PIMA COUNTY

STORM DRAIN DESIGN

GUIDELINES AND STANDARD PLANS

Prepared by: JAMES K. LARRINGTON, P.E.

NOTICE TO USERS OF THESE GUIDELINES:

The following guidelines are presented to aid the designer and should be followed whenever possible. There will be occasions when good engineering judgement dictates the use of something other than what is suggested herein in order to better fit existing field conditions.
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STORM DRAIN DESIGN/PLAN REQUIREMENTS

The Plans shall include, but not be limited to, the following information:

I. Drawing Requirements

A. All design sheets shall be on reproducible Mylar, sized 24" x 36".

B. Storm Drain plans shall be drawn to a horizontal scale of one inch per forty feet (1" = 40') and a vertical scale of one inch per four feet (1" = 4'). Said plans may be drawn on the street plans if so doing does not interfere with the clarity of either plan.

C. See Figure 1 for schematic layout identifying various components of a storm drain system and definitions of terms used in storm drain design/construction.

D. The Hydraulic Grade Line shall be shown on the plans and so noted for each mainline and lateral but is not required for connector pipes.

E. A profile shall be shown for every pipe on the project. Scales shown in B above shall be used for mainlines and laterals. Connector pipe profiles may be done at a horizontal scale of one inch equal four feet (1" = 4') or at the natural scale horizontal scale equal vertical scale of one inch equal four feet (1" = 4'') (H=V; 1" = 4''). Connector pipe profiles shall include a cross-sectional view of both the mainline (or lateral) pipe it joins and the catch basin to which it connects. See Figure 4c for example.

F. See Figures 4a,b,c,d for examples showing the drafting requirements and presentation formats for mainline, lateral and connector pipe plan and profile views.

G. If a separate set of storm plans are prepared then the plan view shall include, but not be limited to, showing the following:

1. Right-of-way lines done with at least a No. 2 pen.

2. Storm Drain system drawn as shown in Figures 4a,b,c,d.

3. Existing or proposed street improvements shown with a light, solid line.

4. Typical section(s) of mainline storm drain shall be shown on each plan sheet in the profile – upper right side - see Figure 4d for format.
5. Utilities shall be shown on all plan views, profiles (where they cross lines being profiled), and typical sections. If unknown, the following depths shall be assumed, plotted on the profiles and cross sections, and noted such thereon:

a) 2" gas lines - 30" cover.
b) water lines to 6" - 36" cover.
c) water lines over 6" - 48" cover.
d) electrical ducts - 36" cover.
e) sewer mainline - shoot manholes on each side and calculate.
f) sewer house connection - two percent (2%) rise from mainline invert plus one foot (1').

II. Design Guidelines

A. Location - If possible the storm drain pipe system should be located behind the curbs - for instance - small systems might only require a system of several catch basins in series connected by pipes behind the curb. Obviously, most large systems will require that pipe be located in the street.

1. Mainlines - should be located to provide the least amount of interference with adjacent utilities and out of the wheel line of vehicles using the roadway (i.e., do not want manholes to fall on the wheel lines). The mainline should have a preferred minimum of 5 feet of cover. This will allow room for utilities to cross over the mainline. It will also allow fall for possible addition of future laterals, should the need arise.

2. Catch Basins - should be located at the end of curb returns on the upstream side of major intersections to intercept flow before it gets into the intersection. At other locations the catch basins should be spaced such that on two-lane-each-way roadways, the inside lane would remain dry. On one-lane roadways, the water should not encroach into more than half of the travel lane.

B. Mainline and Laterals

1. Minimum size due to access requirements for cleaning and maintenance shall be 24".
2. Manhole spacing shall be as follows with small variances allowed to meet existing conditions:
   a. $D = 30''$ or smaller - 300 feet
   b. $D = 33''$ to 42'' inclusive - 400 feet.
   c. $D = 45''$ or larger - 500 feet.

3. Laterals entering a box or vertical wall structure shall meet the following outlet elevation requirements.
   a. $D < 24''$, no more than 5 feet above invert.
   b. $D > 27''$, no more than 18 inches above invert.

4. Angle of confluence, $A$, shall be less than or equal to 45 degrees with 45 degrees preferred except that $A$ shall be equal to or less than 90 degrees for the following:
   a. $Q_{in}$ greater than 10 percent of $Q$ mainline.
   b. $Q_{in}$ has velocity greater than 20 fps.
   c. Diameter ($d$) of lateral is 60 inches or more.

5. Absolute minimum invert slope shall be 0.001 for reinforced concrete pipe with slopes of 0.005 and larger preferred.

6. $Q$ in the pipe shall be shown in the profile as shown on the example plan - Figure 4d.

7. D-Load, size, and length of pipe shall be shown in the profile as shown on the example plan - Figure 4d.

8. All mainline drains requiring pipe diameter equal to or greater than 84 inches shall include a box alternate design.

C. Connector Pipes

1. Minimum size due to access requirements for cleaning and maintenance shall be eighteen inches (18") except for very short lengths 12" and 15" may be considered.

2. Angle of confluence varies from 45 to 90 degrees.

3. Connector pipes inlets into the mainline from both sides of the street at different stations - allow eight feet (8') between each entrance in the mainline pipe.
4. A concrete collar is required where the permitted pull at the pipe joint is exceeded. A concrete collar is not permitted on a main line storm drain without obtaining special permission from the Pima County Flood Control District Design Section. See Figure 8 for allowable joint pulls and concrete collar construction details.

D. Catch Basins

1. Project plans shall call out the station point for all catch basins at the W/2 point. When the basin is to be constructed other than as shown on the standard plans the word "Mod." or "Modified" shall precede the catch Basin Number (7+50 Mod. CB No. 1).

2. Side opening catch basins shall be constructed with a warped gutter 5' in length upstream from the basin and 3' in length downstream. This warped gutter is usually referred to as a "local depression" or L.D. The catch basin opening shall be 1" greater than the abutting curb face height. See Figures 39a and 39b.

3. When the catch basin opening exceeds 9-1/4" a protection bar shall be required. See Figures 26a and 27.

4. For bidding purposes, the cost of the catch basin shall include the warped gutter on each side of it. This should be noted in the Special Provisions or on the plans.

5. The Federal Highway Administration's HEC No. 12 - DRAINAGE OF HIGHWAY PAVEMENTS - has some catch basin inlet capacity charts but these charts are poorly set up, involve some tedious calculations, and are not applicable as presented in many instances. Charts based upon actual model studies of Pima County type basins (CB No. 1) are to be used for computing inlet capacities. Use the chart which has a street slope closest to your situation. See Figures 3d, 3e, 3f and 3g.

IV.
E. Junction Structures (RCP)

1. Figure 7 shall be used to determine the type of pipe-to-pipe junction structure to be used.

2. When joining two pipes of unequal diameter the soffits (crown) of the pipes shall lie on the same grade with the change in diameter occurring across the invert unless circumstances require otherwise (such as a decrease in pipe size going downstream).

3. Figure 6 shall be used to determine the type of pipe manhole to be used.

4. Figure 5 gives additional information on design requirements for junction and transition structures.

F. Pipe Design and Construction Details (RCP)

1. Figure 34 gives bedding requirements for reinforced concrete pipe in trenches.

2. Figure 38 gives requirements for pipe anchors and backfill stabilizers.

3. Figure 37 gives requirements for supports across trenches.

4. Figure 29 gives construction details for monolithic connections which shall be used to connect reinforced concrete pipe to a catch basin or when outletting into a new or existing box structure.

5. Reinforced pipe comes in 4 foot and 8 foot lengths for standard tongue and groove pipe and in 7.7 foot lengths for 0 ring machine pipe. Your design should reflect these lengths as a Contractor must buy the pipe in lengths as shown.

G. Hydraulic Grade Line Determination

1. Pressure Flow (usually the most economical system)
   a. Hydraulic grade line (HGL) calculations for pressure systems are always begun at the outlet and proceed upstream
   b. If joining an existing system begin calculations using the existing HGL.
c. If system outlets into atmosphere (into a non-submerged or non-pressure flow system, begin your hydraulic grade line with the outlet soffit elevation (conservative approach) or the critical depth of flow at the outlet.

d. Use the format shown in Figure 3a for calculating the hydraulic grade line (HGL) and the energy grade line (EGL).

e. See Figures 2a, b for the equations to be used for calculating the various head losses.

f. See Figure 30b for determining the hydraulic grade line at a catch basin. Note the six inches (6") of freeboard required.

g. Try and set construction slope of mainline approximately parallel to street slope with a preferred minimum of five (5) feet of cover.

h. Determine normal depth \(d_n\) and critical depth \(D_c\). If the ratio of (depth of water)/(Pipe diameter) is greater than or equal to 0.82, assume the pipe is flowing full.

i. For pressure flow the friction slope(s) is calculated:

\[
S_f = \left( \frac{Q}{K} \right)^2
\]

\(S_f\) = friction slope in ft. per foot
\(Q\) = quantity of water in pipe in cfs.
\(K\) = conveyance factor for size of pipe - See Figure 3c

j. Try to keep the HGL a minimum of 3 inches above the soffit of the pipe and 3 feet below the surface of the roadway if possible.

k. Pressure flow requires a trial and error solution - usual procedure is to pick a pipe size and calculate a friction slope to see if it will work (the HGL parallels roadway slope and remains at least three feet [3'] below the roadway surface).
2. Open Channel Flow

Please see Woodrow and Posey, Chow, King's or other well-known texts for method of computing water surface profile.

When designing a box with open channel flow, maintain a minimum two feet (2') of free-board.

III. Project Submittal Requirements

A. Construction Plans as set forth in Section I.

B. Hydrology

1. The hydrology shall be done by the Pima County method.

2. The quantity of water should be tabulated to the uppermost catch basin location and then calculated from intersection to intersection through the storm drain construction area in order to properly size catch basins and storm drain mainline and lateral pipes. Flow splits (if any) at intersections should be addressed. An 8-1/2" X 11" or larger sketch shall be submitted with the storm drain calculations showing the Q breakdown. See Figure 40.

C. Hydraulics

1. An 8-1/2" X 11" sketch shall be submitted for all catch basins showing what the roadway section is like just upstream from the proposed catch basin. The calculations for figuring the depth of water in the street using a modified version of Manning's Equation (see HEC No. 12 - Page 11) may also be shown on this sheet. It is possible to set this sheet up to handle several different locations as long as the street section remains the same. See Figure 41.

2. An 8-1/2" X 11" sketch shall be submitted for all catch basin locations which show the approximate location of catch basins, their size (w), and the Q in the street. Calculations are to be shown for determining the size of each catch basin in accordance with instructions given previously in these guidelines. See Figure 42a.
3. An 8-1/2" X 11" sketch shall be submitted for all connector pipe locations which show the approximate location of the connector pipe, their size (inside diameter), and Q into said pipe as determined from the catch basin size calculations. See Figure 43.

D. Structure Layout

An 8-1/2" X 11" plan drawn to scale shall be submitted for each junction and transition structure and for Manhole Number 4. Both plan and elevation views may be required. Refer to Figure 5 and the appropriate standard drawing for information. See Figure 44 for example showing format and required dimensions.
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APPENDIX
STORM DRAIN SYSTEM DEFINITIONS AND TERMINOLOGY

M.H. = MANHOLE
C.B. = CATCH BASIN
J.S. = JUNCTION STRUCTURE
T.S. = TRANSITION STRUCTURE
S.D. = STORM DRAIN
S.S. = SANITARY SEWER
R.C.P. = RCP = REINFORCED CONCRETE PIPE
T.C. = TOP OF CURB
FL. = FLOW LINE
G.O. = GUTTER OUT
L.D. = LOCAL DEPRESSION (OF GUTTER AT CATCH BASIN)

CONNECTOR PIPE
LATERAL
CONFLUENCE ANGLE "A"
MAINLINE

FIGURE 1
FRICITION LOSS \[ h_f = L \times S_f \] where \[ S_f = \left( \frac{Q^2}{K} \right) \]

K = conveyance factor (see Fig. 3c)

\[ S_f = \text{friction slope} \]

CURVE LOSS \[ h_b = 0.002 \times \Delta \times h_v \]

\[ h_v = \text{velocity head of water involved} = \frac{V^2}{2g} \]

\[ \Delta = \text{angle in degrees} \]

ANGLE POINT LOSS \[ h_a = 0.0033 \times \Delta \times h_v \]

\[ \Delta = \text{angle in degrees - must be} \leq 6^\circ \]

ENTRANCE (OUTLET) LOSS \[ h_e = 0.2 \times h_v \]

\[ h_o = \Delta h_v \]

TRANSITION LOSS \[ h_t = \frac{K e}{2} \times \frac{(V_2 - V_1)^2}{2g} \]

(CONTRACTION)

\[ h_t = Ke \times \frac{(V_1 - V_2)^2}{2g} \]

(EXPANSION)

Ke from Figure 2b

MANHOLE LOSS

MH No. 1 \[ h_m = 0.1 \times h_v \]

\[ h_v = \text{outlet head} \]

MH No. 2 and 4 \[ h_m = 0.05 h_v \]

MH No. 3 Negligible

JUNCTION LOSS \[ h_j = \Delta Y + h_{v_1} - h_{v_2} \]

where \[ \Delta Y = \frac{Q_2 V_2 - Q_1 V_1 - Q_2 V_2 \cos \theta}{2g} + \frac{1}{2} \left( S_{t_1} + S_{t_2} \right) L \]

Negligible loss for inflow \leq 10\% of mainline Q

except where:

(i) \( Q_i \geq 30 \text{ cfs} \)

(ii) \( Q_i + Q_e \geq 30 \text{ cfs} \)

(iii) Junction is also a mainline transition

Sudden Expansion (Contraction)

Used when concrete collar joins pipes of unequal diameter

\[ h_R = K_2 \times h_v \]

\[ h_c = K_3 \times h_v \]

Kirn's ch. 6

HGL FOR LINE 3

\[ A'_i = A_i + (A_2 - A_i) \left( \frac{V'_i}{V_1} \right) \]

\[ V'_i = Q'/A'_i \]

HGL = HGL + h_{v_1} - h_v'

FIGURE 2a
Transition Head Loss — Pressure Flow

Contraction (increasing velocity): \( h_t = \frac{K_e (V_2 - V_1)^2}{2g} \)

Expansion (decreasing velocity): \( h_t = K_e \frac{(V_1 - V_2)^2}{2g} \)

Reference: Gibson — Enlargers
Standard of the Hydraulic Institute

\( K_e = 3.50 (\tan \frac{\theta}{2})^{1.22} \)

Expansion Example

Rate of expansion or contraction

RATIO = 10:1
CATCH BASIN FORMULA

\[ Q = C \cdot W^{0.69} \cdot D^{2.0} \]

where:
- \( C = 3.37 \)
- \( W = \) LENGTH OF C.B. OPENING
- \( D = \) DEPTH OF FLOW

8" NORMAL C.F., 9" C.F. AT C.B.

MINIMUM C.B. CAPACITY = \( \frac{W}{5} \) C.F.S

**Figure 2c**

CATCH BASIN CAPACITIES
TO BE USED FOR C.B. NO. 1

D = DEPTH OF FLOW (FT.) ABOVE NORMAL GUTTER GRADE
CATCH BASIN FORMULA

STREET SLOPE = 0.005

\[ Q = CW^{5.3} D^{2.0} \]

\[ C = 2.71 \]

\[ W = \text{LENGTH OF C.B. OPENING} \]

\[ D = \text{DEPTH OF FLOW} \]

9\(^{\circ}\) NORMAL C.F., 9\(^{\circ}\) C.F. AT C.B.

D = DEPTH OF FLOW (FT.) ABOVE NORMAL GUTTER GRADE

MINIMUM C.B. CAPACITY = \( \frac{W}{2.5} \) CFS

CATCH BASIN CAPACITIES TO BE USED FOR C.B. NO. 1

FIGURE 2d
CATCH BASIN FORMULA

STREET SLOPE = 0.020 & 0.050

\[ Q = C \cdot W^{0.63} \cdot D^{2.0} \]

\[ C = 3.25 \]

\[ W = \text{LENGTH OF C.B. OPENING} \]

\[ D = \text{DEPTH OF FLOW} \]

\[ B = \text{NORMAL: C.F., 90° C.F. AT C.B.} \]

\[ \text{MINIMUM C.B. CAPACITY} = \frac{W}{9} \text{ CFS} \]

\[ D = \text{DEPTH OF FLOW (FT.) ABOVE NORMAL GUTTER GRADE} \]

CATCH BASIN CAPACITIES
TO BE USED FOR C.B. NO. 1

FIGURE 2e
SUMP FORMULA

Q = 4.3AD^{0.6} (COMPLETE SUBMERGENCE)
A = AREA OF OPENING (W x 0.65D).
W = LENGTH (FEET) OF CATCH BASIN OPENING
D = DEPTH (FEET) OF FLOW ABOVE NORMAL GUTTER GRADE

8" NORMAL C.F., 9" C.F. AT C.B.

D = DEPTH OF FLOW (FT.) ABOVE NORMAL GUTTER GRADE

CATCH BASIN CAPACITIES FOR SUMP CONDITION
TO BE USED FOR C.B. NO 1

FIGURE 2f
### SUMMARY OF HYDRAULIC CALCULATIONS

**PRESSURE FLOW DESIGN**

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<th>S.D. Type</th>
<th>Q</th>
<th>A</th>
<th>V</th>
<th>K</th>
<th>L</th>
<th>Δ</th>
<th>H_p</th>
<th>H_r</th>
<th>H_j</th>
<th>H_f</th>
<th>H_wkh</th>
<th>H_misc</th>
<th>H_L</th>
<th>E.G.</th>
<th>h_v</th>
<th>H_G</th>
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**Legend:**
- **Q**: Flow Rate
- **A**: Area
- **V**: Velocity
- **K**: Capacity Factor
- **L**: Length
- **Δ**: Delta
- **H_p**: Pressure Head
- **H_r**: Friction Head
- **H_j**: Friction Head
- **H_f**: Flow Head
- **H_wkh**: Waterhammer Head
- **H_misc**: Miscellaneous Head
- **H_L**: Total Head
- **E.G.**: Energy Grade
- **h_v**: Vertical Head
- **H_G**: Total Grade
### WATER SURFACE COMPUTATION SHEET

\[ S = \text{Channel Slope, } E = D + H_v \]

\[ S_f = \left[ \frac{2g n^2}{2.21} \right] \frac{H_v}{R^{4/3}} \text{ or } \left[ \frac{1}{K} \right] \times ^2, \quad H_v = \frac{V^2}{2g}, \quad L = \frac{\Delta E}{S - S_{fov}} \]

\[ X = \frac{2n}{5^{1/3}} = \frac{2g}{g^{1/3}} \]

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<th>Area</th>
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<th>w.p.</th>
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<th>S</th>
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**FIGURE 3b**
## CONVEYANCE FACTORS—R.C. PIPE OR BOX

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\[ K = \frac{4.86}{n} (AR^{2.5}) \]

\[ n = 0.013 \]
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Values of 1.486/n * A * R²/³

2-2/3' x 1/2'

3'' x 1''

6'' x 2''

n = 0.024

n = 0.027

n = 0.033

-11-  FIGURE 3d
### TABLE IV: Horizontal Elliptical Concrete Pipe

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<th>Pipe Size Rise x Span (Inch)</th>
<th>Approximate Equivalent Round Diameter (Inch)</th>
<th>Hydraulic Radius (Square Feet)</th>
<th>R (Feet)</th>
<th>Values of 1.486/n x A x R^{2/3}</th>
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### TABLE V: Concrete Arch Pipe

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<th>R (Feet)</th>
<th>Values of 1.486/n x A x R^{2/3}</th>
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<td>2.17</td>
<td>14935</td>
<td>13689</td>
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**FIGURE 3e**
<table>
<thead>
<tr>
<th>Pipe Size Rise x Span (Inch)</th>
<th>A Area (Square Feet)</th>
<th>R Hydraulic Radius (Feet)</th>
<th>Values of 1.486/n x A x R^{2/3}</th>
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<tr>
<td></td>
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<td>2-2/3' x 1/2' n = 0.024</td>
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<td>11 x 18</td>
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<td>0.280</td>
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<td>18 x 29</td>
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<td>2226</td>
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<td>1.556</td>
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<td>69 x 98</td>
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<td>75 x 112</td>
<td>46.0</td>
<td>1.830</td>
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<td>77 x 114</td>
<td>49.0</td>
<td>1.891</td>
<td>3374</td>
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<td>79 x 117</td>
<td>52.0</td>
<td>1.947</td>
<td>3653</td>
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<tr>
<td>81 x 123</td>
<td>55.0</td>
<td>2.000</td>
<td>3931</td>
</tr>
<tr>
<td>83 x 128</td>
<td>58.0</td>
<td>2.051</td>
<td>4215</td>
</tr>
<tr>
<td>85 x 131</td>
<td>61.0</td>
<td>2.099</td>
<td>4502</td>
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<tr>
<td>87 x 137</td>
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<tr>
<td>89 x 139</td>
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<tr>
<td>91 x 142</td>
<td>71.0</td>
<td>2.260</td>
<td>5505</td>
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<tr>
<td>93 x 148</td>
<td>74.0</td>
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<td>5801</td>
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<tr>
<td>95 x 150</td>
<td>78.0</td>
<td>2.365</td>
<td>6231</td>
</tr>
<tr>
<td>97 x 152</td>
<td>81.0</td>
<td>2.399</td>
<td>6536</td>
</tr>
<tr>
<td>100 x 154</td>
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</tr>
<tr>
<td>101 x 161</td>
<td>89.0</td>
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<td>7418</td>
</tr>
<tr>
<td>103 x 167</td>
<td>93.0</td>
<td>2.575</td>
<td>7864</td>
</tr>
<tr>
<td>105 x 167</td>
<td>97.0</td>
<td>2.629</td>
<td>8321</td>
</tr>
<tr>
<td>107 x 171</td>
<td>101.0</td>
<td>2.680</td>
<td>8773</td>
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<tr>
<td>109 x 178</td>
<td>105.0</td>
<td>2.729</td>
<td>9234</td>
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<td>111 x 184</td>
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<td>2.776</td>
<td>9694</td>
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<td>113.0</td>
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<td>115 x 188</td>
<td>118.0</td>
<td>2.890</td>
<td>10781</td>
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<tr>
<td>118 x 190</td>
<td>122.0</td>
<td>2.931</td>
<td>11251</td>
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<tr>
<td>119 x 197</td>
<td>126.0</td>
<td>2.972</td>
<td>11728</td>
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<tr>
<td>121 x 199</td>
<td>131.0</td>
<td>3.033</td>
<td>12364</td>
</tr>
</tbody>
</table>
L_{min} = 5(D_2 - D_1)

DESIGN CONTROLS

<table>
<thead>
<tr>
<th>MH 4</th>
<th>TS 3</th>
<th>JS 2</th>
<th>JS 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>30° to 60°</td>
<td>90° for Q_{in} ≤ 0.10 Q_{ml}</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>12'' min.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>12'' min.</td>
<td>24'' min.</td>
<td></td>
</tr>
<tr>
<td>Z*</td>
<td>51'' min.</td>
<td>—</td>
<td>57'' min.</td>
</tr>
<tr>
<td>Q</td>
<td>F min. per std. plan</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>U</td>
<td>—</td>
<td>—</td>
<td>12'' min.</td>
</tr>
</tbody>
</table>

*Applies only to manhole step clearance.

△Clearance to nearest transverse construction joint.

R.C. Pipe

R.C. Box

SIDE INLET PROFILE

FIGURE: 5a
### Side Inlet Connections

<table>
<thead>
<tr>
<th>Structure</th>
<th>Mainline</th>
<th>Lateral or Connector Pipe</th>
<th>Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td>JS No. 4</td>
<td>Pipe</td>
<td>I.D. of LAT. ≤ 24&quot;; A ≥ 45°&lt;br&gt; O.D. of LAT. = 1/2 I.D. of Mainline</td>
<td>16b</td>
</tr>
<tr>
<td>JS No. 2</td>
<td>Pipe</td>
<td>O.D. of LAT. &gt; 1/2 I.D. of M.L. or I.D. of LAT. &gt; 24&quot;&lt;br&gt; I.D. of LAT. ≤ 3/4 I.D. of M.L. ≤ 39&quot;&lt;br&gt; No more than one opening per pipe length;&lt;br&gt; Check if A &lt; 45° &amp; B &gt; 24&quot; for horiz. clearance;&lt;br&gt; Use TS No. 3 if vertical angle ≥ 45°&lt;br&gt; Req'd on plans: A, B, C, D, Elev R, Elev S</td>
<td>15a, b</td>
</tr>
<tr>
<td>TS No. 3</td>
<td>Pipe</td>
<td>I.D. of LAT. &gt; 3/4 I.D. of M.L. or &gt; 39&quot;&lt;br&gt; I.D. of LAT. ≥ I.D. of M.L.&lt;br&gt; Req'd on plans: A, B, C, D, D, Elev R, Elev S</td>
<td>19a, b</td>
</tr>
<tr>
<td>JS No. 1</td>
<td>Box</td>
<td>I.D. of LAT. = 12&quot; → 14.4&quot;&lt;br&gt; If inlet does not permit 7&quot; above invert &amp; 6&quot; below soffit, or A ≤ 30° → Investigate for clearance.&lt;br&gt; Req'd on plans: A, B, C, El. R, El. S</td>
<td>14</td>
</tr>
<tr>
<td>JS No. 3</td>
<td>Box</td>
<td>I.D. of LAT. ≤ 30° for C.P. + RCP, 60&quot; for C.M.P.; Provide 12&quot; below soffit and 13&quot; above invert of M.L.; A ≥ 45°&lt;br&gt; Req'd on plans: A, B, C, D, Elev R, Elev S</td>
<td>16a</td>
</tr>
</tbody>
</table>

**Note:** The above information is shown in graph form on figures 6 and 7. Use the graphs then check this table and Fig. 5C for additional requirements.
<table>
<thead>
<tr>
<th>MANHOLE</th>
<th>MAINLINE</th>
<th>LATERAL/CONN. PIPE</th>
<th>FIGURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PIPE (33&quot; OR LESS); ALSO USE IF UPSTREAM ≤ 33&quot; &amp; DOWNSTREAM ≥ 36&quot;; MAX. PIPE I.D. = 42&quot;</td>
<td>PROVIDE 6&quot; BELOW SOFFIT OF M.H. BOX</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>PIPE (36&quot; OR GREATER)</td>
<td>O.D. OF LAT. ≤ ½ I.D. OF M.L. AND 30&quot; OR LESS</td>
<td>10a,b</td>
</tr>
<tr>
<td>3</td>
<td>BOX OR ARCH</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>PIPE (36&quot; OR GREATER)</td>
<td>12&quot;-144&quot; LAT.; I.D. OF LAT. ≤ I.D. OF M.L. REQ'D. ON PLANS: A, B, C, D, D₂, EL. R., EL. S</td>
<td>12a,b</td>
</tr>
</tbody>
</table>

MAXIMUM MANHOLE SPACING:

\[ c \leq 30" \quad \ldots \quad 300' \]
\[ d \leq 42" \quad \geq 33" \quad \ldots \quad 400' \]
\[ d \geq 45" \quad \ldots \quad 500' \]

NOTE: THE ABOVE INFORMATION IS SHOWN IN GRAPH FORM ON FIGURE 6 - USE THE GRAPH TO DETERMINE WHAT STRUCTURE TO USE. THEN CHECK THIS TABLE FOR ADDITIONAL REQUIREMENTS.
Notes:
1. Length of Standard M.H. shall be increased if:
   a. Lateral openings interfere with M.H. steps.
   b. Hor. angle of divergence or convergence exceeds 5°-45°.
2. M.H. 2 & 4 line based on std. wall thickness.
3. Lateral inlets may enter both sides of M.H. structure.
FIGURE 7

Does not apply for:

(a) 18" Non-R.C.P lateral
(b) thickwall R.C.P lateral
**DETAIL "A"

(Sono-Tube, or equal, interior form)

CUT No. 1: Saw the tube at an angle of A/2 with the transverse plane. Reverse one section and tape both sections together forming the deflection angle A.

CUT No. 2: Saw the tube longitudinally removing a strip 3.14(D₂ - D₁) inches wide on the side opposite the open joint. Bend the ends of the cut together and insert the tube in the pipe.

**DETAIL "B"

TYPICAL JOINT FOR REINFORCED CONCRETE PIPE
NOTES

1. A concrete collar is required if the permitted pull of the pipe joint is exceeded. Pulling of joints shall be limited to $\frac{3}{4}$-inch from normal closure for pipe 36-inches or less in diameter and to 1-inch from normal closure for pipe 39-inches or more in diameter.

2. Concrete collars shall not be constructed on main line storm drain unless shown on the plans or ordered by the Engineer.

3. Reinforcing shall be used where the pipe diameter is greater than 21-inches and on all pipes where the space between the extremities (outermost elements) is $2\frac{1}{2}$-inches or larger.

4. CIRCULAR TIES:

<table>
<thead>
<tr>
<th>PIPE DIAMETER</th>
<th>SPACE BETWEEN PIPE EXTREMITIES</th>
<th>NO OF CIRCULAR TIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>21&quot; or less</td>
<td>$2\frac{1}{2}$&quot;</td>
<td>3</td>
</tr>
<tr>
<td>24&quot; to 30&quot;</td>
<td>$2\frac{1}{2}$&quot; or less</td>
<td>3</td>
</tr>
<tr>
<td>33&quot; to 57&quot;</td>
<td>$2\frac{1}{2}$&quot; or less</td>
<td>4</td>
</tr>
<tr>
<td>60&quot; to 66&quot;</td>
<td>$2\frac{1}{2}$&quot; or less</td>
<td>5</td>
</tr>
</tbody>
</table>

Where the space between the pipe extremities exceeds $2\frac{1}{2}$-inches, the number of circular ties shall be increased to maintain an approximate spacing of 6-inches center to center.

5. Concrete shall be Class A.

6. For pipe larger than 66-inches in diameter a special collar detail shall be delineated on the project plans.

7. Where the pipe is 21-inches or less in diameter, an interior form of unsealed Sono-Tube, or equal, shall be used to provide a smooth interior joint. The paper form may be left in place. When the pipe is 24-inches or larger a removable interior form shall be used or the interior joint shall be completely filled with mortar and neatly pointed.

8. Where pipes of different diameters are joined with a concrete collar, L and T shall be those of the larger pipe. A concrete collar shall not be constructed connecting a larger diameter pipe upstream to a smaller diameter pipe downstream unless shown on the improvement plans or ordered by the Engineer.

9. The value for angle A shall be shown on the improvement plans.

CONCRETE COLLAR

SHEET 2 OF 2

FIGURE 86
PLAN
(Shaft not shown)

DETAIL PLAN
(Shaft not shown)

NOTES
H - HEIGHT H (in Sec A-A and Sec B-B) shall not be less than 4'-0", but may be increased provided that the value of H shall be not less than the minimum specified. If the reducer shall be used, for H in Sec C-C, see Note P.

L - LENGTH L shall be 4 feet unless otherwise shown on plan. L may be increased on occasion of manholes situated in front of pipe ends.

M - SHAFT shall be constructed as per Sec C-C and Detail D when depth H from street grade in top of box to be less than 2'-0" for paved streets or 3'-0" for unpaved.

P - DEPTH P may or reduced to an absolute limit of 6' when larger values of P would reduce H in Sec C-C to 3'-6" or less.

T - T shall be 8" for values of H up to 6 feet, T shall be 10" for values of H over 6 feet.

1 - STEPS shall be 3" round, galvanized steel and anchored not less than 6 inches on the sides of manholes unless otherwise shown, steps shall be spaced 6'-0" to 8'-0".

2 - fts 3000 psi at 28 days

3 - REINFORCED STEEL shall be straight bars 1/2" clear from face of concrete.

4 - STATIONS of manholes shown on plan apply at center line of shaft. Elevations are shown at bottom center and refer to the finished invert grade line. See Note L.

5 - FLOOR of manhole shall be steel-troweled.

6 - SINK, reducer and pipe for access shaft shall be sealed in mortar and neatly pointed or wiped inside shaft.

MANHOLE No. 1

SECTION C-C

SECTION A-A

SECTION B-B

FIGURE 9
MANHOLE No. 2

Sheet 1 of 2

Figure 10a
1 - TABLE of values for F are on this plan.
2 - CENTER OF MANHOLE SHAFT shall be located over centerline of storm drain when diameter \( D_1 \) is 48" or less, in which case place E bars symmetrically around shaft at 45° with center line.
3 - LENGTH L shall be 5'-6" unless shown otherwise on improvement plan. At option of Contractor L may be increased or location of manhole shifted to meet pipe ends.
4 - DETAIL M: When depth of manhole from street grade to top of box is less than 2'-10½" for paved streets or 3'-6" for unpaved streets, construct monolithic shaft as per Detail M. The Contractor shall have the option of constructing shaft as per Detail M for any depth of manhole. When diameter \( D_1 \) is 48" or less, center of shaft shall be located as per Note 2.
5 - THICKNESS OF DECK shall vary when necessary to provide level pipe seat, but shall not be less than tabular values for F shown on this plan.
6 - REINFORCING STEEL shall be round, deformed bars, 1½" clear from face of concrete unless shown otherwise. Sizes and lengths are shown in table below.
7 - CONCRETE shall be class A.
8 - STEPS shall be 3" round, galvanized steel and anchored not less than 6 inches in the walls of structure. Unless otherwise shown the spacing shall be 1'-5" on centers. The lowest step shall be not more than 2'-8" above the invert.
9 - RINGS, REDUCER, AND PIPE for access shaft shall be seated in mortar and neatly pointed or wiped inside the shaft.
10 - STATIONS of manholes shown on improvement plan apply at center of shaft. Elevations shown at stations refer to prolonged invert grade lines.
11 - FLOOR of manhole shall be steel-troweled to springing line.
12 - BODY of manhole shall be poured in one continuous operation, except that the Contractor shall have the option of placing at the springing line a construction joint with a longitudinal keyway.

<table>
<thead>
<tr>
<th>STEEL TABLE FOR MANHOLE</th>
<th>D bars</th>
<th>E bars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diam. ( D_1 )</td>
<td>No. Req’d</td>
<td>Site</td>
</tr>
<tr>
<td>36&quot;</td>
<td>6</td>
<td>2'6&quot;</td>
</tr>
<tr>
<td>39&quot;</td>
<td>6</td>
<td>3'3&quot;</td>
</tr>
<tr>
<td>42&quot;</td>
<td>6</td>
<td>3'6&quot;</td>
</tr>
<tr>
<td>45&quot;</td>
<td>6</td>
<td>4'9&quot;</td>
</tr>
<tr>
<td>48&quot;</td>
<td>6</td>
<td>5'2&quot;</td>
</tr>
<tr>
<td>51&quot;</td>
<td>6</td>
<td>5'5&quot;</td>
</tr>
<tr>
<td>54&quot;</td>
<td>8</td>
<td>6'6&quot;</td>
</tr>
<tr>
<td>57&quot;</td>
<td>6</td>
<td>7'-6&quot;</td>
</tr>
<tr>
<td>60&quot;</td>
<td>8</td>
<td>8'-6&quot;</td>
</tr>
<tr>
<td>63&quot;</td>
<td>8</td>
<td>9'-6&quot;</td>
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<tr>
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<td>8</td>
<td>10'-6&quot;</td>
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<td>8</td>
<td>11'-6&quot;</td>
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<td>72&quot;</td>
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<td>12'-6&quot;</td>
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<td>75&quot;</td>
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<td>13'-6&quot;</td>
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<td>84&quot;</td>
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<tr>
<td>90&quot;</td>
<td>6</td>
<td>9'-6&quot;</td>
</tr>
<tr>
<td>96&quot;</td>
<td>6</td>
<td>10'-6&quot;</td>
</tr>
</tbody>
</table>

D bars shall be spaced 3' o.c. E bars shall be spaced 4' o.c. Tie bars shall be \( \frac{2}{3} \), spaced 18 o.c. or closer.

When L greater than 5'-6" is specified on improvement plan, continue D bars at 6' o.c.

Lengths shown in table are for longest bars. Where shorter bars are required, bend or cut to meet tied requirements.

MANHOLE No. 2

FIGURE 10 b
1. ACCESS SHAFT:

2. DEPTH P: When depth P, from street grade to top of pipe seat is less than 2'-10½" in paved streets or 3'-6" in unpaved streets, construct 2 ft diameter shaft, using concrete rings, otherwise construct 3 ft. shaft as shown on this plan.

3. OPTIONAL CONSTRUCTION: Dimension from outside top of arch storm drain to top of pipe seal, shown 8 inches on this plan, may be increased, except that in so doing P shall not be reduced to less than 2'-10½" for paved streets or 3'-6" for unpaved streets, and that reducer shall be used.

4. UNREINFORCED ARCH: When specified with unreinforced concrete arch storm drain, construct manhole as shown on this plan for arch section, using 2'-5 bars.

5. STATIONS shown on plan refer to center line of shaft.

6. REINFORCING STEEL to be per.

7. STEPS shall be 3'-round galvanized steel anchored not less than 6" in walls of structure, and unless otherwise shown shall be spaced 14'-10½" O.C. The lowest step shall be not more than 2 feet above the floor.

8. NOTES

9. f'c = 3000 psi at 28 days

MANHOLE No. 3

FIGURE II
SEAT FOR SHAFT WHEN TOP IS NOT LEVEL

SECTION G-G

SECTION N-M-P-O PROJECTED ON P-P-O

MANHOLE No. 4

MANHOLE FRAME & COVER (SEE NOTE 12)

CONCRETE RINGS (SEE NOTE 11)

CONCRETE REDUCER (SEE NOTE 11)

STEEL STEPS (SEE NOTE 11)

36" PIPE (SEE NOTE 11)

PIPE SEAT (SEE NOTE 11)

TIE BARS

OPTIMAL TOP OF STRUCTURE

OPTIONAL SUBGRADE

CONCRETE STEPS (SEE NOTE 10)

STEEL STEPS (SEE NOTE 10)

TIE BARS

LANY STANDARD PIPE JOINT

LONTUDINAL SECTION

TIE BARS

"G" BARS

LANY STANDARD PIPE JOINT

"G" BARS

"E" BARS

SEAT OF MANHOLE TO PROVIDE LEVEL PIPE SEAT VARIABLE

BUILD UP DECK OF MANHOLE TO PROVIDE LEVEL PIPE SEAT VARIABLE

LONGITUDINAL SECTION

"G" BARS

"E" BARS

SEAT FOR SHAFT WHEN TOP IS NOT LEVEL

SECTION G-G

SECTION N-M-P-O PROJECTED ON P-P-O

MANHOLE No. 4

MANHOLE FRAME & COVER (SEE NOTE 12)

CONCRETE RINGS (SEE NOTE 11)

CONCRETE REDUCER (SEE NOTE 11)

STEEL STEPS (SEE NOTE 11)

36" PIPE (SEE NOTE 11)

PIPE SEAT (SEE NOTE 11)

TIE BARS

OPTIMAL TOP OF STRUCTURE

OPTIONAL SUBGRADE

CONCRETE STEPS (SEE NOTE 10)

STEEL STEPS (SEE NOTE 10)

TIE BARS

LANY STANDARD PIPE JOINT

LONTUDINAL SECTION

"G" BARS

"E" BARS

SEAT FOR SHAFT WHEN TOP IS NOT LEVEL

SECTION G-G

SECTION N-M-P-O PROJECTED ON P-P-O

MANHOLE No. 4

MANHOLE FRAME & COVER (SEE NOTE 12)

CONCRETE RINGS (SEE NOTE 11)

CONCRETE REDUCER (SEE NOTE 11)

STEEL STEPS (SEE NOTE 11)

36" PIPE (SEE NOTE 11)

PIPE SEAT (SEE NOTE 11)

TIE BARS

OPTIMAL TOP OF STRUCTURE

OPTIONAL SUBGRADE

CONCRETE STEPS (SEE NOTE 10)

STEEL STEPS (SEE NOTE 10)

TIE BARS

LANY STANDARD PIPE JOINT

LONGITUDINAL SECTION

"G" BARS

"E" BARS

SEAT FOR SHAFT WHEN TOP IS NOT LEVEL

SECTION G-G

SECTION N-M-P-O PROJECTED ON P-P-O

MANHOLE No. 4

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CONCRETE RINGS (SEE NOTE 11)

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OPTIMAL TOP OF STRUCTURE

OPTIONAL SUBGRADE

CONCRETE STEPS (SEE NOTE 10)

STEEL STEPS (SEE NOTE 10)

TIE BARS

LANY STANDARD PIPE JOINT

LONGITUDINAL SECTION

"G" BARS

"E" BARS

SEAT FOR SHAFT WHEN TOP IS NOT LEVEL

SECTION G-G

SECTION N-M-P-O PROJECTED ON P-P-O

MANHOLE No. 4

MANHOLE FRAME & COVER (SEE NOTE 12)

CONCRETE RINGS (SEE NOTE 11)

CONCRETE REDUCER (SEE NOTE 11)

STEEL STEPS (SEE NOTE 11)

36" PIPE (SEE NOTE 11)

PIPE SEAT (SEE NOTE 11)

TIE BARS

OPTIMAL TOP OF STRUCTURE

OPTIONAL SUBGRADE

CONCRETE STEPS (SEE NOTE 10)

STEEL STEPS (SEE NOTE 10)

TIE BARS

LANY STANDARD PIPE JOINT

LONGITUDINAL SECTION
1. CONCRETE SHALL BE CLASS A

2. DIMENSIONS:
   B. THE LENGTH OF DIMENSIONS "D", "E", AND "L" MAY BE INCREASED AT THE OPTION OF THE CONTRACTOR TO MEET PIPE EXITS, PROVIDED PRIOR APPROVAL IS OBTAINED FROM THE ENGINEER.

3. REINFORCEMENT SHALL CONFORM TO SECTION 260 OF THE STANDARD SPECIFICATIONS, AND TO DETAILS AND SCHEDULES SHOWN IN THE REINFORCEMENT SCHEDULE SHOWN HEREBY:
   A. "A", "B", AND "F" BARS REFER TO DIMENSION "B". EXTEND "A" AND "B" BARS 6" BEYOND THE OPENING.
   B. "C", "D", AND "G" BARS REFER TO DIMENSION "D".
   C. "E" BARS REFER TO DIMENSION "D".
   D. "COVER" MEANS THE DIFFERENCE IN VERTICAL ELEVATION BETWEEN THE TOP OF THE STRUCTURE AND THE SURFACE GRADE ABOVE.
   E. "TIE BARS SHALL BE NO. 8 AT 18 INCHES.
   F. REINFORCEMENT SHALL BE PLACED 1-1/2 INCHES CLEAR FROM THE INSIDE FACE OF CONCRETE EXCEPT AS OTHERWISE INDICATED HEREBY.
   G. WALL AND SLAB THICKNESSES ("I") SHALL BE AS SHOWN HEREBY.
   H. FOR "G" GREATER THAN 72 INCHES OR "D" GREATER THAN 56 INCHES, SEE PROJECT PLANS.

4. A STEEL TRAVEL SURFACE SHALL BE PROVIDED FOR THE CONCRETE FLOOR OF THE STRUCTURE AND TO THE CONCRETE SIDES FROM THE INVERT TO THE SPRING LINE.

5. CONCRETE FOR THE STRUCTURE, INCLUDING THE LATERAL(S) SHALL BE PLACED IN ONE CONTINUOUS OPERATION, EXCEPT THAT THE CONTRACTOR MAY AT HIS OPTION PLACE AT THE SPRING LINE A CONSTRUCTION JOINT WITH A LONGLITUDE OF KEYWAY MEASURING NOT LESS THAN HALF THE VALUE LENS IN BOTH HEIGHT AND WIDTH.


7. WHERE LATERALS ENTER ON BOTH SIDES OF THE STRUCTURE, THEY SHALL BE DESIGNATED ON THE PROJECT PLANS AS RIGHT OR LEFT, FACING IN THE DIRECTION OF STATIONING.


9. WHEN THE DEPTH OF THE MANHOLE FROM THE STREET GRADE TO THE TOP OF THE REDUCER IS LESS THAN 1 FOOT FOR PAVED STREETS OR 1 FOOT 6 INCHES FOR UNPAVED STREETS, CONSTRUCT MONOLITHIC SHAFT PER DETAIL "M" HEREBY. THE CONTRACTOR MAY CONSTRUCT THE SHAFT AS PER DETAIL "M" HEREBY FOR ANY HEIGHT OF MANHOLE, PROVIDED PRIOR APPROVAL IS OBTAINED FROM THE ENGINEER.

10. INSTALL STEPS CONFERRING TO A.O. STANDARDS.

11. INSTALL PIPE SEAT, INSTALL RING, REDUCER, AND PIPE FOR MANHOLE SHAFT CONFORMING TO FIGURE 32.

12. INSTALL MANHOLE FRAME AND COVER CONFORMING TO A.O. STANDARDS.

### STRUCTURAL DATA

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### MANHOLE No. 4

Sheet 2 of 2
NOTES

1. Values for A, B, and C are shown on the project drawings. Elevation R and Elevation S are shown also.
2. Stations specified on drawings apply to the intersection of center lines of main line and laterals, except those stations for catch basin connection pipe apply at inside wall of structure.
3. Reinforcing steel shall be bent at straightest part of pipe unless otherwise shown.
4. W bars are of size and spacing specified for wall steel on plan, and shall be cut in center of opening and bent into top and bottom of junction structure.
5. W bars when invert of spout is 12" or less below soffit of main line, and omit C bars when invert of spout is 12" or less above floor of main line.
6. Floor of structure shall be steel-faced to the spring line.
7. Embedment P. shall be 5' for B < 96 or less and 6' for B > 96.

JUNCTION STRUCTURE No.

FIGURE 14
CONCRETE CRADLE (SEE NOTES 1 AND 3)

PLAN

OPTIONAL CONSTRUCTION

A AND B BARRS

STATION POINT

TIE BARS (H4 @ 18")

F BARRS

(H4 @ 6")

TIE BARS

(H4 @ 12")

MAIN LINE

Y

Z'

Z''

Z'''

SECTION Z'-Z''-Z'''

PROJECTED ON Y-Y-Z''

UNDISTURBED EARTH

POUR AGAINST UNDISTURBED EARTH

MINIMUM

SPRING LINE

CONCRETE CRADLE (SEE NOTES 1 AND 3)

TIE BARS

(H4 @ 18")

EL S

3" R

A BARS

TIE BARS

(H4 @ 12")

F BARRS

(H4 @ 6")

B BARRS

EL R

H

H

H

SECTION M-M

STRUCTURAL DATA

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WHEN B > 39" SEE PROJECT PLANS

JUNCTION STRUCTURE No. 2

SHEET 1 OF 2

FIGURE 15a
NOTES FOR JUNCTION STRUCTURE 2


2. DIMENSIONS:


H = 1/2 PIPE I.D. + 3 INCHES, MINIMUM.
J = 1/2 + 6 INCHES

3. THE MAIN LINE PIPE SHALL BE SUPPORTED LONGITUDINALLY FOR ITS ENTIRE WIDTH BY A CONCRETE CRADLE TO ONE FOOT BEYOND THE LIMITS OF L ON BOTH ENDS. WHERE CONSTRUCTION OF THIS STRUCTURE OCCURS IN CONJUNCTION WITH AN EXISTING MAIN LINE PIPE, THAT PORTION OF THE CRADLE MAY BE OMITTED THAT WOULD BE PLACED ON THE SIDE OPPOSITE THE LATERAL AND BETWEEN THE OUTSIDE EDGE OF AND TO THE CENTERLINE OF THE EXISTING PIPE.

4. THE RECTANGULAR OPENING IN THE MAIN LINE PIPE SHALL BE CUT WITHIN THE LIMITS SHOWN HEREON NORMAL TO THE PIPE SURFACE WITHOUT DAMAGING THE PIPE REINFORCEMENT.

5. REINFORCEMENT SHALL CONFORM TO SECTION 506 OF THE STANDARD SPECIFICATIONS, AND TO DETAILS SHOWN HEREON. A AND B BARS SHALL BE CARRIED TO A POINT NOT LESS THAN A DISTANCE EQUAL TO J FROM THE CENTERLINE. TRANSVERSE REINFORCEMENT IN PIPE SHALL BE CUT IN CENTER OF OPENING AND BENT TO UNIFORM DISTANCE FROM TOP AND BOTTOM OF JUNCTION STRUCTURE.

6. WHEN THE MAIN LINE IS AN ARCH SECTION:

A. DIMENSION D SHALL BE THE CLEAR SPACE OF THE ARCH.

B. REINFORCEMENT SHALL BE CUT AND BENT INTO THE JUNCTION STRUCTURE IN THE SAME FASHION AS IF THE MAIN LINE WERE PIPE.

C. THE CONCRETE CRADLE MAY BE DELETED UNDER THE ARCH SECTION.

7. A STEEL TROWEL SURFACE SHALL BE PROVIDED FOR THE CONCRETE FLOOR OF THE STRUCTURE AND TO THE CONCRETE SIDES FROM THE INVERT TO THE SPRING LINE.

8. THE CONTRACTOR MAY AT HIS OPTION CONSTRUCT A TRANSITION STRUCTURE CONFORMING TO FIGURE 19 IN LIEU OF A JUNCTION STRUCTURE.

JUNCTION STRUCTURE No 2

/SHEET 2 OF 2/

FIGURE 15b
CASE 1 - BEAM SUPPORT

D = 30° OR LESS

CASE 2 - COLUMN SUPPORT

D = 60° OR LESS FOR C.M.P.
D = 30° OR LESS FOR R.C.P. OR C.P.

NOTES:

1. All corrugated metal pipe and fittings shall be galvanized.
2. Use Junction Structure No. 1 where size of inlet pipe exceeds dimensions given above.
3. Unless otherwise specified, Case 2 support shall be used.
4. E1 "5" shall be specified on project drawings only where top of pipe is more than 12" below soffit of box.

JUNCTION STRUCTURE No.3

FIGURE 16a
CASE 1
SADDLE CONNECTION

CASE 2
PIPE CONNECTION THROUGH BARREL

PLAN

PLAN

SECTION

SECTION

1 - CONNECTIONS TO PIPES OR CONDUITS LARGER THAN 21 INCHES IN DIAMETER WITHOUT JUNCTION STRUCTURES OR PRECAST T BRANCHES SHALL BE MADE WITH SADDLES.

2 - THE LENGTH OF THE SADDLE PIPE ON THE SHORT SIDE SHALL NOT BE MORE THAN 8 INCHES INCLUDING THE SOCKET.

3 - THE SADDLE SHALL BE TIPPED OR CUT SO THAT IT WILL FIT SNUGLY OVER THE OUTSIDE OF THE MAIN PIPE, AND SO THAT WHEN IN PLACE ITS AXIS WILL BE ON THE LINE AND GRADE OF THE CONNECTING PIPE.

4 - THE OPENING INTO THE PIPE SHALL BE CUT AND TRIMMED TO FIT THE SADDLE SO THAT NO PART WILL PROJECT WITHIN THE BORE OF THE SADDLE PIPE.

5 - THE JOINT BETWEEN THE SADDLE AND THE MAIN PIPE SHALL BE COVERED WITH CLASS "C" MORTAR.


JUNCTION STRUCTURE No. 4

FIGURE 16 b
1. Concrete shall be Class A per Section 9.2 of the Standard Specifications, where the junction structure is to be constructed within the limits of or is contiguous to a proposed sidewalk. The top slab of the junction structure shall be placed monolithically with the sidewalk, and the sidewalk shall be provided with a weakened plane or a continuous 1-inch deep saw cut around the external perimeter of the junction structure walls, including across the full width of the sidewalk. The surface of all exposed concrete shall conform in slope, grade, color, finish, and scoring to existing or proposed sidewalk adjacent to the junction structure.

2. All curved concrete surfaces shall be formed by curved forms, and shall not be shaped by plastering.

3. The floor of the junction structure shall be given a steel trowel finish any shall have a slope of 1:12 in each direction and sloped to the outlet.

4. Connector pipes shall be placed as indicated on the project plans. The connector pipe center line shall intersect the midpoint of the inside face of the indicated junction structure wall, or if indicated at a corner, it shall intersect the inside corner. Pipe may be cut and trimmed at a skew necessary to insure minimum 3-inch embedment. All anchor bolts within the junction structure walls, and 3-inch radius of rounding of structure concrete, all around, adjacent to pipe ends. A monolithic connection per shall be used to join the connector pipe to the junction structure whenever angle A is less than 70 degrees or greater than 110 degrees, or whenever the connector pipe is located at a corner. The optional use of a monolithic connection in any case is permitted. Monolithic connections may be extended up to 4 feet in length to avoid cutting standard lengths of pipe. Connector pipe may not be cut for any reason except to avoid construction of a monolithic connection.

5. Dowels shall be required at each corner when the top slab is not placed monolithically with a sidewalk. When the top slab is placed monolithically with adjacent sidewalk, the dowels may be omitted.

6. The manhole frame and cover shall conform to ADOt Standards be installed. The frame and cover shall be installed in a corner as shown herein, and in such a manner that the inside of the frame shall be flush with the inside of the two walls, one of which shall contain the outlet pipe connection.

7. Steps shall conform to ADOt Standards and shall be directly below the manhole frame and cover.

8. The intersection of the center lines of the structure shall be constructed at the location indicated on the project plans. When the structure is constructed adjacent to a curb on a curve, one of the structure center lines shall be radial to the curve.

9. Dimensions:
   \[ L = 3' - 0'' \]
   \[ B = 3' - 0'' \]
   \[ Y = 3' - 0'' \]
   \[ D = 1' - 0'' \]
   \[ A = \text{the angle, in degrees, formed by the center line of the connector pipe and the junction structure wall to which the connector pipe is attached.} \]
   \[ t = 4 - 1/2'' \text{ for standard sidewalk} \]

JUNCTION STRUCTURE No. 5

SHEET No. 2 of 2

FIGURE 16d
TRANSITION STRUCTURE
No. 1

* Arch may have a horseshoe-shaped, circular, elliptical or similar cross-section.

NOTES
1. The horizontal angle of divergence or convergence, θ, shall not exceed 5° 45'.
2. Reinforcing steel bar sizes, spacing, pattern and cover over the steel shall be as follows:
   - Box to pipe and box to arch—Use bent bar of box section.
   - Arch to pipe—Use bent bar of arch section.
   - Arch to arch—Use bent bar of arch section having the thicker walls.
   - The bar lengths shall vary uniformly throughout the transition.
3. The concrete thickness shall be as follows:
   - Box to pipe and box to arch—Use bent bar of box section unless the wall thickness of the pipe plus 4 inches is greater, in which case the concrete thickness shall vary uniformly from that of the arch or box section to that of the pipe wall plus 4 inches.
   - Box to arch and arch to arch—Use bent bar of the adjoining box or arch section at each end of the transition and shall vary uniformly between the two ends.
4. The interior surface shall be smooth and vary uniformly between the two adjoining sections.
5. At pipe juncture, embedment P shall be 5 inches for pipe sizes of 96 inches or less, and 8 inches for pipe sizes over 96 inches.
6. $f_c = 3000$ p.s.i. at 28 days.
7. Keyed construction joints of the same dimensions as those of the box or arch section may be carried through the transition structure at the contractor's option. See Sec. 8-8 above.
8. The transition structure shall be constructed in accordance with the general structural notes applying to box or arch structures shown on the project drawings.
TRANSITION STRUCTURE

NOTES

1. The horizontal angle of divergence or convergence, θ, shall not exceed 5°.  
2. The reinforcing steel bar, lapping, and cover over the street of top or bottom consists of through-steel bars of #5, #6, or #7 bars with longitudinal distribution and tie bars in top or bottom consistent with the transition.  
3. The reinforcing bars shall be of the same or equivalent steel as used throughout the transition.  

The bar lengths shall be 6000 p.s.i. at 28 days.

The transition structure shall be constructed in accordance with the project drawings as shown on the project drawings for transition and shall be be uniform with the transition and shall

SECTION A - A

SECTION B - B

PLAN

R.C. Box

Center Line

C

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z

-38-
TRANSITION STRUCTURE No. 3

SECTION N'-N''-N'''
PROJECTED ON M-M-N''
CONCRETE SHALL BE CLASS A PER SECTION 502 OF THE STANDARD SPECIFICATIONS.

2. DIMENSIONS:
A. SEE PROJECT PLANS FOR VALUES OF A, B, C, D, E, F, AND ELEVATIONS "E", "G", AND "L"." T" AND "M" ARE TO BE DETERMINED AT THE OPTION OF THE CONTRACTOR TO MEET PIPE EXS.
C. PRIOR APPROVAL IS OBTAINED FROM THE ENGINEER


WEN ELEVATION "R" IS NOT INDICATED ON THE PROJECT PLANS, THE CONSTRUCTION GRADE BETWEEN THE STATION POINT (ELEVATION "S") AND THE FIRST ELEVATION SHOWN ON THE PROJECT PLANS UPSTREAM OF THE STATION POINT (ELEVATION "S") IS CONSTANT.

3. REINFORCEMENT SHALL CONFORM TO SECTION 504 OF THE STANDARD SPECIFICATIONS, AND TO DETAILS AND SCHEDULES SHOWN IN THE REINFORCEMENT SCHEDULE SHOWN HERED.
A. "A", "B", AND "C" BARS REFERENCE DIMENSION "A";
B. "C" AND "G" BARS REFERENCE DIMENSION "C";
C. "COVER" MEANS THE DIFFERENCE IN VERTICAL ELEVATION BETWEEN THE TOP OF THE STRUCTURE AND THE SURFACE GRADE; 28 INCHES;
D. TIE BARS SHALL BE NO. 4 AT 18 INCHES;
E. REINFORCEMENT SHALL BE PLACED 3-1/2 INCHES CLEAR FROM THE INSIDE FACE OF CONCRETE EXCEPT AS OTHERWISE SHOWN HERED;
F. WALL AND SLAB THICKNESS (T) SHALL BE AS SHOWN HERED
G. FOR "S" GREATER THAN 72 INCHES OR D, GREATER THAN 96 INCHES, SEE PROJECT PLANS.

4. A STEEL TROWEL SURFACE SHALL BE PROVIDED FOR THE CONCRETE FLOOR OF THE STRUCTURE AND TO THE CONCRETE SIDES FROM THE INVERT TO THE SPRING LINE.

5. CONCRETE FOR THE STRUCTURE, INCLUDING THE LATERAL(S) SHALL BE PLACED IN ONE CONTINUOUS OPERATION, EXCEPT THAT THE CONTRACTOR MAY AT HIS OPTION PLACE AT THE SPRING LINE A CONSTRUCTION JOINT WITH A LONSDAL WARNING MEASURING NOT LESS THAN 1/2" THE WALL THICKNESS IN BOTH HEIGHT AND WIDTH.


WHERE LATERALS ENTER OR BOTH SIDES OF THE STRUCTURE, THEY SHALL BE DESIGNATED ON THE PROJECT PLANS AS RIGHT OR LEFT, FACING IN THE DIRECTION OF STATIONING.

### STRUCTURAL DATA

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<th>DIMENSION F OR T</th>
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SEE PROJECT PLANS

**TRANSITION STRUCTURE No. 3**

*Sheet No. 2 of 2*  
*Figure 19 b*
CATCH BASIN No. 1

SECTION A-A

SUPPORT PLATE CHORD LENGTHS ON CURVES
(SEE NOTE 13)

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<th>MINIMUM RADIO</th>
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Dowel Detail

Dowel Detail

Structural Data

Wall and Slab Dimensions and Reinforcement Requirements

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FOR W28 OR V212 SEE PROJECT PLANS
NOTES FOR SITE OPENING CATCH BASINS

1. CONCRETE SHALL BE THE CLASS SPECIFIED IN SECTION 570 OF THE STANDARD SPECIFICATIONS, EXCEPT WHERE THE BASIN IS TO BE CONSTRUCTED WITHIN THE LIMITS OF A PROPOSED SIDEWALK OR IS CONTIGUOUS TO SUCH A SIDEWALK. THE TOP SLAB OF THE BASIN SHALL BE POURED MONOLITHIC WITH THE SIDEWALK, USING THE SAME CLASS OF CONCRETE AS IN THE SIDEWALK. THE SIDEWALK SHALL BE PROVIDED WITH A WEATHERED PLANE OF 1 INCH DEEP SHAVING CONTINUOUSLY ALONG THE EXTERIOR PERIMETER OF THE CATCH BASIN WALLS, INCLUDING ALONG THE FULL WIDTH OF THE SIDEWALK. SURFACE OF ALL EXPOSED CONCRETE SHALL CONFORM IN SLOPE, GRADE, COLOR, FINISH, AND SIZING TO LOCAL CODE OR PROPOSED CURB AND SIDEWALK ADJACENT TO THE BASIN.

2. ALL CURVED CONCRETE SURFACES SHALL BE FORMED BY CURVED FORMS, AND SHALL NOT BE SHAPED BY PLASTERING.

3. FLOOR OF BASIN SHALL BE GIVEN A STEEL TROUBLE FINISH AND SHALL HAVE A CONCRETE AND LATERAL SLOPE OF 1:12, EXCEPT WHERE THE GUTTER SPACE EXCEEDS 8 INCHES, IN WHICH CASE THE CONCRETE SLOPE OF THE FLOOR SHALL BE THE SAME AS THE GUTTER SLOPE.

4. DIMENSIONS:

   B = 3 FEET 2 INCHES

   V = 4.5 FEET. WHERE CATCH BASINS ARE IN SERIES "V" SHALL BE THE DEPTH TO THE INERT OF THE INLET PIPE AND "G" SHALL BE THE DEPTH TO THE INERT OF THE OUTLET PIPE.

   W = 24 IN. INDICATED ON THE PROJECT PLANS.

   1) 1/6 INCHES FOR STANDARD SIDEWALK, AND 6 INCHES FOR SPECIAL SIDEWALK. SEE PROJECT PLANS.

   2) THE ANGLE 13 DEGREES, INTERCEPTED BY THE CENTERLINE OF THE CONNECTOR PIPE AND THE CATCH BASIN WALL TO WHICH THE CONNECTOR PIPE IS ATTACHED.

5. PLACE CONNECTOR PIPES AS INDICATED ON THE PROJECT PLANS. UNLESS OTHERWISE DETAILED ON THE PROJECT PLANS, A CONNECTOR PIPE CENTERLINE SHALL INTERSEC THE MIDPOINT OF THE INSIDE EDGE OF THE BOTTOM OUTLET PIPE, OR IF INDICATED AT THE CORNER, IT SHALL INTERSECT THE INSIDE CORNER. THE PIPE MAY BE CUT AT AN ANGLE AT A SLOPE NECESSARY TO INSURE MINIMUM 3 INCH RADIUS OF ROUNDING OF STRUCTURE CONCRETE, ALL ARMS, ADJACENT TO PIPE ENDS. A MONOLITHIC CONNECTION PER FIGURE 2.9 SHALL BE USED TO JOIN THE CONNECTOR PIPE TO THE CATCH BASIN REGARDLESS OF ANGLE "A" less than 75 DEGREES OR GREATER THAN 130 DEGREES, OR WHENEVER THE CONNECTOR PIPE IS LOCATED IN A CORNER. THE OPCIONAL USE OF A MONOLITHIC CONNECTION IN ANY CASE IS PERMITTED. MONOLITHIC CONNECTIONS MAY BE EXTENDED UP TO A FEET IN LENGTH TO AVOID CUTTING STANDARD LENGTHS OF PIPE. CONNECTOR PIPE MAY NOT BE CUT FOR ANY REASON EXCEPT TO AVOID CONSTRUCTION OF A MONOLITHIC CONNECTION.

6. STEPS SHALL CONFORM TO ABDOT STANDARDS AND SHALL BE DIRECTLY BELOW THE MANHOLE FRAME AND COVER.


8. CURB INLET, SUPPORT PLATE, SUPPORT BOLTS, AND ANCHORS SHALL CONFORM TO FIGURE 2.6.

9. PROTECTION BAR AND SUPPORTS SHALL CONFORM TO FIGURES 2.7.

10. CATCH BASIN MANHOLE FRAMES AND COVERS SHALL CONFORM TO ABDOT STANDARDS.

11. WALL AND BOTTOM SLAB THICKNESSES SHALL BE AS SHOWN HEREIN. REINFORCEMENT, WHEN REQUIRED, SHALL CONFORM TO FIGURE 2.5. FOR ANY VALUE OF "S" OR "W" NOT INDICATED HEREIN, USE THE VALUE FOR THE NEAREST "S" OR "W" THAT IS INDICATED.

12. ALL CONSTRUCTION JOINTS SHALL HAVE PLAIN SURFACES.

13. CATCH BASINS LOCATED ON A CURVE, MAY, AT THE OPTION OF THE CONTRACTOR, BE CONSTRUCTED ON CHORDS AS INDICATED HEREIN. IF MORE THAN ONE CHORD IS USED ON ANY CATCH BASIN, THE CHORD LENGTHS SHALL BE IDENTICAL. THE SUPPORT PLATE SEGMENTS SHALL BE SPACED AS SHOWN ON FIGURE 2.6.

14. UNLESS OTHERWISE INDICATED ON THE PROJECT PLANS:

   - CONSTRUCT WAVED GUTTER TO CONFORM TO FIGURE 34.
ELEVATION A-A

DETAIL OF DOWEL

PLAN

SECTION C-C

SECTION B-B

CATCH BASIN No. 8
CASE A

NOTES

1. Catch Basin shall be Case A unless otherwise specified.

2. The catch basin opening shall be constructed according to:
   Steel castings, mild to medium strength of 4 ft. radius
   and like section shall be used on circular arc portion of
   the catch basin opening in place of steel plate.
   The castings shall be beveled and butt welded to
   the proper length, to a true arc, and secured to the top slab
   by anchors. One anchor shall be placed at each end of the
   assembly and the others spaced evenly between the end
   anchors. There shall be at least one anchor on each casting.

3. Where one or more connective pipes enter into the catch
   basin, the outlet chamber shall be constructed as shown in
   Section A-A, sheet 2.

4. Curvature of the lip and sidewalls at gutter opening shall
   be formed by curved forms.

5. Dimensions: 1'-5" and 1'-3" unless otherwise specified.

6. Floor of basin shall be given a steel-frowned surface
   and shall slope from all directions to the outlet.

7. Manhole shall be placed along back wall near outlet.

NOTES CONTINUED ON SHEET 2

Sheet 1 of 3

Figure 23a
RESIDENTIAL DRIVEWAYS

NOTES TO DESIGNER

1. AVOID USING A CATCH BASIN NO. 8 ADJACENT TO A SKewed DRIVEWAY, OR ANY DRIVEWAY WHICH WILL BE WIDERED EXCESSIVELY IF CONSTRUCTED.

2. AVOID USING A CATCH BASIN NO. 8 ADJACENT TO A DRIVEWAY WHICH ACCOMMODATES A LARGE VOLUME OF HEAVY TRUCK TRAFFIC, OR ADJACENT TO A GASOLINE STATION.

3. THE DESIGNER SHOULD FIELD CHECK PROPOSED LOCATIONS TO DETERMINE IF ABOVE RESTRUCTIONS APPLY AND IF ANY EXISTING FACILITIES WILL INTERFERE WITH CONSTRUCTION. CONSIDERATION SHOULD BE GIVEN TO THE USE OF A CATCH BASIN NO. 6 WHEN CONDITIONS DO NOT FAVOR THE USE OF A CATCH BASIN NO. 8.

COMMERCIAL DRIVEWAY

CATCH BASIN 8
LOCATION DETAILS

SHEET 3 OF 3
FIGURE 23c
**DESIGN NOTES**

1. **MODIFICATIONS ARE TO BE USED AS REQUIRED BY THE PROJECT ENGINEER.** All additional changes are subject to the approval of the engineer.

2. **DETAILS NOT SHOWN SHALL BE PER THE APPLICABLE CATCH BASIN STANDARD DRAWINGS.**

3. **REFER TO THE PROJECT DRAWINGS FOR DETAILS OF THE UTILITY AND CULVERT RELATED TO THE SITE.**

4. **ELBOWING PORTIONS OF EXISTING CULVERTS SHALL BE REPAIRED TO A LINES HORIZONTAL TO THE CULVERT CENTER LINE AND A MINIMUM OF THE CULVERT MEET INLET IF REQUIRED.** SOME CUTTING SHOULD BE USED TO PROVIDE A NEAT JUNCTION ON THE EXPOSED SURFACE.

5. **PLACES STAIRS IN END WALL OF CATCH BASIN UNTIL DETERMINED LATER.**

6. **WHERE REINFORCEMENT IS REQUIRED, A STANDARD REINFORCEMENT NO. 2 0.375 IN. SHALL BE PLACED IN THE 3/16 THICKNESS OF THE PLATED BASIN.**

7. **ELECTRICALLY REINFORCED STDRS 3/16 X 3/4 MELN. HFT OR 1 1/2 IN. OR 2 1/2 IN. AT THE REFERRED LOCATION.**

8. **NO. 4 BARS @ 12" MAY BE USED IN LIEU OF NO. 5 BARS.**

---

**CATCH BASIN MODIFICATIONS**

**CASE I**

CATCH BASIN MODIFICATION WITH REAR CULVERT ENTRANCE AND/OR ENTRANCE PROJECTION

**CASE II**

CATCH BASIN MODIFICATION TO AVOID EXISTING UTILITY

**CASE III**

SAFETY BAR FOR DROP OUTLET CATCH BASIN

**FIGURE 25**
ANCHORS (See Sheet 3)

1/8" x 10" Steel Support Plate formed as shown. (See Note 3)

Hole in Support Plate for Support Bolt and/or Eye Bolt when required. (See Note 4 for location and size)

Hex Nuts to be tightened to secure the steel plate in proper position.

R = 1 1/2" min.

Protection Bar and Support. (See Note 7)

1" x 20" Support Bolt with Hexagonal Nuts. (See Note 5)

SECTION OF CURB INLET
(4 1/2" TOP SLAB)

CASE I

SPLICE PLATE FOR 10" SUPPORT PLATE

CATCH BASIN OPENING DETAILS

FIGURE 26 a

SHEET 1 OF 4

-47a-
SECTION OF CURB INLET
(6" TOP SLAB)

CASE II

CATCH BASIN OPENING DETAILS

FIGURE 26B  SHEET 2 OF 4

SPLICE PLATE FOR 13 11/16" SUPPORT PLATE
HOOK ANCHOR FOR 4\textfrac{1}{2}\text{"} TOP SLAB

\begin{center}
CASE I
\end{center}

ROUND HEAD ANCHOR FOR 4\textfrac{1}{2}\text{"} TOP SLAB

\begin{center}
CASE I
\end{center}

HOOK ANCHOR FOR SPECIAL 6\text{"} TOP SLAB

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CASE II
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ALTERNATE METHODS FOR SUPPORT

PLATE ANCHORAGE

CATCH BASIN OPENING DETAILS

FIGURE 26c

SHEET 3 OF 4
NOTES FOR CATCH BASIN CURB INLET AND SUPPORT DETAILS

1. All metal parts shall be galvanized after fabrication.

2. Location and spacing of anchors
   a. Set one anchor 3 inches from each end of the support plate.
   b. Space anchors as shown for each alternate.
   c. Place one anchor within 6 inches and on each side of splice joint.

3. The length of the support plate shall be equal to the nominal catch basin length, plus 1 foot. Install the support plate so that it extends 6 inches beyond the ends of the catch basin opening when the length of support plate is longer than 22 feet. The support plate may be fabricated in sections provided the sections are spliced as shown hereon, and the joint is located a minimum of one foot from a support bolt.

4. Provide a 1-1/4 inch diameter hole in the support plate at L - 1/8 inches at each location a support bolt is required. Provide a 3/4 inch diameter hole in the support plate at L - 1/8 inches, 12 inches from each end of the support plate, whenever a protection bar is required.

5. Support bolts are required when the length of catch basin opening is 7 feet, or greater, and shall be evenly spaced across the opening. Spacing shall not be less than 3 feet 6 inches O.C. nor greater than 5 feet O.C.

6. Case 1I CURB INLET AND SUPPORT DETAILS shall apply when special sidewalk is indicated on the project plans. Otherwise case 1 CURB INLET AND SUPPORT PLATE DETAILS shall apply.

7. Protection bar and support conforming to Figure 27 are required when curb face at catch basin exceeds 9-1/4 inches.

8. See Figures 7-9 for details of warped gutter and for curb face at the inlet (6 inches unless otherwise indicated on the project plans).

CATCH BASIN OPENING DETAILS

FIGURE 26 d

SHEET 4 OF 4
ADJUSTABLE PROTECTION
BAR STIRRUP

NOTE:
1. Material shall be Cast Steel.
2. Stirrups shall be galvanized.
3. For installation details see...
TYPICAL REINFORCEMENT DETAILS

<table>
<thead>
<tr>
<th>MAX. W</th>
<th>MAX. V</th>
<th>l</th>
<th>&quot;A&quot; &amp; &quot;B&quot; BARS</th>
<th>&quot;C&quot; BARS</th>
<th>&quot;D&quot; BARS</th>
<th>&quot;E&quot; BARS</th>
<th>&quot;F&quot; BARS</th>
<th>&quot;G&quot; BARS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5'</td>
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<td>6'</td>
<td>6&quot;</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5'</td>
<td>12'</td>
<td>8'</td>
<td>8'</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7'</td>
<td>6'</td>
<td>6'</td>
<td>6&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7'</td>
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<td>8&quot;</td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>14'</td>
<td>4'</td>
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<td>6&quot;</td>
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<td>6'</td>
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<td>#4 @ 12&quot;</td>
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<td></td>
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<td>6'</td>
<td>8&quot;</td>
<td>#3 @ 20&quot;</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>28'</td>
<td>6'</td>
<td>8'</td>
<td>8&quot;</td>
<td>#3 @ 12&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28'</td>
<td>7'</td>
<td>8'</td>
<td>8&quot;</td>
<td>#4 @ 17&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28'</td>
<td>8'</td>
<td>8'</td>
<td>8&quot;</td>
<td>#4 @ 15&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28'</td>
<td>9'</td>
<td>8'</td>
<td>10&quot;</td>
<td>#4 @ 15&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28'</td>
<td>10'</td>
<td>8'</td>
<td>10&quot;</td>
<td>#4 @ 12&quot;</td>
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<td></td>
</tr>
<tr>
<td>28'</td>
<td>11'</td>
<td>8'</td>
<td>10&quot;</td>
<td>#5 @ 15&quot;</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>28'</td>
<td>12'</td>
<td>8'</td>
<td>12&quot;</td>
<td>#6 @ 10&quot;</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

FOR W > 28 OR V > 12, SEE PROJECT PLANS

CATCH BASIN REINFORCEMENT

SHEET 1 OF 2

FIGURE 28a
NOTES FOR CATCH BASIN REINFORCEMENT

1. FOR ANY "W" OR "V" NOT INDICATED HERED, USE THE VALUE FOR THE NEXT HIGHER "W" OR "V" THAT IS INDICATED.

2. BAR SPACINGS ARE CENTER TO CENTER OF BARS. BAR COVER IS THE CLEAR DISTANCE BETWEEN SURFACE OF BAR AND FACE OF CONCRETE, AND SHALL BE, EXCEPT AS OTHERWISE INDICATED, 2 INCHES WHEN POURED AGAINST A FORCED SURFACE, OR 3 INCHES WHEN POURED AGAINST EARTH.

3. EXCEPT WHERE OTHERWISE INDICATED, REINFORCEMENT SHALL TERMINATE 2 INCHES FROM FACE OF CONCRETE.

4. FOR THICKNESS AND REINFORCEMENT OF TOP SLAB, SEE APPLICABLE CATCH BASIN STANDARD PLAN.

DESIGN DATA

ALLOWABLE STRESSES (REINFORCED CONCRETE):

\[ f'_c = 3200 \text{ psi} \]
\[ f'_t = 1300 \text{ psi} \]
\[ f'_v = 20,000 \text{ psi} \]

ALLOWABLE TENSILE STRESSES (UNREINFORCED CONCRETE):

\[ f'_t = 182 \text{ psi} \] (F.S. OF 4.0 BASED UPON AN ASSUMED MODULUS OF RUPTURE = 570 psi)

LOADS:

- LL TOP SLAB = 300 psf
- EARTH EQUIV. FLUID PRESSURE = 56 psf
- TRUCK LL ON FRONT WALL = 1820-04

CATCH BASIN REINFORCEMENT

SHEET 2 OF 2

FIGURE 286
NOTES

1. Reinforcing steel shall be 1½" clear from face of concrete unless otherwise shown.

2. Reinforcing steel for inside face of catch basin wall shall be cut at center of opening and bent into walls of monolithic connection. Reinforcing steel for outside face of catch basin wall shall be cut 2" clear of opening.

3. Connection shall be poured monolithic with catch basin. The rounded edge of outlet shall be constructed by pouring concrete against a curved form with a radius of 5".

4. Floor of structure shall be steel-traveled to spring line.

5. Connections shall be constructed when:
   (a) Pipes, 12 inches through 72 inches in diameter, inlet or outlet through corner of catch basin.
   (b) Angle A, for pipes 24 inches through 30 inches in diameter, is 70° or less
   (c) Pipes, 15 inches through 72 inches in diameter, inlet or outlet through any wall of catch basin if the connector pipe may not extend to the wall per the applicable catch basin standard.

1. The connection to the basin for pipes 12 inches thru 72 inches.

<table>
<thead>
<tr>
<th>B</th>
<th>T</th>
<th>C bars</th>
<th>D &amp; E bars</th>
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</thead>
<tbody>
<tr>
<td>12&quot;</td>
<td>4&quot;</td>
<td>#4 @ 18&quot; a.c. or closer.</td>
<td>#4 @ 18&quot; a.c. or closer.</td>
</tr>
<tr>
<td>15&quot;</td>
<td>5&quot;</td>
<td>#4 @ 18&quot; a.c. or closer.</td>
<td>#4 @ 18&quot; a.c. or closer.</td>
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</tr>
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<td>27&quot;</td>
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<td>#4 @ 18&quot; a.c. or closer.</td>
</tr>
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<td>30&quot;</td>
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<td>#4 @ 18&quot; a.c. or closer.</td>
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<tr>
<td>33&quot;</td>
<td>10&quot;</td>
<td>#4 @ 18&quot; a.c. or closer.</td>
<td>#4 @ 18&quot; a.c. or closer.</td>
</tr>
</tbody>
</table>

FIGURE 29
INSTRUCTIONS

<table>
<thead>
<tr>
<th>GIVEN</th>
<th>REqd.</th>
<th>PROP.</th>
<th>PERI.</th>
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<td>h</td>
</tr>
<tr>
<td>h, d, L</td>
<td>a</td>
<td>l</td>
<td>d</td>
</tr>
<tr>
<td>q, d, L</td>
<td>h</td>
<td>l</td>
<td>d</td>
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</tbody>
</table>

SOLUTION

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<th>.prop.</th>
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</tr>
</thead>
<tbody>
<tr>
<td>prop.</td>
<td>h</td>
<td>a</td>
</tr>
</tbody>
</table>

NOTES:

This chart is based on the equation

\[ Q = A \left( \frac{2a h}{1.41 + 0.02a h} \right)^{1/2} \]

and is designed for use with C.B.'s having the standard 3" radius of rounding at the outlet.

See Figure 2, Chart IV for schematic profile showing the controlling hydraulic elements.

TYPICAL EXAMPLE

Given: \( Q = 23 \text{ c.f.s.} \), \( h = 1.0 \)
\( L = 50' \)

Required: \( d \)

Solution: Begin at bottom of chart with \( C = 23 \text{ c.f.s.} \) (Pt. A). Proceed vertically to intersect the \( h = 1.0' \) line (Pt. B) then horizontally to \( L = 50' \) (Pt. C) between \( d = 27'' \) and \( d = 28'' \).

Use the larger size pipe (\( d = 28'' \)).

CHART III FULL PIPE

CATCH BASIN CONNECTING PIPE CAPACITIES

FIGURE 30a
FIGURE 1

TYPICAL EXAMPLE
Given: \( Q = 28 \) c.f.s. & \( d = 21" \)
Find: \( H \)
Solution: From \( Q = 28 \) c.f.s.
  proceed vertically to \( d = 21" \),
  thence horizontally to \( H = 4.8' \)

NOTE:
This chart is designed for use
with C.B.'s having the standard
3" radius of rounding at the outlet.

CHART IV
CONTROL AT C.B. OUTLET

FIGURE 2
(NO SCALE)

\[ H = d + 9' \]
\[ (H = d + 12 \frac{V^2}{2g}) \]
Q \leq 10 \text{ cfs}; \quad \text{AVAILABLE HEAD } H' \geq 1.25'; \quad \text{ConnectorPipe Length } L \leq 60'; \quad V' \geq 3.5'.

\[ 1 \text{ ML. S.D.} \]
\[ \text{PROPOSED OR EX. SURFACE} \]
\[ \text{OVER } L \text{ OF S.D.} \]
\[ T \]
\[ \text{F = C.F.} + 6'' = 1.25' \text{(TYPICAL)} \]
\[ \text{W.S. ALLOWABLE} \]
\[ V = 3.5' \text{ (MINIMUM)} \]

**FULL PIPE**

\[ Q = 10.0; \quad d = 18''; \quad K = 105; \quad A = 1.77 \text{ ft}^2 \]
\[ S^{1/2} = Q/K = 10.0/105 = 0.0952, \quad S = 0.00906 \]
\[ h_f = L \times S = 60(0.00906) = 0.54' \]
\[ V = Q/A = 10.0/1.77 = 5.65 \text{ ft/sec.} \]
\[ h_v = V^2/2g = (5.65)^2/2(32.2) = 0.50', \quad 12h_v = 0.60' \]

**HEAD LOSS (CALC)**

\[ = h_f + 1.2h_v = 0.54 + 0.60 = 1.14' < H = 1.25' \quad \therefore \text{O.K.} \]

**Note:**

From these calcs, a general rule is evident.

For \( Q \leq 10.0 \text{ cfs}; \quad h \geq 1.25'; \quad L \leq 60'; \quad V \geq 3.5' \text{ — USE } 18'' \text{ R.C.P.} \]

**PIECE FLOWING OPEN**

*(CONTROL AT C.B. OUTLET)*

Assume flow passes thru critical depth \( D_c \)

\[ K_c = Q/d^{5/2} = 10.0/2.76 = 3.62 \]
\[ D_c/d = 0.812, \quad D_c = 1.22' \]
\[ A_c = C_a d^2 = 0.683(2.25) = 1.54 \text{ ft}^2 \]
\[ V_c = Q/A_c = 10.0/1.54 = 6.50 \text{ ft/sec.} \]
\[ \]
\[ h_{vc} = V_c^2/2g = (6.50)^2/2(32.2) = 0.66', \quad 12h_{vc} = 0.79' \]

**HEAD LOSS (CALC)**

\[ = D_c + 1.2h_{vc} \]
\[ = 1.22 + 0.79 = 2.01' \]

**HEAD LOSS (ALLOW) = V - F = 3.50 - 1.25' = 2.25' \quad \therefore \text{O.K.} \]

*Occurs if HGL at M.L. is much lower than pipe soffit at C.B. outlet.*
TYPICAL CATCH BASIN CONNECTOR PIPE DESIGN

Q ≤ 15 cfs; AVAILABLE HEAD "H" ≥ 2.50'; CONNECTOR PIPE LENGTH "L" ≤ 60'; "V" ≥ 40'

**FULL PIPE**

\[ Q = 15.0; \quad d=18''; \quad K=105; \quad A=1.77 \text{ ft}^2 \]

\[ S^{1/2} = Q/K = 15.0/105 = 0.1428; \quad S = 0.0204 \]

\[ h_f = L \times S = 60 \times 0.0204 = 1.22' \]

\[ V = Q/A = 15.0 / 1.77 = 8.48 \text{ ft/sec} \]

\[ h_v = V^2/2g = (8.48)^2/2(32.2) = 1.12'; \quad 1.2h_v = 1.35' \]

HEAD LOSS (CALC) = \( h_f + 1.2h_v = 1.22 + 1.35 = 2.57' = H = 2.50' \); OK

NOTE: FROM THESE CALC, A GENERAL RULE IS EVIDENT.

FOR Q ≤ 15.0 cfs; h ≥ 2.50'; L ≤ 60'; V ≥ 4.0' — USE 18'' R.C.P

ASSUME FLOW PASSES THRU CRITICAL DEPTH "D_c" AT C.B. OUTLET.

\[ K'_c = Q/S^{1/2} = 15.0 / 2.76 = 5.44 \]

\[ D_c/d = 0.937; \quad D_c = 1.41' \]

\[ A_c = C_d d^2 = 0.765(2.25) = 1.72 \text{ ft}^2 \]

\[ V_c = Q/A_c = 15.0/1.72 = 8.72 \text{ ft/sec} \]

\[ h_{vc} = V_c^2/2g = (8.72)^2/2(32.2) = 1.18'; \quad 1.2h_{vc} = 1.42' \]

HEAD LOSS (CALC) = \( D_c + 1.2h_{vc} = 1.41 + 1.42 = 2.83' \)

HEAD LOSS (ALLOW) = \( V-F = 4.00 - 1.25 = 2.75' \); OK.

* OCCURS IF HGL AT M.L. IS MUCH LOWER THAN PIPE SOFFIT AT C.B. OUTLET.
CONCRETE BLANKET

(FOR EXISTING PIPES CROSSED OVER BY A NEW PIPE)

NOTES FOR CONCRETE BLANKET:

1. CONCRETE BLANKET IS REQUIRED WHEN THE CLEARANCE BETWEEN THE TOP OF THE EXISTING PIPE AND THE BOTTOM OF THE CROSSING PIPE IS LESS THAN 18".


3. "x"=D/4, MINIMUM, TO PROVIDE BEDDING MATERIAL FOR THE CROSSING CONDUIT. WHEN "x" IS LESS THAN THIS MINIMUM, THE ENTIRE TOP SURFACE OF THE BLANKET SHALL BE RAISED TO MAKE CONTACT WITH THE LOWER 90° OF THE CROSSING PIPE.

4. THE BLANKET SHALL EXTEND LONGITUDINALLY TO THE FIRST JOINT BEYOND THE TRENCH EXCAVATION AT EACH END OF THE BLANKET, EXCEPT THAT THE BLANKET NEED NOT BE EXTENDED MORE THAN 4 FEET BEYOND THE TRENCH.

COMPRESSIBLE BLANKET

(FOR EXISTING PIPES CROSSED OVER BY A NEW BOX OR ARCH)

1. COMPRESSIBLE BLANKET IS REQUIRED WHEN THE CLEARANCE BETWEEN THE TOP OF THE EXISTING PIPE AND THE BOTTOM OF THE CROSSING CONDUIT (BOX OR ARCH) IS LESS THAN 18".

2. THE BLANKET SHALL EXTEND LONGITUDINALLY FOR THE FULL CROSSING CONDUIT TRENCH WIDTH.

BLANKET PROTECTION FOR PIPES

FIGURE 31
CONCRETE RINGS, REDUCER AND PIPE FOR MANHOLE SHAFT

NOTES
1. All joints shall be filled with 1:2 mortar and newly pointed or wiped in inside of shaft.
2. Wall of manhole frame shall be 8 inches thick and reinforced with four hoops, 2 inches on center.
3. Wall of manhole frame shall be 8 inches thick and reinforced with four hoops, 2 inches on center.
4. Eccentric manhole shaft reducer, and rings may be plain concrete. For unreinforced sections, the minimum thickness shall be 8 inches. The concrete used shall be of such strength so as to develop 3500 psi or greater in 28 days.
5. The present concrete manhole structures will be inspected by the Engineer.
CASE 1 BEDDING INSTALLATION
LOAD FACTOR = 1.4

CASE 2 BEDDING INSTALLATION
LOAD FACTOR = 1.6

CASE 3 BEDDING INSTALLATION
LOAD FACTOR = 2.7

CASE 4 BEDDING INSTALLATION
LOAD FACTOR = 3.2

NOTES:
A. INDICATES UNDISTURBED EARTH.
B. TYPE "B" MATERIAL SHALL BE PLACED IN A MANNER SUCH AS BELLING, SHOVEL-BELLING, OR SHOVEL BELLING TO
ENSURE COMPLETE FILLING OF THE "HAUNCH AREAS" BELOW
THE PIPE. SETTING OF TYPE "B" MATERIAL IS NOT
REQUIRED.

NOTES:
A. INDICATES UNDISTURBED EARTH.
B. (INDICATES "LESS THAN", C INDICATES "LESS THAN OR
EQUAL TO", > INDICATES "GREATER THAN OR EQUAL TO".

PIPE BEDDING
IN TRENCHES

FIGURE 34a
SHEET 1 OF 2
CASE 5 BENDING INSTALLATION

LOAD FACTOR = 4.5

FINISHED GRADE

CONCRETE

SUPPORT BLOCK

CONSTRUCTION JOINT (OPTIONAL)

EARLY STRENGTH CONCRETE IF PLACED PRIOR TO PIPE INSTALLATION

ROUGH-ENN CONCRETE IF PLACE IN TRENCH WIDTH (SEE TABLE A)

BEARING MATERIAL

MINIMUM ALLOWABLE THICKNESS

SELECTED MATERIALS

PLASTIC TIES

10' - 12' PER 100线

TABLE B

SUBSTITUTE INSTALLATIONS (APPLICABLE TO ALL PIPE SIZES)

maximum allowable trench width

table of cover

inhale, plastic, lara, etc. with bells, alp & rcp without

covering diameter & cast iron or steel on collars on bell or collar

6" - 12" A - 12" A

12" - 15" A - 15" A

15' - 30" A - 30" A

30" - 48" A - 48" A

48" - 96" A - 32" A

96" - 120" A - 14" A

GREAT THAN

LESS THAN

NOTE:

A. THIS FIGURE INDICATES UNEQUIPPED EART.

B. TREATED PINE SHIM MAY BE USED FOR GRADE ADJUSTMENT.

C. INDICATES "LESS THAN".

D. INDICATES GRATER THAN.

GENERAL NOTES

1. CASE 1 BENDING INSTALLATION SHALL BE USED FOR ALL PIPE GAUGE UNLESS OTHERWISE SPECIFIED ON THE PLAN OR SHOP ORDER.

2. IF THE ACTUAL TRENCH WIDTH EXCEEDS THE MAXIMUM INDICATED IN TABLE 1, THE CONTRACTOR IS ADVISED TO AVOID USING TABLE 1. HOWEVER, IF BENDING, CASTING OR квартирЫ BELL ARE USED, CASE 1 OR 2 SHALL BE THE MAXIMUM INCREASE.

3. IF THE COVER OR CAST PIPE IS LESS THAN 6" MEASURED FROM THE FINISHED GS FOR USE IN TABLE 1, THE INSTALLATION SHALL BE OVER.

4. UNLESS OTHERWISE SPECIFIED IN THE PLAN, THE BENDING INSTALLATION CASE FOR each SUNKEN CONSTRUCTION JOINT SHALL BE THE SAME AS THAT USED FOR THE MAIN LINE.

5. CASE FACTORS SPECIFIED FOR each SUNKEN CONSTRUCTION JOINT ARE BASED ON THE SEATING METHOD USE WITH a 1" LAD SYMBOL FOR EACH CASE FACTOR APPLIED IN THE DESIGN OR AS SPECIFIED.

6. IF BENDING, CASTING OR квартиры BELL ARE USED, THEN CASE 1 OR 2 AS A SERVICE INSTALLATION IS SPECIFIED IN THE PLAN, THE DESIGNER SHALL IMMEDIATELY NOTIFY THE CONSTRUCTION CO. IF IT CAN BE DETERMINED THAT A SERVICE INSTALLATION IS POSSIBLE.

7. THE CONTRACTOR IS ADVISED TO SELECT THE BENDING INSTALLATION WHICH IS MOST SUITABLE FOR EACH JOB, INCLUDING SELECTIVE INSTALLATIONS FROM THIS TABLE. THE SEATING TRENCH WIDTH IS INDICATED FOR EACH CASE, UNLESS OTHERWISE SPECIFIED ON THE PLAN.

8. PIPE TIES AND COUPLINGS MUST TO THE PIPE MATERIAL SHALL BE PREVENTED FROM ENTERING THE SPACE BETWEEN THE PIPE AND MATTING MATERIAL. THE FOLLOWING INSTALLATION DURING THE BENDING INSTALLATION, THE DESIGNER SHALL IMMEDIATELY NOTIFY THE CONSTRUCTION CO. IF IT CAN BE DETERMINED THAT A SERVICE INSTALLATION IS POSSIBLE.

CASE 4 BENDING INSTALLATION

CASE 3 BENDING INSTALLATION

CASE 2 BENDING INSTALLATION

CASE 1 BENDING INSTALLATION

TRENCH WIDTH

RIOT FREE

COVER

MINIMUM ALLOWABLE THICKNESS

1. MACFIESS MAY BE PLACED IMMEDIATELY AFTER PLACEMENT OF CONCRETE BUT SHOULDN'T BE PLACED UNTIL THE CONCRETE IS HARDENED TO A STRENGTH OF 2,000 PSI. THE CONSTRUCTION CO. SHALL PROVIDE ALL STEEL SHAPES NEEDED FOR PLACEMENT OF 12" LEAF OR LEAF.

2. TRENCH CONSTRUCTION JOINTS SHALL BE PROPOSED TO LEVEL AS FOLLOWING:

3. CASE 2 INSTALLATION MAY BE CONSIDERED AS LEVEL 2 OR 3 DEPENDING ON THE SITE CONDITIONS.

4. CASE 1 INSTALLATION MAY BE CONSIDERED AS LEVEL 3 DEPENDING ON THE SITE CONDITIONS.
CASE I
For existing and new sewers less than 15 inches in diameter where clearance between bottom of CIP in Place Storm Drain and top of San Sewer is less than 6 inches, and where the sewer is approximately at right angles to the Storm Drain.

The sanitary sewer shall be CIP unless otherwise specified.

CASE II
For existing sanitary sewers less than 15 inches in diameter where existing sewer is to be maintained in place and where clearance between bottom of CIP in Place Storm Drain and top of sanitary sewer is less than 6 inches.

The encasement for the sewer between the limits of the encasement and the face of the storm drain shall be as shown in Case IV, Sec. D-D.

CASE III
Where clearance between bottom of Precast Pipe Storm Drain and top of sanitary sewer is less than 6 inches. Sanitary sewer shall be CIP unless otherwise specified.

CASE IV
Where clearance between bottom of Precast Pipe or Cast in Place Storm Drain and top of sanitary sewer is from 6 inches to 18 inches.

GENERAL NOTES
1. Where CIP is called for, the Sanitary Sewer shall be constructed or replaced with standard cast iron or steel pipe in the case of house connections, or with cast B- or Class 150” cast iron pipe in the case of main line sewers.
2. Concrete for encasements shall be per adjacent structure, except Case III and Case IV which shall be 420-C-2000 Portland cement concrete.
3. The concrete encasement shall extend across the full width of the storm drain trench plus an additional 12 inches into undisturbed earth on each side of the storm drain trench.
1. All house connections shall be vitrified clay pipe, 6 inches in diameter, except as otherwise required on.
2. The minimum slope for 6 inch house connections shall be $\frac{1}{8}$ inch per foot.
3. A 6 inch saddle shall be used where necessary and shall be connected to the pipe constituting the existing Y or T, or to the next lower pipe length.
4. Y's may be laid "flat" upon approval of the Engineer.
5. Concrete for chimneys shall be 420-C-200D or better.
6. When sanitary sewer house connections are supported on concrete supports, such connections shall be encased per detail for concrete encasement shown on.
7. Chimneys shown are pictorial only, and the actual chimney constructed at any specific location shall meet the approval of the jurisdictional agency involved.

**Remodeling of Sanitary Sewer House Connections**

*Figure 36*
REINFORCED CONCRETE BEAM
FOR 4" TO 24" O.D. PIPE

NOTES
1. WIDTH OF BEAM SHALL EQUAL O.D. OF SUPPORTED PIPE. MINIMUM WIDTH SHALL BE 6".
2. IF SUPPORTED PIPE IS BEDDED IN CONCRETE, BEAM WIDTH SHALL EQUAL BEDDING WIDTH.
3. IF BEAM IS PRECAST, ENDS OF BEAM SHALL BE FULLY BEDDED IN -460-B-2000 CONCRETE FOR LENGTH 1/2". THE BEDDING SHALL HAVE A MINIMUM THICKNESS OF 4". CLASS "C" MORTAR SHALL BE PLACED BETWEEN TOP OF BEAM AND SUPPORTED PIPE TO PROVIDE MINIMUM BEARING SHOWN.
4. THIS CASE IS PERMITTED ONLY IF THE TRENCH WALLS ARE FIRM AND UNYIELDING.
5. MAXIMUM SPACING OF BARS SHALL BE 4" O.C.

REINFORCED CONCRETE BEAM (DIMENSIONS AND REINFORCEMENT)

<table>
<thead>
<tr>
<th>S</th>
<th>T BAR</th>
<th>B T BAR</th>
<th>T BAR</th>
<th>B T BAR</th>
<th>T BAR</th>
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<tr>
<td>0&quot; TO 4.0&quot;</td>
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<td>4&quot;</td>
<td>6&quot;</td>
<td>4&quot;</td>
<td>6&quot;</td>
<td>4&quot;</td>
</tr>
</tbody>
</table>

CASE 2
CONCRETE WALL

NOTES
1. THE SUPPORTING WALL SHALL HAVE A FIRM BEARING ON THE SUBGRADE AND AGAINST THE SIDES OF THE EXCAVATION.
2. ANY CONDUIT PASSING THROUGH THE WALL SHALL HAVE 2-INCH CLEARANCE FROM THE WALL.
3. 4-INCH DIA. OPENINGS THROUGH THE WALL AT 2 FT. O.C. HORIZONTALLY AND AT 5 FT. O.C. VERTICALLY SHALL BE PROVIDED TO PREVENT UNEQUAL PRESSURE RESULTING FROM JETTED BACKFILL.
4. IF SUPPORTED PIPE IS BEDDED IN CONCRETE, MINIMUM THICKNESS OF WALL SHALL EQUAL BEDDING WIDTH.
5. BRICK WITH MORTAR JOINTS MAY BE USED IN LIEU OF CONCRETE FOR WALLS UP TO 5 FT. IN HEIGHT OR LENGTH.

PIPE SUPPORT ACROSS TRENCHES

FIGURE 37a

-SHEET 1 OF 2-
NOTES:
1. ANCHORS SHALL BE CLASS 420-8-2000 CONCRETE.
2. FOR CLAY PIPE, ANCHORS SHALL NOT BE PLACED WITHIN 6-INCHES OF THE PIPE JOINT.
3. TRENCH BACKFILL SHALL BE CONSOLIDATED BY MECHANICAL COMPACTION OR SOIL CEMENT.
4. SOIL CEMENT SHALL HAVE A CEMENT CONTENT OF 5%.

PIPE ANCHORS AND BACKFILL STABILIZERS

FIGURE 38a
SHEET 1 OF 2
NOTES:

1. REDWOOD BOARDS SHALL BE 2"x12" WHERE DEPTH OF COVER OVER PIPE PERMITS, OTHERWISE USE 2"x10".
2. REDWOOD BOARDS SHALL BE PLACED ON THE HIGH GROUND SIDE OF THE POSTS.
3. EACH REDWOOD BOARD SHALL BE FASTENED BY USING 2-164 NAILS TO EACH REDWOOD POST OR A 1/2-INCH BOLT AND NUT WITH WASHERS TO EACH GALVANIZED PIPE.
4. TRENCH BACKFILL SHALL BE CONSOLIDATED BY MECHANICAL COMPACTION OR SOIL CEMENT.
5. WHEN SOIL CEMENT IS USED AS BACKFILL, SLOPE STABILIZERS MAY BE OMITTED.
6. SOIL CEMENT SHALL HAVE A CEMENT CONTENT OF 5%.

TABLE B

<table>
<thead>
<tr>
<th>GROUND SLOPE</th>
<th>SPACING Y, FT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:1</td>
<td>5</td>
</tr>
<tr>
<td>1 1/2:1</td>
<td>9</td>
</tr>
<tr>
<td>2:1</td>
<td>12</td>
</tr>
<tr>
<td>2 1/2:1</td>
<td>16</td>
</tr>
<tr>
<td>3:1</td>
<td>20</td>
</tr>
</tbody>
</table>

PIECE ANCHORS AND STABILIZERS
WARPED GUTTER
AT CATCH BASINS

FIGURE 39a
SHEET 1 OF 2
NOTES

1. Warped gutters and gutter transitions shall be constructed of Class 520-C-7500 Portland Cement Concrete. Warped gutters constructed integral with concrete pavement shall be the same class of concrete as the pavement.

2. DIMENSIONS: (Unless otherwise specified on the plans.)
   a. L = 5 feet unless otherwise specified.
   b. E = 3 feet.
   c. G = 3 feet (G = 6 feet when joining existing 1 foot gutter.)
   d. Gradescare at Point 'B' shall be 6% or less. L, E, and G shall be lengthened to meet this requirement.
   e. Gutter width 'B' - 'E' shall be 2 feet.
   f. N = 2-1/2 inches.
   g. H = 1/2 inch.
   h. B = 8 inches.

3. CURB FACE DIMENSIONS: (Unless otherwise specified on the plans.)
   a. Point 'A' = 9 inches.
   b. Point 'B' is existing or proposed curb face.
   c. Point 'C' is existing or proposed curb face.

4. Point 'E' shall be 1-1/2 inches above Point 'B'. Join existing pavement or specified on the plans.

5. The curb face between side-opening catch basins in series shall be equal to the curb face at Point 'A'.

6. The curb face between skirting basins in series shall be equal to the curb face at Point 'C'. The edge of gutter between skirting basins in series shall be the outer edge of the basin.

7. Warped gutter and/or gutter transition shall be poured monolithic with the curb.

8. The contact joint shown between the warped gutter and the front wall of the catch basin shall be constructed. At the option of the contractor, with either a 2 inch by 2 inch continuous setway or No. 6 domino 12 inches long and 18 inches on center.

WARPED GUTTER AT CATCH BASINS

FIGURE 396

SHEET 2 OF 2
WATER ST. SOUTH OF MUD ST.

\[ Q = 125 \text{ cfs}, \text{ concrete curb and gutter, cross slope} = 1.5\% \]
\[ \text{Gutter slope (longitudinal)} = 2\% \]
\[ \text{and } \frac{7L}{2} = 0.016 \]

FIND: Depth of flow at curb (d) and spread of flow on pavement.

SOLUTION:

1. From Table 9, Appendix B, \( z = 60 \); \( \frac{y}{z} = 3125 \)
2. From Chart 1, Appendix C, \( d = 0.55' \) \( Q = \frac{125}{2} = 62.5 \text{ cu each side} \)
3. Spread = \( 2d = 27.5' \)

GIVEN: Same as above except total \( Q = 85 \text{ cfs} \) (42.5 each side).

(1) \( d = 0.5' \)
(2) Spread = 25' 

GIVEN: Same as above except total \( Q = 49 \text{ cfs} \) (24.5 each side).

(1) \( d = 0.4' \)
(2) Spread = 20' 

FIGURE 41
GIVEN: \( Q = 125 \) (42.5 each, assuming no cross fall and even flow)

Find: Capacity \( Q_i \) = Start with maximum site catch basin size - \( W = 28' \)

Solution: From catch basin capacity chart - Figure 2f herein;

A \( W = 28' \) CB will pick up \( Q_i \) = 15.5 cfs each.

Given: Same as above except \( Q = 62.5 - 15.5 = 47 \) (each side)

Calculate \( d \) (see previous page) \( d = 0.4' \)

Figure 2f gives only 8.4 cfs but minimum pickup for \( W = 28' \) any \( W = 28' \) is 14 cfs (2 cfs per foot of width) - use \( Q_i = 14 \) cfs.

Given: Same as above except \( Q = 47 - 14 = 33 \) cfs (each side)

No need to calculate \( d \) as it will obviously be less than 0.4' and minimum catch basin pickup will govern.

Use a \( W = 28' \) for \( Q_i = 14 \) cfs (each side)

**FIGURE 42a**
G + H

Given: Same as A + B except $Q = 33 - 14 = 19$

No need to calc d again. Use $W = 28$ each side for $Q = 14$ cfs

This leaves 5 cfs which you can let pass since it is less than 10% of original Q.

J + K

Given: $Q = 40$ (25 on S/6 + 15 on N/3)

$S = 0.15$

Calculated $d_{1/6} = 0.4$ (call it 0.4') $d_{1/6} < 0.4'$

$Q = 30$, $d = 0.4'$, Total $W = 25 \times 2 = 50$

$Q = 30$, $d = 0.4'$, Total $W = 25 \times 2 = 50$

$Q = 14$, $W = 21.5$, $Q = 14$

$Q_c = 24.5$

K: $Q = 15$, $d = 0.4$ use $1 - W = 28$

SAME METHOD TO CALC G + H

FIGURE 426
A) GIVN: Q = 15.5 ft³/s, h = 3 ft, L = 35 ft
FIND: d (Diameter of conn. pipe)
SOLUTION:

(a) From Figure 30a, Q = 15.5, h = 3

\[
d = \frac{1.0}{\sqrt{1.0}} \times \frac{Q}{\sqrt{h}} = \frac{15.5}{\sqrt{3}}
\]

\[
d = 2.69\text{ ft}
\]

d REQUIRED = 2.12" THEREFORE USE d = 18".

(b) CHECK USING FIG. 30b, Q = 15.5, d = 18"

\[
H_{\text{REQ'D}} = d + 0.9 = 2.3
\]

MIN H (2.1") < H REQ'D 50 OK

BA) SAME AS A. (ADD'L LENGTH DOES NOT CHANGE THIS PARTICULAR SITUATION)

TO CALCULATE MINIMUM V DEPTH FOR CATCH BASIN A:

\[
\text{MIN } V = \text{dia pipe} = 18" + \text{min wall HT} = 9" + \text{freeboard} = \frac{6}{36} = 2.3" \text{ WHICH IS BELOW STANDARD V-DEPTH} \Rightarrow \text{USE STD. V = 4.5"}
\]

CONTINUE SAME PROGRAM FOR OTHER PIPE S. NOTE: YOU MUST HAVE CALCULATED THE HYDRAULIC "GRADE LINE" (HGL) FOR THE MAINLINE AND LATERAL PIPES PRIOR TO BEGINNING TO SIZE CONNECTOR PIPES. IN ORDER TO GET YOUR H OR H.

FIGURE 43
### SUMMARY OF HYDRAULIC CALCULATIONS

#### PRESSURE FLOW DESIGN

| Structure | Station | S.D. Type | Size | Q   | A   | V   | K   | S_r | L   | Δ   | H_e | H_r | H_j | H_T | H_wh | H_wisc | ΣH_L | E.G. | h_V | H_G |
|-----------|---------|-----------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-------|------|------|------|------|
| Outlet   | 0+00    | 72"   | 600  | 28.27 | 14.15 | 4234 | 0.00803 |     |     |     | 0.89 |     |     |     |       |       | 103.11 | 3.11 | 100.00 |
| BC       | 1+00    |          |      |     |     |     |     |     |     |     | 0.91 |     |     |     |       |       | 104.02 |     | 100.89 |
| EC       | 1+70.69 |          |      |     |     |     |     |     |     |     | 0.91 |     |     |     |       |       | 104.91 |     | 101.80 |
| MH #4    | 4+72    | 12"   | 600  | 28.27 | 14.15 | 4234 | 0.00803 | 301.3 | 0.63 | 0.28 |     |     |     |     |       |       | 107.60 | 3.11 | 104.49 |
|          |         |        |      |     |     |     |     |     |     |     |     |     |     |     |       |       | 108.09 | 3.56 | 104.53 |
| MH #4    | 9+00    | 66"   | 600  | 23.76 | 15.15 | 3357 | 0.01150 |     |     |     |     |     |     |     |       |       | 113.01 | 3.56 | 109.45 |
|          |         |        |      |     |     |     |     |     |     |     |     |     |     |     |       |       | 113.49 | 4.13 | 109.36 |
| JS #4    | 9+50    | 100"  | 320  | 16.30 |     |     |     |     |     |     |     |     |     |     |       |       | 114.25 | 4.13 | 110.12 |
|          |         |        |      |     |     |     |     |     |     |     |     |     |     |     |       |       | 114.49 | 3.39 | 111.60 |
| JS #4    | 9+50    | 240   |     | 14.17 |     |     |     |     |     |     |     |     |     |     |       |       | 115.09 | 3.39 | 111.70 |
|          |         |        |      |     |     |     |     |     |     |     |     |     |     |     |       |       | 115.54 | 2.94 | 112.60 |
1. **BC to EC**

   \[ \Delta = 45^\circ \]
   \[ R = 90', \quad L = 70.69' \]

   \[ h_b = 0.002 \times \Delta \times h_v \]
   \[ = 0.002 \times 45 \times 3.11 = 0.28' \]

   \[ h_b = 0.28' \]

2. **MH & 4**

   \[ h_j = \Delta Y + h_{v_1} - h_{v_2} \]

   where \[ \Delta Y = \frac{Q_2 V_2 - Q_3 V_3 - Q_4 V_4 \cos \theta}{Q_2 (A_1 + A_2) - A_3} + \frac{1}{2} (S_2 + S_3) L \]

3. **Calculations**

   \[ Q_2 = 400, \quad Q_1 = 360, \quad Q_3 = 30, \quad Q_4 = 10 \]
   \[ A_2 = 28.27, \quad A_1 = 23.76, \quad A_3 = 3.14, \quad A_4 = 1.77 \]
   \[ V_2 = 14.15, \quad V_1 = 15.15, \quad V_3 = 9.55, \quad V_4 = 5.65 \]
   \[ h_{v_2} = 3.11, \quad h_{v_1} = 3.56, \quad \theta = 45^\circ, \quad \theta = 60^\circ \]
   \[ d_2 = 72'', \quad d_1 = 66'', \quad d_3 = 24'', \quad d_4 = 18'' \]

   \[ \Delta Y = \frac{400(14.15) - 360(15.15) - 30(9.55) \cos 45^\circ - 10(5.65) \cos 60^\circ}{16.11 (28.27 + 23.76)} + 0.5(0.0089 + 0.0115) 6.5 \]

   \[ = -0.03 + 0.07 \]

   \[ \Delta Y = 0.04 \]

   \[ h_j = \Delta Y + h_{v_1} - h_{v_2} \]

   \[ h_j = 0.04 + 3.56 - 3.11 \]

   \[ h_j = 0.49 \]

   \[ h_j = 0.49' \]

**FIGURE 45a**
9+00 MH No 4

\[ Q_2 = 360 \quad Q_1 = 320 \quad Q_3 = 30 \quad Q_4 = 20 \]

\[ A_2 = 23.76 \quad A_1 = 19.63 \quad A_3 = 3.14 \quad A_4 = 1.77 \]

\[ V_2 = 15.15 \quad V_1 = 16.30 \quad V_3 = 9.55 \quad V_4 = 11.30 \]

\[ h_{V_2} = 3.56 \quad h_{V_1} = 4.13 \quad \theta_3 = 45^\circ \quad \theta_4 = 45^\circ \]

\[ d_2 = 66'' \quad d_1 = 60'' \quad d_3 = 24'' \quad d_4 = 18'' \]

\[
h_j = AY + h_{V_1} - h_{V_2} \quad \text{where} \quad AY = \frac{Q_2 - Q_1 + 0.5(0.01150 + 0.01510) + 0.5(0.01150 + 0.01510) \cdot 6.5}{0.5(15.15) - 320(16.30) - 320(9.55) \cos 45^\circ - 20(11.30) \cos 45^\circ}

+ 0.5(0.01150 + 0.01510) \cdot 6.5

AY = -0.18 + 0.09

AY = -0.09'

\[ h_j = AY + h_{V_1} - h_{V_2} \]

\[ h_j = -0.09 + 4.13 - 3.56 \]

\[ h_j = 0.48' \]

\[ h_j = 0.48' \]

\[ h_j = 0.48' \]

Note: The AY can be negative. But the \( h_j \) must always be positive! If it calcues out negative \( \rightarrow \) set it equal to 0.
\[ Q_2 = 320 \quad Q_1 = 290 \quad \cos \theta = 90^\circ \text{ THEREFORE NO NEED FOR } Q_3 \text{ INFO.} \]
\[ a_2 = 19.63 \quad a_1 = 19.63 \]
\[ V_2 = 16.30 \quad V_1 = 14.77 \]
\[ h_\text{L2} = 4.13 \quad h_\text{L1} = 3.39 \]
\[ d_2 = 60'' \quad d_1 = 60'' \]

\[ \Delta Y = \frac{(320)(16.30) - 290)(14.77)}{16.1(19.63)^2} = 1.48 \]
\[ h_j = 1.48 + 3.39 - 4.13 = 0.74 \quad h_j = 0.74' \]

This a fairly large loss. If this causes the hydraulic grade line to become unacceptable, then the following approach can be taken:

1. Change from a JS #4 to a step down structure with a smaller upstream diameter which will give a larger upstream velocity and probably lower resultant junction loss.

2. Investigate using larger pipe sizes downstream.
NOTE: THE STATION POINT FOR THIS STRUCTURE FALLS OUTSIDE THE LIMITS OF THE STRUCTURE ITSELF - WHICH IS OK!

Fig. 46b
9+50 JS No. 4

No dimensional callouts are necessary for this structure—it is a standard saddle connection and can be used where the requirements as shown on Figure 56 are met. All that is needed of plan view is to call out station as shown below.

[Diagram of structure]
D-LOAD TABLE FOR REINFORCED CONCRETE PIPE

**COVERAGE TO TOP OF PIPE (FEET)**

| PIPE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
|------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 12"  | 1250 | 1500 | 1750 | 2000 | 2250 | 2300 | 2300 | 2500 | 2500 | 2500 | 2500 | 2500 | 2750 | 2750 | 2750 | 2750 | 2750 |
| 18"  | 1250 | 1500 | 1750 | 2000 | 2250 | 2300 | 2300 | 2500 | 2500 | 2500 | 2500 | 2500 | 2750 | 2750 | 2750 | 2750 | 2750 |
| 24"  | 1250 | 1500 | 1750 | 2000 | 2250 | 2300 | 2300 | 2500 | 2500 | 2500 | 2500 | 2500 | 2750 | 2750 | 2750 | 2750 | 2750 |
| 30"  | 1250 | 1500 | 1750 | 2000 | 2250 | 2300 | 2300 | 2500 | 2500 | 2500 | 2500 | 2500 | 2750 | 2750 | 2750 | 2750 | 2750 |
| 36"  | 1250 | 1500 | 1750 | 2000 | 2250 | 2300 | 2300 | 2500 | 2500 | 2500 | 2500 | 2500 | 2750 | 2750 | 2750 | 2750 | 2750 |

**NOTES:**

1. Only the D-Load values and bedding indicated on this table shall be specified. For other D-Load values, consult the Engineering Division.

2. For overexcavation of trench during construction, refer to "Pipes Laying in Trenches".

3. For intermediate cover values, use the higher D-Load of the two adjacent covers.

4. D-Load Calculation Data:
   \[ D-Load = \frac{(D_2 + D_1)FL}{(D_2/D_1)} \]
   
   Where:
   - DL = load load by Horstman's Theory using the following values:
     - Soil Unit Weight (\(\gamma\)) = 110 p.c.f.; Soil Friction Coefficients (\(K_s\)) = 0.15;
     - Settlement Ratio (\(S_e\)) = 0.1;
   - LL = live load - AASHTO-M204 (Highway loading);
   - F = Factor of Safety = 1.15;
   - LF = Load Factor (Refer to Standard Plan "Pipe Laying in Trenches");
   - Case 1 Bedding = 1.5; Case 2 Bedding = 2.7; Case 4 Bedding = 3.2.

5. Trench Condition - For covers greater than 0", the trench width is limited to the values indicated on Standard Plan "Pipe Laying in Trenches".

6. For pipe stress greater than 108" or for covers greater than 40", consult the Engineering Division.

7. If soil tests indicate that the soil unit weight is greater than 110 pounds per cubic foot, increase the D-Load accordingly. For railroad loading and design, consult the Engineering Division.

**LEGEND:**
- Indicates "Thick Wall" RCP with Case 1 Bedding
- Indicates "Standard Wall" RCP with Case 1 Bedding
- Indicates "Standard Wall" RCP with Case 2 Bedding
- Indicates "Standard Wall" RCP with Case 4 Bedding

*FIGURE A7*
## Gage Requirements for DRAGGATED Metal Pipe

### Gages of C.M.P. for H20 Live Loads

<table>
<thead>
<tr>
<th>DIAM. (in.)</th>
<th>AREA (sq. ft.)</th>
<th>1-10</th>
<th>11-15</th>
<th>16-20</th>
<th>21-25</th>
<th>26-30</th>
<th>31-35</th>
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*Use Field Assembled Plate Culverts*

---

### Gages of C.M.P.—Arch for H20 Live Loads

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<tr>
<th>SPAN (in.)</th>
<th>RISE (in.)</th>
<th>&quot;B&quot;**</th>
<th>AREA (sq. ft.)</th>
<th>1</th>
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### Minimum Cover Over C.M.P.

<table>
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<tr>
<th>Load</th>
<th>Surface</th>
<th>Base of Measurement</th>
<th>Pipes</th>
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<tr>
<td>H20</td>
<td>Unpaved Flexible Pavement</td>
<td>Top of Surface</td>
<td>D/5 or 5&quot; Min. (PREFER 12&quot; Min.)</td>
<td>9&quot;</td>
</tr>
<tr>
<td>Rigid Pavement</td>
<td>Top of Slab</td>
<td>D/7 or 3&quot; Cushion Under Slab</td>
<td>Span/14 or 3&quot; Cushion Under Slab</td>
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<tr>
<td>E72</td>
<td>Railroad Track</td>
<td>Bottom of Rail</td>
<td>D/2 or 18&quot;</td>
<td>Span/2 or 24&quot;</td>
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*NOTE: Span of Pipe-Arches is measured "B" inches above invert.*
NOTES FOR SIDE OPENING CATCH BASINS

1. CONCRETE SHALL BE CLASS S-1250.

2. ALL CURVED CONCRETE SURFACES SHALL BE FORMED BY CURVED FORMS, AND SHALL NOT BE SHAPED BY PLASTERING. SURFACE OF ALL EXPOSED CONCRETE SHALL CONFORM IN SLOPE, GRADE, COLOR, FINISH, AND SCORING TO EXISTING OR PROPOSED CURB AND WALK ADJACENT TO THE BASIN.

3. FLOOR OF BASIN SHALL BE GIVEN A STEEL TROWEL FINISH AND SHALL HAVE A LONGITUDINAL AND LATERAL SLOPE OF 1:12, EXCEPT WHERE THE GUTTER GRADE EXCEEDS 8 PERCENT, IN WHICH CASE THE LONGITUDINAL SLOPE OF THE FLOOR SHALL BE THE SAME AS THE GUTTER GRADE. SLOPE FLOOR FROM ALL DIRECTIONS TO THE OUTLET.

4. DIMENSIONS:
   \[ B = 3.0 \text{ FEET} \]
   \[ V = 4.5 \text{ FEET} \] (WHERE CATCH BASINS ARE IN SERIVES "V," SHALL BE THE DEPTH TO THE INVERT OF THE INLET PIPE AND "V," SHALL BE THE DEPTH TO THE INVERT OF THE OUTLET PIPE.)
   \[ W = \text{AS INDICATED ON THE PROJECT PLANS.} \]
   \[ t_0, t_e = \text{SEE STRUCTURAL DATA HEREOF.} \]
   \[ t_s = 4-1/2 \text{ INCHES FOR STANDARD SIDEWALK, AND 6 INCHES FOR SPECIAL SIDEWALK. (SEE PROJECT PLANS)} \]
   \[ A = \text{THE ANGLE, IN DEGREES, INTERCEPTED BY THE CENTERLINE OF THE CONNECTOR PIPE AND THE CATCH BASIN WALL TO WHICH THE CONNECTOR PIPE IS ATTACHED.} \]

5. PLACE CONNECTOR PIPES AS INDICATED ON THE PROJECT PLANS. UNLESS OTHERWISE DETAILLED ON THE PROJECT PLANS, A CONNECTOR PIPE CENTERLINE SHALL INTERSECT THE MID-POINT OF THE INSIDE FACE OF THE INDICATED CATCH BASIN WALL, OR IF INDICATED AT A CORNER, IT SHALL INTERSECT THE INSIDE CORNER. THE PIPE MAY BE CUT AND TRIMMED AT A SLOPE NECESSARY TO ENSURE MINIMUM 3 INCH PIPE EMBEDMENT, ALL AROUND, WITHIN THE CATCH BASIN WALL, AND A 1 INCH RADIUS OF BOUNDING OF STRUCTURE CONCRETE, ALL AROUND, ADJACENT TO PIPE ENDS. A MONOLITHIC CONNECTION PER STANDARD PLAN SD-217 SHALL BE USED TO JOIN THE CONNECTOR PIPE TO THE CATCH BASIN WHENEVER ANGLE "A" IS LESS THAN 70 DEGREES OR GREATER THAN 110 DEGREES, OR WHENEVER THE CONNECTOR PIPE IS LOCATED IN A CORNER. THE OPTIONAL USE OF MONOLITHIC CONNECTION IN ANY CASE IS PERMITTED. MONOLITHIC CONNECTIONS MAY BE EXTENDED UP TO 4 FEET IN LENGTH TO AVOID CUTTING STANDARD LENGTHS OF PIPE. CONNECTOR PIPE MAY NOT BE CUT FOR ANY REASON EXCEPT TO AVOID CONSTRUCTION OF A MONOLITHIC CONNECTION.

6. STEPS SHALL CONFORM TO STANDARD PLAN SD-218, AND SHALL BE DIRECTLY BELOW THE MANHOLE FRAME AND COVER.

7. DOWELS SHALL BE REQUIRED AT EACH CORNER AND AT 7 FEET O.C. (MAXIMUM) ALONG THE BACKWALL WHEN THE TOP SLAB IS POURED SEPARATELY. WHEN TOP SLAB IS POURED MONOLITHIC WITH ADJACENT SIDEWALK, THE DOWELS MAY BE OMITTED.

8. CURB INLET; SUPPORT PLATE, SUPPORT BOLTS, AND ANCHORS SHALL CONFORM TO STANDARD PLAN SD-110.

9. PROTECTION BAR AND SUPPORT PLATE SHALL CONFORM TO STANDARD PLAN SD-113.

10. CATCH BASIN MANHOLE FRAMES AND COVERS SHALL CONFORM TO ADOT STANDARDS.

11. WALL AND BOTTOM SLAB THICKNESS SHALL BE AS SHOWN HEREOF. REINFORCEMENT, WHEN REQUIRED, SHALL CONFORM TO STANDARD PLAN SD-111. FOR ANY VALUE OF "W" OR "V" NOT INDICATED HEREOF, USE THE VALUE FOR THE NEXT HIGHER "W" OR "V" THAT IS INDICATED.

12. ALL CONSTRUCTION JOINTS SHALL HAVE ROUGH SURFACES.

13. CATCH BASINS LOCATED ON A CURVE, MAY, AT THE OPTION OF THE CONTRACTOR, BE CONSTRUCTED ON CHORDS AS INDICATED HEREOF. IF MORE THAN ONE CHORD IS USED ON ANY CATCH BASIN, THE CHORD LENGTH SHALL BE IDENTICAL. THE SUPPORT PLATE SEGMENTS SHALL BE SPLICED AS SHOWN ON STANDARD PLAN SD-110.

14. CONSTRUCT WARPED CUTTER TO CONFORM TO STANDARD PLAN SD-114.
SECTION OF CURB INLET
(4 1/2 TOP SLAB)

CASE I

SPLICE PLATE FOR 10" SUPPORT PLATE

DEPARTMENT OF TRANSPORTATION
AND FLOOD CONTROL DISTRICT
PIMA COUNTY
G.H. HUNGESENBERRY, R.L.S., R.E.
DIRECTOR

CATCH BASIN CURB INLET AND SUPPORT DETAILS

SD-110-0

REFERENCE
SECTION OF CURB INLET
(6" TOP SLAB)

CASE II

Warped Gutter
(See Note 9)

Catch Basin front wall

Hole in Support Plate for Support Bolt and/or Eye Bolt when required.
(See Note 4 for location and size)
Hex Nuts to be tightened to secure the steel plate in proper position.

Protection Bar and Support (See Note 7)

1/2" x 20" Support Bolt with Hexagonal Nuts. (See Note 5)

SPLICE PLATE FOR 13 1/16" SUPPORT PLATE

Located weds in longer segment.

$\frac{5}{8} \times \frac{5}{8} \times 6"$ Steel Splice Plate

$\frac{5}{8} \times \frac{1}{2}"$ Carriage Bolt
(with Hexagonal Nuts)

$\frac{3}{4}"$ Square Holes

$\frac{3}{4}"$ Square Holes

$\frac{5}{8}"$ Support Plate

Joint

$2"$ Joint

$2"$ Joint

Workin Plan No. SD-110-0

Sheet 2 of 4
HOOK ANCHOR FOR 4\(\frac{1}{2}\)" TOP SLAB

CASE I

ROUND HEAD ANCHOR FOR 4\(\frac{1}{2}\)" TOP SLAB

CASE I

HOOK ANCHOR FOR SPECIAL 6" TOP SLAB

CASE II

ALTERNATE METHODS FOR SUPPORT PLATE ANCHORAGE
1. ALL METAL PARTS SHALL BE PAINTED PER ADOT SPECIFICATIONS AFTER FABRICATION.

2. LOCATION AND SPACING OF ANCHORS:
   A. SET ONE ANCHOR 3 INCHES FROM EACH END OF THE SUPPORT PLATE.
   B. SPACE ANCHORS AS SHOWN FOR EACH ALTERNATE.
   C. PLACE ONE ANCHOR WITHIN 6 INCHES ON EACH SIDE OF SPlice JOINT.


5. SUPPORT BOLTS ARE REQUIRED WHEN THE LENGTH OF CATCH BASIN OPENING IS 7 FEET, OR GREATER, AND SHALL BE EVENLY SPACED ACROSS THE OPENING. SPACING SHALL NOT BE LESS THAN 3 FEET 6 INCHES O.C. NOR GREATER THAN 3 FEET 0.0 C.

6. CASE II CURB INLET AND SUPPORT DETAILS SHALL APPLY WHEN SPECIAL SIDEWALK IS INDICATED ON THE PROJECT PLANS. OTHERWISE, CASE I CURB INLET AND SUPPORT PLATE DETAILS SHALL APPLY.

7. PROTECTION BAR AND SUPPORT CONFORMING TO STANDARD PLAN SD-113 ARE REQUIRED WHEN CURB FACE AT CATCH BASIN EXCEEDS 9-1/4 INCHES.

8. SEE STANDARD PLAN SD-114 FOR DETAILS OF WARPED GUTTER AND FOR CURB FACE AT THE INLET (9 INCHES UNLESS OTHERWISE INDICATED ON THE PROJECT PLANS).
**Typical Reinforcement Details**

- Catch Basin Curb Inlet and Support Plate Details per SD-110-O.
- Top Slab Reinforcement (See Note 4).
- Pocket Slab Reinforcement

**Notes for Catch Basin Reinforcement**

1. For any "W" or "V" not indicated herein, use the value for the next higher "W" or "V" that is indicated.
2. Bar spacings are center to center of bars. Bar cover is the clear distance between surface of bar and face of concrete, and shall be, except as otherwise indicated, 2 inches when poured against a formed surface, or 3 inches when poured against earth.
3. Except where otherwise indicated, reinforcement shall terminate 2 inches from face of concrete.
4. For thickness and reinforcement of top slab, see Standard Plan SD-100.

**Design Data**

Allowable Stress (Reinforced Concrete):
- $f'_c = 3250$ psi
- $f'_d = 1500$ psi
- $f'_s = 20,000$ psi

Allowable Tensile Stress (Unreinforced Concrete):
- $f'_t = 142$ psi (F.S. of 4.0 Based upon an assumed modulus of rupture = 570 psi)

**Loads:**
- LL Top Slab = 300 psf.
- Earth Equivalent Fluid Pressure = 36 psf.
- Truck LL on front wall = HS20-44

### Side Opening Catch Basins

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<th>&quot;C&quot;</th>
<th>&quot;D&quot;</th>
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<td>3.8 13'</td>
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For W > 28' or V > 8', see Project Plans.

---

**Catch Basin Reinforcement**

Department of Transportation and Flood Control District

Pima County

C.H. Huckleberry, R.L.S., R.E.,
Director

SD-110-O

SUBMITTED: John E. H. 1/27/1983

APPROVED: John E. H. 7/14/1983

DESIGNED BY: John E. H.
CHECKED BY: John E. H.
WARPED GUTTER AT CATCH BASINS

CASE I

CASE II

CASE III

CASE IV

DEPARTMENT OF TRANSPORTATION AND FLOOD CONTROL DISTRICT

PIMA COUNTY

C.H. MUCKELBERRY R.L.S., P.E.
DIRECTOR

STANDARD PLAN SD-114-0

SUBMITTED 6-25-1982

REVISIONS

REFERENCES

APPROVED 6-25-1982

DESIGNED BY

DRAWN BY

CHECKED BY
NOTES FOR WARPED GUTTER AT CATCH BASINS

1. WARPED GUTTERS AND GUTTER TRANSITIONS SHALL BE CONSTRUCTED OF CLASS S-2500 PORTLAND CEMENT CONCRETE. WARPED GUTTERS CONSTRUCTED INTEGRAL WITH CONCRETE PAVEMENT SHALL BE THE SAME CLASS OF CONCRETE AS THE PAVEMENT.

2. DIMENSIONS: (UNLESS OTHERWISE SPECIFIED ON THE PLANS)
   A. L = 5 FEET UNLESS OTHERWISE SPECIFIED.
   B. K = 3 FEET.
   C. G = 3 FEET (G = 6 FEET WHEN JOINING EXISTING 1 FOOT GUTTER)
   D. GRADEBREAK AT POINT "B" SHALL BE 6% OR LESS. L, K, AND G SHALL BE LENGTHENED TO MEET THIS REQUIREMENT.
   E. GUTTER WIDTH "B" - "E" SHALL BE 2 FEET.
   F. H = 2-1/2 INCHES.
   G. w PER PLAN.
   H. b = 8 INCHES.

3. CURB FACE DIMENSIONS: (UNLESS OTHERWISE SPECIFIED ON THE PLANS)
   A. POINT "A" = 8 INCHES.
   B. POINT "B" IS EXISTING OR PROPOSED CURB FACE.
   C. POINT "C" IS EXISTING OR PROPOSED CURB FACE.

4. POINT "E" SHALL BE 1-1/2 INCHES ABOVE POINT "B", JOIN EXISTING PAVEMENT OR SPECIFIED ON THE PLANS.

5. THE CURB FACE BETWEEN SIDE-OPENING CATCH BASINS IN SERIES SHALL BE EQUAL TO THE CURB FACE AT POINT "A".

6. THE CURB FACE BETWEEN GRATING BASINS IN SERIES SHALL BE EQUAL TO THE CURB FACE AT POINT "C". THE EDGE OF GUTTER BETWEEN GRATING BASINS IN SERIES SHALL BE THE OUTER EDGE OF THE BASIN.

7. WARPED GUTTER AND/OR GUTTER TRANSITION SHALL BE POURED MONOLITHIC WITH THE CURBS.

Minimum of 4 - 4" ties above and 4 - 4" ties below opening and on sides maximum spacing 18".

NOTES
1- Reinforcing steel shall be 1 1/2" clear from face of concrete unless otherwise shown.
2- Concrete shall be of the same class as the structure with which it is poured.
3- Rounded edge of outlet shall be constructed by pouring concrete against a curved form.
4- Interior surface of connection shall be smooth and clean.
NOTE:
Steps shall be steel conforming to ASTM designation A307 and shall be galvanized after bending.

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<th>Depth At Manhole</th>
<th>Steps Required</th>
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<td>3'-6&quot; or Less</td>
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<td>—</td>
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<td>3'-6&quot; thru 4'-6&quot;</td>
<td>1</td>
<td>12&quot; Above Floor</td>
<td>4&quot;</td>
</tr>
</tbody>
</table>
| Greater than 4'-6" | Varies       | 1. Top step 6" below top surface 2. Steps spaced 12" apart 3. Bottom step max. of 16" above floor | Top step = 2 1/2" Others 4"

DEPARTMENT OF TRANSPORTATION
AND FLOOD CONTROL DISTRICT
PIMA COUNTY
G. H. HUCKELBERRY R.L.S., P.E.
DIRECTOR

STEEL STEP FOR CONCRETE STRUCTURES
STANDARD PLAN
SD-218-0
NOTES FOR MANHOLE NO. 1

1. CONCRETE SHALL BE CLASS S-3250.

2. DIMENSIONS:
   A. "L" = 4'0" UNLESS SHOWN OTHERWISE ON IMPROVEMENT PLAN. THE LENGTH "L" MAY BE INCREASED, AT THE OPTION OF THE CONTRACTOR, TO MEET PIPE ENDS;
   B. "H" = 4'0" UNLESS SHOWN OTHERWISE ON THE IMPROVEMENT PLANS. "H" MAY BE INCREASED AT THE OPTION OF THE CONTRACTOR, PROVIDED THAT THE VALUE OF "H" SHALL BE NOT LESS THAN THE MINIMUM SPECIFIED AND THAT THE REDUCER SHALL BE USED;
   C. MAIN-LINE ELEVATIONS SHOWN ON THE IMPROVEMENT PLANS REFER TO ENDS OF PIPE AND ARE BASED ON ANY CHANGES IN GRADE AND/OR PIPE DIAMETER OCCurring AT THE STATION LINE (SEE SECTION B-8);
   D. THICKNESS OF THE DECK SHALL VARY AS NECESSARY TO PROVIDE A LEVEL PIPE SEAT, BUT SHALL NOT BE LESS THAN 8";
   E. "T" = 8" FOR VALUES OF "H", UP TO AND INCLUDING 8'. "T" = 10" FOR VALUES OF "H" OVER 8'.

3. REINFORCEMENT SHALL CONFORM TO SECTION 506 OF THE STANDARD SPECIFICATIONS, AND TO DETAILS SHOWN HEREON:
   A. ALL STEEL REINFORCEMENT SHALL BE #4 BARS SPACED 4" O.C.;
   B. REINFORCEMENT SHALL BE PLACED 1-1/2" CLEAR FROM THE INSIDE FACE OF CONCRETE.

4. A STEEL TROWEL SURFACE SHALL BE PROVIDED FOR THE CONCRETE FLOOR OF THE STRUCTURE TO THE SPRING LINE.

5. CONCRETE FOR THE STRUCTURE SHALL BE PLACED IN ONE CONTINUOUS OPERATION, EXCEPT THAT THE CONTRACTOR MAY, AT HIS OPTION, PLACE AT THE SPRING LINE A CONSTRUCTION JOINT WITH A LONGITUDINAL KEYWAY MEASURING NOT LESS THAN 1/2" "T" IN BOTH HEIGHT AND WIDTH.

6. STATIONING APPLICABLE TO THIS STRUCTURE APPLIES ALONG THE CENTER LINE OF THE MAIN LINE AS SHOWN ON SECTION B-8 AND REFERS TO CENTER OF MANHOLE SHAFT. ANY INLETS TO THIS STRUCTURE SHALL BE CONSTRUCTED USING A JUNCTION STRUCTURE NO. 1. SEE STANDARD PLAN SD-121 FOR APPLICABLE DETAILS.

7. WHEN THE DEPTH OF THE MANHOLE FROM THE STREET GRADE TO THE TOP OF THE REDUCER IS LESS THAN 1 FOOT FOR PAVED STREETS OR 1 FOOT 6 INCHES FOR UNPAVED STREETS, CONSTRUCT MONOLITHIC SHAFT PER SECTION "C-C" HEREON. THE CONTRACTOR MAY, AT HIS OPTION, CONSTRUCT THE SHAFT AS PER SECTION "C-C" HEREON FOR ANY HEIGHT OF MANHOLE.

8. INSTALL STEPS CONFORMING TO STANDARD PLAN SD-218 OR APPROVED EQUAL.

9. CONSTRUCT PIPE SEAT, INSTALL RINGS, REDUCER, AND PIPE FOR MANHOLE SHAFT CONFORMING TO STANDARD PLAN SD-300.

10. INSTALL MANHOLE FRAME AND COVER CONFORMING TO ADOT STANDARDS.
NOTES FOR MANHOLE NO. 2

1. CONCRETE SHALL BE CLASS S-1250.

2. DIMENSIONS:
   A. "L" = 5'-10" UNLESS SHOWN OTHERWISE ON IMPROVEMENT PLAN. THE LENGTH "L" MAY BE INCREASED, AT THE OPTION
      OF THE CONTRACTOR, TO MEET PIPE ENDS;
   B. MAINLINE ELEVATIONS SHOWN ON THE IMPROVEMENT PLAN REFER TO ENDS OF PIPE AND ARE BASED ON ANY CHANGES
      IN GRADE AND/OR PIPE DIAMETER OCCURRING AT THE STATION LINE (SEE SECTION 3-B)
   C. THICKNESS OF THE DECK SHALL VARY AS NECESSARY TO PROVIDE A LEVEL PIPE SEAT, BUT SHALL NOT BE LESS THAN
      THE TABULAR VALUE OF "F" AS SHOWN HEREON.

3. REINFORCEMENT SHALL CONFORM TO SECTION 506 OF THE STANDARD SPECIFICATIONS, AND TO DETAILS SHOWN HEREON.
   A. ALL STEEL REINFORCEMENT SHALL BE #4 BARS, SPACING AS SHOWN HEREON;
   B. "D" BARS SHALL BE SPACED 3" O.C.;
   C. "E" BARS SHALL BE SPACED 4" O.C.;
   D. TIE BARS SHALL BE #3, SPACED 18" O.C. OR CLOSER;
   E. REINFORCEMENT SHALL BE PLACED 1-1/2" CLEAR FROM THE INSIDE FACE OF CONCRETE EXCEPT AS OTHERWISE NOTED
      HEREON;
   F. WHEN "L" GREATER THAN 5'10" IS SPECIFIED ON IMPROVEMENT PLAN, CONTINUE "D" BARS AT 6" O.C. LENGTHS
      SHOWN IN TABLE HEREBE ARE FOR LONGEST BARS. WHERE SHORTER BARS ARE REQUIRED, BEND OR CUT TO MEET
      FIELD REQUIREMENTS.
   G. FOR "D" GREATER THAN 96", SEE PROJECT PLANS;

4. A STEEL TROWEL SURFACE SHALL BE PROVIDED FOR THE CONCRETE FLOOR OF THE STRUCTURE AND TO THE CONCRETE SIDES
   FROM THE INVERT TO THE SPRING LINE.

5. CONCRETE FOR THE STRUCTURE SHALL BE PLACED IN ONE CONTINUOUS OPERATION, EXCEPT THAT THE CONTRACTOR MAY, AT
   HIS OPTION, PLACE AT THE SPRING LINE A CONSTRUCTION JOINT WITH A LONGITUDINAL KEYWAY MEASURING NOT LESS
   THAN HALF THE WALL THICKNESS IN BOTH HEIGHT AND WIDTH.

6. STATIONING APPLICABLE TO THIS STRUCTURE APPLIES ALONG THE CENTER LINE OF THE MAIN LINE AS SHOWN ON
   SECTION 3-B AND REFERS TO CENTER OF MANHOLE SHAFT. WHEN INLETS ARE TO ENTER STRUCTURE ON BOTH SIDES, "L"
   SHALL BE INCREASED SUFFICIENTLY TO ALLOW FOR PROPER PLACEMENT OF STEPS OUTSIDE ANY INLET OPENING. AN
   INLET STATION (DESIGNATED LEFT AND/OR RIGHT) AND APPLICABLE ELEVATION SHALL BE SHOWN ON IMPROVEMENT
   PLANS. INLET STATION(S) SHALL APPLY TO INTERSECTION OF INSIDE WALL OF STRUCTURE WITH CENTER LINE OF INLET PIPE(S).

7. THE CENTER OF MANHOLE SHAFT SHALL BE LOCATED OVER CENTER OF STORM DRAIN WHEN DIAMETER D₁ IS 48" OR LESS,
   IN WHICH CASE "E" BARS SHOULD BE PLACED SYMMETRICALLY AROUND SHAFT AT 45° ANGLE WITH CENTER LINE.

8. WHEN THE DEPTH OF THE MANHOLE FROM THE STREET GRADE TO THE TOP OF THE REDUCER IS LESS THAN 1 FOOT FOR PAVED
   STREETS OR 1 FOOT 6 INCHES FOR UNPAVED STREETS, CONSTRUCT MONOLITHIC SHAFT PER DETAIL "M" HEREON. THE
   CONTRACTOR MAY, AT HIS OPTION, CONSTRUCT THE SHAFT AS PER DETAIL "M" HEREON FOR ANY HEIGHT OF MANHOLE.

9. INSTALL STEPS CONFORMING TO STANDARD PLAN SD-218 OR APPROVED EQUAL.

10. CONSTRUCT PIPE SEAT, INSTALL RINGS, REDUCER, AND PIPE FOR MANHOLE SHAFT CONFORMING TO STANDARD PLAN SD-100.

11. INSTALL MANHOLE FRAMES AND COVER CONFORMING TO ADOPT STANDARDS.

STEEL TABLE FOR MANHOLE NO. 2

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STANDARD PLAN NO. SD-311-0  SHEET 2 OF 2
1. CONCRETE SHALL BE CLASS S-3250.

2. DIMENSIONS:
   B. THE LENGTH OF DIMENSIONS "C", "E", & "L" MAY BE INCREASED AT THE OPTION OF THE CONTRACTOR TO MEET PIPE ENDS, PROVIDED PRIOR APPROVAL IS OBTAINED FROM THE ENGINEER.
   C. LATERALS SHOULD ENTER THE MAINLINE RADIALY WHENEVER POSSIBLE. WHEN DIMENSION "C" IS NOT INDICATED ON THE PROJECT PLANS, NO LATERAL SHALL BE CONSTRUCTED, AND "A", "B", AND "F" BARS SHALL BE OMITTED.

3. REINFORCEMENT SHALL CONFORM TO SECTION 506 OF THE STANDARD SPECIFICATIONS, AND TO DETAILS AND SCHEDULES SHOWN IN THE REINFORCEMENT SCHEDULE SHOWN HEREON:
   A. "A", "B", & "F" BARS REFER TO DIMENSION "B"; EXTEND "A" & "B" BARS 6" BEYOND THE OPENING;
   B. "C", "D", & "G" BARS REFER TO DIMENSION "D";
   C. "E" BARS REFER TO DIMENSION "D";
   D. "COVER" MEANS THE DIFFERENCE IN VERTICAL ELEVATION BETWEEN THE TOP OF THE STRUCTURE & THE SURFACE GRADE ABOVE;
   E. TIE BARS SHALL BE NO. 4 AT 18 INCHES;
   F. REINFORCEMENT SHALL BE PLACED 1-1/2 INCHES CLEAR FROM THE INSIDE FACE OF CONCRETE EXCEPT AS OTHERWISE INDICATED HEREON;
   G. WALL AND SLAB TENSION BARS ("T") SHALL BE AS SHOWN HEREON;
   H. FOR "B" GREATER THAN 72 INCHES OR "D" GREATER THAN 96 INCHES, SEE PROJECT PLANS.

4. A STEEL TROWEL SURFACE SHALL BE PROVIDED FOR THE CONCRETE FLOOR OF THE STRUCTURE AND TO THE CONCRETE SIDES FROM THE INVERT TO THE SPRING LINE.

5. CONCRETE FOR THE STRUCTURE, INCLUDING THE LATERAL (S) SHALL BE PLACED IN ONE CONTINUOUS OPERATION, EXCEPT THAT THE CONTRACTOR MAY AT HIS OPTION PLACE AT THE SPRING LINE A CONSTRUCTION JOINT WITH A LONGITUDINAL KINAY MEASURING NOT LESS THAN HALF THE WALL THICKNESS IN BOTH HEIGHT AND WIDTH.


7. WHERE LATERALS ENTER ON BOTH SIDES OF THE STRUCTURE, THEY SHALL BE DESIGNATED ON THE PROJECT PLANS AS RIGHT OR LEFT, FACING IN THE DIRECTION OF STATIONING.


9. WHEN THE DEPTH OF THE MANHOLE FROM THE STREET GRADE TO THE TOP OF THE REDUCER IS LESS THAN 1 FOOT FOR PAVED STREETS OR 1 FOOT 6 INCHES FOR UNPAVED STREETS, CONSTRUCT MONOLITHIC SHAFT PER DETAIL "M" HEREON. THE CONTRACTOR MAY CONSTRUCT THE SHAFT AS PER DETAIL "M" HEREON FOR ANY HEIGHT OF MANHOLE, PROVIDED PRIOR APPROVAL IS OBTAINED FROM THE ENGINEER.

10. INSTALL STEPS CONFORMING TO STANDARD PLAN SD-218.

11. CONSTRUCT PIPE SEAT, INSTALL RINGS, REDUCER, AND PIPE FOR MANHOLE SHAFT CONFORMING TO STANDARD PLAN SD-300.

12. INSTALL MANHOLE FRAME AND COVER CONFORMING TO ADOPT STANDARDS.

### Structural Data

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<th>Dimension F or T</th>
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<th>D Bars</th>
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STANDARD PLAN NO. SD-313-0  SHEET 2 OF 2

2. DIMENSIONS:
   A. SEE PROJECT PLANS FOR VALUES OF A, B, C, C₁, L₁, L₂, X, ELEVATION R AND ELEVATION S.
   B. THE LENGTH OF DIMENSIONS C AND C₁ MAY BE INCREASED TO MEET PIPE ENDS, PROVIDED PRIOR APPROVAL IS OBTAINED FROM THE ENGINEER.

3. STRUCTURAL DATA:
   A. REINFORCING STEEL SHALL BE 1-1/2 INCHES CLEAR FROM FACE OF CONCRETE.
   B. OMIT "H" BARS WHEN SOFFIT OF LATERAL IS LESS THAN ONE FOOT BELOW SOFFIT OF MAIN LINE. OMIT "G" BARS WHEN INVERT OF LATERAL IS LESS THAN ONE FOOT ABOVE FLOOR OF MAIN LINE.

4. ELEVATION "S" IS ON THE PROLONGATION OF THE LATERAL INVERT GRADE AT THE INSIDE FACE OF THE MAIN LINE.

5. SEE PROJECT PLANS FOR ADDITIONAL REQUIREMENTS WHEN PROJECT PLANS REQUIRE A MANHOLE TO BE CONSTRUCTED AT THE SAME LOCATION AS THIS JUNCTION.


7. CONCURRENT CONSTRUCTION OF JUNCTION STRUCTURE WITH R.C. BOX:
   A. THE CONTRACTOR MAY BLOCK OUT AN OPENING FOR THE JUNCTION, PROVIDED HE SUBMITS A PLAN SATISFACTORY TO AND APPROVED BY THE ENGINEER WHICH PROVIDES FOR SUCH BLOCKING AND THE BRACING, SUPPORT, AND STRUCTURAL INTEGRITY OF THE BOX. OTHERWISE, THE JUNCTION STRUCTURE AND THE MAIN LINE STRUCTURAL CONCRETE SHALL BE Poured MONOLITHICALLY IN ONE CONTINUOUS OPERATION.
   B. W BARS SHALL BE CUT IN THE CENTER OF THE OPENING AND BENT INTO THE LATERAL AS SHOWN HEREBY. SEE PROJECT PLANS FOR SIZE AND SPACING OF W BARS FOR BOX TO BE CONSTRUCTED.

8. CONNECTION OF JUNCTION STRUCTURE "D" TO AN EXISTING R.C. BOX:
   A. REMOVE ALL SOIL AND ANY OTHER BURDEN OVER TOP OF EXISTING R.C. BOX WITHIN INDICATED REMOVAL LIMITS PRIOR TO BREAKING OUT OF ANY CONCRETE OR CONSTRUCTING THE JUNCTION. SUCH SOIL AND OTHER BURDEN MAY BE ALLOWED TO REMAIN IN PLACE DURING CONSTRUCTION OF THE JUNCTION PROVIDED THE CONTRACTOR SUBMITS A PLAN SATISFACTORY TO AND APPROVED BY THE ENGINEER WHICH PROVIDES FOR THE BRACING, SUPPORT, AND STRUCTURAL INTEGRITY OF THE EXISTING R.C. BOX, AND THE BYPASSING OF FLOWS AROUND SUCH BRACING AND SUPPORTS.
   B. THE CONCRETE WITHIN THE REMOVAL LIMITS SHALL BE REMOVED BY FIRST MAKING A ONE-INCH DEEP SAWCUT ON THE EXPOSED CONCRETE AT THE INDICATED REMOVAL LIMIT LINES USING AN APPROVED CONCRETE SAW; THEN ADJACENT TO THE SAWCUT LINE, AND WITHIN THE REMOVAL LIMITS, CUT A GROOVE EQUAL TO THE DEPTH OF THE SAWCUT USING AN APPROVED CHIPPING HAMMER; THEN REMOVE THE REMAINING CONCRETE USING HAND OPERATED EQUIPMENT AND TOOLS, LEAVING A CLEAN PLANE SURFACE FOR JOINING WITH THE NEW CONCRETE.
   C. THE EXPOSED EXISTING REINFORCEMENT SHALL BE CUT IN THE CENTER OF THE OPENING, CLEANED, AND BENT INTO THE NEW LATERAL.
NOTES FOR JUNCTION STRUCTURE 2

1. CONCRETE SHALL BE CLASS S-3250.

2. DIMENSIONS:
   B. "H" = 1/2 PIPE O.D. + 3 INCHES, MINIMUM.
   C. "J" = \( \frac{2D}{L} + 6 \) INCHES.
   E. ELEVATION "H" OCCURS AT THE INTERSECTION OF THE LATERAL INVERT WITH THE OUTSIDE WALL OF THE EXISTING PIPE AND IS GIVEN AS AN AID TO THE CONTRACTOR IN DETERMINING THE LOCATION OF THE BREAKOUT.

3. THE MAIN-LINE PIPE SHALL BE SUPPORTED LONGITUxDINALLY FOR ITS ENTIRE WIDTH BY A CONCRETE CRADLE TO ONE FOOT BEYOND THE LIMITS OF "L" ON BOTH ENDS. WHERE CONSTRUCTION OF THIS STRUCTURE OCCURS IN CONNECTION WITH AN EXISTING MAIN-LINE PIPE, THAT PORTION OF THE CRADLE MAY BE OMITTED THAT WOULD BE PLACED ON THE SIDE OPPOSITE THE LATERAL AND BETWEEN THE OUTSIDE EDGE OF AND TO THE CENTERLINE OF THE EXISTING PIPE.


5. REINFORCEMENT SHALL CONFORM TO SECTION 506 OF THE STANDARD SPECIFICATIONS, AND TO DETAILS SHOWN HEREON. "A" AND "B" BARS SHALL BE CARRIED TO A POINT NOT LESS THAN A DISTANCE EQUAL TO "J" FROM THE CENTERLINE. TRANSVERSE REINFORCEMENT IN PIPE SHALL BE CUT IN CENTER OF OPENING AND BENT TO UNIFORM DISTANCE FROM TOP AND BOTTOM OF JUNCTION STRUCTURE.

6. A STEEL TROWEL SURFACE SHALL BE PROVIDED FOR THE CONCRETE FLOOR OF THE STRUCTURE AND TO THE CONCRETE SIDES FROM THE INVERT TO THE SPRING LINE.

7. THE CONTRACTOR MAY, AT HIS OPTION, CONSTRUCT A TRANSITION STRUCTURE NO. 3 CONFORMING TO STANDARD PLAN SD-323 IN LIEU OF A JUNCTION STRUCTURE NO. 2.
1. CONCRETE SHALL BE CLASS S-3250.

2. DIMENSIONS:
   A. SEE PROJECT PLANS FOR VALUES OF A, B, C, D, E, L, ELEVATION "R", ELEVATION "S", AND MAINLINE STATIONS AND ELEVATIONS.
   B. THE LENGTH OF DIMENSIONS "C", "E", AND "L" MAY BE INCREASED AT THE OPTION OF THE CONTRACTOR TO MEET PIPE ENDS.

3. REINFORCEMENT SHALL CONFORM TO SECTION 506 OF THE STANDARD SPECIFICATIONS, AND TO DETAILS AND SCHEDULES SHOWN IN THE REINFORCEMENT SCHEDULE SHOWN HERETON:
   A. "A", "B", AND "F" BARS REFER TO DIMENSION "B";
   B. "C" AND "G" BARS REFER TO DIMENSION "D";
   C. "COVER" MEANS THE DIFFERENCE IN VERTICAL ELEVATION BETWEEN THE TOP OF THE STRUCTURE AND THE SURFACE GRADE ABOVE.
   D. TIE BARS SHALL BE NO. 4 AT 18 INCHES;
   E. REINFORCEMENT SHALL BE PLACED L-1/2 INCHES CLEAR FROM THE INSIDE FACE OF CONCRETE EXCEPT AS OTHERWISE SHOWN HERETON;
   F. WALL AND SLAB THICKNESS (T) SHALL BE AS SHOWN HERETON;
   G. FOR "B" GREATER THAN 72 INCHES OR D_2 GREATER THAN 96 INCHES, SEE PROJECT PLANS.

4. A STEEL TROMEL SURFACE SHALL BE PROVIDED FOR THE CONCRETE FLOOR OF THE STRUCTURE AND TO THE CONCRETE SIDES FROM THE INVERT TO THE SPRING LINE.

5. CONCRETE FOR THE STRUCTURE, INCLUDING THE LATERAL(S) SHALL BE PLACED IN ONE CONTINUOUS OPERATION, EXCEPT THAT THE CONTRACTOR MAY, AT HIS OPTION, PLACE AT THE SPRING LINE A CONSTRUCTION JOINT WITH A LONGITUDINAL KEYWAY MEASURING NO LESS THAN HALF THE WALL THICKNESS IN BOTH HEIGHT AND WIDTH.


7. WHERE LATERALS ENTER ON BOTH SIDES OF THE STRUCTURE, THEY SHALL BE DESIGNATED ON THE PROJECT PLANS AS RIGHT OR LEFT, FACING IN THE DIRECTION OF STATIONING.

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### STRUCTURAL DATA

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<tr>
<th>DIMENSION B OR D_2</th>
<th>DIMENSION FOR T</th>
<th>A &amp; B BARS</th>
<th>C BARS</th>
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STANDARD PLAN NO. SD-333-0 SHEET 2 OF 2
DETAIL "A"

(Sano-Tebe, or equal, interior form)

CUT No. 1: Saw the tube at an angle of A/2 with the transverse plane. Reverse one section and tape both sections together forming the deflection angle A.

CUT No. 2: Saw the tube longitudinally removing a strip 3.14 (D₁₀-D₉₁) inches wide on the side opposite the open joint. Bend the ends of the cut together and insert the tube in the pipe.

**Δ₂ = Difference in slopes of D₀ and D₂.**

i.e., 0.025 Would be a 2 1/2 % difference.

Exceed this value and a collar is required.

DETAIL "B"

TYPICAL JOINT FOR REINFORCED CONCRETE PIPE