | 931     | 13 Var.   | 37'-2 to 39'-5          | 748  | 6m1  |  |
| 6m2                                                                 | Apron, Trans., Top                |              | 4 Var.    | 42'-3 to 43'-5           | 272  | 1         | 41'-11                    | 67       | 3 Var.    | 30'-3 to 31'-9           | 140  | 7 Var.    | 27'-5 to 31'-11          | 312     | 10 Var.   | 24'-7 to 31'-4          | 420  | 6m2  |  |
| 6m3                                                                 | Apron, Trans., Top                |              | 42 Var.   | 10'-3 to 33'-4           | 1375 | 41 Var.   | 9'-7 to 32'-1             | 1283     | 39 Var.   | 8'-3 to 29'-8            | 1111 | 35 Var.   | 7'-8 to 26'-10           | 907     | 31 Var.   | 7'-1 to 24'-0           | 724  | 6m3  |  |
| 6m4                                                                 | Apron, Trans., Bott.              |              | 24 Var.   | 38'-10 to 63'-4          | 1921 | 22 Var.   | 38'-7 to 61'-0            | 1718     | 20 Var.   | 38'-4 to 58'-7           | 1521 | 18 Var.   | 38'-4 to 56'-6           | 1340    | 16 Var.   | 38'-4 to 54'-4          | 1164 | 6m4  |  |
| 6p1                                                                 | Curtain, Horizontal               |              | 4         | 45'-3                    | 286  | 4         | 45'-0                     | 285      | 4         | 44'-9                    | 283  | 4         | 44'-9                    | 283     | 4         | 44'-9                   | 283  | 6p1  |  |
| 6p2                                                                 | Curtain, Horizontal, Long         |              | 4         | 42'-4                    | 269  | 4         | 39'-2                     | 235      | 4         | 36'-0                    | 216  | 4         | 32'-10                   | 197     | 4         | 29'-8                   | 178  | 6p2  |  |
| 6p3                                                                 | Curtain, Horizontal, Short        |              | 4         | 15'-8                    | 94   | 4         | 14'-7                     | 88       | 4         | 13'-7                    | 82   | 4         | 12'-7                    | 76      | 4         | 11'-7                   | 70   | 6p3  |  |
| 6s1                                                                 | Wing Slope, Both F., Long         |              | 2         | 8'-4                     | 25   | 2         | 8'-4                      | 25       | 2         | 8'-4                     | 25   | 2         | 8'-4                     | 25      | 2         | 8'-4                    | 25   | 6s1  |  |
| 6s2                                                                 | Wing Slope, Both F., Short        |              | 2         | 7'-11                    | 24   | 2         | 7'-11                     | 24       | 2         | 7'-11                    | 24   | 2         | 7'-11                    | 24      | 2         | 7'-11                   | 24   | 6s2  |  |
| 6s3                                                                 | Wing Slope, Both F., Long         |              | 2         | 68'-7                    | 213  | 2         | 62'-8                     | 196      | 2         | 56'-9                    | 178  | 2         | 50'-10                   | 160     | 2         | 44'-11                  | 142  | 6s3  |  |
| 6s4                                                                 | Wing Slope, Both F., Short        |              | 2         | 41'-8                    | 132  | 2         | 38'-0                     | 114      | 2         | 34'-5                    | 103  | 2         | 30'-9                    | 92      | 2         | 27'-1                   | 81   | 6s4  |  |
| 6s5                                                                 | Wing Slope, F.F. Long             |              | 1         | 74'-8                    | 116  | 1         | 68'-9                     | 107      | 1         | 62'-10                   | 98   | 1         | 56'-11                   | 89      | 1         | 51'-0                   | 80   | 6s5  |  |
| 6s6                                                                 | Wing Slope, F.F. Short            |              | 1         | 47'-8                    | 75   | 1         | 44'-0                     | 70       | 1         | 40'-4                    | 64   | 1         | 36'-9                    | 55      | 1         | 33'-1                   | 50   | 6s6  |  |
| 6s7                                                                 | Interior Wall, Both F.H.          |              | 4         | 39'-1                    | 235  | 4         | 36'-2                     | 217      | 4         | 33'-3                    | 200  | 4         | 30'-3                    | 182     | 4         | 27'-3                   | 164  | 6s7  |  |
| 5t1                                                                 | Curtain, Vertical                 |              | 69        | 7'-11                    | 570  | 66        | 7'-8                      | 528      | 63        | 7'-5                     | 487  | 60        | 7'-2                     | 448     | 56        | 6'-11                   | 404  | 5t1  |  |
|                                                                     | Estimated Quantities One Headwall | Reinf. Steel | 18,344 LB |                          |      | 16,372 LB |                           |          | 14,476 LB |                          |      | 12,703 LB |                          |         | 10,926 LB |                         |      |      |  |
|                                                                     |                                   |              | Concrete  | Parapet Δ                | 4.8  | 155.8 CY  | 4.7                       | 133.7 CY | 4.6       | 113.8 CY                 | 4.6  | 99.4 CY   | 4.6                      | 85.7 CY |           |                         |      |      |  |
|                                                                     |                                   | Wingwalls    |           | 50.5                     | 39.6 |           | 30.3                      |          | 25.2      |                          | 20.4 |           |                          |         |           |                         |      |      |  |
|                                                                     |                                   | Apron *      |           | 100.5                    | 89.4 |           | 78.9                      |          | 69.6      |                          | 60.7 |           |                          |         |           |                         |      |      |  |

Δ Includes top of wingwall quantities.

\* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall  
"Long" Denotes Long Wingwall

### Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

LATEST REVISION DATE

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Standard Design - Triple Reinforced Concrete Box Culverts

### Flared Wing Headwalls

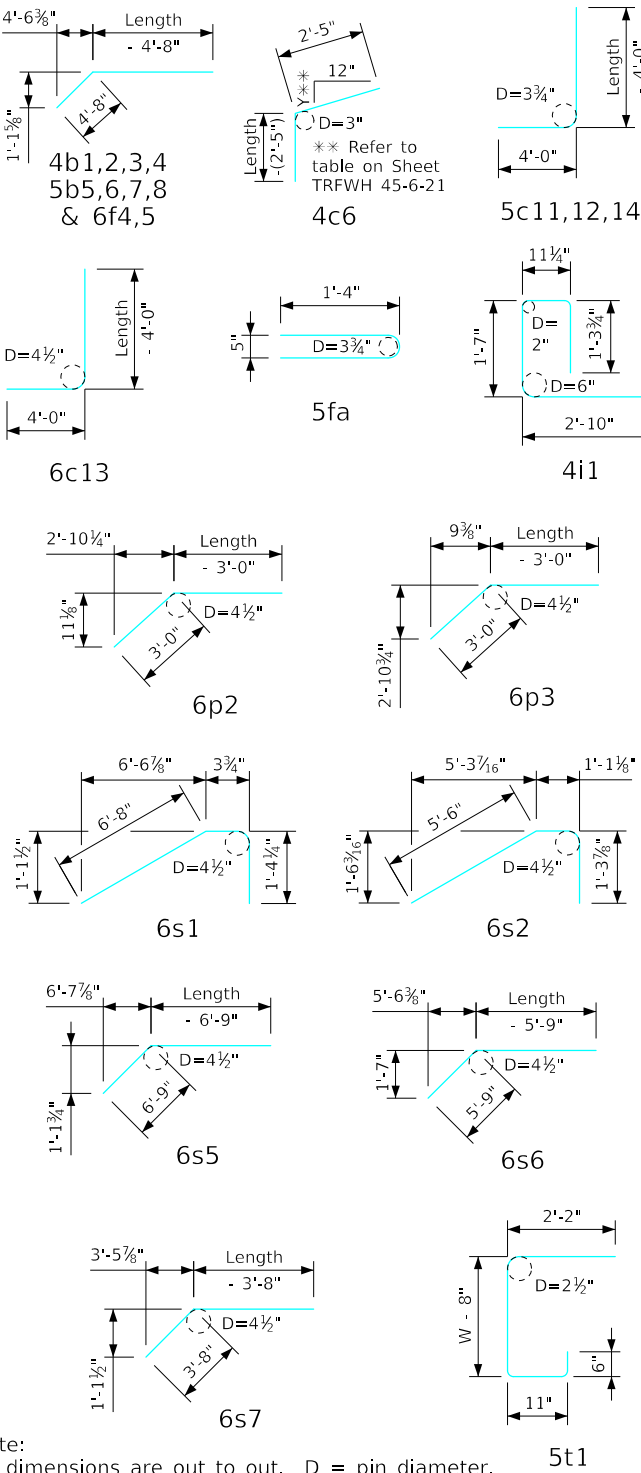
February, 2021

Quantity Tabulation  
10'-0" Span  
45° Skew

TRFWH  
45-8-21  
Sheet 1 of 2

Note:  
All dimensions are out to out. D = pin diameter.

### Bent Bar Details



| Bill of Reinforcing for One Headwall 45° Skew Span x Culvert Height |                                   |              |           |                            |         |          |                             |      |          |                            |         |          |                            |      |      |
|---------------------------------------------------------------------|-----------------------------------|--------------|-----------|----------------------------|---------|----------|-----------------------------|------|----------|----------------------------|---------|----------|----------------------------|------|------|
| Bar                                                                 | Location                          | Shape        | 10' x 7'  |                            |         | 10' x 6' |                             |      | 10' x 5' |                            |         | 10' x 4' |                            |      | Bar  |
|                                                                     |                                   |              | No.       | Length                     | Wt.     | No.      | Length                      | Wt.  | No.      | Length                     | Wt.     | No.      | Length                     | Wt.  |      |
| 5fa                                                                 | Fence Anchor (Galv.)              |              | 2         | 2'-10                      | 6       | 2        | 2'-10                       | 6    | 2        | 2'-10                      | 6       | 2        | 2'-10                      | 6    | 5fa  |
| 4b1                                                                 | Wingwall, B.F.H. Long             |              | 1         | 47'-2                      | 33      | 1        | 41'-4                       | 29   | 1        | 35'-6                      | 24      | 1        | 29'-8                      | 20   | 4b1  |
| 4b2                                                                 | Wingwall, B.F.H. Short            |              | 1         | 30'-1                      | 20      | 1        | 26'-7                       | 18   | 1        | 23'-1                      | 15      | 1        | 19'-7                      | 13   | 4b2  |
| 4b3                                                                 | Wingwall, B.F.H. Long             |              | 5 Var.    | 21'-2 to 44'-5             | 111     | 4 Var.   | 21'-1 to 38'-7              | 80   | 3 Var.   | 21'-1 to 32'-9             | 54      | 2 Var.   | 21'-1 to 26'-11            | 32   | 4b3  |
| 4b4                                                                 | Wingwall, B.F.H. Short            |              | 5 Var.    | 14'-6 to 28'-5             | 72      | 4 Var.   | 14'-6 to 24'-11             | 53   | 3 Var.   | 14'-6 to 21'-5             | 36      | 2 Var.   | 14'-6 to 17'-11            | 22   | 4b4  |
| 5b5                                                                 | Wingwall, F.F.H. Long             |              | 1         | 47'-2                      | 52      | 1        | 41'-4                       | 46   | 1        | 35'-6                      | 37      | 1        | 29'-9                      | 31   | 5b5  |
| 5b6                                                                 | Wingwall, F.F.H. Short            |              | 1         | 30'-1                      | 31      | 1        | 26'-7                       | 28   | 1        | 23'-1                      | 24      | 1        | 19'-7                      | 20   | 5b6  |
| 5b7                                                                 | Wingwall, F.F.H. Long             |              | 6 Var.    | 15'-4 to 44'-5             | 189     | 5 Var.   | 15'-4 to 38'-7              | 141  | 4 Var.   | 15'-4 to 32'-9             | 100     | 3 Var.   | 15'-4 to 26'-11            | 66   | 5b7  |
| 5b8                                                                 | Wingwall, F.F.H. Short            |              | 6 Var.    | 11'-0 to 28'-6             | 124     | 5 Var.   | 11'-0 to 25'-0              | 94   | 4 Var.   | 11'-0 to 21'-6             | 68      | 3 Var.   | 11'-0 to 18'-0             | 45   | 5b8  |
| 5b9                                                                 | Interior Wall, Both F.H.          |              | 22 Var.   | 2 Each<br>7'-0 to<br>23'-8 | 352     | 18 Var.  | 2 Each<br>7'-1 to<br>20'-10 | 262  | 14 Var.  | 2 Each<br>7'-3 to<br>18'-0 | 184     | 10 Var.  | 2 Each<br>7'-5 to<br>15'-1 | 117  | 5b9  |
| 4c1                                                                 | Wingwall, F.F.V. Long             |              | 43 Var.   | 2'-8 to 9'-11              | 181     | 37 Var.  | 2'-8 to 8'-11               | 143  | 31 Var.  | 2'-8 to 7'-10              | 109     | 25 Var.  | 2'-8 to 6'-10              | 79   | 4c1  |
| 4c2                                                                 | Wingwall, F.F.V. Short            |              | 26 Var.   | 2'-9 to 9'-11              | 110     | 22 Var.  | 2'-9 to 8'-9                | 85   | 19 Var.  | 2'-9 to 7'-11              | 68      | 15 Var.  | 2'-9 to 6'-9               | 48   | 4c2  |
| 4c3                                                                 | Wingwall, F.F.V. Long             |              | --        | --                         | --      | --       | --                          | --   | --       | --                         | --      | --       | --                         | --   | 4c3  |
| 4c4                                                                 | Wingwall, F.F.V. Short            |              | --        | --                         | --      | --       | --                          | --   | --       | --                         | --      | --       | --                         | --   | 4c4  |
| 4c5                                                                 | Wingwall, F.F.V. Long             |              | 1         | 8'-8                       | 6       | 1        | 7'-8                        | 5    | 2        | 6'-8                       | 9       | 2        | 5'-8                       | 8    | 4c5  |
| 4c5                                                                 | Wingwall, F.F.V. Short            |              | 1         | 8'-8                       | 6       | 2        | 7'-8                        | 10   | 1        | 6'-8                       | 4       | 2        | 5'-8                       | 8    | 4c5  |
| 4c6                                                                 | Interior Wall, Both F.V.          |              | 4         | 4'-0                       | 11      | 4        | 4'-0                        | 11   | 4        | 4'-0                       | 11      | 4        | 4'-0                       | 11   | 4c6  |
| 4c7                                                                 | Interior Wall, Both F.V.          |              | 76 Var.   | 2 Each<br>1'-9 to<br>7'-4  | 231     | 66 Var.  | 2 Each<br>1'-9 to<br>6'-5   | 180  | 54 Var.  | 2 Each<br>1'-9 to<br>5'-4  | 128     | 44 Var.  | 2 Each<br>1'-9 to<br>4'-5  | 91   | 4c7  |
| 4c8                                                                 | Interior Wall, Both F.V.          |              | 6         | 7'-6                       | 30      | 6        | 6'-6                        | 26   | 6        | 5'-6                       | 22      | 6        | 4'-6                       | 18   | 4c8  |
| 5c9                                                                 | Wingwall, B.F.V. Long             |              | 15 Var.   | 2'-8 to 5'-1               | 61      | 15 Var.  | 2'-8 to 5'-1                | 61   | 15 Var.  | 2'-8 to 5'-1               | 61      | 15 Var.  | 2'-8 to 5'-1               | 61   | 5c9  |
| 5c10                                                                | Wingwall, B.F.V. Short            |              | 4 Var.    | 2'-9 to 3'-7               | 13      | 4 Var.   | 2'-9 to 3'-7                | 13   | 4 Var.   | 2'-9 to 3'-7               | 13      | 4 Var.   | 2'-9 to 3'-7               | 13   | 5c10 |
| 5c11                                                                | Wingwall, B.F.V. Long             |              | 28 Var.   | 9'-3 to 13'-11             | 338     | 22 Var.  | 9'-3 to 12'-11              | 254  | 16 Var.  | 9'-3 to 11'-10             | 176     | 10 Var.  | 9'-3 to 10'-10             | 105  | 5c11 |
| 5c12                                                                | Wingwall, B.F.V. Short            |              | 22 Var.   | 7'-11 to 13'-11            | 250     | 18 Var.  | 7'-11 to 12'-9              | 194  | 15 Var.  | 7'-11 to 11'-11            | 155     | 11 Var.  | 7'-11 to 10'-9             | 107  | 5c12 |
| 6c13                                                                | Wingwall, B.F.V. Long             |              | 18        | 10'-6                      | 284     | 12       | 10'-6                       | 189  | --       | --                         | --      | --       | --                         | --   | 6c13 |
| 6c13                                                                | Wingwall, B.F.V. Short            |              | 11        | 10'-6                      | 173     | 7        | 10'-6                       | 110  | --       | --                         | --      | --       | --                         | --   | 6c13 |
| 5c14                                                                | Wingwall, B.F.V. Long             |              | 1         | 12'-8                      | 13      | 1        | 11'-8                       | 12   | 2        | 10'-8                      | 22      | 2        | 9'-8                       | 20   | 5c14 |
| 5c14                                                                | Wingwall, B.F.V. Short            |              | 1         | 12'-8                      | 13      | 2        | 11'-8                       | 24   | 1        | 10'-8                      | 11      | 2        | 9'-8                       | 20   | 5c14 |
| 4d1                                                                 | Apron, Longit., Bott.             |              | 21        | 24'-5                      | 343     | 21       | 21'-7                       | 303  | 21       | 18'-9                      | 263     | 21       | 15'-11                     | 223  | 4d1  |
| 4d2                                                                 | Apron, Longit., Bott. Long        |              | 3         | 39'-9                      | 80      | 3        | 33'-11                      | 68   | 3        | 28'-1                      | 56      | 3        | 22'-3                      | 45   | 4d2  |
| 4d3                                                                 | Apron, Longit., Bott. Short       |              | 3         | 25'-1                      | 50      | 3        | 21'-7                       | 43   | 3        | 18'-1                      | 36      | 3        | 14'-7                      | 29   | 4d3  |
| 6f1                                                                 | Apron, Longit., Top               |              | 31        | 24'-5                      | 1137    | 31       | 21'-7                       | 1005 | 31       | 18'-9                      | 873     | 31       | 15'-11                     | 741  | 6f1  |
| 6f2                                                                 | Apron, Longit., Top Long          |              | 8 Var.    | 6'-5 to 20'-8              | 163     | 7 Var.   | 5'-7 to 17'-10              | 123  | 5 Var.   | 6'-10 to 15'-0             | 82      | 4 Var.   | 6'-0 to 12'-2              | 55   | 6f2  |
| 6f3                                                                 | Apron, Longit., Top Short         |              | 5 Var.    | 7'-4 to 21'-0              | 106     | 4 Var.   | 7'-11 to 18'-2              | 78   | 3 Var.   | 8'-6 to 15'-4              | 54      | 2 Var.   | 9'-1 to 12'-6              | 32   | 6f3  |
| 6f4                                                                 | Apron, Longit., Top Long          |              | 1         | 47'-2                      | 74      | 1        | 41'-4                       | 66   | 1        | 35'-6                      | 53      | 1        | 29'-9                      | 45   | 6f4  |
| 6f5                                                                 | Apron, Longit., Top Short         |              | 1         | 30'-1                      | 45      | 1        | 26'-7                       | 40   | 1        | 23'-1                      | 35      | 1        | 19'-7                      | 29   | 6f5  |
| 4i1                                                                 | Parapet, Vertical                 |              | 63        | 6'-8                       | 281     | 63       | 6'-8                        | 281  | 63       | 6'-8                       | 281     | 63       | 6'-8                       | 281  | 4i1  |
| 7j1                                                                 | Parapet, Horizontal               |              | 4         | 46'-2                      | 397     | 4        | 46'-2                       | 397  | 4        | 46'-2                      | 397     | 4        | 46'-2                      | 397  | 7j1  |
| 6m1                                                                 | Apron, Trans., Top                |              | 9 Var.    | 36'-10 to 38'-4            | 508     | 5 Var.   | 36'-10 to 37'-7             | 279  | 1        | 36'-10                     | 55      | 23 Var.  | 13'-2 to 29'-8             | 740  | 6m1  |
| 6m2                                                                 | Apron, Trans., Top                |              | 14 Var.   | 21'-8 to 31'-5             | 558     | 18 Var.  | 18'-10 to 31'-7             | 682  | 22 Var.  | 16'-0 to 31'-9             | 789     | 16 Var.  | 4'-1 to 12'-6              | 199  | 6m2  |
| 6m3                                                                 | Apron, Trans., Top                |              | 27 Var.   | 6'-5 to 21'-0              | 556     | 23 Var.  | 5'-10 to 18'-2              | 415  | 20 Var.  | 4'-8 to 15'-4              | 300     | --       | --                         | --   | 6m3  |
| 6m4                                                                 | Apron, Trans., Bott.              |              | 14 Var.   | 38'-1 to 52'-0             | 991     | 12 Var.  | 38'-1 to 49'-10             | 829  | 10 Var.  | 38'-1 to 47'-9             | 674     | 8 Var.   | 38'-1 to 45'-7             | 524  | 6m4  |
| 6p1                                                                 | Curtain, Horizontal               |              | 4         | 44'-6                      | 282     | 4        | 44'-6                       | 282  | 4        | 44'-5                      | 281     | 4        | 44'-5                      | 281  | 6p1  |
| 6p2                                                                 | Curtain, Horizontal, Long         |              | 4         | 26'-6                      | 159     | 4        | 23'-4                       | 140  | 4        | 20'-2                      | 121     | 4        | 17'-0                      | 102  | 6p2  |
| 6p3                                                                 | Curtain, Horizontal, Short        |              | 4         | 10'-7                      | 64      | 4        | 9'-6                        | 57   | 4        | 8'-6                       | 51      | 4        | 7'-6                       | 45   | 6p3  |
| 6s1                                                                 | Wing Slope, Both F., Long         |              | 2         | 8'-4                       | 25      | 2        | 8'-4                        | 25   | 2        | 8'-4                       | 25      | 2        | 8'-4                       | 25   | 6s1  |
| 6s2                                                                 | Wing Slope, Both F., Short        |              | 2         | 7'-11                      | 24      | 2        | 7'-11                       | 24   | 2        | 7'-11                      | 24      | 2        | 7'-11                      | 24   | 6s2  |
| 6s3                                                                 | Wing Slope, Both F., Long         |              | 2         | 39'-0                      | 117     | 2        | 33'-1                       | 99   | 2        | 27'-2                      | 82      | 2        | 21'-3                      | 64   | 6s3  |
| 6s4                                                                 | Wing Slope, Both F., Short        |              | 2         | 23'-6                      | 71      | 2        | 19'-10                      | 60   | 2        | 16'-2                      | 49      | 2        | 12'-7                      | 38   | 6s4  |
| 6s5                                                                 | Wing Slope, F.F. Long             |              | 1         | 45'-1                      | 71      | 1        | 39'-2                       | 59   | 1        | 33'-3                      | 50      | 1        | 27'-5                      | 41   | 6s5  |
| 6s6                                                                 | Wing Slope, F.F. Short            |              | 1         | 29'-5                      | 44      | 1        | 25'-10                      | 39   | 1        | 22'-2                      | 33      | 1        | 18'-6                      | 28   | 6s6  |
| 6s7                                                                 | Interior Wall, Both F.H.          |              | 4         | 24'-4                      | 146     | 4        | 21'-4                       | 128  | 4        | 18'-4                      | 110     | 4        | 15'-4                      | 92   | 6s7  |
| 5t1                                                                 | Curtain, Vertical                 |              | 53        | 6'-8                       | 369     | 49       | 6'-5                        | 328  | 47       | 6'-5                       | 315     | 43       | 6'-5                       | 288  | 5t1  |
|                                                                     | Estimated Quantities One Headwall | Reinf. Steel |           | 9371 LB                    |         |          | 7924 LB                     |      |          | 6426 LB                    |         |          | 5329 LB                    |      |      |
|                                                                     |                                   | Concrete     | Parapet Δ | 4.4                        |         | 4.4      |                             | 4.4  |          | 4.4                        |         | 4.4      |                            | 4.4  |      |
|                                                                     |                                   |              | Wingwalls | 14.6                       |         | 11.1     |                             | 8.1  |          | 5.5                        |         | 5.5      |                            | 30.8 |      |
|                                                                     |                                   |              | Apron *   | 51.8                       | 70.8 CY | 43.9     | 59.4 CY                     | 37.2 | 49.7 CY  | 30.8                       | 40.7 CY |          |                            |      |      |

Δ Includes top of wingwall quantities.

\* Assumes apron and floor are equal thickness, adjust concrete quantities for transition where apron and floor thickness are not equal.

Note: Weight of bars over 40'-0" long include an allowance of 2'-5" for lap. Lengths shown for bars over 40'-0" long do not include lap.

"Short" Denotes Short Wingwall  
"Long" Denotes Long Wingwall

### Headwall Notes:

- See Sheet TRFWH G1-21 for General Notes, Specifications, and Design Stresses.
- This headwall is based on a 3:1 slope normal to centerline of roadway.
- The sides of the apron are to be formed to ensure correct line and grade.
- All apron reinforcing steel is to be supported by bar chairs at intervals of not more than 3'-0" in either direction as outlined in the Standard Specifications.
- Clear distance from face of concrete to near reinforcing bar is to be 2" unless otherwise noted or shown. Clearance to the bottom ends of vertical bars shall be 3 inches.
- Concrete quantities are estimated from back of parapet.
- Horizontal tails of bars "b" & "s" estimated to extend 2'-5" beyond back of parapet (into end of barrel). Longitudinal bars "d", "6f1", "6f4" and "6f5" estimated to project into end section of barrel a minimum of 2'-5" beyond back of parapet. The "length" column reflects total number of feet necessary to meet these requirements.
- Dimensions are in feet and inches unless otherwise noted.

### Bent Bar Details

Note:  
All dimensions are out to out. D = pin diameter.



Standard Design - Triple Reinforced Concrete Box Culverts

### Flared Wing Headwalls

February, 2021

Quantity Tabulation  
10'-0" Span  
45° Skew

TRFWH  
45-8-21  
Sheet 2 of 2