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DIVISION II

COUNTY OF ORANGE LOCAL DRAINAGE MANUAL
REVISIONS, DELETION, AND ADDITIONS

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SECTION 1 – REVISIONS, DELETIONS, AND ADDITIONS

As stated in the Introduction, the City of Anaheim has adopted the County of Orange Local Drainage Manual (COLDM) as the governing manual for hydraulic analysis and drainage design within the City of Anaheim except as modified below. An understanding of the criteria presented in the COLDM is necessary for the competent preparation of hydraulic analysis and drainage design in the City of Anaheim. In addition to the COLDM, revisions, deletions, and additions to the COLDM described in this section shall be incorporated into the analysis and design of all storm drains in the City of Anaheim.

The COLDM has seven chapters: 1) Design Criteria, 2) Submittal Requirements, 3) Classification of Drainage Systems and Channel Covering Criteria/Procedures, 4) Local Drainage Hydrology, 5) Hydraulics, 6) Structures, and 7) Flood Plains. The organization of the revisions, deletions and additions is based on the organization of the COLDM. Only those chapters and sections which are modified are included below.

CHAPTER 1 DESIGN CRITERIA

Section I. PROTECTION LEVELS

Subsection B. Streets, first paragraph, as shown on Page 1-1, shall be revised as follows:

Protection Levels for Streets are outlined in Table II-1-1 and in Figures 1 and 2. In all cases, the 100-year storm shall be contained within the City right-of-way. It is recommended that the building pad elevation be 6 inches or more above the 100-year water surface elevation.

<table>
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<tr>
<th>Type of Street</th>
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<th>Maximum Allowable Flooding</th>
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<td>At or below ROW Line</td>
<td>2</td>
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<td>Sump Condition, Local</td>
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<td>Same as above</td>
<td>1 &amp; 2</td>
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<tr>
<td>Street or Arterial Highway</td>
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</table>

Subsection B. Streets, part 1. Arterial Highway, subpart a, as shown on Page 1-1 shall be deleted:
Subsection B. Streets, part 1. Arterial Highway, subpart b, as shown on Page 1-1 shall be deleted.

To subsection C. General Criteria, as shown on Page 1-3, add the following:

5. Drainage design requirements in the City of Anaheim shall be in accordance with the City of Anaheim Master Plan of Drainage.

6. In addition to the COLDM criteria and procedures, the use of underground storm drain systems shall be required when any of the following conditions exist:
   a. The limitations outlined in Table II-1-1 above and in Figures 1 and 2 are exceeded.
   b. Excess nuisance water in residential areas (surface flow maximum – 1000 ft)
   c. The need exists for cross drainage of surface flow on arterial highways
   d. Median drainage is required
   e. Product of depth times velocity is greater than six at street/highway gutter flow line
   f. Future upstream development will cause drainage problems

7. If the existing downstream storm drain facilities are undersized, the following alternates may be used for retaining flows in excess of the downstream storm drain capacity, as approved by the City Engineer:
   a. All tributary areas retain flows onsite.
   b. Construction of detention basin.
   c. Retaining excess flows in pipes.

Figure 1-1, as shown on Page 1-2, shall be deleted. Figures 1 & 2 shall replace this figure.
10-YEAR AND 25-YEAR STORMS
MAXIMUM FLOODED WIDTHS AND DEPTHS

NOTES:
1. THESE CONDITIONS SHALL APPLY TO ALL STREETS AND HIGHWAYS WITH A SLOPE GRADIENT OR IN A SUMP CONDITION.
NOTES:

1. THIS CONDITION SHALL APPLY TO ALL STREETS AND HIGHWAYS.
Section IV. CONDUIT ALIGNMENT

Subsection G, as shown on page 1-6, shall be deleted.

Section V. STORM DRAIN EASEMENTS

This section, as shown on page 1-7, shall be revised to state the following:

A. No structural encroachments shall be allowed within easements.
B. Public drainage devices shall be located entirely within an easement.
C. Easements parallel to lot lines shall be on one lot only.
D. Surface structures shall not surcharge storm drain facilities.
E. Storm drain easement shall be a minimum 15 feet in width. For deep pipes, the easement shall be (2 x depth - O.D.) to maximum 25 feet.
F. An access road shall be provided to all manholes outside of roadways. The access/maintenance road shall be minimum 12 feet in width. The road must be paved with a minimum 0.25 ft of asphalt concrete over 0.35 ft base material. The location of access roads shall be approved by the Street and Sanitary Maintenance Division and either the Street Design Division or Development Services Division.
G. Easement sketches, legal descriptions and closure calculations must be reviewed and approved by the City. The easement shall be dedicated to the City on a Final Map or by separate deed.

Figure 1-3 EASEMENT

This Figure, as shown on page 1-8, shall be deleted.

Section VIII. CONDUIT MAINTENANCE AND ACCESS CRITERIA

To Subsection B. Manhole Location, as shown on page 1-9, add the following:

Manholes are required at the following locations:
1. Beginning or ending of curves
2. Pipe size changes.
3. Angle Points and as required at junctions.
4. As required for maintenance.

Manholes are restricted to, in order of preference:
1. Parking Lane
2. Center of travel lane nearest right curb
3. Center of travel lane to the left of the travel lane nearest the right curb

NOTE: Laterals entering both sides of manholes No's 1 and 2 are undesirable for safety reasons and should be avoided wherever possible. If not, provide modified manhole details to be approved by the City Engineer.

Subsection F. Minimum Pipe Size, as shown on page 1-10, shall be deleted.

To Section VIII, CONDUIT MAINTENANCE AND ACCESS CRITERIA, as shown on page 1-10, add the following:

G. Connections to Existing Storm Drains

The minimum pipe diameter for lateral connections to main line storm drains shall be 18 inches.

The minimum diameter for connections to existing catch basins shall be 15".

H. Connected Catch Basins

A maximum of two catch basins may be connected prior to a lateral connection to the main line storm drain.

I. Alignment

1. Storm drain shall be located in street, and not near curb and gutter. Storm drain trench shall not extend under the edge of the gutter.

2. Curves: Standard small radii are 22.50 ft, 45 ft, and 90 ft.

Section IX. MINIMUM PAD ELEVATION

Subsection C. Hydrology Manual, as shown on page 1-10, shall be revised to state the following:

The 100-year water surface shall be at or below the elevation at the right of way line. It is recommended that the building pad elevation be at least 6" above the right of way line elevation.

Section X. ABANDONMENT OF FACILITIES

Subsection B. Storm Drains, as shown on page 1-10, shall be revised to state the following:

1. If existing culverts, pipes or other facilities are abandoned or removed, provisions must be made for drainage and approval obtained from the City Engineer.
2. If facilities are abandoned, the pipes shall be removed.
3. Easements for abandoned facilities, which are no longer needed, shall be abandoned.

ADDITIONAL DESIGN CRITERIA

The following additional design criteria shall be implemented for all storm drain design in the City of Anaheim.

XI. GRADE

Concrete collars shall be used at grade breaks as required per City of Anaheim Standard Detail # 380-2.

XII. ENCASEMENT

Encasement is required when clearance between pipes is less than 18 inches.

XIII. OPEN LINED CHANNELS

A. Open lined channels require prior approval from City Engineer.
B. Structural calculations shall be submitted with the plans.
C. Structural details shall be shown on plans.
D. No open lined channels are allowed in the street right-of-way.

XIV. SURFACE DRAINAGE TRANSITIONS

A. If it is necessary to grade to drain, the grade on the ditch shall be shown on the plan with existing facilities shown and how they will be treated.
B. The length of the ditch construction shall be shown on the plan.
C. Grading and erosion control facilities shall be provided to keep mud and debris out of storm drains and help ensure good water quality and erosion control.
D. Asphalt concrete swales and inlet aprons shall be provided to project improvements where appropriate.
E. Grading shall be provided 50-100 feet upstream from proposed improvements as required to avoid ponding.
CHAPTER 2 SUBMITTAL REQUIREMENTS

Section I. GENERAL,

Paragraphs 1 and 2, as shown on page 2-1, shall be revised as follows:

This chapter addresses requirements of the City of Anaheim for plan check submittals.

Unless the facility is being built as a condition of approval of a subdivision or other development within the limits of the subdivision, an understanding between all parties involved will be necessary to establish City requirements for design, plan check and maintenance. These items should be resolved prior to commencing design. When a development services condition or Agreement does not provide for City acceptance of the completed facility for maintenance, an Agreement is required to define the project and acceptance conditions. Developers and Engineers are encouraged to meet with Department of Public Works staff to discuss these matters before commencing design.

Paragraph 3, as shown on page 2-1, shall be deleted.

Paragraph 4, as shown on page 2-1, shall be revised as follows:

When City acceptance for maintenance is intended, adequate information in the form of maps, calculations, drawings, inspection, construction and maintenance of the facility will be required. Specific submittal requirements for improvement plan checking are given later in this section. However, the following paragraphs describe these requirements in general terms.

Subsection on Hydrology, Hydraulic and Structural Calculations, as shown on page 2-1, shall be revised as follows:

Design calculations and hydrology maps for all contributory areas shall be submitted with the plans.

Submittals shall be prepared using approved methodologies, presentation of computer outputs and/or hand calculations, and mapping that can be easily followed by the plan checker. Studies and reports shall provide for convenient filing (i.e., tract, street, name, facility) that can be easily recalled in the future. The hydrology map, grading and street plans shall agree as to the grades, drainage areas, etc.

Specific requirements for Hydrology, Hydraulic, and Structural Calculations are listed below:

Drainage Report
A drainage report shall be submitted and shall contain the following:

1. **TITLE SHEET**
   - Developer's and Engineering firm's name, address and phone number.
   - Engineer's name, signature, stamp, R.C.E. number and expiration date, and date.
   - Project description.

2. **REPORT**
   - Location description;
   - Drainage basin description;
   - Drainage design criteria:
     - Development criteria;
     - Hydrological criteria;
   - Hydraulic criteria
     - Drainage system design:
       - General concept;
   - Specific details:
   - Hydrology computations and Hydraulic computations;
     - Hydrology maps;
     - References;
     - Appendices.

3. **HYDROLOGY CALCULATIONS**
   - General formula to be used is \( Q = CIA \), and modified formula is \( Q = 0.9 (I-Fm) A \)
   a. Time of Travel
      i. Overland - use valley chart or representative sample section of natural channel.
      ii. Streets - Refer to the street flow charts (see Tables II-2-1, II-2-2, and II-2-3). Use \( Q \) est./ A to find \( V \). Use \( L/(V \times 60) \) to find \( t \).
      iii. Pipes - for pipes flowing full, use \( Q/A \) to find \( V \). For pipes flowing open, calculate \( A \) and \( V \). Use \( L/(V \times 60) \) to find \( t \).
iv. Travel times at points of confluence can be adjusted in accordance with the Orange County Hydrology Manual.

b. Rainfall intensity - Obtain from Orange County Hydrology Manual

c. Coefficient of runoff - Obtain from Orange County Hydrology Manual.

d. Check critical sections for flow splits, i.e., where flow exceeds crown (center of the street). Use the street flow charts.

e. Check flood width (FW) on arterials for flooding. Use street flow charts.

f. Street sections should not transverse or super-elevate away from catch basins.

g. Check the Q's in pipes (option - tc may be adjusted at points of confluence or pickup after entering basins).
### CITY OF ANAHEIM

#### DRAINAGE MANUAL FOR PUBLIC AND PRIVATE DRAINAGE FACILITIES

**DIVISION II**

#### STREET FLOW CHART

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**CITY OF ANAHEIM**

**TABLE**

**II-2-1**
### CITY OF ANAHEIM

**STREET FLOW CHART**

**TABLE II-2-2**

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**AFTER FLASHING, VALUES ARE APPLICABLE FOR THE NEXT SECTIONS**

CITY OF ANAHEIM

STREET FLOW CHART

TABLE II-2-2
### City of Anaheim

#### Drainage Manual for Public and Private Drainage Facilities

**Division II**

**August 2005**

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#### Table II-2-3

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AFTER FLASHING, VALUES ARE APPLICABLE FOR THE NEXT SECTIONS

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**CITY OF ANAHEIM**

**Street Flow Chart**

**Table II-2-3**
Subsection on **Topographic, Hydrological Mapping**, as shown on page 2-1, shall be revised as follows:

Maps shall be legible after microfilming and shall be of a scale of at least 1” = 200 ft. Specific requirements for hydrological mapping are listed below:

A. The hydrology map shall be on a topographic map of sufficient scale to show drainage patterns and quantities of runoff.

B. The site must be shown on the hydrology map including on-site and off-site topography showing the entire tributary drainage area.

C. Show North arrow and scale.

D. Show all Q's (with time of concentration) flowing in the streets. Designate $Q_{10}$, $Q_{25}$ and $Q_{100}$. If one side of a street carries more Q than the other side, show it.

E. Show all cross-over Q's and where they occur.

F. Show all street flow confluences and their calculations. Refer to calculation set (section, page) if computer program is used.

G. Show all Q's approaching, entering, and carried over from catch basins.

H. Identify all catch basins by numbers or letters.

I. Show lengths of all catch basins.

J. Identify critical locations.

K. Show the locations where street capacity and momentum calculations were made in "I" above. Refer to calculation set (section, page) if computer program is used.

L. Show and verify with legible contours or other adequate means, all Q's entering the project. If previous studies were used, reference them.

M. Show all Q's leaving the project. Include their time of concentration.

N. Show names or some other designation for all streets in and around the project.

O. Show the Tract number or Parcel Map number if applicable.
P. Show the name and telephone number of the engineer who performed the hydrology study.

Q. Show and identify all storm drains (use same designation as on improvement plans), their sizes, Q's and times of concentration. Distinguish between \( Q_{10} \) and \( Q_{25} \), or between \( Q_{25} \) & \( Q_{100} \).

R. If the project contains more than one soil group (A, B, C or D), delineate each group.

S. The drainage areas shall close and the acreage shall be shown. Areas shall be closed at all points of confluence and at pickup points.

T. All off-site drainage areas must be shown with a reasonable analysis of the interim and ultimate Q's from those areas. Include the necessary supporting calculations or reference a previous acceptable study which is either already on file or will be supplied with the submittal.

U. The hydrology maps for all tributary areas shall be submitted to the City of Anaheim with the plans.

Initial areas should be limited to from 3 to 4 acres with a maximum flow path of 300 feet.

**Subsection on Drawings and Drafting Standards**, as shown on page 2-2, shall be revised as follows:

Construction drawings shall be prepared on 24” x 36” mylar and drawn to an appropriate scale.

**Section III. CALCULATIONS**

**Subsection A, Hydrology Study/Calculations**, as shown on page 2-3, shall be revised as follows:

A hydrology study based on the 1986 Hydrology Manual, and subsequent addendums, must be submitted and approved by the City Engineer. The design calculations and hydrology maps for all tributary areas shall be submitted to the City of Anaheim with the plans.

**Section VI. TITLE SHEETS**

This section, as shown on page 2-4, shall be revised as follows:

Title sheets shall match the plan in size. A blank, reproducible copy of the appropriate title sheet is available from Development Services Division or Design Services Division for producing a photo mylar. All information
blocks shall be completed. Design engineer’s signature with stamp and expiring date of license on plans shall be included with final submittal.

Section VIII. **DRAFTING STANDARDS**,

This section, as shown on page 2-4, shall be deleted.

Section X. **EXHIBITS**,  
This section, as shown on page 2-4, shall be deleted.

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**CHAPTER 3 CLASSIFICATION OF DRAINAGE SYSTEMS AND CHANNEL COVERING CRITERIA/PROCEDURES**

Section I. **CLASSIFICATION OF DRAINAGE**  
Subsection D. **Local Drainage Facilities**, second paragraph, as shown on page 3-4, shall be revised as follows:

Local facilities may be owned by the City or County. If the ownership of a facility is in question, before plan preparation begins, the design engineer shall discuss ownership issues with the City.

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**CHAPTER 4 HYDROLOGY**

Section II. **HYDROLOGY STUDY GUIDELINES**

Subsection A. **Minimum Recurrence Intervals**, as shown on page 4-1, shall be revised as follows:

The minimum recurrence intervals for the design of new local drainage facilities shall be:

a. Habitable structures shall have 100-year flood protection.

b. A 25 year storm event for all open and underground channels and storm drains with drainage areas less than 640 acres, and tributary to the Santa Ana River watershed

c. A 10 year storm event for all open and underground channels and storm drains with drainage areas less than 640 acres, and tributary to all other watersheds.

The above criteria are the minimum requirements for sizing a storm drainage system and that sizing shall be increased, as necessary, to address all requirements including those noted for the 100-year event.
CHAPTER 5 HYDRAULICS

Section II. STREET FLOW TABLES

Subsection A. General, paragraph 2, as shown on page 5-1, shall be revised as follows:

There are tables for the standard "vertical face" curb types (see Table II-2-1, Table II-2-2 and Table II-2-3). The engineer must use considerable care in selecting a chart, to be sure that the particular table applies.

Subsection C. Street Flow Hydraulic Formula, paragraph 1, as shown on page 5-2, shall be revised as follows:

The Street Flow tables are based on City of Anaheim standard curb types for 6" and 8" configurations and Manning's formula (ignoring the friction along the vertical face as insignificant). Use of other configurations will require a separate calculation using the following triangular and trapezoidal formulas.

Figure 5-2, as shown on page 5-3, shall be deleted. See City Standard Details No. 120 and 160-A.

Subsection C. Street Flow Hydraulic Formula, part 2 Standard A2-6 and A2-8 Curb and Gutter, as shown on page 5-3, shall be revised as follows:

Title shall be “2. Standard 6 inch and 8 inch Curb and Gutter”.

a. For determination of wetted perimeter, vertical depth is used for curb face and horizontal distance is used for gutter, pavement and parkway.

b. Separate area and perimeter calculations are made for parkway and roadway. A composite Manning’s ‘n’ is then used in final conveyance determination in Manning’s equation.

c. 8 inch curbs shall be used for arterial roadways.

Subsection C. Street Flow Hydraulic Formula, part 3 Standard Rolled Curb and Gutter, as shown on page 5-4, shall be deleted:

Subsection D. Use of Tables, as shown on page 5-5, shall be revised as follows:

There are three basic ways in which the tables may be used:

1. Check the capacity of the half-street.

2. Determine whether the flow splits and the routing.
3. Calculate flow conditions to size inlet.

   Example:

   1. **Check the Capacity of the half-street:**

      Given: Longitudinal slope of street (S=1%)

      Local Street (Street Cross Section, width = 36 ft, half-width = 18 ft., 6 in. curb)

      Find maximum street flow (depth should not exceed curb height). Note, crown height is control for half street flow for most streets.

      See Table II-2-3 (a portion of street capacity tables) maximum conveyance number is $Q/S^{0.5}$. (discharge divided by square root of street slope), which is 106.9 to top of curb.

      $$\frac{Q}{S^{0.5}} = 106.9$$

      Therefore $Q_{max} = 106.9 \times (S^{0.5}) = 106.9 \times 0.01^{0.5} = 10.7$ cfs

      Note: If street capacity is less than required $Q$ from hydrology report then upstream inlet is required.

   2. **Check Split in Street Flow:**

      Given $Q = 13$ cfs

      $S^{0.5} = 0.1 \ \frac{Q}{S^{0.5}} = 130$

      Note: Table II-2-3 shows that crown is exceeded. Review of Table II-2-3 shows that flow begins to exceed the crown at a conveyance factor of 106.9.

      Therefore, at $Q = 106.9 \times S^{0.5} = 106.9 \times 0.01^{0.5} = 10.7$ cfs, street flow could flow over the crown.

      $2 \times 10.7$ cfs = 21.4 cfs, this is larger than 13 cfs. So, one side of the street carries 10.7 cfs, and the other carries $13 - 10.7 = 2.3$ cfs.

      Caution must be exercised in split flow assumptions. A better design provides for no split flow.

   3. **Calculate flow conditions to size inlet.**

      From the example above, depth of flow in the street is 0.49 ft (see Table II-2-3). This is one of the required inputs into the inlet table.
Figure 5-4, as shown on page 5-5, shall be revised as follows:

Street half-width dimension shown shall be revised from 16’ to 18’. Curb type shall be revised from “Type A2-6” to “6 inch”.

Table 5-1, as shown on page 5-6, shall be deleted.

Street Capacity Table 5-2, as shown on page 5-9, shall be revised as follows:

All street flow tables are deleted and replaced by Table II-2-1, Table II-2-2 and Table II-2-3.

Section III. INLETS

Subsection A. General, Part 1. Types, paragraph 4, as shown on page 5-32, shall be revised as follows:

When proposing a sump condition the designer must verify 100-year protection of habitable areas assuming the inlet clogs 100%. This will require a secondary emergency outlet for the sump waters which should provide a minimum of 0 ft freeboard (6 inches suggested) between the maximum water surface elevation and the minimum finish floor elevation. This emergency outlet system must direct overflows to either a downstream street with adequate capacity or natural conveyance system. Point of discharge must be analyzed with regard to prevention of downstream problems. Such a system need not consist of additional structure, but may require modification of surrounding grading, allowing water to flow between dwelling units.

To Subsection A. General, Part 2. Inlet Location Requirements, subpart a. Recommended Locations, as shown on page 5-33, add the following:

Catch basins shall be provided at maximum 1,000 ft. spacing

Subsection B. Curb Opening Inlets, Part 2. Standard Lengths of Curb Inlets, as shown on page 5-36, shall be revised as follows:

For curb opening catch basins (Standard Detail #300-2), the minimum width of the curb opening, W, shall be 6 ft. Design values for W shall be rounded up to the nearest 2 ft. up to a maximum value of 20 ft. Minimum separation between curb opening inlets shall be two pipe lengths, or 16 ft.

Subsection B. Curb Opening Inlets, Part 6, Figure 5-12, as shown on page 5-41, shall be deleted and replaced by Figure 3.
Subsection B. Curb Opening Inlets, Part 8, Figure 5-14, as shown on page 5-44, shall be deleted and replaced by Figure 4.

Subsection C. Grate Type Inlets, as shown on pages 5-45, shall be deleted.

Subsection C. Grate Type Inlets, Part 3 Design Procedure for Grate Only Inlets, Figures 5-15, 5-16, and 5-17, as shown on pages 5-47, 5-48, and 5-49, shall be deleted.

Subsection D. Grate Inlets at Sump, as shown on page 5-50, shall be deleted.

Subsection E. Detailing Information, part 2, as shown on page 5-52, shall be deleted.

Figures 5-20, as shown on page 5-53, shall be deleted.

Subsection F. Combination Type Inlets, as shown on page 5-56, shall be deleted.

Figures 5-23 and 5-24, as shown on page 5-57 and 5-58, shall be deleted.

Subsection G. Slotted Type Inlets, as shown on page 5-56, shall be deleted.

Figure 5-26, as shown on page 5-62, shall be deleted.

Subsection I. Over-Shoulder Type Inlets, as shown on page 5-63, shall be deleted.

Figure 5-27, as shown on page 5-64, shall be deleted.
C. B. #

STA.

CURB OPENING (INTERCEPTION)

Given: (a) Discharge \( Q = \) ______ CFS.
(b) Street slopes \( S = \) ______ %
(c) Curb type ___ A ___ 8" C.F. ___ 6" C.F.
___ B ___ 8" C.F. ___ 6" C.F.
(d) half street width = ______ ft.

Solution:

\[
\frac{0.5}{Q/S} = \frac{\bar{Q}}{(\bar{S}).05}
\]

\[
= \frac{\bar{Q}}{(\bar{S}).05}
\]

Therefore \( y = \) ______ ft.

\[
Q/L = \frac{\bar{Q}}{L}
\]

\[
L = \frac{\bar{L}}{(L \text{ for total interception})} = \frac{\bar{L}}{\text{ft.}}
\]

TRY: \( L_p = \) ______ ft. (From chart)

\[
\frac{L_p/L}{\bar{L}} = \frac{\bar{L}}{\bar{L}} = \frac{\bar{L}}{\bar{L}}
\]

\[
a/y = .17/\frac{\bar{L}}{\bar{L}} = \frac{\bar{L}}{\bar{L}}
\]

\[
\frac{Q_p/Q}{Q} = \frac{\bar{Q}}{Q} = \frac{\bar{Q}}{Q}
\]

\[
Q_p = \frac{\bar{Q}}{Q} \times \frac{\bar{Q}}{Q} = \frac{\bar{Q}}{Q} \times \frac{\bar{Q}}{Q} \text{ CFS.}
\]

(Intercepted)

\[
Q_c = \frac{\bar{Q}}{Q} - \frac{\bar{Q}}{Q} = \frac{\bar{Q}}{Q} - \frac{\bar{Q}}{Q} \text{ CFS.}
\]

(Carryover)
C. B. # ________________
STA. ________________

CURB OPENING (SUMP)

Given:

(a) Discharge \( Q = \) __________ CFS.
(b) Street slope \( S = \) __________ %
(c) Curb type ____ A ____ 8"C.F. ____ 6"C.F.
        ____ B ____ 8"C.F. ____ 6"C.F.
(d) Half street width : ____ ft.

Solution:

\[
\frac{0.5}{Q/S} = \frac{0.5}{(\text{________})}
\]

Therefore \( y = \) __________ ft.

\( H \) (depth at opening) = 0.17 + _____ = _____ ft.

\( h \) (height of opening) = _____ ft. ( 8" CF., \( h = 8.5" \) )
        ( 6" CF., \( h = 6.5" \) )

\( H/h \) ______ / _____ = ______

From Chart:

\( Q/\text{ft. of opening} = \) ________________ CFS

\( L \) required = ______ / _____ = _____ ft.

USE \( L = \) ______ ft.

CITY OF ANAHEIM

CURB OPENING
(SUMP)

FIGURE

4
ADDITIONAL HYDRAULICS REQUIREMENTS

IX. HYDRAULIC CALCULATIONS

A. Identify all calculations by referring to the storm drain line number and its location.

B. Begin all hydraulic grade line calculations at the downstream end of a system and proceed upstream to the catch basin or other inlet facility.

C. Calculations must proceed from point to point in a logical, easy to follow analysis. Start with a beginning water surface (obtained from existing plans which has been verified and double checked and add losses in a systematic manner as they accrue along the pipeline. Sum these losses and show the hydraulic grade line elevations at critical points.

D. The HGL of the main line to be a minimum of 2 feet below finished surface.

E. When using Thompson's Y, write your equation first and then plug in the numbers. Numbers alone will not suffice. The minimum loss in basin is \(1.2 \times \frac{V^2}{2g}\). Check Thompson's Y for catch basins in series.

F. At all junctions, show a detail including angles between the mainline storm drain and incoming laterals, values of B, C, D1, D2 as required per City Standard Details No. 313, 320, and 321.

G. For storm drain connecting to the Santa Ana River, HGL at the connection point shall be equal to the water surface elevation + 2 feet.

H. Water surface elevation in Santa Ana River shall be obtained from Orange County Resources Development Management Department.

CHAPTER 6 STRUCTURES

Section I. GENERAL

Subsection C. Conduit Designations, as shown on page 6-2, shall be deleted.

Section II. DESIGN LOADS

Subsection D. Miscellaneous Criteria, Part 2. Corrugated Steel Pipe, as shown on page 6-6, shall be deleted.

Subsection D. Miscellaneous Criteria, Part 3. Asbestos Cement Pipe, as shown on page 6-7, shall be deleted.
Section III. **RCP ALTERNATE STRUCTURES (PIPE)**

This Section, as shown on page 6-7, shall be deleted.

Section IV. **STANDARD PLANS**, as shown on page 6-9 shall be revised as follows:

Structural designs not needing specific analysis are those structures in the City of Anaheim Standard Plans, except where otherwise noted.

Any separate or unusual soils or loading conditions will require separate analysis by the designer.

Section VII, **REINFORCED-CONCRETE PIPE (RCP)**

**Subsection C. D-Load Calculations**, as shown on page 6-15, shall be revised as follows:

1. The D-load table for Reinforced Concrete pipe has been included as Figure 5, and is based on a $B_F = 1.5$ to meet City of Anaheim requirements.

2. D-load chart per Figure 5 for trench width = OD + 20". Multiply the D-Load by 1.2 to convert to load factor of 1.5.

3. The shallowest portion of any pipeline shall be installed not less than 30" below the street finished surface or finished grade.


5. Bedding Detail: Use City Standard Detail #132 and Standard Specifications for Public Works Construction (Green Book) Section 306-1.2.1 Bedding, for cover above RCP between 3 ft and 15 ft. For cover less than 3 ft or greater than 15 ft, special bedding is required. A detail of the special bedding shall be shown on the plans.

6. Calculations and supporting soils reports to be provided by the design engineer.

**Subsection C. D-Load Calculations**, as shown on page 6-17, shall be revised as follows:

Table 6-8, D-Load Table, shall be deleted and replaced by Figure 5.

**To Subsection E. Design**, as shown on page 6-18, add the following:

3. Construct RCP with rubber-gaskets for systems with a pressure head greater than 10 feet.
# City of Anaheim

## D-Load Table for Design of R.C.P.

### Figure 5

#### Required "D" Load for Reinforced Concrete Pipe Laid Per Std. Dwg. 2 - D 177

**Case III Bedding**  
**Design Density = 120 pcf**

<table>
<thead>
<tr>
<th>Pipe Size (inches)</th>
<th>Depth of Cover in Feet</th>
<th>Load Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>16</td>
<td>2</td>
<td>1.0</td>
</tr>
<tr>
<td>18</td>
<td>3</td>
<td>1.0</td>
</tr>
<tr>
<td>20</td>
<td>4</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**NOTE:**  
For General Notes see Sheet 1.

*Multiply "D" load by 1.2 to convert to a load factor of 1.5 to meet City of Anaheim requirements.*

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**Los Angeles County Flood Control District**  
**"D" Load Table for Design of Reinforced Concrete Pipe**

**Date:**
- Load factor = 1.6
- Live load = 1 H 20 S 16 truck

**Note:**
- For General Notes see Sheet 1.
Subsection F. Design Example, as shown on page 6-18, shall be revised as follows:

Given:

Diameter of pipe = 48"
Live Load = H20-S16-44 Truck
Soil = 120 pcf
Cover = 7'
Load Factor = 1.2
No unusual soils conditions

Solutions

See Figure 5
Find Pipe Size—move across the table to appropriate depth of cover.

Pipe D-Load = 1200
Multiply by 1.2 to achieve $B_F = 1.5$,
Pipe D-Load = 1440, Choose 1450

To Subsection G. Special Provision for Steel Cover, Part 2, as shown on page 6-18, add the following:

Minimum steel clearance to be used at the invert of R.C.P. is shown in Table II-6-I.

<table>
<thead>
<tr>
<th>Velocity</th>
<th>Clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 20 fps</td>
<td>1&quot;</td>
</tr>
<tr>
<td>20 fps to 27 fps</td>
<td>1 ½ &quot;</td>
</tr>
<tr>
<td>27 fps to 34 fps</td>
<td>2&quot;</td>
</tr>
<tr>
<td>34 to 40 fps</td>
<td>2 ½&quot;</td>
</tr>
</tbody>
</table>

For radius 45 ft. or less and velocity is more than 20 fps -- add 1/2 in. to each of the above.

For Pipe flows with velocities greater than 40 fps, dissipater rings shall be designed. Design shall be based upon Hydraulic Design of Energy

Section VIII. **CORRUGATED STEEL PIPE (CSP)**
This Section, as shown on page 6-18, shall be deleted.

Section IX. **CORRUGATED STEEL PLATE PIPE (CSPP)**
This Section, as shown on page 6-31, shall be deleted.

Section X. **CORRUGATED ALUMINUM PIPE (CAP)**
This Section, as shown on page 6-35, shall be deleted.

Section XI. **SPIRAL RIBBED PIPE (SRP)**
This Section, as shown on page 6-39, shall be deleted.

Section XII. **CAST-IN-PLACE NON-REINFORCED CONCRETE PIPE (CIPCP)**
This Section, as shown on page 6-43, shall be deleted.

Section XIII. **PLASTIC PIPE**
This Section, as shown on page 6-50, shall be deleted.

Section XIV. **ASBESTOS CEMENT PIPE**
This Section, as shown on page 6-52, shall be deleted.

Section XVI. **SLOTTED DRAIN (CSP)**
This Section, as shown on page 6-53, shall be deleted.

Section XIX. **ANCHORAGE ON SLOPES/SLOPE DRAINS**

**Subsection C. Structural Criteria, part 3,** as shown on page 6-68, shall be revised as follows:

3. Adequate anchorage shall be installed at 10’ vertical intervals for all conduit pipe placed on or within slopes of 30% or steeper. Slope anchors and backfill stabilizers are required when pipe slope exceeds 30%. (Standard Detail # 393).

**To Subsection C. Structural Criteria, part 3,** as shown on page 6-68, add the following:

6. Storm drains should normally be 5 ft. to 6 ft. deep in slopes.
Section XXI. DEBRIS AND SILT CONTROL FACILITIES

Part 6. Debris Control Structures, first paragraph, as shown on page 6-71, shall be revised as follows:

The debris control structures should have openings wide enough to allow as much debris as possible to pass through and yet must be narrow enough to protect the smallest conduit in the downstream storm drain system. Track racks and/or de-silting basins are required at unimproved locations.