ENGINEERING STANDARDS
FOR
PRECAST/PRESTRESSED CONCRETE DOUBLE BOX BEAM BRIDGES

33" DOUBLE BOX BEAMS ON PRECAST CONCRETE CAPS
WITH DRIVEN STEEL H-PILE FOUNDATIONS

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NOTE:
"S" INDICATES SECTION OR DETAIL IS CUT AND SHOWN ON THE SAME SHEET.
"S" INDICATES SECTION OR DETAIL IS SHOWN ON THE SAME SHEET.
### Design Notes:

1. **Precast/Prestressed Concrete Double Box Beam and Precast Concrete Cap Design** have been performed in accordance with the SCRRA standards for railway engineering and maintenance. All necessary calculations and drawings have been provided in accordance with the SCRRA standard for railway engineering. Chapter 5 is for concrete structures and foundations, Part 7 (Reinforced Concrete Design and Part 8: Miscellaneous). 

2. **Beam Design** have been performed in accordance with the SCRRA standards for railway engineering. Chapter 5 is for concrete structures and foundations, Part 7 (Reinforced Concrete Design and Part 8: Miscellaneous). 

3. **Allowable Stress Design** is the primary method used for the design of the double box beam. 

4. **Maximum Service Stresses** and **Factored Shear Capacity** are provided for the location of maximum service moment along the length of the span, typically at or near midspan. These values are not considered for the critical capacity to demand ratio for shear along the entire length of the span. 

### Design Criteria:

- Maximum service moment demand and factored shear capacity are provided for the location of maximum ultimate moment along the length of the span, typically at or near midspan. These values are not considered for the critical capacity to demand ratio for shear along the entire length of the span. 

### Table Values:

<table>
<thead>
<tr>
<th>Nominal Span (ft)</th>
<th>Nominal Span (m)</th>
<th>Max. Prec. Load (kips)</th>
<th>Shear Capacity (kips)</th>
<th>ultimate Demand (kips)</th>
<th>Allowable Stresses (ksi)</th>
<th>Allowable Shear (kips)</th>
<th>Factored Shear (kips)</th>
<th>Ultimate Capacity (kips)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20' - 20'</td>
<td>6.10 - 6.10</td>
<td>383</td>
<td>340</td>
<td>411</td>
<td>2300</td>
<td>314</td>
<td>423</td>
<td>487</td>
</tr>
<tr>
<td>24' - 24'</td>
<td>7.32 - 7.32</td>
<td>430</td>
<td>397</td>
<td>464</td>
<td>2450</td>
<td>315</td>
<td>437</td>
<td>493</td>
</tr>
<tr>
<td>32' - 32'</td>
<td>9.75 - 9.75</td>
<td>440</td>
<td>402</td>
<td>517</td>
<td>2600</td>
<td>320</td>
<td>447</td>
<td>503</td>
</tr>
</tbody>
</table>

### Notes:

1. The **Nominal Span** is the length centered at the bearing. 

2. The **Allowable Stress** is the maximum shear demand and factored shear capacity. 

3. The **Allowable Shear** is the maximum service moment demand. 

4. The **Factored Shear** is the ultimate capacity. 

5. The **Ultimate Capacity** is the maximum shear demand. 

### Maximum Allowable Degree of Curve for Design Speed:

<table>
<thead>
<tr>
<th>Design Speed (mph)</th>
<th>Maximum Allowable Degree of Curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>19.4°</td>
</tr>
<tr>
<td>40</td>
<td>13°13'</td>
</tr>
<tr>
<td>50</td>
<td>9°19'</td>
</tr>
<tr>
<td>60</td>
<td>6°39'</td>
</tr>
<tr>
<td>70</td>
<td>4°39'</td>
</tr>
<tr>
<td>80</td>
<td>3°19'</td>
</tr>
<tr>
<td>90</td>
<td>2°04'</td>
</tr>
<tr>
<td>100</td>
<td>1°01'</td>
</tr>
<tr>
<td>110</td>
<td>0°58'</td>
</tr>
</tbody>
</table>
CONSTRUCTION NOTES:

PILING:

FIELD WELDING CAPS AND BRACING:

INSTALLING HMA DETAILS:

WALKWAYS:

HANDRAIL:

MICROVAN STEEL AND HARDWARE:

CONSTRUCTION NOTES:

HMA DETAILS:

DECK PLATES:

§ 509-03
Beam Arrangement Diagrams

Elevation - Single Span Bridge

Scale: 1"=1'-0"

27'-0" for 28'-0" span, 32'-0" for 33'-0" span, 34'-0" for 35'-0" span

27'-2" for 28'-2" span, 32'-2" for 33'-2" span, 34'-2" for 35'-2" span

For Handrail End Post Detail, Refer to Sheet 5

Double Bent Requirements

Lifting Weights

<table>
<thead>
<tr>
<th>Beam Mark</th>
<th>Weight in Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>PB34.83-C</td>
<td>24.3</td>
</tr>
<tr>
<td>PB32.83-C</td>
<td>22.3</td>
</tr>
<tr>
<td>PB27.83-C</td>
<td>20.4</td>
</tr>
</tbody>
</table>

Type - I

Type - II

Type - III

Notes:

1. *Y* is the distance from base of rail to pile collar for design elevations. It shall be established in coordination with SCRRA Director of Engineering and Construction.

2. When necessary to clear an existing pile, piles battered in the direction of the track may also be battered slightly in the direction normal to the track.
TYPICAL PARTIAL SECTIONS

SECTION SHOWING DOUBLE TRACK BRIDGE AND INTERIOR BEAMS WITH CURBS

SECTION SHOWING SINGLE TRACK BRIDGE BETWEEN BEAMS OR BETWEEN BEAM AND CURB. BRACKET AS REQUIRED FOR GRATING CONNECTION.

SECTION SHOWING DOUBLE TRACK BRIDGE AND INTERIOR BEAMS WITHOUT CURBS

DIAGONAL STRUT

TYPICAL PLACEMENT OF DECK PLATES

NOTE:
1. INSTALL SAFETY CHAIN WITH A 3" SAG.
2. REMOVE WEIGHTS.
3. STRETCH CABLE, HANG A MINIMUM OF 10 LBS
4. REMOVE WEIGHTS.
5. THREAD CABLE THROUGH ALL HANDRAIL POSTS AND EYEBOLTS ON ONE END HANDRAIL POST.
6. REMOVE WEIGHTS.
7. DRILL STRUT AS SHOWN (TYP).
8. CUT AND WELL INSTALLATION INSTRUCTIONS.
9. REMOVE WEIGHTS.
10. FIELD DRILL 3/8" DIA HOLE INTO WINGWALL AND INSTALL 3/8" THREADED ROD USING HILTI Adhesive Anchor System OR EQUAL.

CABLE INSTALLATION INSTRUCTIONS:
1. INSTALL …" DIA x 6\(^{\prime}\)" BOLT (TYP) FOR CURB PLATE CP2.
2. FIELD DRILL 3/8" DIA HOLE IN SIDEWALK BRACKET AS REQUIRED FOR CONNECTING CABLE (TYP).
3. INSTALL …" DIA EYEBOLT WITH NUT AND WASHER (TYP) IN SIDEWALK BRACKET AS REQUIRED FOR GRATING CONNECTION.
4. REMOVE WEIGHTS.
5. TIGHTEN CLIPS AND EYEBOLTS AT REMAINING HANDRAIL POST.
6. THREAD CABLE THROUGH ALL HANDRAIL POSTS AND EYEBOLTS ON ONE END HANDRAIL POST.
7. STRETCH CABLE, HANG A MINIMUM OF 10 LBS
8. REMOVE WEIGHTS.
9. FIELD DRILL 3/8" DIA HOLE INTO WINGWALL AND INSTALL 3/8" THREADED ROD USING HILTI Adhesive Anchor System OR EQUAL.
10. REMOVE WEIGHTS.

ENGINEERING STANDARDS

SECTIONS AND DETAILS

PRECAST/PRESTRESSED CONCRETE DOUBLE BOX BEAM BRIDGES

SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY
ONE GATEWAY PLAZA, 12TH FLOOR, L. A., CA. 90012

NOTE:
- INSTALL SAFETY CHAIN WITH A 3" SAG.
- REMOVE WEIGHTS.
- STRETCH CABLE, HANG A MINIMUM OF 10 LBS
- REMOVE WEIGHTS.
- FIELD DRILL 3/8" DIA HOLE INTO WINGWALL AND INSTALL 3/8" THREADED ROD USING HILTI Adhesive Anchor System OR EQUAL.

METROLINK

SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY
ONE GATEWAY PLAZA, 12TH FLOOR, L.A., CA. 90012

NOTE:
- INSTALL SAFETY CHAIN WITH A 3" SAG.
- REMOVE WEIGHTS.
- STRETCH CABLE, HANG A MINIMUM OF 10 LBS
- REMOVE WEIGHTS.
- FIELD DRILL 3/8" DIA HOLE INTO WINGWALL AND INSTALL 3/8" THREADED ROD USING HILTI Adhesive Anchor System OR EQUAL.
NOTES:
1. ALL PILES ARE HPM17 ASTM A572 50 STEEL BEARING PILES UNLESS OTHERWISE SPECIFIED BY THE ENGINEER.
2. ALL BRACING ANGLES TO BE CUT TO LENGTH AS REQUIRED.
3. AFTER PRECAST CONCRETE MEMBERS ARE SET FULL RECESSES AT LIFT ANCHORS WITH EPOXY CEMENT TO TOP OF SURROUNDING CONCRETE.
4. FOR "TYPICAL PILE SPACING DETAIL" SEE SHEET 13.
5. THE FOLLOWING FORMULA WILL GIVE ESTIMATED QUANTITIES OF CONCRETE IN THE CONCRETE COLLARS IN CUBIC YARDS:
   $ \text{Concrete Collars} = \frac{X \times Y}{2} \times \frac{Z}{12}$
WHERE "X" IS THE DISTANCE FROM BASE OF RAIL TO GROUND LINE IN FEET.
6. **X** IS THE DISTANCE FROM BASE OF RAIL TO PILE CUT-OFF. FOR DESIGN ELEVATIONS, "Y" WILL BE ESTABLISHED IN COORDINATION WITH SCRRA DIRECTOR OF ENGINEERING AND CONSTRUCTION. WHERE "X" IS THE DISTANCE FROM BASE OF RAIL TO PILE CUTOFF. FOR SINGLE ROW PILE BENTS (2 TOTAL - FIELD CUT TO FIT).
7. CONCRETE TIES, "Y" = 6'-11" FOR SINGLE ROW PILE BENTS.
8. CONSTRUCTION. FOR A TOTAL OF 12" DEPTH (BALLAST PLUS HMA) BELOW STANDARD BASE OF RAIL.
9. CONCRETE COLLARS IN CUBIC YARDS; THE FOLLOWING FORMULA WILL GIVE ESTIMATED QUANTITIES OF CONCRETE IN THE CONCRETE COLLARS.
10. ALL BRACING ANGLES TO BE CUT TO LENGTH AS REQUIRED.
11. ALL PILES ARE HP14x117, ASTM A572 GRADE 50 STEEL BEARING PILES UNLESS OTHERWISE SPECIFIED.
NOTES:
1. ALL PILES ARE MH64.17 ASTM A572 GRADE 50 STEEL BEARING PILES UNLESS OTHERWISE SPECIFIED BY THE ENGINEER.
2. ALL BRACING ANGLES TO BE CUT TO LENGTH AS REQUIRED.
3. AFTER PRECAST CONCRETE MEMBERS ARE SET, ALL RECESSES AT LIFT ANCHORS WITH EPOXY CLOUT TO TOP OF SURROUNDING CONCRETE.
4. FOR "TYPICAL PILE SPLICE DETAIL", "WING WALL TO END CAP DETAIL" AND "HEAD OF BANK DETAIL" SEE SHEET 13.
5. THE FOLLOWING FORMULA WILL GIVE ESTIMATED QUANTITIES OF CONCRETE IN THE BANK DETAILS; SEE SHEET 13.
6. CONCRETE COLLARS IN CUBIC YARDS; THE FOLLOWING FORMULA WILL GIVE ESTIMATED QUANTITIES OF CONCRETE IN THE BANK DETAILS. WHERE "X" IS THE DISTANCE FROM BASE OF RAIL TO PILE CUTOFF. FOR DESIGN ELEVATIONS, "X" IS THE DISTANCE FROM BASE OF RAIL TO PILE CUTOFF. FOR "TYPICAL PILE SPLICE DETAIL", "WING WALL TO END CAP DETAILS" AND "HEAD OF BANK DETAILS" SEE SHEET 13.
7. QUANTITIES PROVIDED FOR CONCRETE COLLARS INCLUDE BOTH SIDES.

SINGLE BENT DOUBLE TRACK TYPE H15: "X" = 9'-0" (FILLER TO FIT) TYPE H14: "X" = 12'-0" TO 16'-0" (COLLAR, NO BRACING) TYPE H16: "X" = 16'-1" TO 20'-0" (COLLAR, NO BRACING)

REINFORCING STEEL REQUIRED PER CONCRETE COLLAR

<table>
<thead>
<tr>
<th>BENT TYPE</th>
<th>REINFORCING STEEL MARK</th>
<th>REINFORCING STEEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>H14</td>
<td>H15</td>
<td>H16</td>
</tr>
<tr>
<td>556</td>
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</tr>
<tr>
<td>24</td>
<td>24</td>
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</tbody>
</table>

ESTIMATED QUANTITIES PER COLLAR

<table>
<thead>
<tr>
<th>BENT TYPE</th>
<th>REINFORCING STEEL (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H14</td>
<td>518</td>
</tr>
<tr>
<td>H15</td>
<td>530</td>
</tr>
<tr>
<td>H16</td>
<td>555</td>
</tr>
</tbody>
</table>

EXECUTED THIS 30TH DAY OF AUGUST, ONE THOUSAND SEVEN HUNDRED AND NINETEEN (1709) IN THE CITY OF LOS ANGELES, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, BEFORE ME, JOHN A. CARLOS, DIRECTOR OF ENGINEERING AND CONSTRUCTION, WHO IS AUTHORIZED TO PERFORM THE SAME ACCORDING TO LAW.

SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY
20130617 - 01-09-11 G:\Data\Sheet\6000\ES6001-10.dgn

METROLINK.
SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY
ONE GATEWAY PLAZA, 12TH FLOOR, L.A., CA. 90012

ENGINEERING STANDARDS

SINGLE ROW PILE BENTS (4 OF 4)
PRECAST/PRESTRESSED CONCRETE DOUBLE BOX BEAM BRIDGES
NOTES:
1. ALL PILES ARE HPC 457 NPS X 80 GRADE A572B - 60MM DIA X 60MM SHAFT STEEL BEARING PILES UNLESS OTHERWISE SPECIFIED BY THE ENGINEER.
2. ALL BRACING ANGLES TO BE CUT TO LENGTH AS REQUIRED.
3. AFTER PRECAST CONCRETE MEMBERS ARE SET, FILL RECESSES AT LIFT ANCHORS WITH EXPANSION JOINT FILLER.
4. FOR "TYPICAL PILE SPLICE DETAIL", "RING WALL TO END CAP DETAILS" AND "HEAD OF COLLAR AND BRACING" SEE SHEET 13.
5. THE FOLLOWING FORMULA WILL GIVE ESTIMATED QUANTITIES OF CONCRETE IN CUBIC YARDS:
   \[ \text{Concrete Collars in Cubic Yards} = \frac{0.143 \times \text{X} + 6.4}{2} \]
   WHERE "X" IS THE DISTANCE FROM BASE OF RAIL TO GROUND LINE IN FEET.
6. "X" IS THE DISTANCE FROM BASE OF RAIL TO CUTOFF. FOR DESIGN ELEVATIONS, "Y" SHALL BE ESTABLISHED IN COORDINATION WITH SCRRA DIRECTOR OF ENGINEERING AND CONSTRUCTION. FOR A TOTAL OF 12" DEPTH (BALLAST PLUS HMA) BELOW STANDARD SHALL BE ESTABLISHED IN COORDINATION WITH SCRRA DIRECTOR OF ENGINEERING AND CONSTRUCTION. FOR A TOTAL OF 12" DEPTH (BALLAST PLUS HMA) BELOW STANDARD CONCRETE TIES, "Y" IS THE DISTANCE FROM BASE OF RAIL TO PILE CUTOFF. FOR DESIGN ELEVATIONS, "Y" SHOULD BE ESTABLISHED IN COORDINATION WITH SCRRA DIRECTOR OF ENGINEERING AND CONSTRUCTION. FOR A TOTAL OF 12" DEPTH (BALLAST PLUS HMA) BELOW STANDARD CONCRETE TIES, "Y" IS THE DISTANCE FROM BASE OF RAIL TO PILE CUTOFF.

**ESTIMATED QUANTITIES PER COLLAR**

<table>
<thead>
<tr>
<th>BENT TYPE</th>
<th>REINFORCING STEEL</th>
<th>REINFORCING STEEL MARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>H18</td>
<td>457</td>
<td>24 24 24 24 03</td>
</tr>
<tr>
<td>H19</td>
<td>457</td>
<td>16 16 16 04</td>
</tr>
<tr>
<td>H20</td>
<td>475</td>
<td>- - - 0 0</td>
</tr>
</tbody>
</table>

**DOUBLE BENT - SINGLE TRACK**

- **TYPE H17 - X = 12'-1" TO 16'-0" (COLLAR AND BRACING)**
- **TYPE H18 - X = 12'-1" TO 16'-0" (COLLAR, NO BRACING)**
- **TYPE H19 - X = 16'-1" TO 22'-0" (COLLAR AND BRACING)**
- **TYPE H20 - X = 22'-1" TO 26'-0" (COLLAR AND BRACING)**
- **TYPE H21 - X = 26'-1" TO 30'-0" (COLLAR AND BRACING)**

**DOUBLE BENT - SINGLE TRACK**

- **TYPE H30 - X = 22'-1" TO 30'-0"**

**REINFORCING STEEL REQUIRED PER CONCRETE COLLAR**

- **A44 FOR "X" = 22'-1" TO 26'-0"**
- **A44 FOR "X" = 26'-1" TO 30'-0" (4 TOTAL - FIELD CUT TO FIT)**
- **A44 FOR "X" = 30'-1" TO 36'-0" (4 TOTAL - FIELD CUT TO FIT)**

**CONCRETE TIES**

- **"Y" = 7'-7" FOR DOUBLE ROW PILE BENTS.**
- **"Y" = 7'-7" FOR DOUBLE ROW PILE BENTS.**

**CONCRETE TIES**

- **"Y" = 7'-7" FOR DOUBLE ROW PILE BENTS.**
- **"Y" = 7'-7" FOR DOUBLE ROW PILE BENTS.**
**NOTES:**

1. All piles are H14 x 117, ASTM Grade 50 steel bearing piles unless otherwise specified by the Engineer.
2. All bracing angles to be cut to length as required.
3. After prestress concrete members are set fill recesses at lift anchors with epoxy grout to top of surrounding concrete.
4. Special pile space detail is Drawn on Sheet.
5. The following formula will give estimated quantities of concrete in the concrete collar in cubic yards:

   \[ \text{Concrete Collar} \times 0.143 \times x + 14.4 \]

   Where \( x \) is the distance from base of rail to ground-line in feet.

6. Shall be established in coordination with SCRRA Director of Engineering and Construction for a total of 12'-0" H23, 16'-1" H24 and 19'-1" H25.

**Estimated Quantities Per Collar**

<table>
<thead>
<tr>
<th>Bent Type</th>
<th>Reinforcing Steel (lbs)</th>
<th>Bent Type</th>
<th>Reinforcing Steel (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H23</td>
<td>887</td>
<td>H24</td>
<td>888</td>
</tr>
<tr>
<td>H25</td>
<td>910</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DOUBLE BENT - DOUBLE TRACK**

- **Type H23** - "x" = 12'-1" to 16'-0" (collar, no bracing)
- **Type H24** - "x" = 16'-1" to 19'-0" (collar, no bracing)
- **Type H25** - "x" = 22'-1" to 30'-0" (collar, bracing)

**Notes:**

- For "x" = 22'-1" to 30'-0":
  - A45 for "x" = 22'-1" to 30'-0" (total field) cut to fit
  - A46 for "x" = 22'-1" to 30'-0" (field, cut to fit)

**Concrete Collar Dimensions:**

- 1" x 12" x 5'-0" expansion joint filler (Type B)
- 1" x 12" x 5'-0" expansion joint filler (Type C)
- 1" x 12" x 5'-0" expansion joint filler (Type D)

**Concrete Collar Material:**

- Concrete Collar
- 1" x 12" x 5'-0" expansion joint filler (Type B)
- 1" x 12" x 5'-0" expansion joint filler (Type C)
- 1" x 12" x 5'-0" expansion joint filler (Type D)

**Concrete Collar Bracing:**

- 2-H4 (Typ) - 12'-0" to 16'-0" (collar, no bracing)
- 2-H4 (Typ) - 16'-1" to 19'-0" (collar, no bracing)
- 2-H4 (Typ) - 22'-1" to 30'-0" (collar and bracing)

**Concrete Collar Cut to Fit:**

- 8 total - field cut to fit

**Concrete Collar Filler:**

- 1" x 12" x 5'-0" expansion joint filler (Type B)
- 1" x 12" x 5'-0" expansion joint filler (Type C)
- 1" x 12" x 5'-0" expansion joint filler (Type D)

**Concrete Collar Locations:**

- 2 piles (Type H23)
- 2 piles (Type H24)
- 2 piles (Type H25)

**Concrete Collar Dimensions:**

- 1" x 12" x 5'-0" expansion joint filler (Type B)
- 1" x 12" x 5'-0" expansion joint filler (Type C)
- 1" x 12" x 5'-0" expansion joint filler (Type D)

**Concrete Collar Filler:**

- 1" x 12" x 5'-0" expansion joint filler (Type B)
- 1" x 12" x 5'-0" expansion joint filler (Type C)
- 1" x 12" x 5'-0" expansion joint filler (Type D)

**Concrete Collar Cut to Fit:**

- 8 total - field cut to fit

**Concrete Collar Filler:**

- 1" x 12" x 5'-0" expansion joint filler (Type B)
- 1" x 12" x 5'-0" expansion joint filler (Type C)
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**Concrete Collar Filler:**

- 1" x 12" x 5'-0" expansion joint filler (Type B)
- 1" x 12" x 5'-0" expansion joint filler (Type C)
- 1" x 12" x 5'-0" expansion joint filler (Type D)

**Concrete Collar Cut to Fit:**

- 8 total - field cut to fit

**Concrete Collar Filler:**

- 1" x 12" x 5'-0" expansion joint filler (Type B)
- 1" x 12" x 5'-0" expansion joint filler (Type C)
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**Concrete Collar Dimensions:**

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- 1" x 12" x 5'-0" expansion joint filler (Type D)

**Concrete Collar Filler:**

- 1" x 12" x 5'-0" expansion joint filler (Type B)
- 1" x 12" x 5'-0" expansion joint filler (Type C)
- 1" x 12" x 5'-0" expansion joint filler (Type D)

**Concrete Collar Cut to Fit:**

- 8 total - field cut to fit

**Concrete Collar Filler:**

- 1" x 12" x 5'-0" expansion joint filler (Type B)
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**Concrete Collar Cut to Fit:**

- 8 total - field cut to fit

**Concrete Collar Filler:**

- 1" x 12" x 5'-0" expansion joint filler (Type B)
- 1" x 12" x 5'-0" expansion joint filler (Type C)
- 1" x 12" x 5'-0" expansion joint filler (Type D)
WEIGHT OF REINFORCING STEEL = 1186 LBS
ESTIMATED LIFTING WEIGHT = 10.5 TONS

PRECAST CAP PC13B
SCALE: 3'-10" = 1'-0"
ESTIMATED LIFTING WEIGHT = 9.4 TONS
WEIGHT OF REINFORCING STEEL = 1009 LBS
ESTIMATED LIFTING WEIGHT = 10.5 TONS

NOTES:
1. ALL CONCRETE, CONCRETE WORK AND PLACEMENT OF REINFORCEMENT SHALL BE IN ACCORDANCE WITH SCRRA STANDARD SPECIFICATIONS.
2. THE FORMS OF THE PLATE PP3 OR PP5 NUTS IN CONTACT WITH CONCRETE SHALL BE CLEANED OF ALL OIL, GREASE AND ALL LOOSE SCALE AND DIRT BEFORE CONCRETE IS PLACED.
3. THE ULTIMATE COMPRESSIVE STRENGTH OF CONCRETE SHALL BE NOT LESS THAN 4000 PSI IN 28 DAYS. MAXIMUM SIZE OF COARSE AGGREGATE SHALL BE ONE INCH.
4. MINIMUM CONCRETE COVER ON REINFORCEMENT SHALL BE TWO INCHES.
5. ALL CONCRETE, CONCRETE WORK AND PLACEMENT OF REINFORCEMENT SHALL BE IN ACCORDANCE WITH SCRRA STANDARD SPECIFICATIONS.
6. CONCRETE MEMBERS SHALL NOT BE REMOVED FROM THE CASTING BED BEFORE THE CONCRETE ACQUIRES A STRENGTH OF 2800 PS.
7. ALL EXPOSED EDGES OF CONCRETE MEMBERS SHALL BE CHAMFERED 1/8".
8. CONCRETE MEMBERS SHALL NOT BE REMOVED FROM THE CASTING BED BEFORE THE CONCRETE ACQUIRES A STRENGTH OF 2800 PS.
9. CONCRETE MEMBERS SHALL NOT BE REMOVED FROM THE CASTING BED BEFORE THE CONCRETE ACQUIRES A STRENGTH OF 2800 PS.
10. ANCHOR ROD AR1 MUST BE PLACED WITHIN 1/4" OF PLAN LOCATION OR BEAMS WILL NOT FIT.
PRECAST CAP PC14
ESTIMATED LIFTING WEIGHT = 19.7 TONS
REQUIRED VOLUME OF CONCRETE = 9.3 CY
WEIGHT OF REINFORCING STEEL = 1947 LBS

PRECAST CAP PC14B
ESTIMATED LIFTING WEIGHT = 17.6 TONS
REQUIRED VOLUME OF CONCRETE = 8.2 CY
WEIGHT OF REINFORCING STEEL = 1656 LBS

WEIGHT OF REINFORCING STEEL = 1947 LBS
REQUIRED VOLUME OF CONCRETE = 9.3 CY
ESTIMATED LIFTING WEIGHT = 19.7 TONS

WEIGHT OF REINFORCING STEEL = 1656 LBS
REQUIRED VOLUME OF CONCRETE = 8.2 CY
ESTIMATED LIFTING WEIGHT = 17.6 TONS

NOTES:
1. BEAMS WILL NOT FIT.
2. ANCHOR ROD AR1 MUST BE PLACED WITHIN 1/2" OF PLAN LOCATION OR BEAMS WILL NOT FIT.

CAP (SYMM)
NOTES:
1. ALL DIMENSIONS SHOWN ARE TO OUT SCHEDULE OF BARS.
2. BEND #4 BARS AROUND 2'-0" OA PIN (EXCEPT C1 THRU C7 BARS, WHICH SHALL BE BENT AROUND 2'-0" OA PIN FOR C1 AND C2 AND 4'-0" OA PIN FOR C3 THRU C7). BARS AROUND 3'-0" OA PIN AND #6 BARS AROUND 4'-0" OA PIN.
4. FABRICATION OF REINFORCEMENT SHALL BE IN ACCORDANCE WITH CHAPTER 7 OF THE CURRENT CSRI MANUAL OF STANDARD PRACTICE.
**NOTES:**

1. ALL BAR DIMENSIONS ARE OUT TO OUT OF BARS. BEND #4 BARS AROUND 3" DIA PIN, #5 BARS AROUND 2½" DIA PIN, #6 BARS AROUND 3½" DIA PIN (EXCEPT BAR B2 WHICH SHALL BE BENT AROUND 3½" DIA PIN) AND #5 BARS AROUND 2½" DIA PIN.

2. "K" = "BL" - 18"  
   "G" = "BL" - 20"/4  
   "F" = "BL" - 5"  
   "E" = "BL" - 10"  
   "D" = "BL" - 16"  
   "C" = "BL" - 20"/4  
   "B" = "BL" - 18"  
   "A" = "BL" - 20"/4  
   "M" = "BL" - 16"

---

**QUANTITIES FOR STANDARD BEAMS**

<table>
<thead>
<tr>
<th>BEAM MARK</th>
<th>REQUIRED VOLUME OF CONCRETE</th>
<th>WEIGHT OF MILD STEEL REINFORCING</th>
</tr>
</thead>
<tbody>
<tr>
<td>PB34.83-C</td>
<td>14.9 CY</td>
<td>3355 LBS</td>
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<td>PB34.83</td>
<td>13.6 CY</td>
<td>3206 LBS</td>
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<td>PB32.83-C</td>
<td>14.1 CY</td>
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<td>PB32.83</td>
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<td>PB27.83-C</td>
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<td>2810 LBS</td>
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<tr>
<td>PB27.83</td>
<td>11.2 CY</td>
<td>2614 LBS</td>
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</table>
DESIGN NOTES:
1. PRECAST/PRESTRESSED CONCRETE SLAB BEAM AND PRECAST CONCRETE CAP DESIGNS HAVE BEEN PERFORMED IN ACCORDANCE WITH THE 2009 AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION MANUAL FOR RAILWAY ENGINEERING, CHAPTER 10: CONCRETE STRUCTURES AND FOUNDATIONS, PART 2: REINFORCED CONCRETE DESIGN AND PART 5: PRESTRESSED CONCRETE.


4. PRECAST CONCRETE SLAB BEAM DESIGN LOADING EFFECTS FOR EACH CURVE ARE IN ACCORDANCE WITH THE 2009 AREMA MANUAL FOR RAILWAY ENGINEERING, CHAPTER 15: STEEL STRUCTURES, PART 10: BEARING DESIGN, AND THE SPECIFICATIONS FOR ALTERNATE STRAND ARRANGEMENT SUBMITTAL REQUIREMENTS.

5. DESIGN OF STANDARD SLAB BEAMS, IS VALID FOR TIMBER TIES OR CONCRETE TIES, WITH A MAXIMUM DEPTH OF BASEMENT, THE A. 120 MINIMUM DEPTH OF THE B. 120 MAXIMUM DEPTH OF THE DEPTH OF BALLAST TO BE INCLUDED IN THE DEPTH BELOW THE TIE SHALL NOT BE LESS THAN 12".

6. DESIGN OF STANDARD SLAB BEAMS IS VALID FOR THE MAXIMUM DEPTH OF THE B. 120 MAXIMUM DEPTH OF THE DEPTH OF BALLAST TO BE INCLUDED IN THE DEPTH BELOW THE TIE SHALL NOT BE LESS THAN 8".

7. DESIGN OF STANDARD SLAB BEAMS IS VALID FOR THE MAXIMUM DEPTH OF THE B. 120 MAXIMUM DEPTH OF THE DEPTH OF BALLAST TO BE INCLUDED IN THE DEPTH BELOW THE TIE SHALL NOT BE LESS THAN 4".

8. DESIGN OF STANDARD SLAB BEAMS IS VALID FOR THE MAXIMUM DEPTH OF THE B. 120 MAXIMUM DEPTH OF THE DEPTH OF BALLAST TO BE INCLUDED IN THE DEPTH BELOW THE TIE SHALL NOT BE LESS THAN 0".

9. CONTROLLED LOADING EFFECTS FOR EACH CURVE ARE IN ACCORDANCE WITH THE 2009 AREMA MANUAL FOR RAILWAY ENGINEERING, CHAPTER 15: STEEL STRUCTURES, PART 10: BEARING DESIGN, AND REQUIREMENTS OF THE SCRRA DESIGN CRITERIA MANUAL.

10. STRAND PATTERN FOR SLAB BEAMS CONSISTS OF 6/24-SW/L, STRENGTH LOW-RELAXATION STRANDS AS 3" MINIMUM SPACING. ELLIPSES MAY BE ALLOWED TO SUBSTITUTE AN ALTERNATE STRAND SIZE, SHAPE, AND ORIENTATION PATTERN THAT PROVIDE THE SAME TOTAL AREA OF PRESTRESSING STEEL AND THE SAME CAPABILITY TO PREVENT THE SLAB FROM SPACING WITHIN THE RANGE OF TIE CLASSES GREATER THAN 12" SMALL TO BE USED IN SLAB BEAMS. SEE THE SPECIFICATIONS FOR ALTERNATE STRAND ARRANGEMENT SUBMITTAL REQUIREMENTS.

11. REQUIRED COMpressive STRENGTHS OF CONCRETE AT RELEASE, FLK, AND AT 28 DAYS, FCI, ARE PROVIDED FOR EACH DESIGN. MINIMUM FLK SHALL BE 2000 PSI RELIEVE AND MINIMUM FCI SHALL BE 3000 PSI AT 28 DAYS.

12. PRECAST/PRESTRESSED CONCRETE SLAB BEAM DESIGNS ARE PROVIDED AT 4" INCHES OF OUT-TO-OUT BEAM LENGTH, "UL", BETWEEN 12" AND 22" SPAN LENGTH CENTER-TO-CENTER OF BEARINGS. "UL" IS LESS THAN "EL" FOR SLAB BEAMS. FOR ACTUAL VALUES, USE THE DESIGN FOR THE NEXT LARGER "EL" FOR EXAMPLE, THE STANDARD 15'-11" OUT-TO-OUT LENGTH OF 20" SLAB BEAM WOULD USE THE NUMBER OF STRANDS, STRAND PATTERN AND REQUIRED PERIODIC STRENGTHS FOR THE 20'-0" DESIGN FOR THE 20" SLAB BEAM.

13. CALCULATIONS FOR DESIGN OF PRECAST/PRESTRESSED CONCRETE SLAB BEAMS AND PRECAST CONCRETE CAPS HAVE BEEN SIGNED AND SEALED BY A LICENSED PROFESSIONAL CIVIL ENGINEER IN THE STATE OF CALIFORNIA AND ARE KEPT ON FILE AT SCRRA HEADQUARTERS.
### CONTROLLING DESIGN LOAD EFFECTS FOR PRECAST/PRESTRESSED CONCRETE SLAB BEAMS

#### NOMINAL SPAN | DESIGN BED PRETENSION | ELASTIC SHORTENING LOSS | TOTAL LONG-TERM PRESTRESS LOSS | INITIAL PRESTRESS | AREA OF PRESTRESSING STEEL PROVIDED | INITIAL TOTAL PRESTRESSING FORCE | FINDTOTAL PRESTRESSING FORCE |
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<th></th>
<th></th>
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<tbody>
<tr>
<td>10'-0&quot;</td>
<td>15'-0&quot;</td>
<td>20'-0&quot;</td>
<td>25'-0&quot;</td>
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#### ESTIMATED PRESTRESSING

<table>
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<tr>
<th>Design Bed Pretension</th>
<th>Elastic Shortening Loss</th>
<th>Total Long-Term Prestress Loss</th>
<th>Initial Prestress</th>
<th>Area of Prestressing Steel Provided</th>
<th>Initial Total Prestressing Force</th>
<th>Final Total Prestressing Force</th>
<th>Eccentricity of Total Prestressing Force from Neutral Axis</th>
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</thead>
<tbody>
<tr>
<td>10'-0&quot;</td>
<td>15'-0&quot;</td>
<td>20'-0&quot;</td>
<td>25'-0&quot;</td>
<td></td>
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#### ALLOWABLE STRESSES

<table>
<thead>
<tr>
<th>Beam</th>
<th>Live</th>
<th>Impact</th>
<th>Centrifugal</th>
<th>Total</th>
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<tr>
<td></td>
<td>(ksi)</td>
<td>(ksi)</td>
<td>(ksi)</td>
<td>(ksi)</td>
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</tbody>
</table>

#### ULTIMATE CAPACITY

<table>
<thead>
<tr>
<th>Beam</th>
<th>Maximum Service Moments</th>
<th>Top Fiber Service Load Stresses</th>
<th>Bottom Fiber Service Load Stresses</th>
<th>Maximum Ultimate Moment Demand</th>
<th>Factored Moment Capacity</th>
<th>Maximum Ultimate Shear Demand</th>
<th>Factored Shear Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(ksi-ft)</td>
<td>(ksi)</td>
<td>(ksi)</td>
<td>(ksi-ft)</td>
<td>(ksi-ft)</td>
<td>(ksi)</td>
<td>(ksi)</td>
</tr>
</tbody>
</table>

### NOTES:

1. "H" = DEPTH OF SLAB BEAM
2. "L" = OUT TO OUT BEAM LENGTH
3. "S" = SPAN LENGTH CENTER TO CENTER OF BEARINGS
4. "M" = STANDARD SPAN
5. "F" = FACTORED LOAD STRESSES, "T" = TENSION AND "C" = COMPRESSION
6. TABLE VALUES OF MAXIMUM SERVICE MOMENTS AND FACTORED MOMENT CAPACITY ARE PROVIDED FOR THE LOCATION OF MAXIMUM SERVICE MOMENT ALONG THE LENGTH OF THE SPAN, TYPICALLY AT OR NEAR WAISTSPAN.
7. TABLE VALUES OF MAXIMUM ULTIMATE MOMENT DEMAND AND FACTORED MOMENT CAPACITY ARE PROVIDED FOR THE LOCATION OF MAXIMUM ULTIMATE MOMENT ALONG THE LENGTH OF THE SPAN, TYPICALLY AT OR NEAR WAISTSPAN. THESE VALUES MAY NOT REPRESENT THE CRITICAL CAPACITY TO DEMAND RATIO FOR MOMENT ALONG THE ENTIRE LENGTH OF THE SPAN.
8. TABLE VALUES OF MAXIMUM ULTIMATE SHEAR DEMAND AND FACTORED SHEAR CAPACITY ARE PROVIDED AT "O" FROM CENTERLINE OF BEARING. THESE VALUES MAY NOT REPRESENT THE CRITICAL CAPACITY TO DEMAND RATIO FOR SHEAR ALONG THE ENTIRE LENGTH OF THE SPAN.
INSTALLING WING WALLS:

ADJOINING SURFACES OF END CAP AND WING WALL SHALL BE COATED WITH GROUT WHILE CEMENT IS STILL PLIABLE. POSITION WALL OVER THREADED RODS AND EMBED IN PLACE. WASH NUTS TO BOLTS, TIGHTEN NUTS AND TACK WELD NUTS TO WASHER. REPAIR DAMAGED GALVANIZED SURFACES.

CAST-IN-PLACE CONCRETE:

ALL CONCRETE MATERIALS, PLACEMENT AND WORKSHOP SHALL COMPLY TO SCRRA STANDARD SPECIFICATIONS SECTION 34 80 41. STRUCTURAL CONCRETE FOR RAILROAD AND CIVIL WORKS, REINFORCING STEEL MATERIALS AND PLACEMENT SHALL COMPLY TO SCRRA STANDARD SPECIFICATIONS SECTION 34 80 42. REINFORCEMENT FOR RAILROAD CONCRETE AND CIVIL WORKS, MINIMUM 28-DAY CONCRETE COMpressive STRENGTH SHALL BE 4000 PSI. POSITION PLACING TO BE ENGAGED IN CONCRETE. CLEANED OF ALL SPILL, OIL AND DIRT AND ALLOW SOLE PLATE AND BOLT BEFORE CONCRETE IS PLACED TO PROVIDE ADEQUATE BOND.

PLACING PRECAST CAPS:

PRECAST CAPS SHALL BE PLACED IN THE PROPER LOCATIONS AND SECURED Prior TO WELDING CAPS TO HINGE PLATES EMBEDDED IN CAPS. PROPER LOCATION OF PRECAST CAPS SHALL BE DETERMINED USING CONSTRUCTION SURVEYING WITH REEDED CONTROL. ERECTED WITH TAP MEASUREMENTS FROM A KNOWN REFERENCE POINT AS BUILT DIMENSIONS BETWEEN EMBEDDED PIPES AND OTHER CAPS AND ALSO EMBEDDED IN CAPS IN ADJACENT BENTS SHALL BE CHECKED Prior TO WELDING CAPS TO FIGURE.

FIELD WELDING CAPS AND BRACING:

PRES SHALL BE WELDED TO THE PILE PLATES FOLLOWED BY WELDING CAPS TO HINGE PLATES EMBEDDED IN CAPS. PROPER WELDING CAPS TO AVOID PLACEMENT OF CAPS. WELDING CAPS TO EMBEDDED HINGE PLATES SHALL MEET THE REQUIREMENTS OF ANSI 8.2 BURGE WELDING CAPS AND PRECAST/PRESTRESSED CONCRETE BEAMS USING AN ADHESIVE RECOMMENDED BY THE BEARING PAD MANUFACTURER. PILING BETWEEN THE PILE PLATES AND CONCRETE COLLARS OR GROUND LINE, ANGLE BRACING AND ANY OTHER NON-GALVANIZED EXPOSED STEEL SHALL BE CLEANED OF SSS DP 9 "COMMERCIAL BLAST CLEAN" AND PAINTED USING SYSTEM 9.

INSTALLING BEARING PADS:

RANDOM ORIENTED PRESSED STEEL BEARING PADS SHALL MEET THE REQUIREMENTS OF SCRRA STANDARD SPECIFICATIONS SECTION 34 80 43. SCRRA STANDARD SPECIFICATIONS. BEARING PADS AND PRECAST/PRESTRESSED CONCRETE BEAMS USING AN ADHESIVE RECOMMENDED BY THE BEARING PAD MANUFACTURER. PILING BETWEEN THE PILE PLATES AND CONCRETE COLLARS OR GROUND LINE, ANGLE BRACING AND ANY OTHER NON-GALVANIZED EXPOSED STEEL SHALL BE CLEANED OF SSS DP 9 "COMMERCIAL BLAST CLEAN" AND PAINTED USING SYSTEM 9.

CREATION OF BEAMS:

BEAMS SHALL BE PLACED IN THE PROPER LOCATION, TAKING CARE NOT TO DAMAGE CONCRETE WING WALLS OR WELDING AND WELDING POSITIONS. REPAIR DAMAGE TO CONCRETE WING WALLS OR WELDING POSITIONS.

DECK PLATES:

DECK PLATES MAY BE ADJUSTED AND TRIMMED AS NECESSARY TO PROVIDE A TIGHT FIT. OVER TO LOCAL CONDITIONS, DECK PLATES AT JOINTS SHALL BE WELDED REMOVE SCALE AND REPAIR DAMAGED SURFACES AFTER COOLING.

WALKWAYS:

SIDEWALK BRACKETS SHALL BE ERECTED PLUMB AND STRAIGHT. WALKWAY SURFACE SHALL BE EVEN WITH ANY ABRUT CHANGES IN ELEVATION OF 5'-0" OR LESS BETWEEN WALKWAY CREATING PANELS. PANEL LAYOUT SHALL BE ADJUSTED TO MINIMIZE DISTANCE THAT PANELS EXCEED ACROSS BRIDGE JOINTS. DECKING AS REQUIRED AND REPAIR DAMAGED GALVANIZED SURFACES.

HANDRAIL:

MATERIALS SHALL NOT BE ORDERED AND FABRICATION SHALL NOT BE COMPLETE PRIOR TO APPROVAL OF SCRRA STANDARD SPECIFICATIONS SECTION 34 80 41: STRUCTURAL REQUIREMENTS. TRIM GRATING AS REQUIRED AND REPAIR DAMAGED GALVANIZED SURFACES.

PILING:

STEEL BEARING PILES SHALL MEET THE REQUIREMENTS OF SCRRA STANDARD SPECIFICATIONS SECTION 34 80 41. PILING SHOULD BE EMERGED TO A MINIMUM ALLOWABLE COMpressive LOAD COMPRESSION OF 150 TONS PER THE SPECIFICATIONS SECTION 34 80 21: PILING. PILES SHALL BE DRIVEN TO CONCRETE WING WALLS AT NO ADDITIONAL COST TO SCRRA. MEMBERS AND BEAMS THAT DO NOT MEET THE REQUIRED SPECIFICATIONS WILL BE REJECTED.

PLACING:

STEEL BEARING PILES SHALL MEET THE REQUIREMENTS OF SCRRA STANDARD SPECIFICATIONS SECTION 34 80 41. PILING SHOULD BE EMERGED TO A MINIMUM ALLOWABLE COMpressive LOAD COMPRESSION OF 150 TONS PER THE SPECIFICATIONS SECTION 34 80 21: PILING. PILES SHALL BE DRIVEN TO CONCRETE WING WALLS AT NO ADDITIONAL COST TO SCRRA. MEMBERS AND BEAMS THAT DO NOT MEET THE REQUIRED SPECIFICATIONS WILL BE REJECTED.

PRECAST/PRESTRESSED CONCRETE BEAMS SHALL MEET THE REQUIREMENTS OF SCRRA STANDARD SPECIFICATIONS SECTION 34 80 41. STRUCTURAL CONCRETE FOR RAILROAD AND CIVIL WORKS, REINFORCING STEEL MATERIALS AND PLACEMENT SHALL COMPLY TO SCRRA STANDARD SPECIFICATIONS SECTION 34 80 42. REINFORCEMENT FOR RAILROAD CONCRETE AND CIVIL WORKS, MINIMUM 28-DAY CONCRETE COMpressive STRENGTH SHALL BE 4000 PSI. POSITION PLACING TO BE ENGAGED IN CONCRETE. CLEANED OF ALL SPILL, OIL AND DIRT AND ALLOW SOLE PLATE AND BOLT BEFORE CONCRETE IS PLACED TO PROVIDE ADEQUATE BOND.

DECK PLATES:

DECK PLATES MAY BE ADJUSTED AND TRIMMED AS NECESSARY TO PROVIDE A TIGHT FIT. OVER TO LOCAL CONDITIONS, DECK PLATES AT JOINTS SHALL BE WELDED REMOVE SCALE AND REPAIR DAMAGED SURFACES AFTER COOLING.
**ENGINEERING STANDARDS**

**INTERIOR PILE BENTS (1 OF 2)**  
Precast/Prestressed Concrete Slab Beam Bridges

---

### INTERIOR BENT - SINGLE TRACK

- **Base of Rail to Pile Cutoff for Slabs**: Where "X" is the distance from the base of rail to the ground line in feet.
- **"Y"** is the distance from the base of rail to the pile cutoff. For design elevations, "Y" shall be established in coordination with SCRRA Director of Engineering and Construction. For a total of 12" depth (ballast plus HMA) below standard concrete, "Y" is provided for standard slab beam spans in the table "Base of Rail to Pile Cutoff for Slabs".
- **Notes**: 
  1. All piles are HP4 x 117, ASTM A500 Grade 50 steel bearing piles unless otherwise specified by the engineer.
  2. All framing angles to be cut to length as required.
  3. Pre-cast concrete members are set to the necessary at lift anchors with epoxy grout to top of surrounding concrete.
  4. For "Typical Pile Splice Detail" see Sheet 10.
  5. The following formulas will give estimated quantities of concrete in the concrete columns in cubic yards:
     - Bents H2, H3, H4, and H5: \(0.07 \times X + 3.3\)
     - Where "X" is the distance from base of rail to ground line in feet.
  6. "Y" is the distance from base of rail to pile cutoff. For design elevations, "Y" shall be established in coordination with SCRRA Director of Engineering and Construction. For a total of 12" depth (ballast plus HMA) below standard concrete, "Y" is provided for standard slab beam spans in the table "Base of Rail to Pile Cutoff for Slabs".

### REINFORCING STEEL REQUIRED PER CONCRETE COLLAR

<table>
<thead>
<tr>
<th>BENT TYPE</th>
<th>REINFORCING STEEL MARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>H2</td>
<td>259</td>
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<tr>
<td>H3</td>
<td>264</td>
</tr>
<tr>
<td>H4</td>
<td>264</td>
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</tbody>
</table>

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**CADD FILE**: ES6002-08

**SCALE**: 6002

---

**NOTES**:

1. All piles are HP4 x 117, ASTM A500 Grade 50 steel bearing piles unless otherwise specified by the engineer.
2. All framing angles to be cut to length as required.
3. Pre-cast concrete members are set to the necessary at lift anchors with epoxy grout to top of surrounding concrete.
4. For "Typical Pile Splice Detail" see Sheet 10.
5. The following formulas will give estimated quantities of concrete in the concrete columns in cubic yards:
   - Bents H2, H3, H4, and H5: \(0.07 \times X + 3.3\)
     - Where "X" is the distance from base of rail to ground line in feet.
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---

**INTENDED USE**

- **Non-SCRRA Approved Uses**: For non-SCRRA approved uses, refer to the Engineering Standards.
- **Notes**: 
  1. All piles are HP4 x 117, ASTM A500 Grade 50 steel bearing piles unless otherwise specified by the engineer.
  2. All framing angles to be cut to length as required.
  3. Pre-cast concrete members are set to the necessary at lift anchors with epoxy grout to top of surrounding concrete.
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     - Bents H2, H3, H4, and H5: \(0.07 \times X + 3.3\)
     - Where "X" is the distance from base of rail to ground line in feet.
  6. "Y" is the distance from base of rail to pile cutoff. For design elevations, "Y" shall be established in coordination with SCRRA Director of Engineering and Construction. For a total of 12" depth (ballast plus HMA) below standard concrete, "Y" is provided for standard slab beam spans in the table "Base of Rail to Pile Cutoff for Slabs".

---

** base of rail to pile cutoff for slabs**

<table>
<thead>
<tr>
<th>SPAN</th>
<th>LENGTH</th>
<th>INTERIOR BENTS</th>
<th>&quot;X&quot;</th>
<th>&quot;Y&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>10'-0&quot;</td>
<td>12'-0&quot;</td>
<td>H2</td>
<td>9</td>
<td>12</td>
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<tr>
<td>14'-0&quot;</td>
<td>14'-0&quot;</td>
<td>H3</td>
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<td>16'-0&quot;</td>
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<td>20'-0&quot;</td>
<td>20'-0&quot;</td>
<td>H5</td>
<td>24</td>
<td>24</td>
</tr>
</tbody>
</table>

---

**INTENDED USE**

- **Non-SCRRA Approved Uses**: For non-SCRRA approved uses, refer to the Engineering Standards.
- **Notes**: 
  1. All piles are HP4 x 117, ASTM A500 Grade 50 steel bearing piles unless otherwise specified by the engineer.
  2. All framing angles to be cut to length as required.
  3. Pre-cast concrete members are set to the necessary at lift anchors with epoxy grout to top of surrounding concrete.
  4. For "Typical Pile Splice Detail" see Sheet 10.
  5. The following formulas will give estimated quantities of concrete in the concrete columns in cubic yards:
     - Bents H2, H3, H4, and H5: \(0.07 \times X + 3.3\)
     - Where "X" is the distance from base of rail to ground line in feet.
  6. "Y" is the distance from base of rail to pile cutoff. For design elevations, "Y" shall be established in coordination with SCRRA Director of Engineering and Construction. For a total of 12" depth (ballast plus HMA) below standard concrete, "Y" is provided for standard slab beam spans in the table "Base of Rail to Pile Cutoff for Slabs".

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**CADD FILE**: ES6002-08

**SCALE**: 6002

---

**NOTES**:

1. All piles are HP4 x 117, ASTM A500 Grade 50 steel bearing piles unless otherwise specified by the engineer.
2. All framing angles to be cut to length as required.
3. Pre-cast concrete members are set to the necessary at lift anchors with epoxy grout to top of surrounding concrete.
4. For "Typical Pile Splice Detail" see Sheet 10.
5. The following formulas will give estimated quantities of concrete in the concrete columns in cubic yards:
   - Bents H2, H3, H4, and H5: \(0.07 \times X + 3.3\)
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**CADD FILE**: ES6002-08

**SCALE**: 6002

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**NOTES**:

1. All piles are HP4 x 117, ASTM A500 Grade 50 steel bearing piles unless otherwise specified by the engineer.
2. All framing angles to be cut to length as required.
3. Pre-cast concrete members are set to the necessary at lift anchors with epoxy grout to top of surrounding concrete.
4. For "Typical Pile Splice Detail" see Sheet 10.
5. The following formulas will give estimated quantities of concrete in the concrete columns in cubic yards:
   - Bents H2, H3, H4, and H5: \(0.07 \times X + 3.3\)
     - Where "X" is the distance from base of rail to ground line in feet.
   - "Y" is the distance from base of rail to pile cutoff. For design elevations, "Y" shall be established in coordination with SCRRA Director of Engineering and Construction. For a total of 12" depth (ballast plus HMA) below standard concrete, "Y" is provided for standard slab beam spans in the table "Base of Rail to Pile Cutoff for Slabs".
Curb Angle CA3
Scale: 3" = 1'-0"
GALVANIZE AFTER FABRICATION

Curb Plate CP2
Scale: 3" = 1'-0"
GALVANIZE AFTER FABRICATION

Curb Plate CP3
Scale: 3" = 1'-0"
GALVANIZE AFTER FABRICATION

Deck Plate DP11
Scale: 3" = 1'-0"
WEIGHT See Table
GALVANIZE AFTER FABRICATION

Deck Plate DP12
Scale: 3" = 1'-0"
WEIGHT See Table
GALVANIZE AFTER FABRICATION

Deck Plate DP13
Scale: 3" = 1'-0"
WEIGHT See Table
GALVANIZE AFTER FABRICATION

Material Notes:
1. Structural steel bars, steel plates and angles shall meet the requirements of the current A36 and A384 for Grade 1020 solid flux filled headed studs.
2. Shear connector studs shall meet the requirements of Section 7 of the current AWS Structural Welding Code D1.1 for Grade 1020 solid flux filled headed studs.

Shop Notes:
1. Fabrication and arc welding of structural steel shall be in accordance with current AWS standard specifications.
2. Deep exposed welds shall be gouged and deep exposed welds shall be done with complete fusion in accordance with Appendices of the current AWS Structural Welding Code D1.1.
3. Galvanized ast, WP, conduit brackets, sidewalk brackets, CA3, CP2, CP3, DP1, DP12, DP13 and W1 shall be galvanized after fabrication in accordance with the current AWS specification as applicable. All elements shall be free of abrasions, rough or sharp edges, and other surface defects.
4. Nuts shall be tapped oversize to fit galvanized threads and be grinded after galvanizing to prevent rotation on the threads rod.
5. Ast and CA3 shall be shipped with the nut on the threaded rod.

Precast/Prestressed Concrete Slab Beam Bridges

GALVANIZE AFTER FABRICATION

SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY
ENGINEERING STANDARDS
STEEL DETAILS (1 OF 2)
PRECAST/PRESTRESSED CONCRETE SLAB BEAM BRIDGES

Sheet 6002

SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY
ONE GATEWAY PLAZA, 12TH FLOOR, L.A., CA. 90012

Department: PRECAST CONCRETE
Prepared By: PBC-CAD
Checked By: PBC-CAD

Date: 10/11/2011
Rev: 02

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SCRRA ENGINEERING STANDARDS ARE INTENDED FOR SCRRA APPROVED USES ONLY.
NOTES:

A. SPECIFICATIONS
1. DESIGN ARENA - 2004 SERVICE LOAD DESIGN
2. LOAD COMBINATION 5B + L + I + E, EARTH MAT.
3. 8-TON SWIFT LIFT ANCHOR - DISTRIBUTION OF LIVE LOAD TO THE CULVERT SHALL BE IN ACCORDANCE WITH FIGURE 8-16-2, SECTION 16, CHAPTER 8 OF AREMA MANUAL.
4. IMPACT = 39.1%

B. LOADINGS:
1. LIVE LOAD - COOPER E80 - DISTRIBUTION OF LIVE LOAD TO THE CULVERT SHALL BE IN ACCORDANCE WITH FIGURE 8-16-2, SECTION 16, CHAPTER 8 OF AREMA MANUAL.
2. IMPACT = 39.1%
3. DEAD LOAD - INCLUDES WEIGHT OF TRACK, BALLAST, AND FILL ON TOP SLAB OF THE STRUCTURE IN ADDITION TO THE BOX SELF WEIGHT.
4. EQUIVALENT FLUID PRESSURE OF 40 PSI.
5. MATERIAL PROPERTIES:
   - FY = 60,000 PSI
   - FC' = 5,000 PSI
   - EQUIVALENT FLUID PRESSURE OF 40 PSI
   - UNIFORM LATERAL SURCHARGE PRESSURE OF 570 PSF.
   - EQUIVALENT FLUID PRESSURE OF 40 PSI

C. MATERIALS
1. ALL WEIGHT ARE STRESS CONFORM TO ASTM A497
   - ALLOWABLE TENSION STRESS OF 14,000 P.S.I. SERVICE LOAD DESIGN

GENERAL DETAILS

1. LIVE LOAD - COOPER E80 - DISTRIBUTION OF LIVE LOAD TO THE CULVERT SHALL BE IN ACCORDANCE WITH FIGURE 8-16-2, SECTION 16, CHAPTER 8 OF AREMA MANUAL.
2. IMPACT = 39.1%

MATERIAL PROPERTIES:
- FY = 60,000 PSI
- FC' = 5,000 PSI
- EQUIVALENT FLUID PRESSURE OF 40 PSI
- UNIFORM LATERAL SURCHARGE PRESSURE OF 570 PSF.

STANDARD PRECAST CONCRETE

CULVERTS DESIGNED IN ACCORDANCE WITH SECTION 16, CHAPTER 8 OF AREMA MANUAL

ACCORDANCE WITH FIGURE 8-16-2, SECTION 16, CHAPTER 8 OF AREMA MANUAL

SINGLE BOX CULVERTS

NOTES:

- FY = 60,000 PSI
- FC' = 5,000 PSI
- EQUIVALENT FLUID PRESSURE OF 40 PSI
- UNIFORM LATERAL SURCHARGE PRESSURE OF 570 PSF.

ACCORDANCE WITH Fig. 8-16-2, Section 16, Chapter 8 of AREMA Manual

1. LIVE LOAD - COOPER E80 - DISTRIBUTION OF LIVE LOAD TO THE CULVERT SHALL BE IN ACCORDANCE WITH FIGURE 8-16-2, SECTION 16, CHAPTER 8 OF AREMA MANUAL.
2. IMPACT = 39.1%
3. DEAD LOAD - INCLUDES WEIGHT OF TRACK, BALLAST, AND FILL ON TOP SLAB OF THE STRUCTURE IN ADDITION TO THE BOX SELF WEIGHT.
NOTE:

* A.B IS CROSS WIRE SIZE WELDED TO ALL OTHER WIRE CALLOUT.

### Details:

- **Lifting Line**: B-TON SHIFT LIFT ANCHOR
- **Surface of Concrete**: GASH FORMED BY B-TON SHIFT LIFT RECESS PLUG
- **Lifting Detail**: TOP JOINT TIE PLATE
- **Box Side Elevation**: BOTTOM JOINT TIE PLATE

---

**Engineering Standards**

**Southern California Regional Rail Authority**

**General Details**

- Precast Concrete
- Double Box Culverts

---

**Notes**:

A. **Specifications**
- L-TON C-EN - 2004 Service Load Design
- Culverts designed in accordance with Section 13, Chapter 8 of AREMA Manual
- 2. Load Combination Group: D + L + I + E

B. **Loadings**
- Live Load - Includes Weight of Track, Ballast, and Rail on Top Plate of Culvert in Addition to the Box Self Weight
- Dead Load - Includes Weight of Track, Ballast, and Rail on Top Plate of Culvert in Addition to the Box Self Weight

C. **Materials**
- Alliaed Wire Reinforcement Shall Conform to AWS A49
- Allowable Tensile Stress of 24,000 Psi Service Load Design

---

**Dimensions**

- Width (W) = 8 ft
- Height (H) = 4 ft
- Length (L) = 12 ft
**INSTALLATION NOTES**

1. BRIDGE AND RESTLE MARKER SHALL BE SET ON FIELD SIDE OF OUTSIDE TRACK AND USED ONLY AT SUCH LOCATIONS AS APPROVED BY SCRRA.

2. CULVERT MARKER SHALL BE INSTALLED AT LOCATIONS WHERE HEADWALL, PORTAL OR CULVERT OPENING IS NOT VISIBLE FROM THE TRACK SUCH AS CULVERTS IN HIGH FILLS. MARKER SHALL BE PLACED 5 FEET FROM THE TRACK SIDE WHEN FACING IN THE DIRECTION OF INCREASING MILE POSTS.

3. MARKER POST SHALL BE USED TO INDICATE STRUCTURES PROTECTED BY HIGH WATER DETECTOR. MARKERS SHALL BE PLACED AT EACH END OF STRUCTURE WHERE STRUCTURE HANDRAIL AND MARKER MAY BE PLACED ON ENDPOST OF HANDRAIL.

**MATERIAL NOTES**

1. SIGNS SHALL INCLUDE ALUMINUM PANEL, RETROREFLECTIVE SHEETING, POLYURETHANE PAINT, SCREENED-PROCESS COLORS OR FILM, UV PROTECTION OVERLAY, ANTI-GRAFFITI OVERLAY, POSTS, ANCHORS AND HARDWARE.

2. ALUMINUM PANEL SHALL BE ALCOA 6061-T6 OR EQUAL.

3. TEXT FONT SHALL BE TYPHOON "ARIAL" AS PER SCRRA ES1212, SIZE AS INDICATED.

4. POSTS, ANCHORS AND HARDWARE MAY BE AS PER SCRRA ES5210.

5. PANEL SHALL BE PAINTED ON ALL SIDES WITH TWO PART ACRYLIC POLYURETHANE PAINT COATING.

6. RETROREFLECTIVE SHEETING SHALL CONFORM TO THE REQUIREMENTS OF ASTM D4956, CLASS IX OR GREATER. RETROREFLECTIVE SHEETING SHALL HAVE CLASS 1, 3, OR 4 ADHESIVE BACKING WHICH SHALL BE GLOSSY, SENSITIVE AND FOGRESISTANT.

7. SCREENED-PROCESS COLORS AND NONREFLECTIVE, OPAQUE BLACK FILM SHALL HAVE EQUIVALENT OUTDOOR WEATHERABILITY CHARACTERISTICS AS THE RETROREFLECTIVE SHEETING.
### MATERIAL NOTES:

1. Signs shall include aluminum panel, retroreflective sheeting, pressure-sensitive film, screened-process colors or film, UV protection overlay, anti-graffiti overlay, anchors and hardware.

2. Aluminum panel shall be Alcoa 6061-T6 or equal.

3. Text font shall be 1/2" Arial Bold as per SCRRA ES1212, see as indicated.

4. Panel shall be painted on all sides with two part acrylic polyurethane paint coating.

5. Retroreflective sheeting shall conform to the requirements of ASTM D4956, Class IX or greater. Retroreflective sheeting shall have Class 1, 3 or 4 adhesive backing. Panel shall be pressure sensitive and tujący resistant.

6. Screened-process colors and nonreflective, opaque black film shall have equivalent outdoor weatherability characteristics as the retroreflective sheeting.

### MATERIAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>PRODUCT SYSTEM</th>
<th>MANUFACTURER AND PRODUCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH INTENSITY SHEETING (WHITE)</td>
<td>1. J. M. SCOTCHMITE HIGH INTENSITY PRismatic WHITE GRADE 3930 SHEETING</td>
</tr>
<tr>
<td></td>
<td>2. NIPPON CARBIDE RETRO-REFLECTIVE SHEETING TYPE V CRYSTAL GRADE</td>
</tr>
<tr>
<td></td>
<td>3. AVERY DENNISON DWYER T-9000 PRismatic HIGH INTENSITY SHEETING</td>
</tr>
<tr>
<td>COPY / GRAPHICS (BLACK)</td>
<td>1. J. M. PROCESS COLOR SERIES 8813 INK</td>
</tr>
<tr>
<td></td>
<td>2. NIPPON CARBIDE GRAPHITE-RESISTANT 3803 INK</td>
</tr>
<tr>
<td></td>
<td>3. AVERY DENNISON 4930 INK</td>
</tr>
<tr>
<td>ANTI-GRAFFITI OVERLAY</td>
<td>1. J. M. PREMIUM PROTECTIVE OVERLAY FILM 1100</td>
</tr>
<tr>
<td></td>
<td>2. NIKKALITE BRAND Hi SCALE F-40081</td>
</tr>
<tr>
<td></td>
<td>3. AVERY DENNISON DL - 1000 PREMIUM ANTI-GRAFFITI FILM</td>
</tr>
<tr>
<td>EXPANSION ANCHOR</td>
<td>1. HILTI KWIK BOLT KB 1/2&quot; DIA x 2&quot; LONG THREAD W/ HEX NUT NOS. 0630805</td>
</tr>
<tr>
<td></td>
<td>2. RED HEAD TRUBOLT HDG WEDGE TYPE ANCHOR 1/2&quot; DIA x 2&quot; LONG NOS. WS-12546</td>
</tr>
<tr>
<td>PANEL</td>
<td>1/2&quot; THICK ALUMINUM, ALCOA 6061-T6 OR EQUAL</td>
</tr>
</tbody>
</table>
DIRECTOR OF ENGINEERING AND CONSTRUCTION

ENGINEERING STANDARDS

REVISION

STANDARD SHEET

SCALE:

CADD FILE:

ENG.

DES.

DATE

REV.

DESCRIPTION

DRAWN BY:

DATE:

FOR NON-SCRRA APPROVED USES:

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LOCATION PLAN

BEGIN CHANNEL SIGN

SIGN PANEL

FIELD SIDE OF NEAREST RAIL

ELEVATION OF TOP OF NEAREST TF

2" SQUARE POST

PERPENDICULAR TO CL OF TRACK

2'-0" MIN

8'-0" MAX

15'-0" MIN

15'-0" MAX

3'-0"

6'-0" MIN

MATERIAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>SYSTEM</th>
<th>MANUFACTURER AND PRODUCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AVERT DENNISON OWN-CUBE T-11500</td>
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</tr>
<tr>
<td>2</td>
<td>AVERT Bенинson BLACK VINYL DL-2000 OR 4950 INK</td>
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<tr>
<td>3</td>
<td>AVERT DENNISON DL-1000 PREMIUM ANTI-GRAFFITI FILM</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>AVERT DENNISON DL-1000 PREMIUM ANTI-GRAFFITI FILM</td>
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<td>5</td>
<td>AVERT DENNISON DL-1000 PREMIUM ANTI-GRAFFITI FILM</td>
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<tr>
<td>6</td>
<td>AVERT DENNISON DL-1000 PREMIUM ANTI-GRAFFITI FILM</td>
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<tr>
<td>7</td>
<td>AVERT DENNISON DL-1000 PREMIUM ANTI-GRAFFITI FILM</td>
<td></td>
</tr>
</tbody>
</table>

INSTALLATION NOTES

1. SIGNS SHALL BE LOCATED ON THE RIGHT HAND SIDE AND SHALL FACE IN THE DIRECTION OF APPROACH.
2. THE POST SHALL BE SET PER THE LOCATION PLAN ON THIS SHEET. EXCEPTIONS SHALL REQUIRE THE APPROVAL OF SCRRA.

MATERIAL NOYES:

1. SIGNS SHALL INCLUDE ALUMINUM PANEL RETROREFLECTIVE SHEETING, POLYURETHANE PAINT, SCREENED-PROCESS COLORS OR FILM UV PROTECTION OVERLAY, ANTI-GRAFFITI OVERLAY, POSTS, ANCHORS AND HARDWARE.
2. ALUMINUM PANEL SHALL BE ALCOA 6061-T6 OR EQUAL.
3. TEXT FONT SHALL BE "ARIEL BOLD" AS PER SCRRA ES1212, SIZE AS INDICATED.
4. SIGNS SHALL INCLUDE ALUMINUM PANEL, RETROREFLECTIVE SHEETING, POLYURETHANE PAINT, SCREENED-PROCESS COLORS OR FILM, UV PROTECTION OVERLAY, ANTI-GRAFFITI OVERLAY, POSTS, ANCHORS AND HARDWARE.
5. RETROREFLECTIVE SHEETING SHALL CONFORM TO THE REQUIREMENTS OF ASTM D4956, CLASS IX OR GREATER. RETROREFLECTIVE SHEETING SMALL SIZE AS INDICATED.
6. RETROREFLECTIVE SHEETING SHALL HAVE EQUIVALENT OUTDOOR WEATHERABILITY CHARACTERISTICS AS THE RETROREFLECTIVE SHEETING.

MATERIAL NOTES:

1. SIGNS SHALL INCLUDE ALUMINUM PANEL RETROREFLECTIVE SHEETING, POLYURETHANE PAINT, SCREENED-PROCESS COLORS OR FILM UV PROTECTION OVERLAY, ANTI-GRAFFITI OVERLAY, POSTS, ANCHORS AND HARDWARE.
2. ALUMINUM PANEL SHALL BE ALCOA 6061-T6 OR EQUAL.
3. TEXT FONT SHALL BE "ARIEL BOLD" AS PER SCRRA ES1212, SIZE AS INDICATED.
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**MATERIAL SPECIFICATIONS**

<table>
<thead>
<tr>
<th>PRODUCT SYSTEM</th>
<th>MANUFACTURER AND PRODUCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3M SCOTCHLITE HIGH INTENSITY PRISMATIC WHITE GRADE 3930 SHEETING</td>
</tr>
<tr>
<td>2</td>
<td>NIPPON CARBIDE RETRO-REFLECTIVE SHEETING TYPE VMICRYSTAL GRADE</td>
</tr>
<tr>
<td>3</td>
<td>AVERY DENNISON OPAQUE VELVET 3500 PRismatic HIGH INTENSITY SHEETING</td>
</tr>
<tr>
<td>4</td>
<td>3M PROCESS COLOR SERIES B550 INK</td>
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<tr>
<td>5</td>
<td>NIPPON CARBIDE GRAFFITIRESISTANT 3803 INK</td>
</tr>
<tr>
<td>6</td>
<td>AVERY DENNISON 4930 INK</td>
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<td>7</td>
<td>3M PREMIUM PROTECTIVE OVERLAY FILM 1560</td>
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<td>8</td>
<td>NIKKALITE BRAND HT SCALE F40801</td>
</tr>
<tr>
<td>9</td>
<td>AVERY DENNISON 4930 INK</td>
</tr>
</tbody>
</table>

**INSTALLATION NOTES**

1. MOUNT SIGNS TO TUNNEL WALL USING HOT DIPPED GALVANIZED CONCRETE EXPANSION ANCHORS.
2. EXPANSION ANCHORS MUST BE INSTALLED IN ACCORDANCE WITH THE REQUIREMENTS OF THE MANUFACTURER.
3. INCREASE DEPTH OF EXPANSION ANCHOR TO 4 INCHES WHEN MOUNTING ON SMOOTH SURFACE.
4. USE WASHERS WITH 2" MINIMUM O.D. ON BOTH FACES OF SIGN FOR ALL MOUNTING CONDITIONS.
5. MOUNT BOTTOM OF SIGN A MINIMUM OF 8'-0" ABOVE TOP OF RAIL.
6. PLACE SIGNS ON BOTH SIDES OF TUNNEL SPACED AT NOT MORE THAN 100 FEET BETWEEN SIGNS, STAGGERED.

**MATERIAL NOTES:**

1. SIGNS SHALL INCLUDE ALUMINUM PANEL, RETROREFLECTIVE SHEETING, POLYURETHANE PAINT, SCREENED-PROCESS COLORS OR FILM, UV PROTECTION OVERLAY, ANTI-GRAFFITI OVERLAY, POSTS, ANCHORS AND HARDWARE.
2. ALUMINUM PANEL SHALL BE ALCOA 6016-T6 OR EQUAL.
3. TEXT FONT SHALL BE "ARIEL BOLD" AS PER SCRRA ES1212, SIZE AS INDICATED.
4. PANEL SHELL SHALL BE PAINTED ON ALL SIDES WITH TWO PART ACRYLIC POLYURETHANE PAINT COATING.
5. RETROREFLECTIVE SHEETING SHALL CONFORM TO THE REQUIREMENTS OF ASTM D4570, CLASS IX OR GREATER. RETROREFLECTIVE SHEETING SHALL HAVE CLASS 1, 3, OR 4 ADHESIVE BACKING WHICH SHALL BE PRESSURE SENSITIVE AND FUNGUS RESISTANT.
6. SCREENED-PROCESS COLORS AND NONREFLECTIVE OPACIFY BLACK FILM SHALL HAVE EQUIVALENT OUTDOOR WEATHERABILITY CHARACTERISTICS AS THE RETROREFLECTIVE SHEETING.
GENERAL NOTES:
1. All work requirements shown on these drawings shall be accomplished as specified in the most current American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for railway engineering and SCRRA Standard Specifications.
2. Cast-in-place concrete has been designed in accordance with the AREMA Manual, Chapter B - Concrete Structures and Foundations.
3. Type A headwalls have been designed for active earth pressure and E-80 loading live load subgrade at no closer than 12'-0" from the centerline of the nearest track to the back face of the headwall.

CAST-IN-PLACE CONCRETE NOTES:
CONCRETE:
1. All concrete material, placement, and workmanship shall be in accordance with SCRRA standards specification S4 80 43. Precast prestressed concrete for railway bridges.
2. Compressive strength = 4000 lb per square inch at 28 days.
3. Exposed surfaces shall be formed in a manner that will produce a smooth and uniform appearance without rubbing or plastering exposed edges of 90 degrees or less to be chamfered 3/8" 45° top surface to have a smooth finishfree of all float or trowel marks.
4. Concrete shall be proportioned such that the water-cement ratio by weight does not exceed 0.35. Concrete must contain a minimum of 60% of cement.
5. Concrete shall be Type I, Type II or Type III Portland cement.
6. Aggregates shall be graded in accordance with ASTM C33.
7. Fine aggregate shall be natural sand.
8. Air content shall be between 5% and 7% by volume.
9. Reinforcing steel shall be of the proper size and type.
10. Concrete shall be reinforced by using Any form of reinforcement.

REINFORCING STEEL:
1. Reinforcing steel shall be designed, new select bars per current ASTN specifications and meet grade 60 requirement.
2. Fabrication of reinforcing steel shall be per Chapter 7 of the CRSI Manual of Standard Practice. Dimensions of bending details are out of 90°.
3. Reinforcing steel is to be blocked and tied to proper location and securely wired against displacement. Steel bars are to be installed at every other bar intersection so that at least 50% percent of the intersecion bars are secured. Reinforcing is provided within concrete cover on reinforcing not otherwise noted shall meet current AREMA Manual for railway engineering requirements.

PIPE END TREATMENTS FOR PIPE CULVERTS
END ANCHOR DATA

<table>
<thead>
<tr>
<th>PIPE DIAMETER</th>
<th>ANGLE</th>
<th>NO. OF ANCHORS</th>
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</thead>
<tbody>
<tr>
<td>12&quot; - 36&quot;</td>
<td>90°</td>
<td>4</td>
</tr>
<tr>
<td>36&quot; - 60&quot;</td>
<td>45°</td>
<td>8</td>
</tr>
<tr>
<td>60&quot; - 72&quot;</td>
<td>0°</td>
<td>12</td>
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NOTE:
End anchors shall be used for all steel pipe culverts.

CONCRETE HEADWALL TABLE
END ANCHOR LOCATION DETAIL
SCALE: NONE

<table>
<thead>
<tr>
<th>DIAMETER</th>
<th>TYPE A HEADWALL</th>
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<tbody>
<tr>
<td>24&quot;</td>
<td>H = 3'-6&quot;</td>
</tr>
<tr>
<td>36&quot;</td>
<td>H = 4'-0&quot;</td>
</tr>
<tr>
<td>48&quot;</td>
<td>H = 4'-6&quot;</td>
</tr>
<tr>
<td>72&quot;</td>
<td>H = 7'-6&quot;</td>
</tr>
</tbody>
</table>

END TREATMENTS FOR PIPE CULVERTS
GENERAL NOTES

SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY
ONE GATEWAY PLAZA, 12TH FLOOR, L.A., CA. 90012
END ANCHOR LOCATION DETAIL
SCALE: NONE

<table>
<thead>
<tr>
<th>PIPE DIAMETER</th>
<th>ANGLE</th>
<th>NO. OF ANCHORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>12&quot; - 36&quot;</td>
<td>90°</td>
<td>4</td>
</tr>
<tr>
<td>36&quot; - 60&quot;</td>
<td>45°</td>
<td>8</td>
</tr>
<tr>
<td>60&quot; - 72&quot;</td>
<td>0°</td>
<td>12</td>
</tr>
</tbody>
</table>

NOTE:
End anchors shall be used for all steel pipe culverts.

CONCRETE HEADWALL TABLE
END ANCHOR LOCATION DETAIL
SCALE: NONE

<table>
<thead>
<tr>
<th>DIAMETER</th>
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</tr>
<tr>
<td>48&quot;</td>
<td>H = 4'-6&quot;</td>
</tr>
<tr>
<td>72&quot;</td>
<td>H = 7'-6&quot;</td>
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</tbody>
</table>

END TREATMENTS FOR PIPE CULVERTS
GENERAL NOTES
### Culvert Pipe Lengths, PL (ft) for Type A Headwalls

<table>
<thead>
<tr>
<th>Width (in)</th>
<th>20' Track Centers</th>
<th>25' Track Centers</th>
<th>30' Track Centers</th>
<th>35' Track Centers</th>
<th>40' Track Centers</th>
<th>45' Track Centers</th>
<th>50' Track Centers</th>
<th>55' Track Centers</th>
<th>60' Track Centers</th>
</tr>
</thead>
<tbody>
<tr>
<td>D=24&quot; to 36&quot; H=6'-0&quot;</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
</tr>
<tr>
<td>D=24&quot; to 48&quot; H=7'-6&quot;</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
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<td>16.0</td>
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<td>16.0</td>
</tr>
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<td>D=24&quot; to 60&quot; H=9'-0&quot;</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
</tr>
<tr>
<td>D=24&quot; to 72&quot; H=10'-0&quot;</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
</tr>
</tbody>
</table>

### Notes:
1. Tables assume 15'-0" shoulder for single track and 15'-6" shoulder for 20' track centers.
2. Add 12" to pipe length for each access road.
3. Length shown are for standard cross sections for tangent track and 2' to pipe length to outside of curve if super-elevation is 2" or greater.
4. Standard cross section includes 2" crown, 6" subballast, and 1'-4" ballast (including ties).
5. Type A headwalls for steel pipe culverts up to 27" diameter include type A headwalls for single pipe type A-2 headwalls for two pipes type A-3 headwalls for three pipes and type A-4 headwalls for multiple pipes.
NOTES:

1. EQUATIONS REQUIRE VARIABLES TO BE IN INCHES.
2. D = PIPE DIAMETER (INCHES)
3. S = SIDE SLOPE (RUN PER UNIT OF RISE)
4. Z = D + 12
5. XL + Z = (1.155 x Y)
6. W = XL + 34.641
7. ROUND DIMENSIONS TO THE NEAREST 1/4".

FOR CSP & RCP, D = INSIDE PIPE DIAMETER
FOR SSP & RCP, D = OUTSIDE PIPE DIAMETER
NOTES:

1. REINFORCING CALLOUT CONVENTION:
   - A = APRON BARS
   - H = HEADWALL BARS
   - W = WINGWALL BARS
   - T = TOEWALL BARS
   - M = Z / 12 (ROUND M DOWN TO NEAREST INTEGER)
   - P = (Z / 2) - (6 x M) + 6 (ROUND P TO NEAREST")

2. A2 AND W3 CAN BE EITHER SINGLE BAR OR BAR SET.

3. EQUATIONS REQUIRE VARIABLES TO BE IN INCHES.

4. M = Z / 12 (ROUND M DOWN TO NEAREST INTEGER)

5. P = (Z / 2) - (6 x M) + 6 (ROUND P TO NEAREST")

NOTE:

RF = BACK FACE
EF = EACH FACE
FF = FRONT FACE
LLV = LONG LEG VERTICAL

SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY
ONE GATEWAY PLAZA 12TH FLOOR L.A. CA. 90012

METROLINK.
ENGINEERING STANDARDS
TYPE A-1 HEADWALL
REINFORCING DETAILS

CSP, RCP, SSP OR SPP (SYMMETRICAL ABOUT THIS)
4'-0" MAX.
6304

DIRECTOR OF ENGINEERING AND CONSTRUCTION
ASSISTANT DIRECTOR: STANDARDS & DESIGN

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3'  CLR.

5'-6"

7'-6"

9"
### TYPE A-2 HEADWALL DIMENSIONS

<table>
<thead>
<tr>
<th>W</th>
<th>X</th>
<th>S</th>
<th>W</th>
<th>XL</th>
<th>Z</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>3'-6&quot;</td>
<td>24&quot;</td>
<td>12&quot;</td>
<td>10'-4 1/2&quot;</td>
<td>9'-8 3/4&quot;</td>
<td>6'-6&quot;</td>
<td>3'-6&quot;</td>
</tr>
<tr>
<td>4'-0&quot;</td>
<td>30&quot;</td>
<td>15&quot;</td>
<td>11'-10&quot;</td>
<td>10'-8 1/2&quot;</td>
<td>7'-6&quot;</td>
<td>4'-0&quot;</td>
</tr>
<tr>
<td>4'-6&quot;</td>
<td>36&quot;</td>
<td>18&quot;</td>
<td>13'-0&quot;</td>
<td>12'-0 1/2&quot;</td>
<td>9'-0&quot;</td>
<td>5'-0&quot;</td>
</tr>
<tr>
<td>5'-0&quot;</td>
<td>48&quot;</td>
<td>24&quot;</td>
<td>18'-4 1/2&quot;</td>
<td>17'-0 1/2&quot;</td>
<td>11'-0&quot;</td>
<td>7'-0&quot;</td>
</tr>
<tr>
<td>6'-0&quot;</td>
<td>60&quot;</td>
<td>30&quot;</td>
<td>24'-6 1/4&quot;</td>
<td>23'-10 1/2&quot;</td>
<td>15'-0&quot;</td>
<td>9'-0&quot;</td>
</tr>
<tr>
<td>7'-0&quot;</td>
<td>72&quot;</td>
<td>36&quot;</td>
<td>30'-0&quot;</td>
<td>29'-3 3/4&quot;</td>
<td>18'-0&quot;</td>
<td>11'-0&quot;</td>
</tr>
</tbody>
</table>

* For CSP & RCP, D = OUTSIDE PIPE DIAMETER
* For SSP & SPP, D = INSIDE PIPE DIAMETER

### NOTES:
1. Equations require variables to be in inches.
2. D = PIPE DIAMETER (INCHES)
3. S = SPACING BETWEEN ADJACENT PIPES (INCHES)
4. Y = SS x (H - 24)
5. Z = (2 x D) + S + 12
6. XL = Z + (1.155 x Y)
7. ROUND DIMENSIONS TO THE NEAREST 1/8".

---

### FRAMING DETAILS

#### TYPE A-2 HEADWALL FRAMING DETAILS

**NOTES:**
1. For concrete specifications, see ES6301 and SCRRA standards specifications.
2. For pipe bedding specifications, see SCRRA standard specification 53 42 00, cement and drainage pipe.
3. CSP, RCP, SSP, or SPP

---

**CONSTRUCTION SEQUENCE**
(72" dia. pipe shown)

---

**ENGINEERING STANDARDS**

**METROLINK**

SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY
ONE GATEWAY PLAZA, 12TH FLOOR, L.A., CA. 90012
REINFORCING CALLOUT CONVENTION:
A - APRON BARS  
H - HEADWALL BARS  
W - WINGWALL BARS  
T - TOEWALL BARS  

1. REINFORCING CALLOUT CONVENTION:
   A - APRON BARS  
   H - HEADWALL BARS  
   T - TOEWALL BARS  
   W - WINGWALL BARS  

2. A2 AND W3 CAN BE EITHER SINGLE BAR OR BAR SET.

3. EQUATIONS REQUIRE VARIABLES TO BE IN INCHES.

4. M = Z / 2 (ROUND M DOWN TO NEAREST INTEGER)

5. P = (Z / 2) - (6 x M) + 6 (ROUND P TO NEAREST "\n
WINGWALL SECTION

NOTE:
BF - BACK FACE  
ET - EACH FACE  
FF - FRONT FACE  
M = Z / 12 (ROUND DOWN TO NEAREST INTEGER)

PHASE ONE

PHASE TWO

PHASE THREE

ENGINEERING STANDARDS

SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY
ONE GATEWAY PLAZA, 12TH FLOOR, L. A., CA. 90012

METROLINK.

REINFORCING DETAILS

SCALE:
STANDARD

SHEET
NONE

CADD FILE:
ES6306-02

REVISION
A

NOTES:

1. REINFORCING CALLOUT CONVENTION:
   A - APRON BARS  
   H - HEADWALL BARS  
   T - TOEWALL BARS  
   W - WINGWALL BARS  

2. A2 AND W3 CAN BE EITHER SINGLE BAR OR BAR SET.

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5. P = (Z / 2) - (6 x M) + 6 (ROUND P TO NEAREST "\n
WINGWALL SECTION

NOTE:
BF - BACK FACE  
ET - EACH FACE  
FF - FRONT FACE  
M = Z / 12 (ROUND DOWN TO NEAREST INTEGER)

PHASE ONE

PHASE TWO

PHASE THREE

ENGINEERING STANDARDS

SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY
ONE GATEWAY PLAZA, 12TH FLOOR, L. A., CA. 90012

METROLINK.
### Engineering Standards

#### Type A-2 Headwall

**Reinforcing Schedule**

<table>
<thead>
<tr>
<th>Depth</th>
<th>Bending Diagram</th>
<th>Set List</th>
<th>Concrete Quantities</th>
</tr>
</thead>
<tbody>
<tr>
<td>3'-6&quot;</td>
<td><img src="image1.png" alt="Bending Diagram" /></td>
<td><img src="image2.png" alt="Set List" /></td>
<td><img src="image3.png" alt="Concrete Quantities" /></td>
</tr>
<tr>
<td>4'-0&quot;</td>
<td><img src="image1.png" alt="Bending Diagram" /></td>
<td><img src="image2.png" alt="Set List" /></td>
<td><img src="image3.png" alt="Concrete Quantities" /></td>
</tr>
<tr>
<td>4'-6&quot;</td>
<td><img src="image1.png" alt="Bending Diagram" /></td>
<td><img src="image2.png" alt="Set List" /></td>
<td><img src="image3.png" alt="Concrete Quantities" /></td>
</tr>
<tr>
<td>5'-0&quot;</td>
<td><img src="image1.png" alt="Bending Diagram" /></td>
<td><img src="image2.png" alt="Set List" /></td>
<td><img src="image3.png" alt="Concrete Quantities" /></td>
</tr>
<tr>
<td>6'-0&quot;</td>
<td><img src="image1.png" alt="Bending Diagram" /></td>
<td><img src="image2.png" alt="Set List" /></td>
<td><img src="image3.png" alt="Concrete Quantities" /></td>
</tr>
</tbody>
</table>

**NOTES:**

1. Quantities are for one headwall only.
2. Bar designations consist of an size & length followed by the letter "A". Any size & length corresponding to two bars is shown as "A". All bar lengths are given in feet and inches. The last two digits are "A".
3. Concrete quantities are for one headwall only. The reinforcing schedule is as follows:

   - 2'-8" Dia. = 1.02 Cu. Yd.
   - 3'-0" Dia. = 1.00 Cu. Yd.
   - 3'-3" Dia. = 0.98 Cu. Yd.
   - 3'-8" Dia. = 0.96 Cu. Yd.
   - 4'-0" Dia. = 0.92 Cu. Yd.
   - 4'-6" Dia. = 0.84 Cu. Yd.
   - 5'-0" Dia. = 0.72 Cu. Yd.
   - 7'-0" Dia. = 0.58 Cu. Yd.

**Reinforcing Bar Legend**

- A - Wingwall bars
- H - Headwall bars
- T - Typical bars
- W - Wingwall bars

**Concrete Quantities**

<table>
<thead>
<tr>
<th>Size</th>
<th>Total</th>
<th>Required</th>
<th>Total</th>
<th>Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>3'-6&quot;</td>
<td>1.0</td>
<td>2.0</td>
<td>2.7</td>
<td>4.7</td>
</tr>
<tr>
<td>4'-0&quot;</td>
<td>1.0</td>
<td>1.7</td>
<td>1.3</td>
<td>3.7</td>
</tr>
<tr>
<td>4'-6&quot;</td>
<td>1.0</td>
<td>1.3</td>
<td>1.7</td>
<td>3.0</td>
</tr>
<tr>
<td>5'-0&quot;</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>2.0</td>
</tr>
<tr>
<td>5'-3&quot;</td>
<td>1.0</td>
<td>2.0</td>
<td>2.0</td>
<td>4.0</td>
</tr>
<tr>
<td>6'-0&quot;</td>
<td>1.0</td>
<td>8.8</td>
<td>8.8</td>
<td>17.6</td>
</tr>
</tbody>
</table>

**Reinforcing Schedule - 5'-6" Headwall**

<table>
<thead>
<tr>
<th>Size</th>
<th>No. of Bars</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1-W2</td>
<td>28</td>
<td>1'-8&quot;</td>
</tr>
<tr>
<td>W3-W4</td>
<td>28</td>
<td>1'-10&quot;</td>
</tr>
<tr>
<td>W5-W6</td>
<td>14</td>
<td>2'-6&quot;</td>
</tr>
<tr>
<td>W7-W8</td>
<td>14</td>
<td>2'-8&quot;</td>
</tr>
</tbody>
</table>

**Reinforcing Schedule - 3'-6" Headwall**

<table>
<thead>
<tr>
<th>Size</th>
<th>No. of Bars</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1-W2</td>
<td>28</td>
<td>1'-8&quot;</td>
</tr>
<tr>
<td>W3-W4</td>
<td>28</td>
<td>1'-10&quot;</td>
</tr>
<tr>
<td>W5-W6</td>
<td>14</td>
<td>2'-6&quot;</td>
</tr>
<tr>
<td>W7-W8</td>
<td>14</td>
<td>2'-8&quot;</td>
</tr>
</tbody>
</table>

**Reinforcing Schedule - 4'-0" Headwall**

<table>
<thead>
<tr>
<th>Size</th>
<th>No. of Bars</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1-W2</td>
<td>28</td>
<td>1'-8&quot;</td>
</tr>
<tr>
<td>W3-W4</td>
<td>28</td>
<td>1'-10&quot;</td>
</tr>
<tr>
<td>W5-W6</td>
<td>14</td>
<td>2'-6&quot;</td>
</tr>
<tr>
<td>W7-W8</td>
<td>14</td>
<td>2'-8&quot;</td>
</tr>
</tbody>
</table>

**Reinforcing Schedule - 4'-6" Headwall**

<table>
<thead>
<tr>
<th>Size</th>
<th>No. of Bars</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1-W2</td>
<td>28</td>
<td>1'-8&quot;</td>
</tr>
<tr>
<td>W3-W4</td>
<td>28</td>
<td>1'-10&quot;</td>
</tr>
<tr>
<td>W5-W6</td>
<td>14</td>
<td>2'-6&quot;</td>
</tr>
<tr>
<td>W7-W8</td>
<td>14</td>
<td>2'-8&quot;</td>
</tr>
</tbody>
</table>

**Reinforcing Schedule - 5'-0" Headwall**

<table>
<thead>
<tr>
<th>Size</th>
<th>No. of Bars</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1-W2</td>
<td>28</td>
<td>1'-8&quot;</td>
</tr>
<tr>
<td>W3-W4</td>
<td>28</td>
<td>1'-10&quot;</td>
</tr>
<tr>
<td>W5-W6</td>
<td>14</td>
<td>2'-6&quot;</td>
</tr>
<tr>
<td>W7-W8</td>
<td>14</td>
<td>2'-8&quot;</td>
</tr>
</tbody>
</table>

**Reinforcing Schedule - 5'-3" Headwall**

<table>
<thead>
<tr>
<th>Size</th>
<th>No. of Bars</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1-W2</td>
<td>28</td>
<td>1'-8&quot;</td>
</tr>
<tr>
<td>W3-W4</td>
<td>28</td>
<td>1'-10&quot;</td>
</tr>
<tr>
<td>W5-W6</td>
<td>14</td>
<td>2'-6&quot;</td>
</tr>
<tr>
<td>W7-W8</td>
<td>14</td>
<td>2'-8&quot;</td>
</tr>
</tbody>
</table>

**Reinforcing Schedule - 6'-0" Headwall**

<table>
<thead>
<tr>
<th>Size</th>
<th>No. of Bars</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1-W2</td>
<td>28</td>
<td>1'-8&quot;</td>
</tr>
<tr>
<td>W3-W4</td>
<td>28</td>
<td>1'-10&quot;</td>
</tr>
<tr>
<td>W5-W6</td>
<td>14</td>
<td>2'-6&quot;</td>
</tr>
<tr>
<td>W7-W8</td>
<td>14</td>
<td>2'-8&quot;</td>
</tr>
</tbody>
</table>

**Reinforcing Schedule - 6'-6" Headwall**

<table>
<thead>
<tr>
<th>Size</th>
<th>No. of Bars</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1-W2</td>
<td>28</td>
<td>1'-8&quot;</td>
</tr>
<tr>
<td>W3-W4</td>
<td>28</td>
<td>1'-10&quot;</td>
</tr>
<tr>
<td>W5-W6</td>
<td>14</td>
<td>2'-6&quot;</td>
</tr>
<tr>
<td>W7-W8</td>
<td>14</td>
<td>2'-8&quot;</td>
</tr>
</tbody>
</table>

**Reinforcing Schedule - 7'-0" Headwall**

<table>
<thead>
<tr>
<th>Size</th>
<th>No. of Bars</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1-W2</td>
<td>28</td>
<td>1'-8&quot;</td>
</tr>
<tr>
<td>W3-W4</td>
<td>28</td>
<td>1'-10&quot;</td>
</tr>
<tr>
<td>W5-W6</td>
<td>14</td>
<td>2'-6&quot;</td>
</tr>
<tr>
<td>W7-W8</td>
<td>14</td>
<td>2'-8&quot;</td>
</tr>
</tbody>
</table>
TYPE A-3 HEADWALL DIMENSIONS

<table>
<thead>
<tr>
<th>H</th>
<th>W</th>
<th>XL</th>
<th>Z</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1'-0&quot;</td>
<td>24&quot;</td>
<td>10&quot;</td>
<td>15'-0&quot;</td>
<td>34'-0&quot;</td>
</tr>
<tr>
<td>4'-0&quot;</td>
<td>36&quot;</td>
<td>18&quot;</td>
<td>28'-0&quot;</td>
<td>52'-0&quot;</td>
</tr>
<tr>
<td>8'-0&quot;</td>
<td>48&quot;</td>
<td>24&quot;</td>
<td>37'-0&quot;</td>
<td>74'-0&quot;</td>
</tr>
<tr>
<td>10'-0&quot;</td>
<td>60&quot;</td>
<td>30&quot;</td>
<td>42'-0&quot;</td>
<td>85'-0&quot;</td>
</tr>
</tbody>
</table>
| 12'-0" | 72" | 36" | 48'-0" | 94'-0"

# FOR CSP & RCP, D = OUTSIDE PIPE DIAMETER
# FOR SPP, D = MINIMUM PIPE DIAMETER

NOTES:
1. EQUATIONS REQUIRE VARIABLES TO BE IN INCHES
2. D = PIPE DIAMETER (INCHES)
3. S = SPACING BETWEEN ADJACENT PIPES (INCHES)
4. Y = SS x (H - 24)
5. XL = Z + (1.155 x Y)
6. W = XL + 34.641
6. W = XL - 34.641
7. ROUND DIMENSIONS TO THE NEAREST 1/2".

NOTES:
1. FOR CONCRETE SPECIFICATIONS, SEE ES6301 AND SCRRA STANDARD SPECIFICATIONS.
2. FOR PIPE BEDDING SPECIFICATIONS, SEE SCRRA STANDARD SPECIFICATION 33 42 00, CULVERT AND DRAINAGE PIPE.

ENGINEERING STANDARDS

FOR CSP & SPP, D = INSIDE PIPE DIAMETER
FOR SSP & RCP, D = OUTSIDE PIPE DIAMETER
NOTES:

1. EQUATIONS REQUIRE VARIABLES TO BE IN INCHES.
2. \( W = XL + 34.641 \)
3. \( XL = Z + (1.155 \times Y) \)
4. \( Z = (2 \times D) + S + 12 \)
5. \( Y = SS \times (H - 24) \)
6. \( SS = \text{SIDE SLOPE (RUN PER UNIT OF RISE)} \)
7. \( S = \text{SPACING BETWEEN ADJACENT PIPES (INCHES)} \)
8. \( D = \text{PIPE DIAMETER (INCHES)} \)
9. \( N = \text{NUMBER OF PIPES} \)

EQUATIONS REQUIRE VARIABLES TO BE IN INCHES.

**TYPE A-M HEA万达H WALL DIMENSIONS**

<table>
<thead>
<tr>
<th>HEADWALL</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>2'-6&quot;</td>
<td>24&quot;</td>
<td>5'-0&quot;</td>
</tr>
<tr>
<td>3'-0&quot;</td>
<td>36&quot;</td>
<td>5'-6&quot;</td>
</tr>
<tr>
<td>3'-6&quot;</td>
<td>48&quot;</td>
<td>6'-0&quot;</td>
</tr>
<tr>
<td>4'-0&quot;</td>
<td>60&quot;</td>
<td>6'-6&quot;</td>
</tr>
</tbody>
</table>

**HEA万达H WALL DIMENSIONS**

- CSP, RCP, SSP or SPP
- CSP, RCP, SSP or SPP
- CSP, RCP, SSP or SPP

**NOTES:**

1. For concrete specifications, see ES6601 and SCRRA Standard specifications.
2. For pipe bedding specifications, see SCRRA Standard Specification 33 42 00, Culvert and Drainage Pipe.
**TABLE 1 - ROUND SMOOTH STEEL PIPE (SSP)**

<table>
<thead>
<tr>
<th>DIAMETER (IN.)</th>
<th>THICKNESS (IN.)</th>
<th>WEIGHT (FT.)</th>
<th>MAX COVER (IN.)</th>
<th>MAX 30° LENGTH (FT.)</th>
<th>WEIGHT (LB.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>3/8</td>
<td>24</td>
<td>1-3/4</td>
<td>18'-0&quot;</td>
<td>480</td>
</tr>
<tr>
<td>18</td>
<td>1/4</td>
<td>48</td>
<td>1-3/4</td>
<td>18'-0&quot;</td>
<td>960</td>
</tr>
<tr>
<td>21</td>
<td>5/32</td>
<td>69</td>
<td>1-3/4</td>
<td>18'-0&quot;</td>
<td>1,380</td>
</tr>
<tr>
<td>24</td>
<td>3/8</td>
<td>80</td>
<td>1-3/4</td>
<td>18'-0&quot;</td>
<td>1,600</td>
</tr>
<tr>
<td>30</td>
<td>3/16</td>
<td>118</td>
<td>1-3/4</td>
<td>18'-0&quot;</td>
<td>2,380</td>
</tr>
<tr>
<td>36</td>
<td>7/32</td>
<td>190</td>
<td>1-3/4</td>
<td>18'-0&quot;</td>
<td>3,600</td>
</tr>
<tr>
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<td>1/4</td>
<td>222</td>
<td>1-3/4</td>
<td>18'-0&quot;</td>
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</tr>
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<td>317</td>
<td>1-3/4</td>
<td>18'-0&quot;</td>
<td>8,340</td>
</tr>
<tr>
<td>60</td>
<td>3/16</td>
<td>475</td>
<td>1-3/4</td>
<td>18'-0&quot;</td>
<td>12,000</td>
</tr>
<tr>
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<td>7/32</td>
<td>686</td>
<td>1-3/4</td>
<td>18'-0&quot;</td>
<td>18,320</td>
</tr>
</tbody>
</table>

*Covers to be measured from base of rail to top of pipe.*

---

**TABLE 2 - ROUND CORRUGATED STEEL PIPE (CSP)**

<table>
<thead>
<tr>
<th>PIPE DIAMETER (IN.)</th>
<th>GAUGE</th>
<th>THICKNESS (IN.)</th>
<th>WEIGHT (FT.)</th>
<th>MAX COVER (IN.)</th>
<th>MAX 30° LENGTH (FT.)</th>
<th>CONNECTING BANDS</th>
<th>GAUGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>16</td>
<td>0.079</td>
<td>12</td>
<td>1-3/4</td>
<td>9'-0&quot;</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>18</td>
<td>14</td>
<td>0.079</td>
<td>18</td>
<td>1-3/4</td>
<td>9'-0&quot;</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>21</td>
<td>16</td>
<td>0.079</td>
<td>21</td>
<td>2'-6&quot;</td>
<td>12'-0&quot;</td>
<td>6</td>
<td>16</td>
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<tr>
<td>24</td>
<td>14</td>
<td>0.079</td>
<td>24</td>
<td>2'-6&quot;</td>
<td>12'-0&quot;</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>30</td>
<td>16</td>
<td>0.079</td>
<td>30</td>
<td>2'-6&quot;</td>
<td>12'-0&quot;</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>36</td>
<td>14</td>
<td>0.079</td>
<td>43</td>
<td>2'-6&quot;</td>
<td>12'-0&quot;</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>42</td>
<td>16</td>
<td>0.079</td>
<td>47</td>
<td>2'-6&quot;</td>
<td>12'-0&quot;</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
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<td>12</td>
<td>0.109</td>
<td>74</td>
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<td>12'-0&quot;</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>60</td>
<td>12</td>
<td>0.109</td>
<td>92</td>
<td>2'-6&quot;</td>
<td>18'-0&quot;</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>72</td>
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<td>0.158</td>
<td>140</td>
<td>2'-6&quot;</td>
<td>24'-0&quot;</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

*Covers to be measured from base of rail to top of pipe.*

---

**CONSTRUCTION NOTES**

**GENERAL:**
These structures are designed for Cooper end live load with impact, and cover as shown in Table 1 and Table 2.
Table 1 indicates the minimum required thickness for structural stability.

**INSTALLATION:**
Installation of smooth steel pipe (SSP) shall conform to the current AREMA (American Railway Engineering and Maintenance-Of-Way Association) Manual for Railway Engineering, Chapter 1.

**MATERIALS:**
Pipe shall be in accordance with ASTM A53. Pipe to be grade B and steel shall have a minimum yield strength of 35 KSI. A hydrostatic test is not required.
Smooth steel pipe shall have a welded straight longitudinal seam. The ends of each section of pipe shall be square cut: one end shall be suitably beveled for field welding sections together.

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**ENGINEERING STANDARDS**
CONSTRUCTION NOTES AND TABLE FOR SMOOTH AND CORRUGATED STEEL PIPE CULVERTS