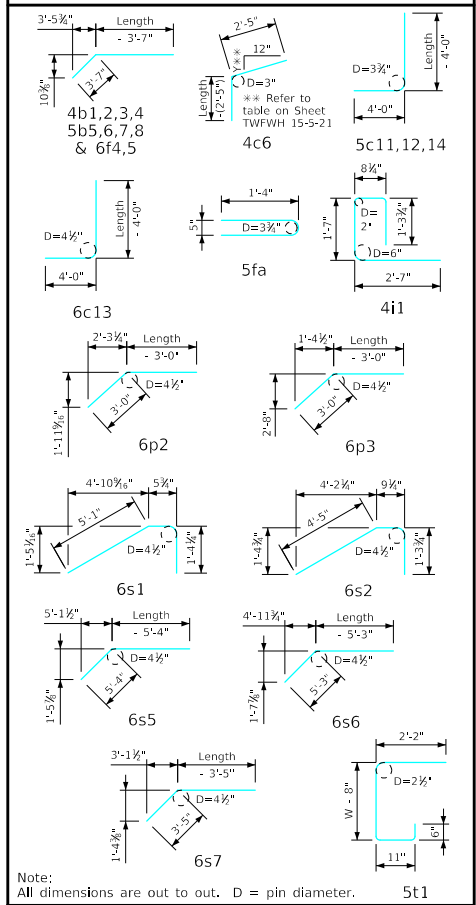


ENGLISHRFDISIGNEDWINCULVERTSFHW.DGN - TWFHW 15-6-21 S1 - THIS SHEET ISSUED 02-2021.

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. | | 21 | Var. 5'-6" to 28'-6" | 372 | 19 | Var. 5'-6" to 26'-5" | 316 | 17 | Var. 5'-6" to 24'-4" | 264 | 15 | Var. 5'-7" to 22'-3" | 218 | 13 | Var. 5'-7" to 20'-2" | 175 | 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 | | |
| 4c6 | 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 | 4c6 | | |
| 4c7 | Interior Wall, Both F.V. | | 2 | 4'-2" | 6 | 2 | 4'-2" | 6 | 2 | 4'-2" | 6 | 2 | 4'-2" | 6 | 2 | 4'-2" | 6 | 4c7 | | |
| 4c8 | Interior Wall, Both F.V. | | 49 | Var. 2'-0" to 12'-5" | 236 | 45 | Var. 1'-11" to 11'-5" | 200 | 41 | Var. 1'-11" to 10'-5" | 169 | 37 | Var. 1'-11" to 9'-6" | 141 | 33 | Var. 1'-11" to 8'-6" | 115 | 4c8 | | |
| 5e9 | 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 | 5e9 | | |
| 5e10 | 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 | 5e10 | | |
| 5e11 | 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 | 5e11 | | |
| 5e12 | 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 | 5e12 | | |
| 6c13 | Wingwall, B.F.V. Long | | 24 | 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. | | 17 | 28'-10" | 327 | 17 | 26'-9" | 304 | 17 | 24'-9" | 281 | 17 | 22'-8" | 257 | 17 | 20'-7" | 234 | 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 | | 24 | 28'-10" | 1039 | 24 | 26'-9" | 964 | 24 | 24'-9" | 892 | 24 | 22'-8" | 817 | 24 | 20'-7" | 742 | 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 | | |
| 4j1 | Parapet, Vertical | | 51 | 6'-2" | 210 | 49 | 6'-2" | 202 | 49 | 6'-2" | 202 | 49 | 6'-2" | 202 | 49 | 6'-2" | 202 | 4j1 | | |
| 7j1 | Parapet, Horizontal | | 4 | 27'-7" | 226 | 4 | 27'-4" | 223 | 4 | 27'-1" | 221 | 4 | 27'-1" | 221 | 4 | 27'-1" | 221 | 7j1 | | |
| 6m1 | Apron, Trans., Top | | 6 | Var. 27'-10" to 28'-9" | 255 | 6 | Var. 27'-7" to 28'-6" | 253 | 6 | Var. 27'-4" to 28'-3" | 250 | 6 | Var. 27'-4" to 28'-3" | 250 | 6 | Var. 27'-4" to 28'-3" | 250 | 6m1 | | |
| 6m2 | Apron, Trans., Top | | 25 | Var. 29'-1" to 38'-1" | 1261 | 22 | Var. 28'-10" to 36'-9" | 1084 | 19 | Var. 28'-7" to 35'-4" | 912 | 17 | Var. 28'-7" to 34'-7" | 806 | 14 | Var. 28'-7" to 33'-5" | 652 | 6m2 | | |
| 6m3 | Apron, Trans., Top | | 9 | Var. 8'-0" to 28'-11" | 250 | 9 | Var. 8'-0" to 28'-10" | 249 | 9 | Var. 7'-11" to 28'-10" | 248 | 9 | Var. 5'-5" to 26'-4" | 215 | 9 | Var. 5'-7" to 26'-5" | 216 | 6m3 | | |
| 6m4 | Apron, Trans., Bott. | | 24 | Var. 21'-6" to 33'-10" | 997 | 22 | Var. 21'-4" to 32'-8" | 892 | 20 | Var. 21'-3" to 31'-6" | 792 | 18 | Var. 21'-3" to 30'-5" | 698 | 16 | Var. 21'-3" to 29'-4" | 608 | 6m4 | | |
| 6p1 | Curtain, Horizontal | | 4 | 26'-2" | 157 | 4 | 26'-1" | 157 | 4 | 25'-11" | 156 | 4 | 25'-11" | 156 | 4 | 25'-11" | 156 | 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. | | 2 | 30'-9" | 92 | 2 | 28'-6" | 86 | 2 | 26'-3" | 79 | 2 | 23'-11" | 72 | 2 | 21'-8" | 65 | 6s7 | | |
| 5t1 | Curtain, Vertical | | 42 | 7'-11" | 347 | 40 | 7'-8" | 320 | 38 | 7'-5" | 294 | 37 | 7'-2" | 277 | 35 | 6'-11" | 252 | 5t1 | | |
| Estimated Quantities | | | Reinf. Steel | | | Reinf. Steel | | | Reinf. Steel | | | Reinf. Steel | | | Reinf. Steel | | | Reinf. Steel | | |
| One Headwall | | | Concrete | | | Concrete | | | Concrete | | | Concrete | | | Concrete | | | Concrete | | |
| | | | Parapet Δ | | | Parapet Δ | | | Parapet Δ | | | Parapet Δ | | | Parapet Δ | | | Parapet Δ | | |
| | | | Wingwalls | | | Wingwalls | | | Wingwalls | | | Wingwalls | | | Wingwalls | | | Wingwalls | | |
| | | | Apron * | | | Apron * | | | Apron * | | | Apron * | | | Apron * | | | Apron * | | |
| | | | 10,924 LB | | | 9,731 LB | | | 8,610 LB | | | 7,628 LB | | | 6,557 LB | | | 5,144 LB | | |
| | | | 2.9 | | | 2.8 | | | 2.8 | | | 2.8 | | | 2.8 | | | 2.8 | | |
| | | | 29.5 | | | 23.2 | | | 17.9 | | | 14.8 | | | 12.1 | | | 9.4 | | |
| | | | 60.0 | | | 53.4 | | | 47.2 | | | 41.8 | | | 36.5 | | | 31.1 | | |
| | | | 92.4 CY | | | 79.4 CY | | | 67.9 CY | | | 59.4 CY | | | 51.4 CY | | | 43.9 CY | | |

Bent Bar Details



Δ Includes top of wingwall quantites.
 * Assumes apron and floor are equal thickness, adjust concrete quantites 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 TWFHW 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 - Twin Reinforced Concrete Box Culverts | |
| | | Flared Wing Headwalls February, 2021 | |
| Quantity Tabulation | | TWFHW | |
| 12'-0" Span | | 15-6-21 | |
| 15° Skew | | Sheet 1 of 2 | |