DESIGN CHARTS
FOR

CATCH BASIN OPENINGS

AS DETERMINED BY

EXPERIMENTAL HYDRAULIC MODEL STUDIES

BUREAU OF ENGINEERING
City of Los Angeles

LYALL A. PARDEE
City Engineer

OFFICE STANDARD NO. 108
STORM DRAIN DESIGN DIVISION
1965

OFFICE STANDARD NO. 108

DESIGN CHARTS

FOR

X-5 CATCH BASIN OPENINGS

AND

CATCH BASIN NO. 39, NO. 40 AND NO. 47 OPENINGS

AS DETERMINED BY

EXPERIMENTAL HYDRAULIC MODEL STUDIES

CONDUCTED BY

BUREAU OF ENGINEERING

CITY OF LOS ANGELES

STORM DRAIN DESIGN DIVISION

PART I		APRIL 1955
PART II		APRIL 1955
PART III	ADDED	JULY 1956
PART IV	ADDED	MAY 1957
PART V	ADDED	NOV. 1957
PART VI	ADDED	NOV. 1957
PART VII	ADDED	JAN. 1959
PART VIII	ADDED	MAY 1961

L. O. Turner - Division Engineer 1955-1959
Ulmont Swan - Division Engineer 1960 To Date
F. J. Doran - Project Engineer

June 1, 1961

I N D E X

Description and Use of Design Charts.

Sample Problem.

Supplement No. 1.

Supplement No. 2

PART I - C.B. No. 45 & No. 46 (X-5 Type Curb Opening).

Fig. 1 - Details of X-5 Catch Basin Opening.

Chart LL-7 - Design Charts, S = 0.002.

Chart LL-8 - Design Charts, S = 0.005.

Chart LL-9 - Design Charts, S = 0.02 and 0.05.

Chart LL-10 - Design Charts, Sump Conditions, S = Zero.

PART II - C.B. No. 40 Type Curb Opening.

Fig. 2 - Details of No. 40 Type Basin Opening.

Chart LL-12 - Design Charts, S = 0.002.

Chart LL-13 - Design Charts, S = 0.005.

Chart LL-14 - Design Charts, S = 0.002 and 0.05.

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PART III - C.B. No. 47 (Pasadena Type)

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Chart LL-17 - Design Charts, S = 0.03; 0.05 and 0.09.

I N D E X (Continued)

PART IV - City of Los Angeles Standard Grating Capacity Charts

Chart No.
LL-18 - Standard Curb & Gutter, S = 0.002
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LL-20 - Standard Curb & Gutter, S = 0.050
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LL-23 - Standard Curb & Gutter, All Slopes, Grating No. 1 & 2
LL-24 - Standard Curb & Gutter, All Slopes, Grating No. 2 & 4
LL-25 - Standard Curb & Gutter, All Slopes, Grating No. 1, 2, 3 and 4

PART VII - Description and Use of Catch Basin Connecting Pipe Capacity Charts, combined with "Catch Basin Outlet Transition Structure."

Chart No.
1. - Full Pipe (with Standard Transition Structure)
2. - Control At Inlet (with Standard Transition)

PART VIII - Description and Use of Catch Basin Connecting Pipe Capacity Charts, without Catch Basin Outlet Transition Structure.

Chart No.
3. - Full Pipe (without Standard Transition Structure)
4. - Control at Inlet (without Standard Transition Structure.)

Added 3/3/59
Added 2/3/60

DESCRIPTION AND USE OF DESIGN CHARTS

FOR SIDE-OPENING CATCH BASINS

TYPES X-5 AND NO. 39 - NO. 40

Experimental hydraulic model studies of a new type of catch basin and catch basin opening have resulted in the development of the design curves attached hereto. The new opening referred to is known as the X-5 type and Charts Nos. LL-7 to LL-10, inclusive, give the hydraulic characteristics thereof on the several slopes indicated on said charts. Figure 1 illustrates the details of catch basin openings of this type.

A similar set of charts numbered LL-12 to LL-15, inclusive, reflect the hydraulic characteristics of openings applicable to Catch Basins No. 39 and No. 40 with appurtenant Local Depressions. These charts may be used as guides to the capacity of existing curb openings and catch basins of this type. Figure 2 illustrates the details of catch basin openings of this type.

Both sets of charts have been developed from tests made on street slopes of 0.00, 0.002, 0.005, 0.02, and 0.05. A sample problem and solution applying to the design charts prepared for the X-5 type of opening has been included for the benefit of the designer. Similar problems pertaining to No. 39 and No. 40 catch basin charts may be solved by the application of the same principles.

CONCLUSION

The studies so far conducted and the information contained in the attached charts do not cover the entire range of desirable catch basin information. Additional supplemental data is expected to be available from time to time which may be added to that contained herein.

SAMPLE PROBLEM

USE OF DESIGN CHARTS

GIVEN:

The storm water flow in half a street, constructed on a 0.02 slope, is 90 cfs. and the resultant computed depth of flow "D" above gutter grade is 0.85 feet.

REQUIRED:

The number of basins and the length of each basin of the X-5 type of opening required to intercept this flow.

SOLUTION:

1. Chart LL-9, S = 0.02 (indicates the capacities of catch basins of various lengths when D = 0.85 feet). The designer must now determine from field investigation and proper construction cost the most desirable catch basin length applicable to the particular problem.

2. In this example, a catch basin length "W" of 28 feet has been selected which has a capacity of 37.5 cfs. for this depth of flow.

3. The difference between the total of 90 cfs. and 37.5 cfs. (intercepted by the first basin) leaves a remainder of 52.5 cfs. to be intercepted by the next or succeeding basins. The computed "D" for 52.5 cfs. is 0.71 feet.

4. Again assuming a desirable length of basin of 28 feet, Chart LL-9 indicates that such a basin will intercept 26.0 cfs. at a value of "D" of 0.71 feet, leaving a remainder of 26.5 cfs. to be intercepted by the next or succeeding basins. The calculated "D" for 26.5 cfs. is 0.60 feet.

5. From Chart LL-9 a 28-foot basin would have a capacity of 18.5 cfs. for a 0.60 foot value of "D", leaving a residual flow of 8 cfs. to be intercepted by a fourth basin. However, further examination of this chart indicates that a 42-foot basin will intercept the entire flow of 26.5 cfs. with a depth of 0.60 feet. It remains next for the designer to best judge from the available alternatives which selection of catch basin lengths will best fit the local conditions.

COMMENT:

From the above, it is evident that a fairly wide choice of number and lengths of basins (depending upon local conditions and economic factors) is available to the designer by the intelligent use of these charts. In general the efficiency, per foot of length of basin, becomes less as the length of the basin increases. Conversely the efficiency, per foot of basin, increases as its length is reduced. Economics as well as limiting physical conditions, therefore, control the number and length of basins required to intercept a given quantity of water.

OFFICE STANDARD NO. 108

SUPPLEMENTAL INSTRUCTIONS

August 15, 1955

Since the issuance of this standard, a number of instances of improper application and/or interpretation of the use thereof has come to our attention. Charts Nos. LL-7 to LL-10 inclusive, applicable to the X-5 type of basin, and Charts Nos. LL-12 to LL-15 inclusive, applicable to types 39 and 40 basins (having appurtenant local depressions) were developed to indicate the "Maximum Interception" of each type of basin for each length on each slope for various values of "D". From the experimental data accumulated in the model study, formulas applicable to each chart were developed and the curves shown thereon have been plotted from these formulas.

Subsequent to the issuance of this office standard, attempts have been made to use these charts to determine "Total Interception" of small quantities of water. The charts were not basically conceived or developed to answer such questions. More recent model study has indicated a deviation between the actual measured quantities of "Total Interception" and the theoretical quantities indicated on the charts for small values of "D" (generally below 0.4 feet to 0.7 feet prototype).

The experimental model studies from which these charts were derived were based upon streets of zero crossfall, uniform crown height "H" (above gutter) of 0.0125W, where "H" and "W" are measured in feet. A specific "Street Capacity" curve should be developed using increasing values of "D" and proper values of "s" for this or any other specific street cross section being studied. When this curve is superimposed on the proper Design Curve, the specific use of the Design Curve is limited to those points to the right of and above the "Street Capacity" curve. Conversely, all points to the left of and below the "Street capacity" curve are imaginary. In all cases it should be recognized that it is necessary to determine the correct value of "D" to secure valid results and "D" is extremely critical on most street sections when Q is small, say less than 5 cfs.

For those who desire specific solutions of "Total Interception" for each of the two general types of catch basins on streets having the characteristics used in the model study, the attached tabulations developed from the model study will supply the desired answers. It should not be assumed, however, under any circumstances, that these answers are applicable to streets of other crowns and cross sections.

LOT:cd

Bureau of Engineering
City of Los Angeles
Storm Drain Design Division

Bureau of Engineering
City of Los Angeles
Storm Drain Design Division

OFFICE STANDARD NO. 108
Supplement No. 1
August 1955

TABULATION OF TOTAL (100%) INTERCEPTION
For X-5 Type Catch Basin (See Fig. 1)

On Streets With Crown Height
H = 0.0125W Where H and W Are Measured in Feet

Total Interception Formula $Q = 0.049W^{1.4}\left(\frac{D}{s}\right)^{0.155}$

W	s = 0.002		s = 0.005		s = 0.020		s = 0.050	
	Q	D	Q	D	Q	D	Q	D
10	2.7	0.40	2.3	0.31	1.8	0.22	1.5	0.17
14	4.5	0.47	3.8	0.38	2.9	0.27	2.5	0.21
21	8.2	0.56	6.9	0.46	5.4	0.33	4.5	0.26
28	12.6	0.64	10.6	0.52	8.2	0.39	6.9	0.31
35	17.5	0.70	14.7	0.58	11.4	0.43	9.6	0.35
42	23.0	0.76	19.4	0.63	15.0	0.47	12.7	0.39
49	28.5	0.81	23.9	0.67	18.7	0.50	15.6	0.42
60	38.3	0.89	32.2	0.73	25.0	0.55	21.0	0.45

TABULATION OF TOTAL (100%) INTERCEPTION
For Nos. 39 and 40 Type Catch Basins With Standard L.D. (See Fig. 2)

On Streets With Crown Height
H = 0.0125W Where H and W Are Measured in Feet

Total Interception Formula $Q = 0.353W^{0.924}\left(\frac{D}{S}\right)^{0.137}$

W	s = 0.002		s = 0.005		s = 0.020		s = 0.050	
	Q	D	Q	D	Q	D	Q	D
3.5	2.3	0.38	2.0	0.30	1.6	0.21	1.3	0.17
7.0	4.5	0.46	3.9	0.38	3.0	0.27	2.6	0.22
14.0	8.8	0.57	7.6	0.47	6.0	0.35	5.1	0.28
21.0	12.9	0.64	11.2	0.53	8.9	0.40	7.6	0.32
28.0	17.1	0.70	14.7	0.58	11.7	0.44	10.0	0.36
35.0	21.2	0.74	18.4	0.62	14.6	0.47	12.6	0.39
42.0	25.3	0.78	21.9	0.65	17.4	0.49	15.0	0.41
49.0	29.8	0.82	25.7	0.68	20.2	0.52	17.4	0.43

SUPPLEMENT NO. 2
OFFICE STANDARD NO. 108
SUPPLEMENTAL INSTRUCTIONS

JULY 17, 1959

Since the issuance of this Standard, a number of instances of improper application of Catch Basins Nos. 45, 46, and 47 with (1) Standard Catch Basin Outlet Structure, and (2) Catch Basin Connecting Pipe Size have come to our attention.

The efficiency of these catch basins is dependent upon the following: (1) the improved curb inlet, (2) the scientifically shaped catch basin with the proper value of "V" (depth of basin), (3) the tapered transition section between the lower end wall of the catch basin and the outlet pipe, and (4) a catch basin connecting pipe of proper size and slope.

The following statements of policy are issued for the designer's information and guidance:

1. Catch Basins Nos. 45, 46, and 47. These catch basins should, in most cases, be specified with a "Standard Catch Basin Outlet Structure" (Standard Plan No. B-3649), with the following exception. When the quantity of water to be intercepted by the catch basin is less than 10 cfs., the "Standard Catch Basin Outlet Structure" may be omitted, providing "V" (depth of catch basin) is 5 feet or more, and "d" (diameter of catch basin connecting pipe) is 18 inches or greater.

2. Connecting Pipes. The minimum diameter for catch basin connecting pipe shall be 18 inches.

3. Curb Face. The effect of increasing the curb face at the catch basin from 9 inches to 10 inches, as has been suggested, is as follows:

   a. The catch basin capacity chart values (Office Standard No. 108, Parts I and III) may be increased by approximately 10 per cent for values of "Q" greater than those shown in the "Tabulation of Total Interception" (Supplement No. 1, dated August 1955). This increase in capacity varies somewhat with "D" depth of flow in the gutter above the catch basin, "s" slope of the gutter, and "W" width of the catch basin opening. When the curb face exceeds 9¼ inches, a plain round protection bar 1 inch in diameter is required.

4. Catch Basins in Series. When one or more connector pipes inlet into the catch basin, an outlet chamber similar to Los Angeles County Flood Control District Drawing No. 2-D249.2, Section A_1-A_1, shall be detailed on the improvement plan pending the publication of the new Outlet Chamber Standard Plan. Designers should keep in mind that loss of head in this Outlet Chamber is greatly increased due to turbulence; therefore, the outlet connector pipe from the Outlet Chamber should be 3 inches larger in diameter than that computed using Figure 1, Chart II, of Part VII, Office Standard No. 108.

5. Improvement Plan.

   a. The catch basin location (tie to the center line of the opening on Catch Basin No. 45 or tie to $\frac{W}{2}$ on Catch Basins Nos. 46 and 47), elevation of the catch basin outlet, and Δ (delta) of the curve on Case 2 of the "Catch Basin Outlet Transition Structure" shall be specified on the improvement plan.

   b. Dimensions "X" and "Y" for Table A, Case 2, Catch Basin Outlet Transition Structure (Standard Plan No. B-3649) may be computed from the following equations:

$$Y = \frac{R - (D + 12)}{\text{Tan } \Delta}$$

$$X = \frac{R - (D + 12)}{\text{Sin } \Delta}$$

L. O. TURNER, Engineer
Storm Drain Design Division

FJD:cd

X-5 CATCH BASIN OPENING
1" DEPRESSED GUTTER
S= VARIES
CROWN: H= 0.0125 RDWY. WIDTH
CROSSFALL= 0.00

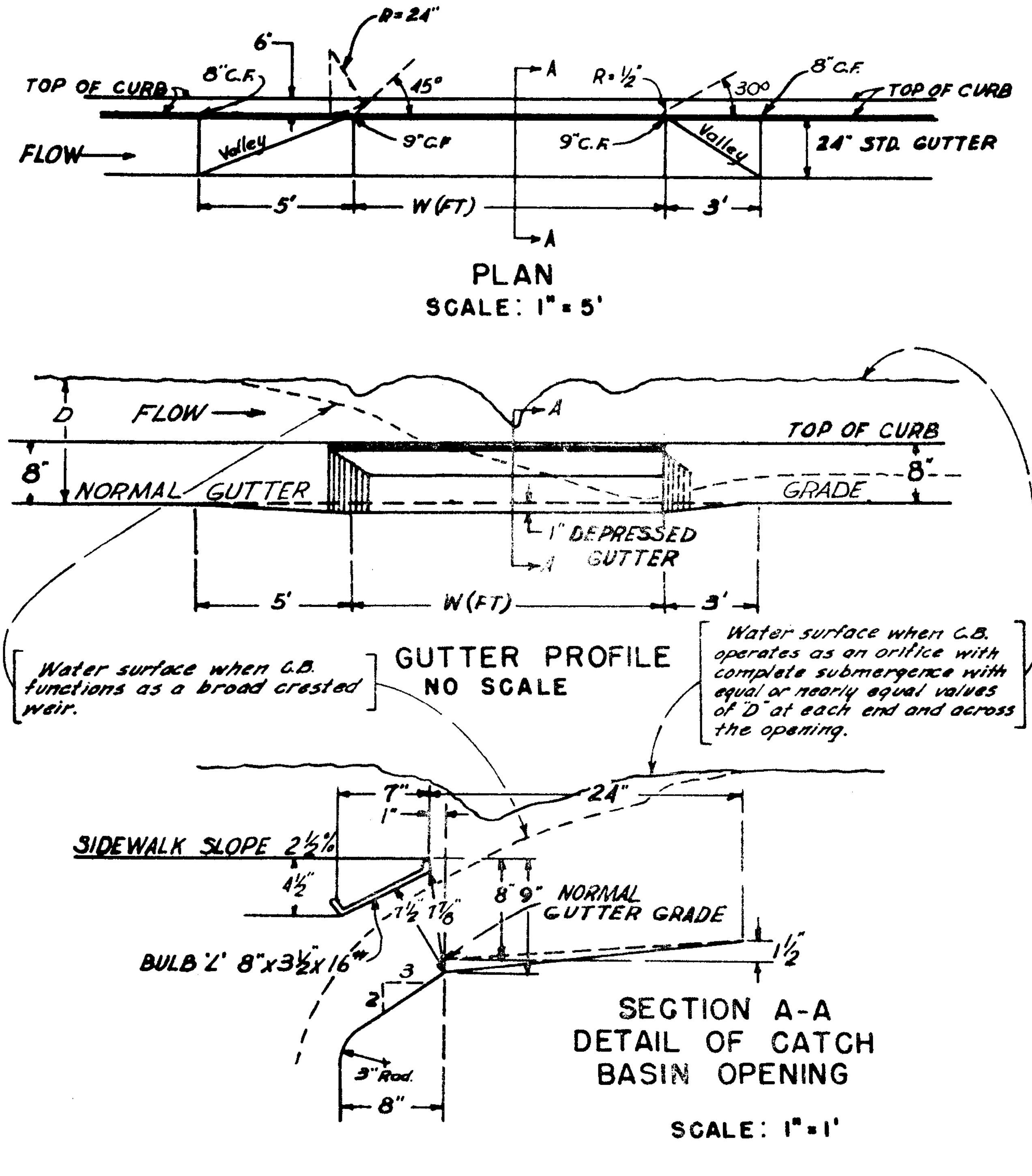


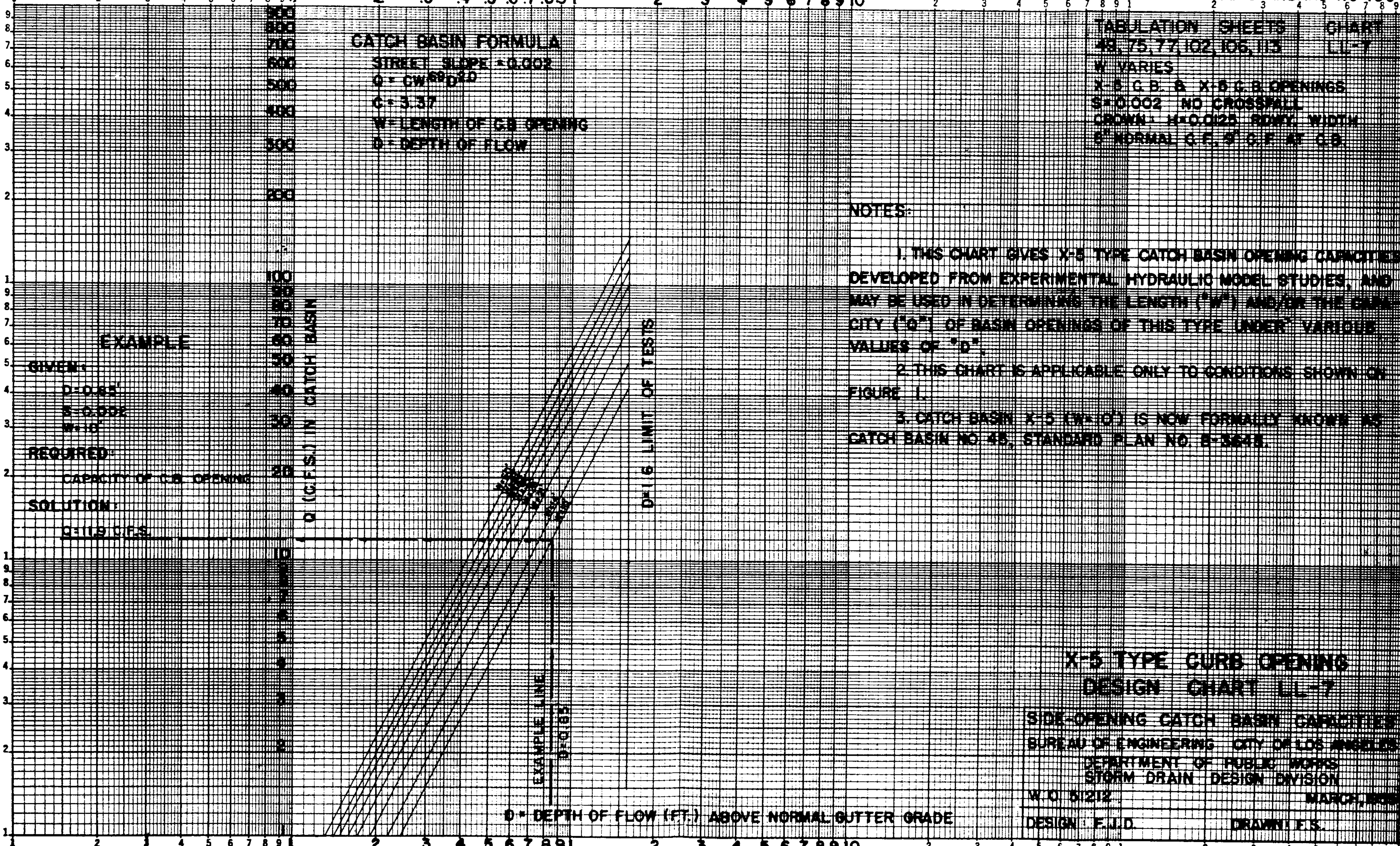
FIGURE 1

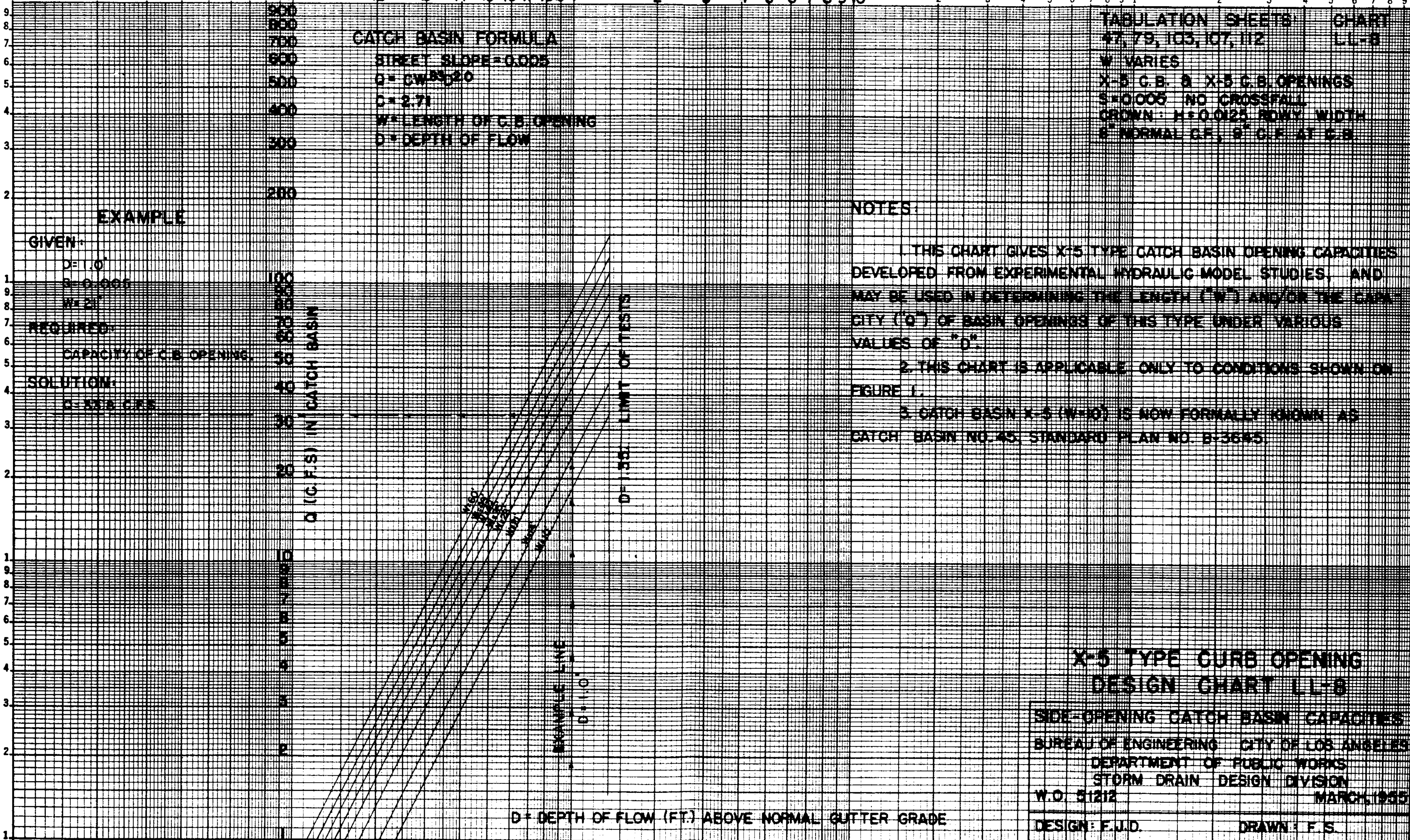
X-5 CATCH BASIN OPENING DETAIL

BUREAU OF ENGINEERING CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION

W.O. 36079 JUNE 1954

OFFICE STANDARD NO 108





NOTES:

1. THIS CHART GIVES X-5 TYPE CATCH BASIN OPENING CAPACITIES DEVELOPED FROM EXPERIMENTAL HYDRAULIC MODEL STUDIES, AND MAY BE USED IN DETERMINING THE LENGTH ("W") AND/OR THE CAPACITY ("Q") OF BASIN OPENINGS OF THIS TYPE UNDER VARIOUS VALUES OF "D".

2. THIS CHART IS APPLICABLE ONLY TO CONDITIONS SHOWN ON FIGURE 1.

3. CATCH BASIN X-5 (W = 10') IS NOW FORMALLY KNOWN AS CATCH BASIN NO. 45, STANDARD PLAN NO. B-3645.

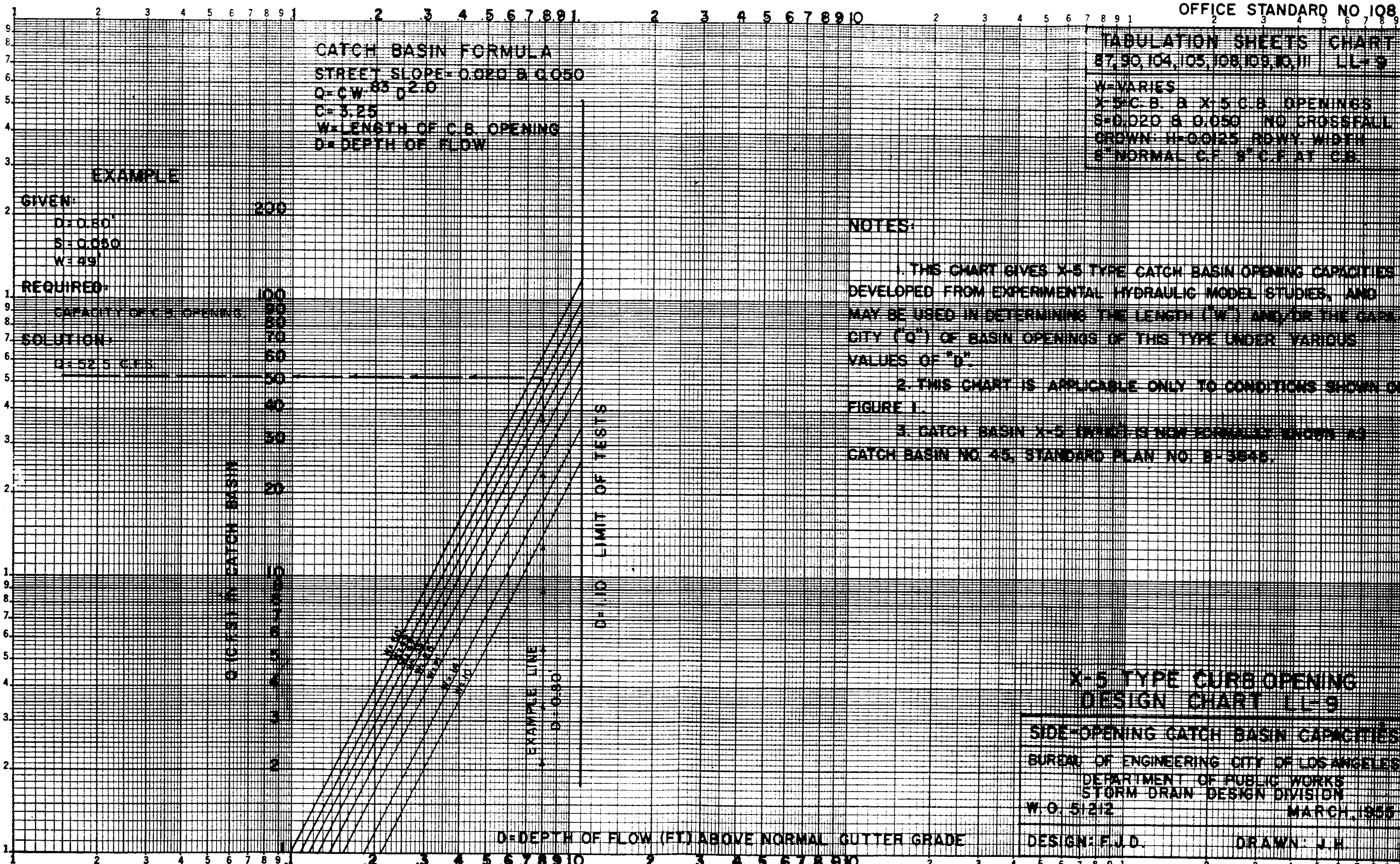
X-5 TYPE CURB OPENING DESIGN CHART LL-8

SIDE-OPENING CATCH BASIN CAPACITIES

BUREAU OF ENGINEERING CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION

W.O. 51212 MARCH, 1955

DESIGN: F.J.D. DRAWN: F.S.


OFFICE STANDARD NO 108
TABULATION SHEETS 87, 90, 104, 105, 108, 109, 110, 111
CHART LL-9
W=VARIES
X-5 C.B. & X-5 C.B. OPENINGS
S=0.020 & 0.050 NO CROSSFALL
CROWN: H=0.0125 RDWY. WIDTH
6" NORMAL C.F. 9" C.F. AT C.B.
CATCH BASIN FORMULA
STREET SLOPE=0.020 & 0.050
Q=CW.83 D2.0
C=3.25
W=LENGTH OF C.B. OPENING
D=DEPTH OF FLOW
EXAMPLE
GIVEN:
D=0.80'
S=0.050
W=49'
REQUIRED:
CAPACITY OF C.B. OPENING.
SOLUTION:
Q=52.5 C.F.S.
Q (C.F.S.) IN CATCH BASIN
EXAMPLE LINE D=0.80
D=1.10 LIMIT OF TESTS
D=DEPTH OF FLOW (FT) ABOVE NORMAL GUTTER GRADE
NOTES:
1. THIS CHART GIVES X-5 TYPE CATCH BASIN OPENING CAPACITIES DEVELOPED FROM EXPERIMENTAL HYDRAULIC MODEL STUDIES, AND MAY BE USED IN DETERMINING THE LENGTH ("W") AND/OR THE CAPACITY ("Q") OF BASIN OPENINGS OF THIS TYPE UNDER VARIOUS VALUES OF "D".
2. THIS CHART IS APPLICABLE ONLY TO CONDITIONS SHOWN ON FIGURE 1.
3. CATCH BASIN X-5 (WHICH IS NOW FORMALLY KNOWN AS CATCH BASIN NO. 45, STANDARD PLAN NO. B-3545.
X-5 TYPE CURB OPENING
DESIGN CHART LL-9
SIDE-OPENING CATCH BASIN CAPACITIES
BUREAU OF ENGINEERING CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION
W.O. 51212
MARCH, 1955
DESIGN: F.J.D.
DRAWN: J.H.

TABULATION SHEETS 81, 91, 114 — CHART LL-10

SUMP CONDITIONS (W VARIES)
X-5 C.B. OPENING (SEE FIGURE 1)
S=0.00 NO CROSSFALL
CROWN: H=0.0125 RDWY. WIDTH
8" NORMAL C.F., 9" C.F. AT C.B.

EXAMPLE

GIVEN:

71.7 C.F.S. COMPUTED FLOW TO SUMP
MAXIMUM PERMISSIBLE DEPTH "D" OF WATER IN SUMP= 1.10 FT.

REQUIRED:

LENGTH (W) OF CURB OPENING (S)

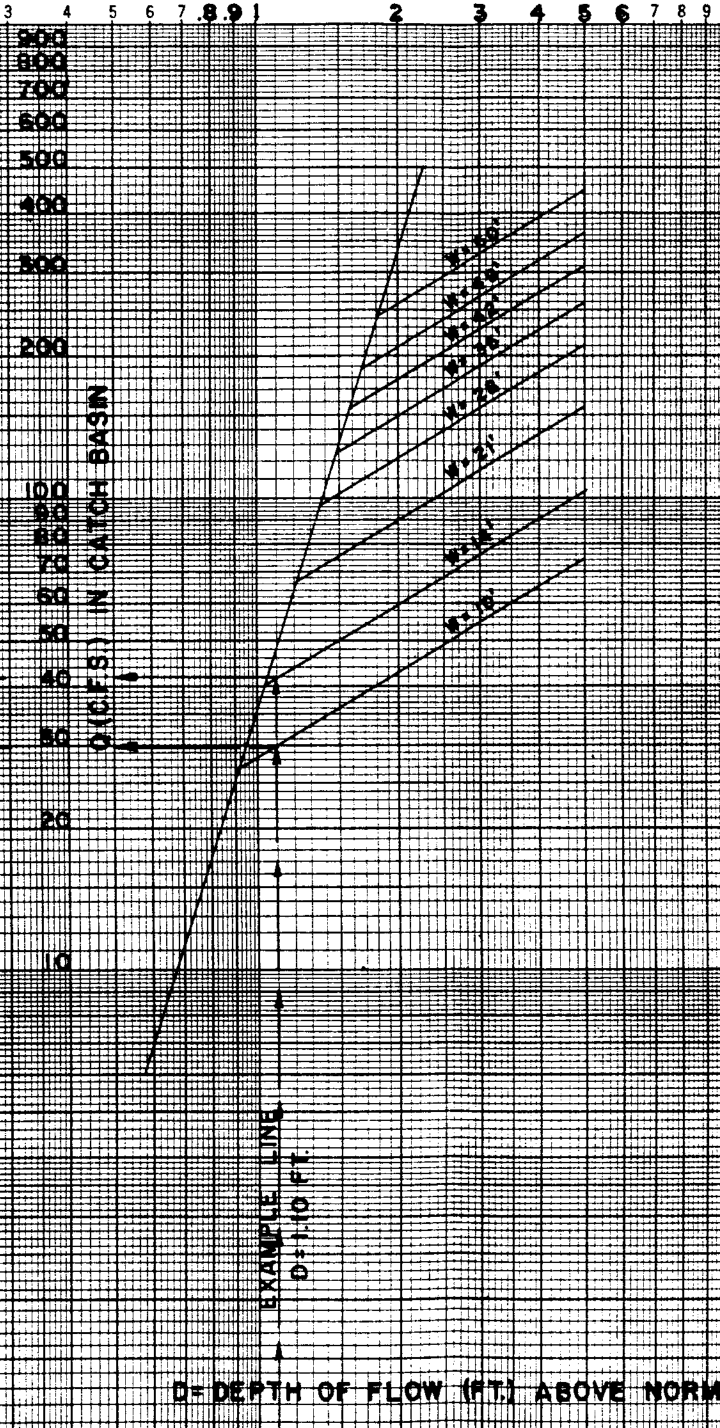
SOLUTION:

FOR D=1.10 FT.

FOR W=14 FT. Q=41.8 C.F.S.

FOR W=10 FT. Q=29.9 C.F.S.

TOTAL Q=71.7 C.F.S.



NOTES:

1. THIS CHART GIVES X-5 TYPE CATCH BASIN OPENING CAPACITIES DEVELOPED FROM EXPERIMENTAL HYDRAULIC MODEL STUDIES, AND MAY BE USED IN DETERMINING THE LENGTH ("W") AND/OR THE CAPACITY ("Q") OF BASIN OPENINGS OF THIS TYPE UNDER VARIOUS VALUES OF "D".

2. THIS CHART IS APPLICABLE ONLY TO CONDITIONS SHOWN ON FIGURE 1, AND MAY BE USED FOR ANY CROSSFALL BY SELECTING THE PROPER VALUE OF "D" RESULTING THEREFROM.

3. SUMP FORMULA:
   $Q = 4.3\ AD^{0.6}$ (COMPLETE SUBMERGENCE).
   A= AREA OF OPENING (W x 0.656).
   W= LENGTH (FEET) OF CATCH BASIN OPENING.
   D= DEPTH (FEET) OF FLOW ABOVE NORMAL GUTTER GRADE.

4. CATCH BASIN X-5 (W=10') IS NOW FORMALLY KNOWN AS CATCH BASIN NO. 45, STANDARD PLAN NO. B-3646.

SUMP
X-5 TYPE CURB OPENING
DESIGN CHART LL-10

SIDE-OPENING CATCH BASIN CAPACITIES

BUREAU OF ENGINEERING CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION

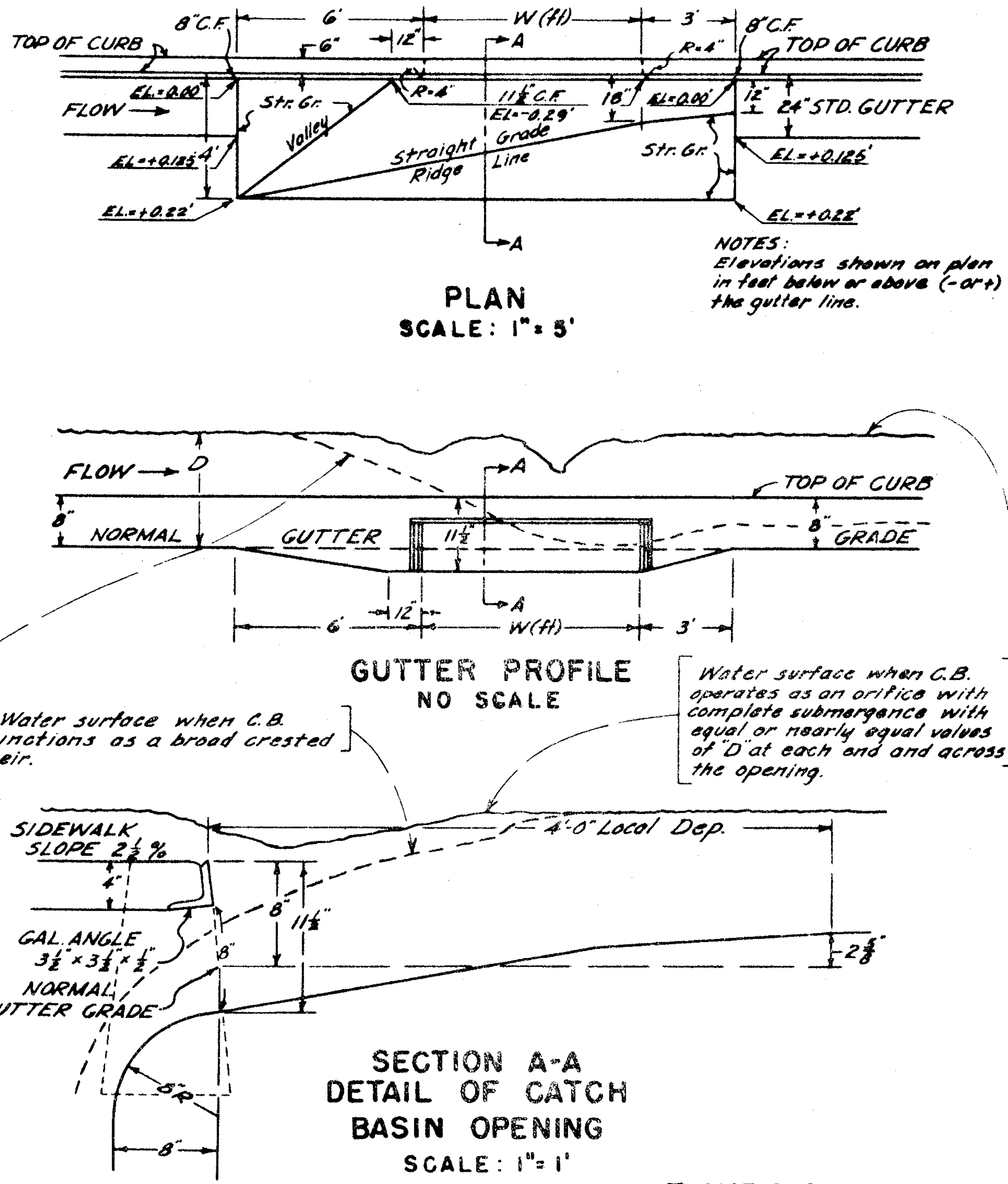
W.O. 51212 — MARCH, 1955

DESIGN: F.J.D. — DRAWN: L.L.G.

OFFICE STANDARD NO 108

STANDARD CATCH BASIN OPENING

L.D. NO 3 CASE I (STD. PLAN D-1993)
S = VARIES, 11.5 C.F. AT C.B.
CROWN: H = 0.0125 RDWY WIDTH
CROSSFALL = 0.00



PLAN
SCALE: 1" = 5'

GUTTER PROFILE
NO SCALE

SECTION A-A
DETAIL OF CATCH BASIN OPENING
SCALE: 1" = 1'

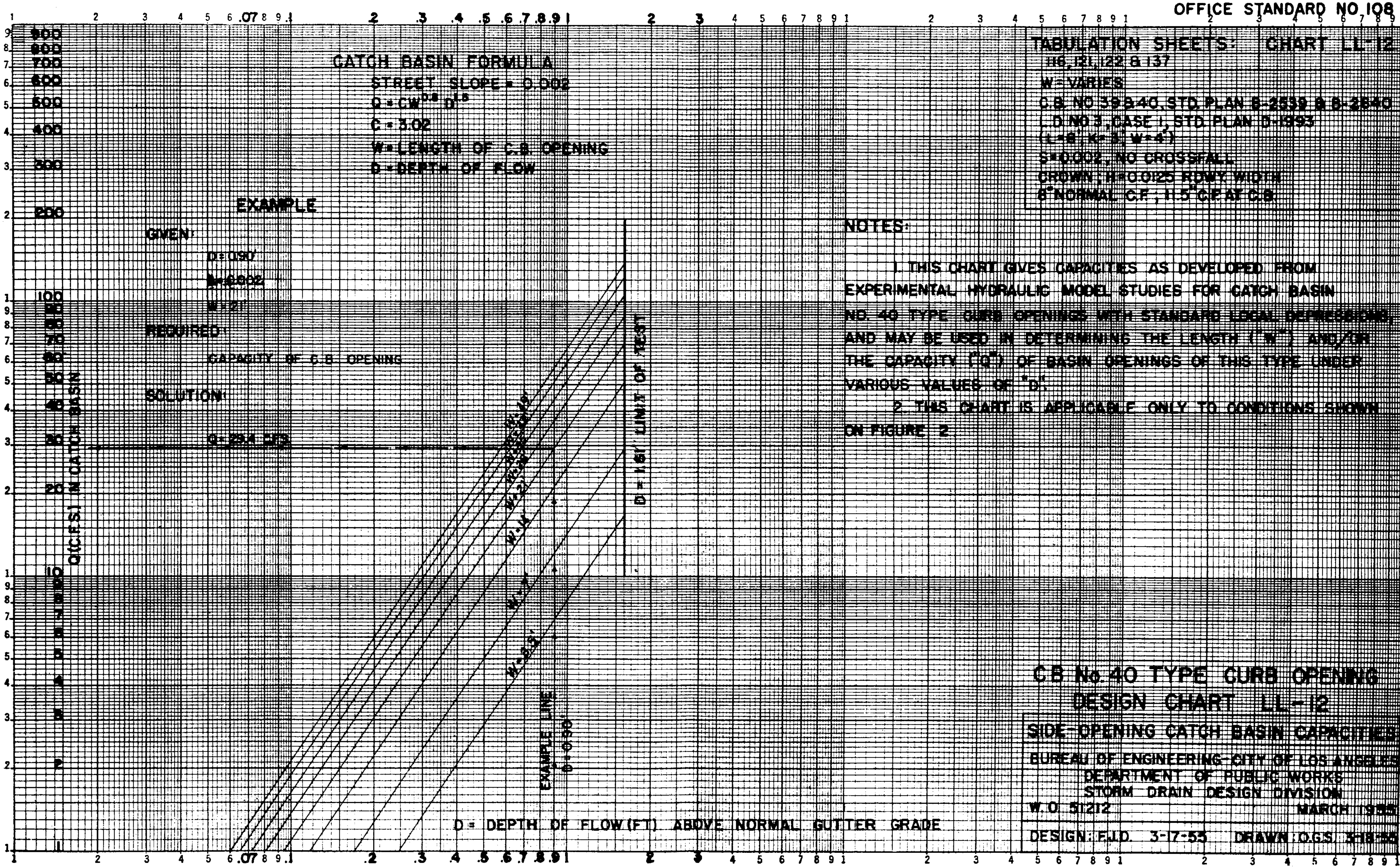
FIGURE 2

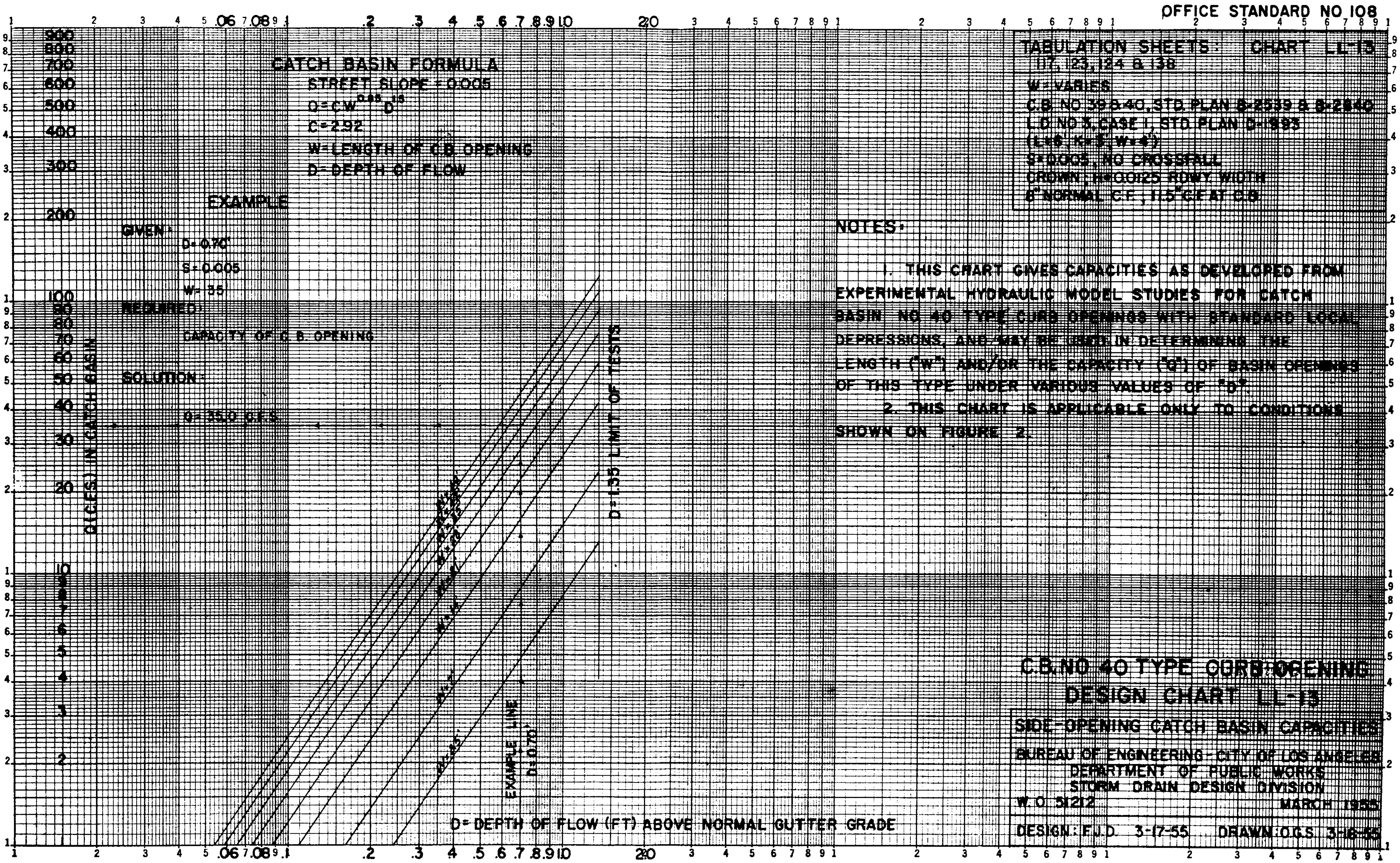
STANDARD CATCH BASIN OPENING DETAIL

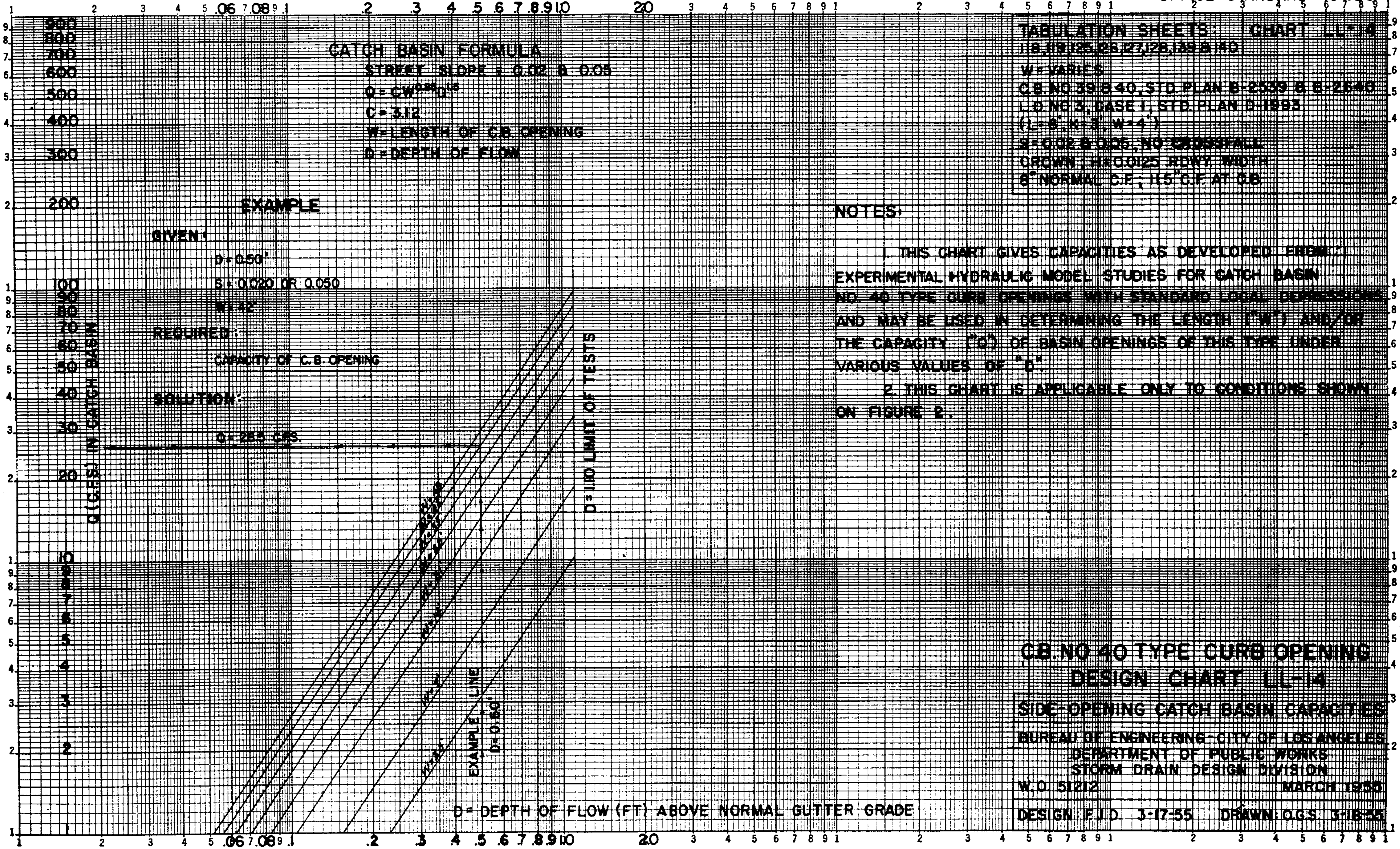
BUREAU OF ENGINEERING CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION

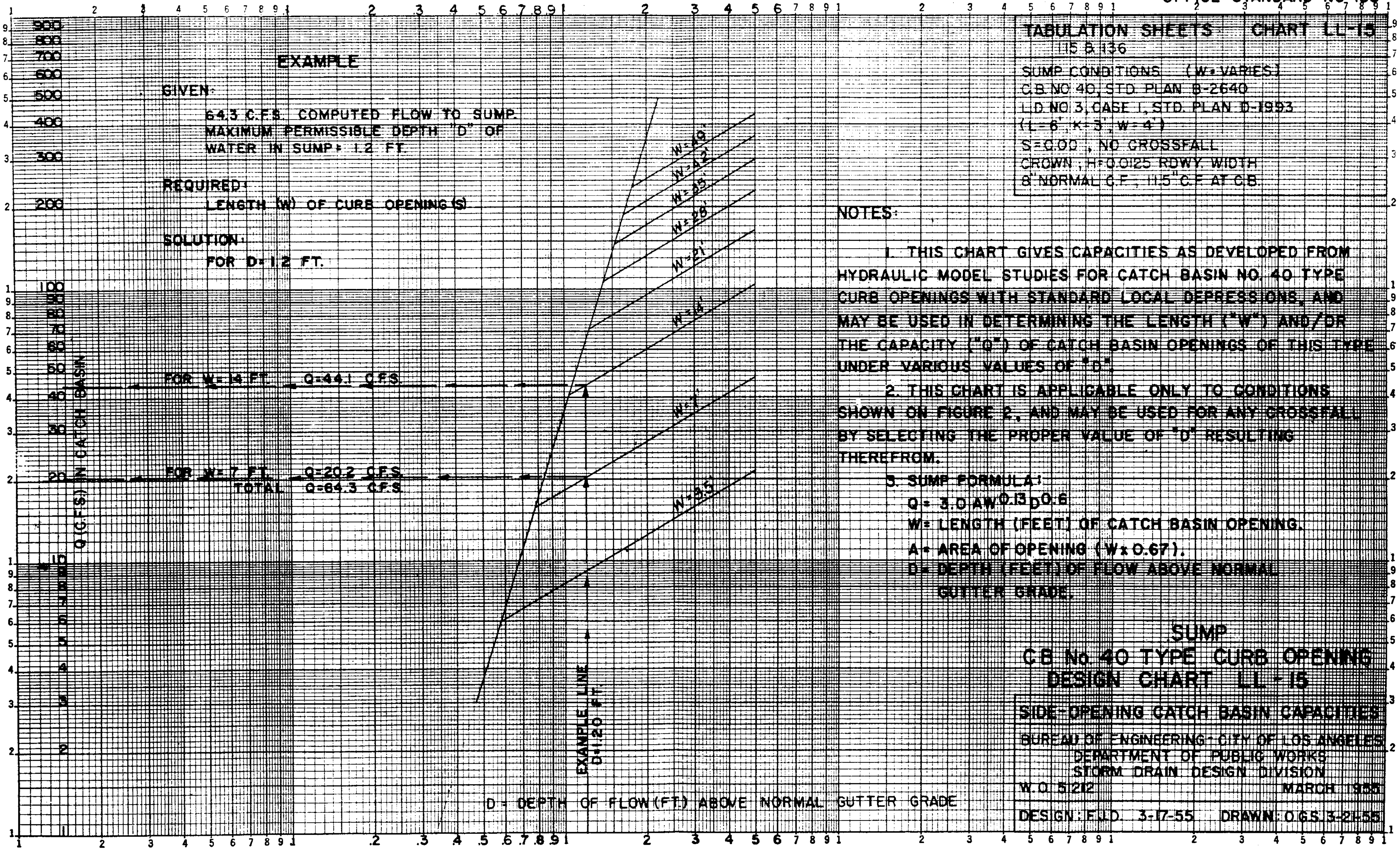
W.O. 51212 MARCH 1955

OFFICE STANDARD NO. 108




OFFICE STANDARD NO 108
CATCH BASIN FORMULA
STREET SLOPE = 0.005
Q = CW^0.85 D^1.5
C = 2.92
W = LENGTH OF C.B. OPENING
D = DEPTH OF FLOW
EXAMPLE
GIVEN:
D = 0.70'
S = 0.005
W = 35
REQUIRED:
CAPACITY OF C.B. OPENING
SOLUTION:
Q = 35.0 C.F.S.
Q (C.F.S.) IN CATCH BASIN
D = 1.35 LIMIT OF TESTS
EXAMPLE LINE
D = 0.70'
D = DEPTH OF FLOW (FT) ABOVE NORMAL GUTTER GRADE
TABULATION SHEETS: CHART LL-13
117, 123, 124 & 138
W = VARIES
C.B. NO 39 & 40, STD. PLAN B-2539 & B-2840
L.D. NO 3, CASE I, STD. PLAN D-1993
(L=6', K=3', W=4')
S=0.005, NO CROSSFALL
CROWN: H=0.0125 RDWY. WIDTH
8" NORMAL C.F.; 11.5" C.F. AT C.B.
NOTES:
1. THIS CHART GIVES CAPACITIES AS DEVELOPED FROM EXPERIMENTAL HYDRAULIC MODEL STUDIES FOR CATCH BASIN NO 40 TYPE CURB OPENINGS WITH STANDARD LOCAL DEPRESSIONS, AND MAY BE USED IN DETERMINING THE LENGTH ("W") AND/OR THE CAPACITY ("Q") OF BASIN OPENINGS OF THIS TYPE UNDER VARIOUS VALUES OF "D".
2. THIS CHART IS APPLICABLE ONLY TO CONDITIONS SHOWN ON FIGURE 2.
C.B. NO 40 TYPE CURB OPENING
DESIGN CHART LL-13
SIDE-OPENING CATCH BASIN CAPACITIES
BUREAU OF ENGINEERING - CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION
W.O. 51212
MARCH 1955
DESIGN: F.J.D. 3-17-55
DRAWN: O.G.S. 3-18-55

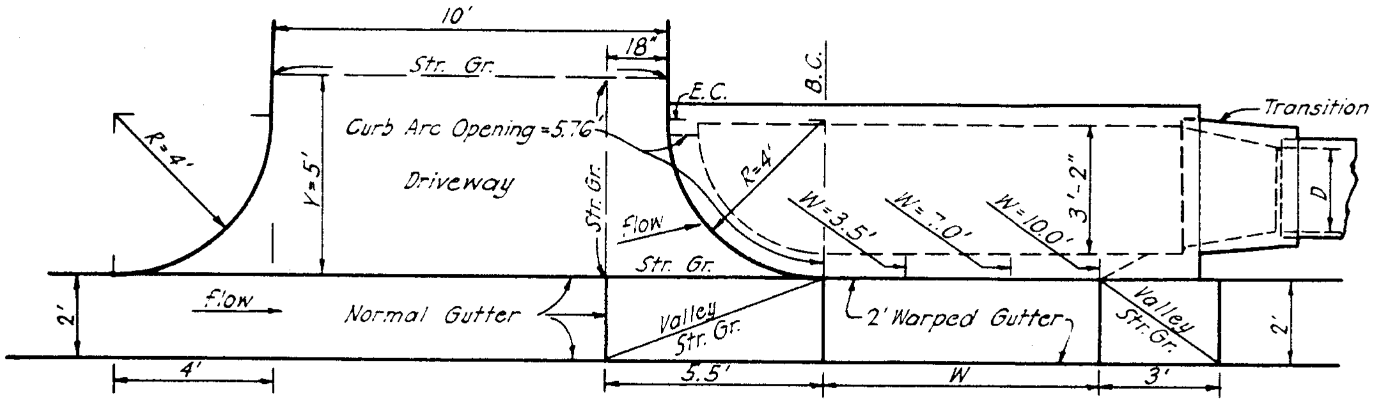

TABULATION SHEETS: CHART LL-14
118,119,125,126,127,128,139 & 140
W = VARIES
C.B. NO 39 & 40, STD. PLAN B-2539 & B-2540
L.D. NO 3, CASE I, STD. PLAN D-1993
(L = 8', K = 3', W = 4')
S = 0.02 & 0.05, NO CROSSFALL
CROWN; H = 0.0125 RDWY. WIDTH
8" NORMAL C.F.; 11.5" C.F. AT C.B.
CATCH BASIN FORMULA
STREET SLOPE = 0.02 & 0.05
Q = CW^0.85 D^1.5
C = 3.12
W = LENGTH OF C.B. OPENING
D = DEPTH OF FLOW
EXAMPLE
GIVEN:
D = 0.50'
S = 0.020 OR 0.050
W = 42'
REQUIRED:
CAPACITY OF C.B. OPENING
SOLUTION:
Q = 26.5 CFS.
Q (C.F.S.) IN CATCH BASIN
D = 1.10 LIMIT OF TESTS
EXAMPLE LINE
D = 0.50'
D = DEPTH OF FLOW (FT) ABOVE NORMAL GUTTER GRADE
NOTES:
1. THIS CHART GIVES CAPACITIES AS DEVELOPED FROM: EXPERIMENTAL HYDRAULIC MODEL STUDIES FOR CATCH BASIN NO. 40 TYPE CURB OPENINGS WITH STANDARD LOCAL DEPRESSIONS AND MAY BE USED IN DETERMINING THE LENGTH ("W") AND/OR THE CAPACITY ("Q") OF BASIN OPENINGS OF THIS TYPE UNDER VARIOUS VALUES OF "D".
2. THIS CHART IS APPLICABLE ONLY TO CONDITIONS SHOWN ON FIGURE 2.
C.B. NO 40 TYPE CURB OPENING
DESIGN CHART LL-14
SIDE-OPENING CATCH BASIN CAPACITIES
BUREAU OF ENGINEERING - CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION
W.O. 51212
MARCH 1955
DESIGN: F.J.D. 3-17-55
DRAWN: O.G.S. 3-18-55


TABULATION SHEETS CHART LL-15
115 & 136
SUMP CONDITIONS (W = VARIES)
C.B. NO. 40, STD. PLAN B-2640
L.D. NO. 3, CASE I, STD. PLAN D-1993
(L = 6', K = 3', W = 4')
S = 0.00, NO CROSSFALL
CROWN; H = 0.0125 RDWY. WIDTH
8" NORMAL C.F.; 11.5" C.F. AT C.B.
EXAMPLE
GIVEN:
64.3 C.F.S. COMPUTED FLOW TO SUMP.
MAXIMUM PERMISSIBLE DEPTH "D" OF WATER IN SUMP = 1.2 FT.
REQUIRED:
LENGTH (W) OF CURB OPENING(S)
SOLUTION:
FOR D = 1.2 FT.
FOR W = 14 FT. Q = 44.1 C.F.S.
FOR W = 7 FT. Q = 20.2 C.F.S.
TOTAL Q = 64.3 C.F.S.
W = 49'
W = 42'
W = 35'
W = 28'
W = 21'
W = 14'
W = 7'
W = 3.5'
Q (C.F.S.) IN CATCH BASIN
EXAMPLE LINE D = 1.20 FT.
D = DEPTH OF FLOW (FT.) ABOVE NORMAL GUTTER GRADE
NOTES:
1. THIS CHART GIVES CAPACITIES AS DEVELOPED FROM HYDRAULIC MODEL STUDIES FOR CATCH BASIN NO. 40 TYPE CURB OPENINGS WITH STANDARD LOCAL DEPRESSIONS, AND MAY BE USED IN DETERMINING THE LENGTH ("W") AND/OR THE CAPACITY ("Q") OF CATCH BASIN OPENINGS OF THIS TYPE UNDER VARIOUS VALUES OF "D".
2. THIS CHART IS APPLICABLE ONLY TO CONDITIONS SHOWN ON FIGURE 2, AND MAY BE USED FOR ANY CROSSFALL BY SELECTING THE PROPER VALUE OF "D" RESULTING THEREFROM.
3. SUMP FORMULA:
Q = 3.0 AW^0.13 D^0.6
W = LENGTH (FEET) OF CATCH BASIN OPENING.
A = AREA OF OPENING (W x 0.67).
D = DEPTH (FEET) OF FLOW ABOVE NORMAL GUTTER GRADE.
SUMP
C.B. No. 40 TYPE CURB OPENING
DESIGN CHART LL-15
SIDE-OPENING CATCH BASIN CAPACITIES
BUREAU OF ENGINEERING - CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION
W.O. 5212 MARCH 1955
DESIGN: F.J.D. 3-17-55 DRAWN: O.G.S. 3-21-55

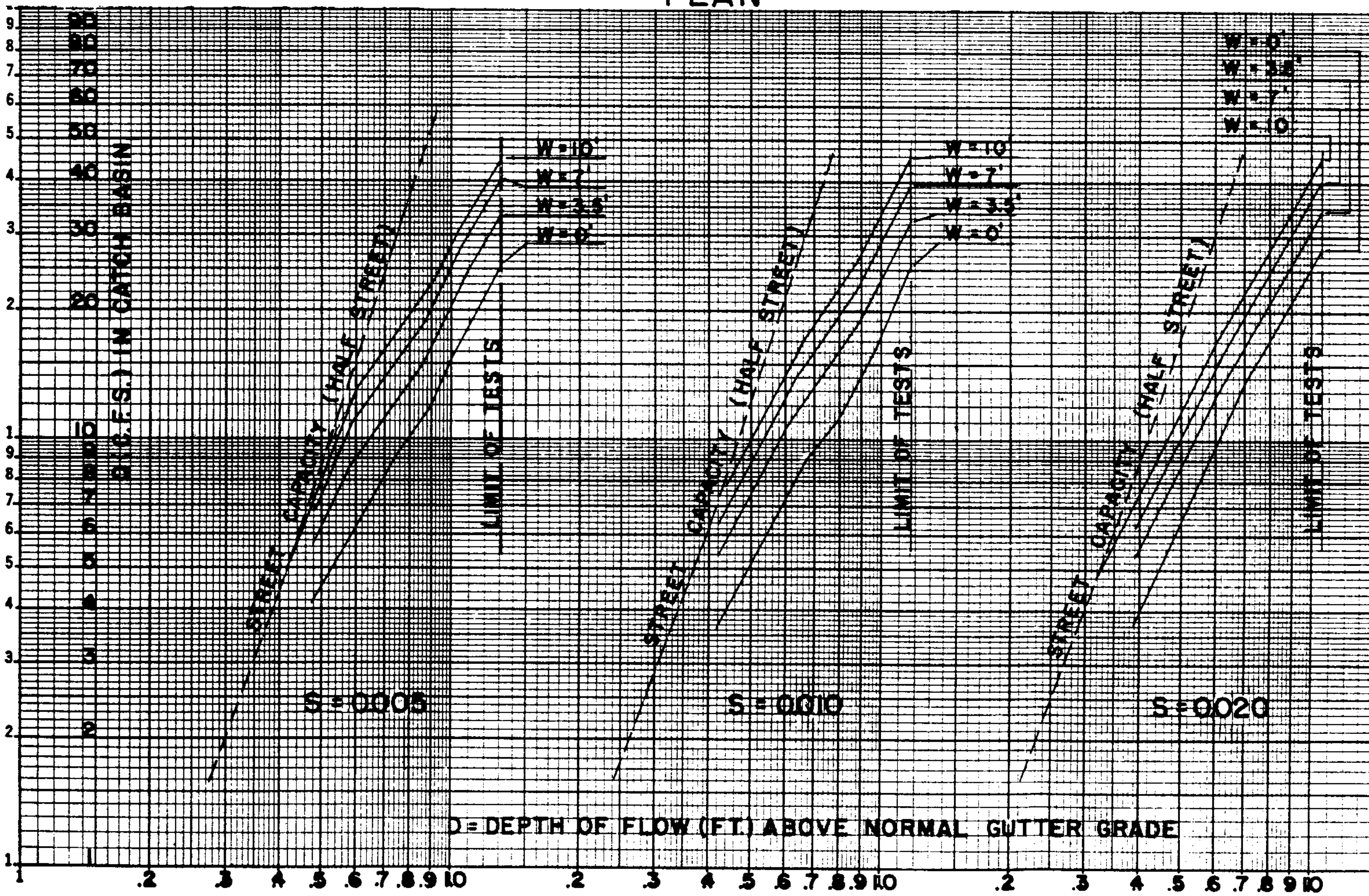
OFFICE STANDARD NO 108

TABULATION SHEETS 204 - 215	CHARTS SC 87 & 88
W VARIES	OUTLET PIPE = 21"
K - 8 C.B.	TRANSITION = 33" x 21"
S VARIES	NO CROSSFALL

CROWN : H = 0.125 ROADWAY WIDTH
6" NORMAL C.F., 9" C.F. AT C.B. (SEE STD. PLAN)



PLAN



NOTES:

1. THIS CHART GIVES CATCH BASIN NO 47 CAPACITIES DEVELOPED FROM EXPERIMENTAL HYDRAULIC MODEL STUDIES, AND MAY BE USED IN DETERMINING THE REQUIRED LENGTH ("W") AND/OR THE CAPACITY ("Q") OF CATCH BASINS OF THIS TYPE UNDER VARIOUS VALUES OF "D" AND "S".

2. THIS CHART IS APPLICABLE ONLY TO CONDITIONS SHOWN ON ABOVE SKETCH. SEE STANDARD PLAN NO B-3747 FOR DETAILS.

CATCH BASIN NO 47

(PASADENA TYPE)

DESIGN CHART LL-16

CURB OPENING DRIVEWAY-BASIN CAPACITIES

BUREAU OF ENGINEERING CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION

W.O. 51005 JULY 1956

DESIGN : F.J.D. & W.T. DRAWN : O.S.

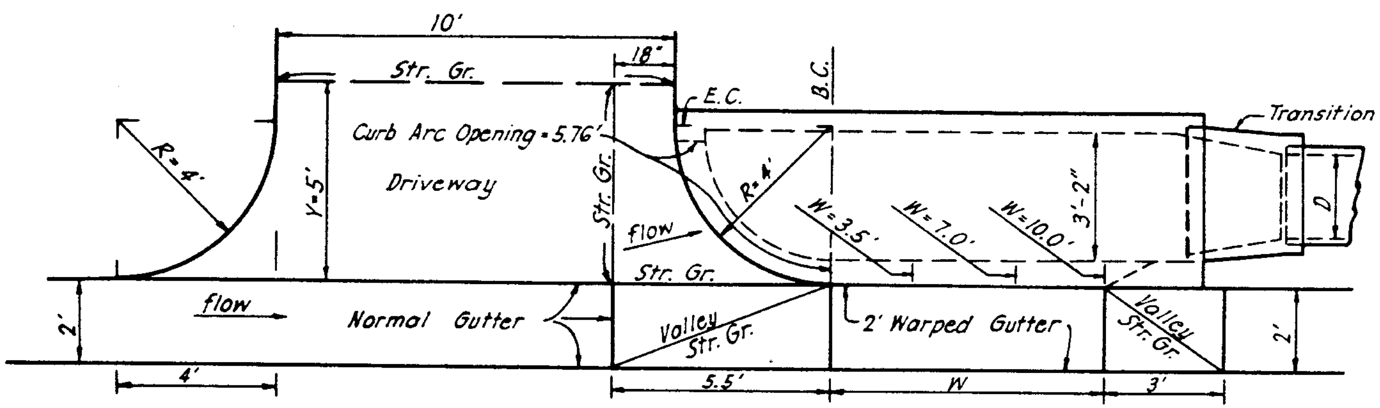
OFFICE STANDARD NO 108

TABULATION SHEETS 195—205 & 220—223

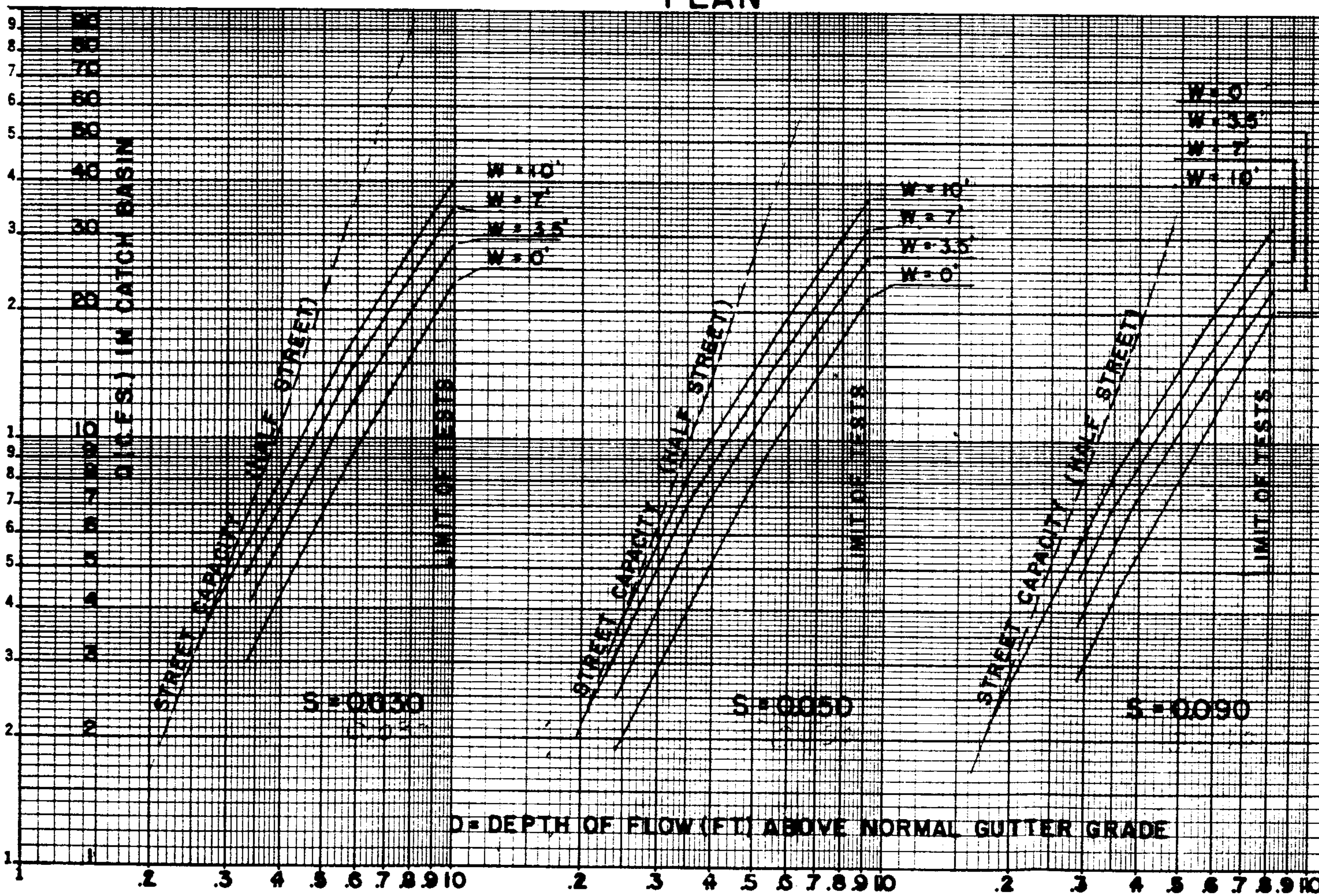
CHARTS SC 88 & 89

W VARIES
X=8 C.B.
S VARIES
CROWN: H=.0125 ROADWAY WIDTH
8" NORMAL C.F., 9" C.F. AT C.B. (SEE STD. PLAN)

OUTLET PIPE = 21"
TRANSITION = 33"x21"
NO CROSSFALL



PLAN



NOTES:

1. THIS CHART GIVES CATCH BASIN NO 47 CAPACITIES DEVELOPED FROM EXPERIMENTAL HYDRAULIC MODEL STUDIES, AND MAY BE USED IN DETERMINING THE REQUIRED LENGTH ("W") AND/OR THE CAPACITY ("Q") OF CATCH BASINS OF THIS TYPE UNDER VARIOUS VALUES OF "D" AND "W".

2. THIS CHART IS APPLICABLE ONLY TO CONDITIONS SHOWN ON ABOVE SKETCH. SEE STANDARD PLAN NO B-3747 FOR DETAILS.

CATCH BASIN NO 47

(PASADENA TYPE)

DESIGN CHART LL-17

CURB OPENING DRIVEWAY—BASIN CAPACITIES

BUREAU OF ENGINEERING CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION

W.O. 51005 JULY 1958

DESIGN: F.J.D. & W.T. DRAWN: O.S.

PART IV

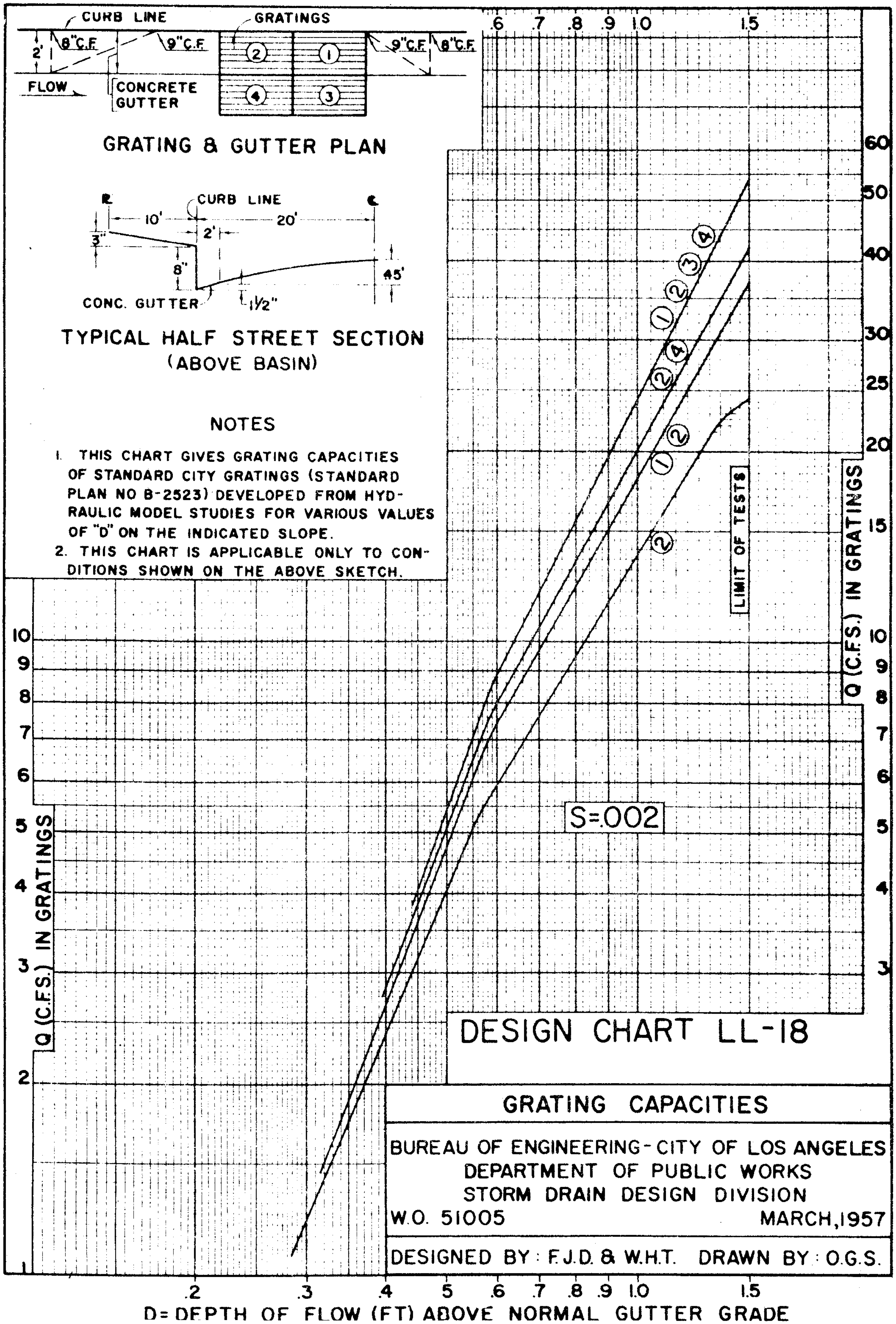
DESCRIPTION AND USE OF GRATING CAPACITY CHARTS

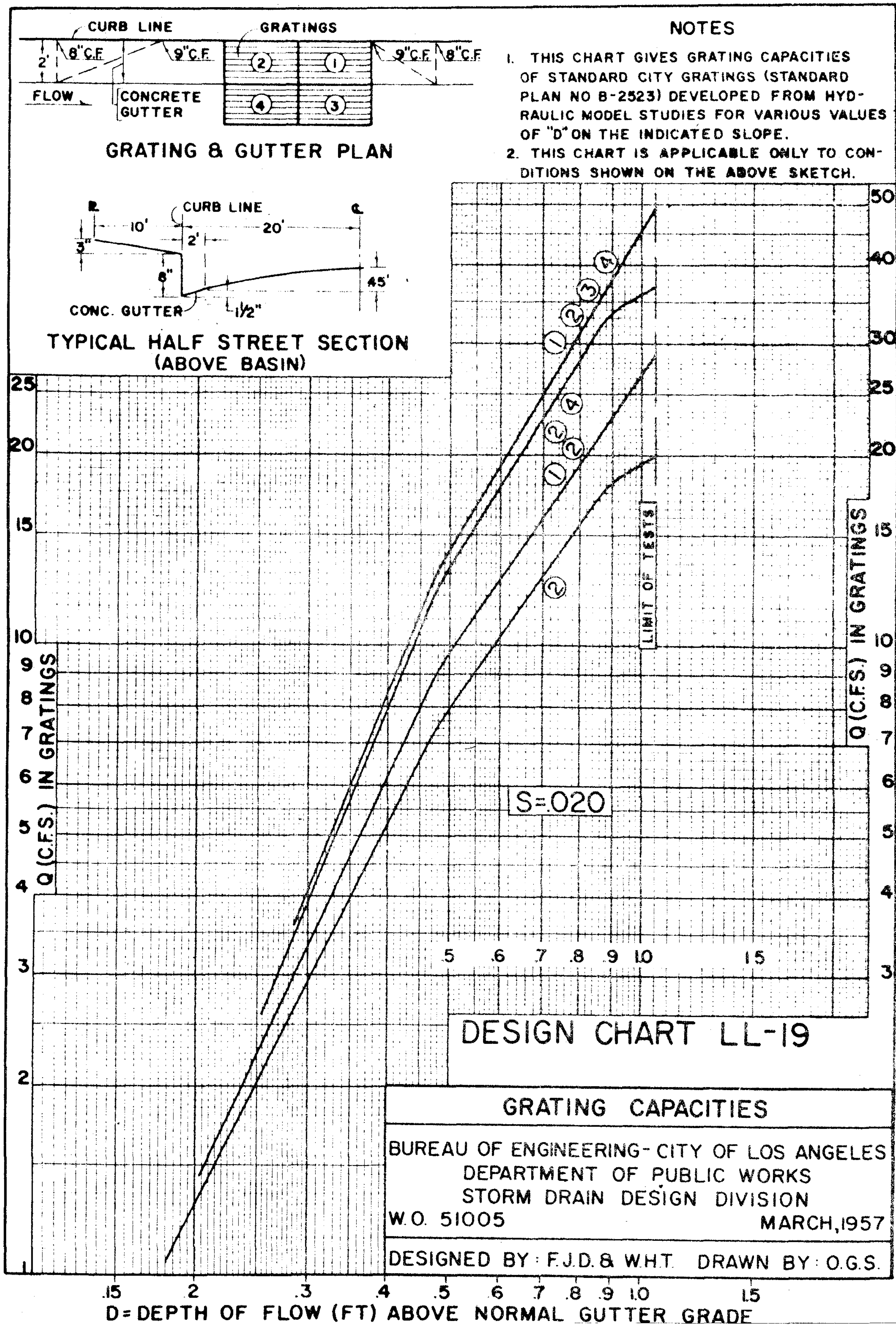
These charts represent the results of Hydraulic Model tests of Standard City gratings (Standard Plan No. B-2523) on half of a typical 60-foot street, 40 feet between curbs, normal 8-inch curb face, 9-inch curb face at gratings, 2-foot gutters, and height of crown above the outside edge of the gutter = .0125 x 36 = .45 feet.

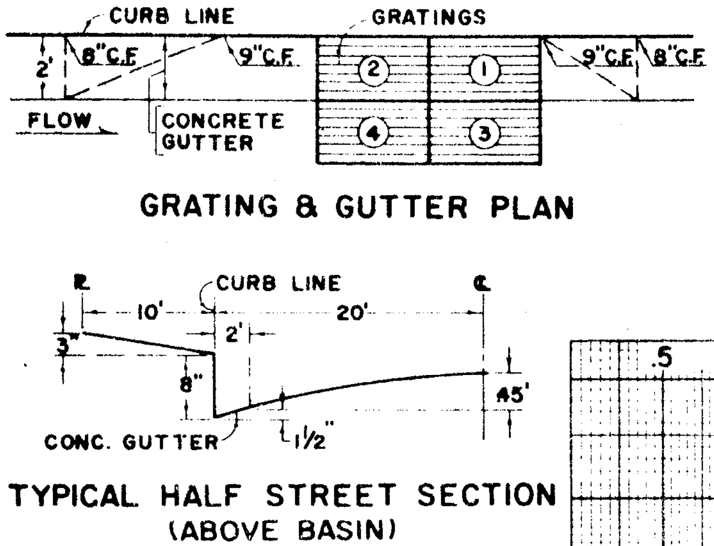
Hydraulic Model tests indicate that the use of 3/4-inch spacers (City Standard Plan No. B-3656 and Los Angeles County Flood Control District Drawing No. 2-D227) instead of 1-inch spacers on grating catch basins will reduce the interception capacity by as much as 5 per cent when the grate or grates are clean and completely covered with water. When the grate or grates are only partially covered, no reduction in interception will occur.

In using these charts, consideration must be given to the fact that gratings have a tendency to clog with debris, such as leaves and paper, and the interception capacities indicated are, therefore, the maximum which can be anticipated. The lower end of each curve indicates "Total Interception" for the slope and grating(s) referred to.

FJD:cd
4-25-57

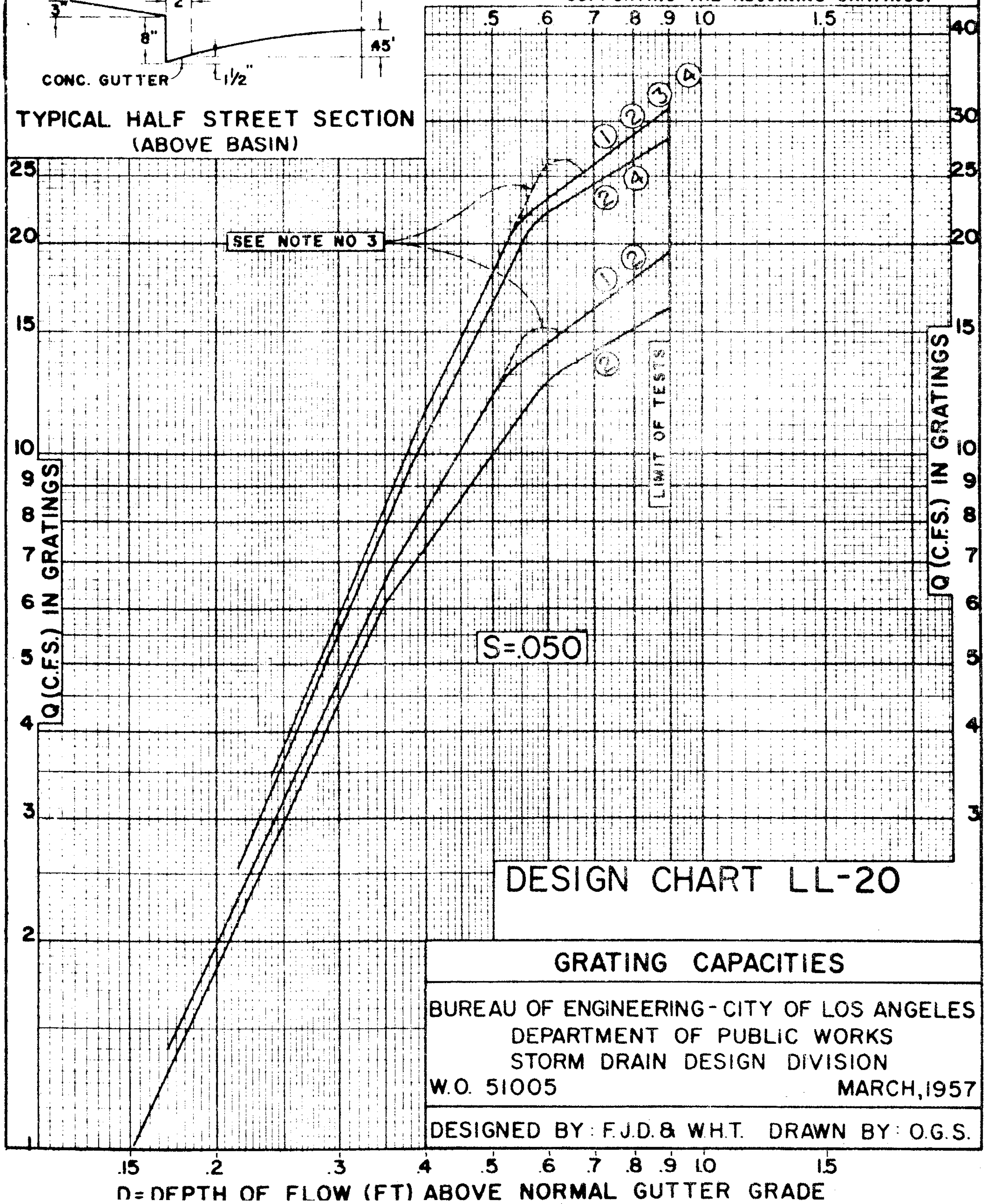

CURB LINE
GRATINGS
8"C.F.
9"C.F.
9"C.F.
8"C.F.
2'
FLOW
CONCRETE GUTTER
GRATING & GUTTER PLAN
CURB LINE
10'
20'
2'
3"
8"
.45'
CONC. GUTTER
1½"
TYPICAL HALF STREET SECTION
(ABOVE BASIN)
NOTES
1. THIS CHART GIVES GRATING CAPACITIES OF STANDARD CITY GRATINGS (STANDARD PLAN NO B-2523) DEVELOPED FROM HYDRAULIC MODEL STUDIES FOR VARIOUS VALUES OF "D" ON THE INDICATED SLOPE.
2. THIS CHART IS APPLICABLE ONLY TO CONDITIONS SHOWN ON THE ABOVE SKETCH.
LIMIT OF TESTS
S=.002
Q (C.F.S.) IN GRATINGS
D=DEPTH OF FLOW (FT) ABOVE NORMAL GUTTER GRADE
DESIGN CHART LL-18
GRATING CAPACITIES
BUREAU OF ENGINEERING - CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION
W.O. 51005
MARCH, 1957
DESIGNED BY: F.J.D. & W.H.T.
DRAWN BY: O.G.S.


CURB LINE
GRATINGS
8"C.F.
9"C.F.
2'
FLOW
CONCRETE GUTTER
GRATING & GUTTER PLAN
NOTES
1. THIS CHART GIVES GRATING CAPACITIES OF STANDARD CITY GRATINGS (STANDARD PLAN NO B-2523) DEVELOPED FROM HYDRAULIC MODEL STUDIES FOR VARIOUS VALUES OF "D" ON THE INDICATED SLOPE.
2. THIS CHART IS APPLICABLE ONLY TO CONDITIONS SHOWN ON THE ABOVE SKETCH.
CURB LINE
10'
20'
2'
3"
8"
.45'
CONC. GUTTER
1½"
TYPICAL HALF STREET SECTION
(ABOVE BASIN)
Q (C.F.S.) IN GRATINGS
LIMIT OF TESTS
S=.020
DESIGN CHART LL-19
GRATING CAPACITIES
BUREAU OF ENGINEERING - CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION
W.O. 51005
MARCH, 1957
DESIGNED BY: F.J.D. & W.H.T.
DRAWN BY: O.G.S.
D = DEPTH OF FLOW (FT) ABOVE NORMAL GUTTER GRADE



NOTES

1. THIS CHART GIVES GRATING CAPACITIES OF STANDARD CITY GRATINGS (STANDARD PLAN NO B-2523) DEVELOPED FROM HYDRAULIC MODEL STUDIES FOR VARIOUS VALUES OF "D" ON THE INDICATED SLOPE.
2. THIS CHART IS APPLICABLE ONLY TO CONDITIONS SHOWN ON THE ABOVE SKETCH.
3. THIS IRREGULARITY RESULTS FROM THE HYDRAULIC INTERFERENCE OF THE H BEAM SUPPORTING THE ADJOINING GRATINGS.



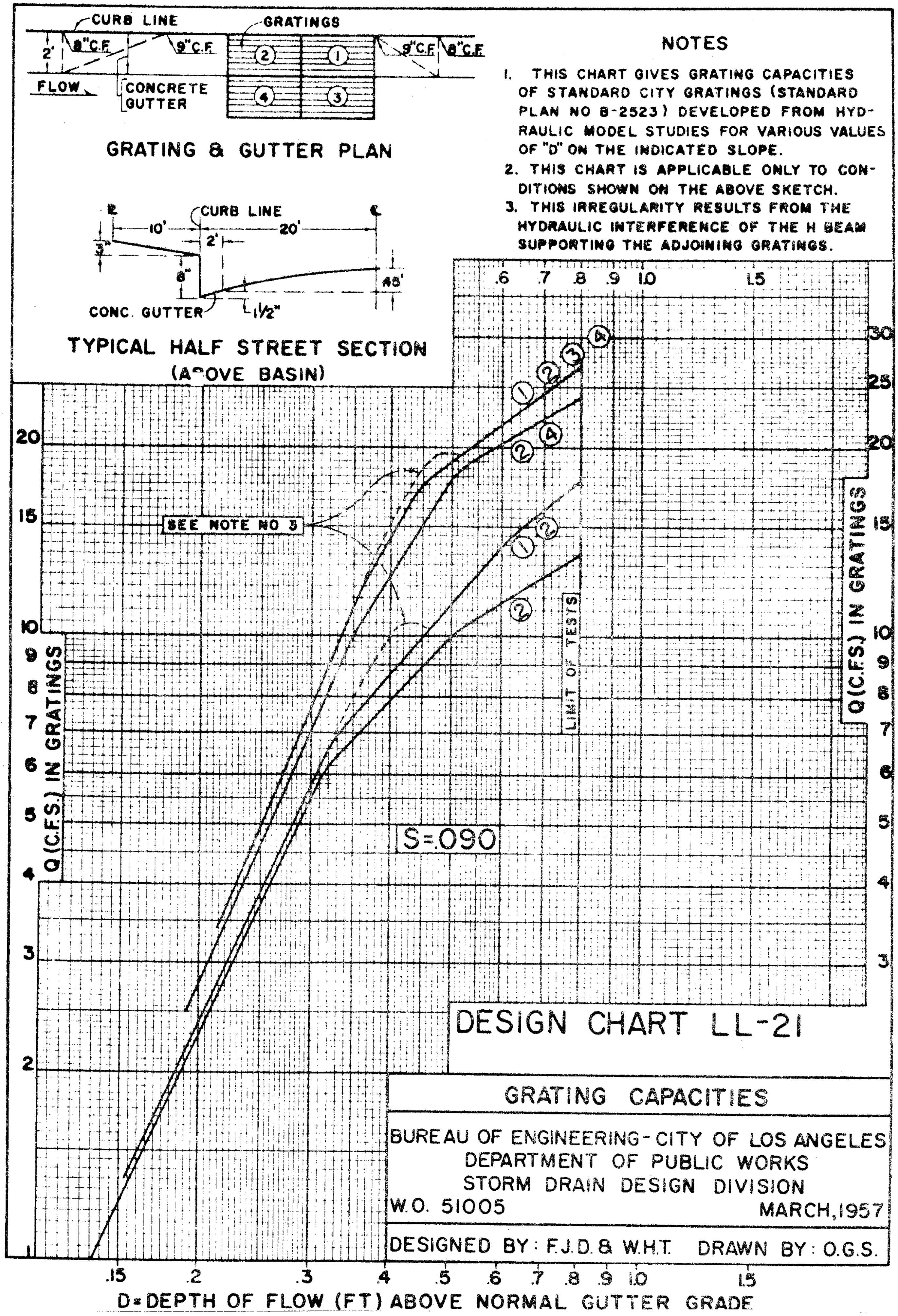
DESIGN CHART LL-20

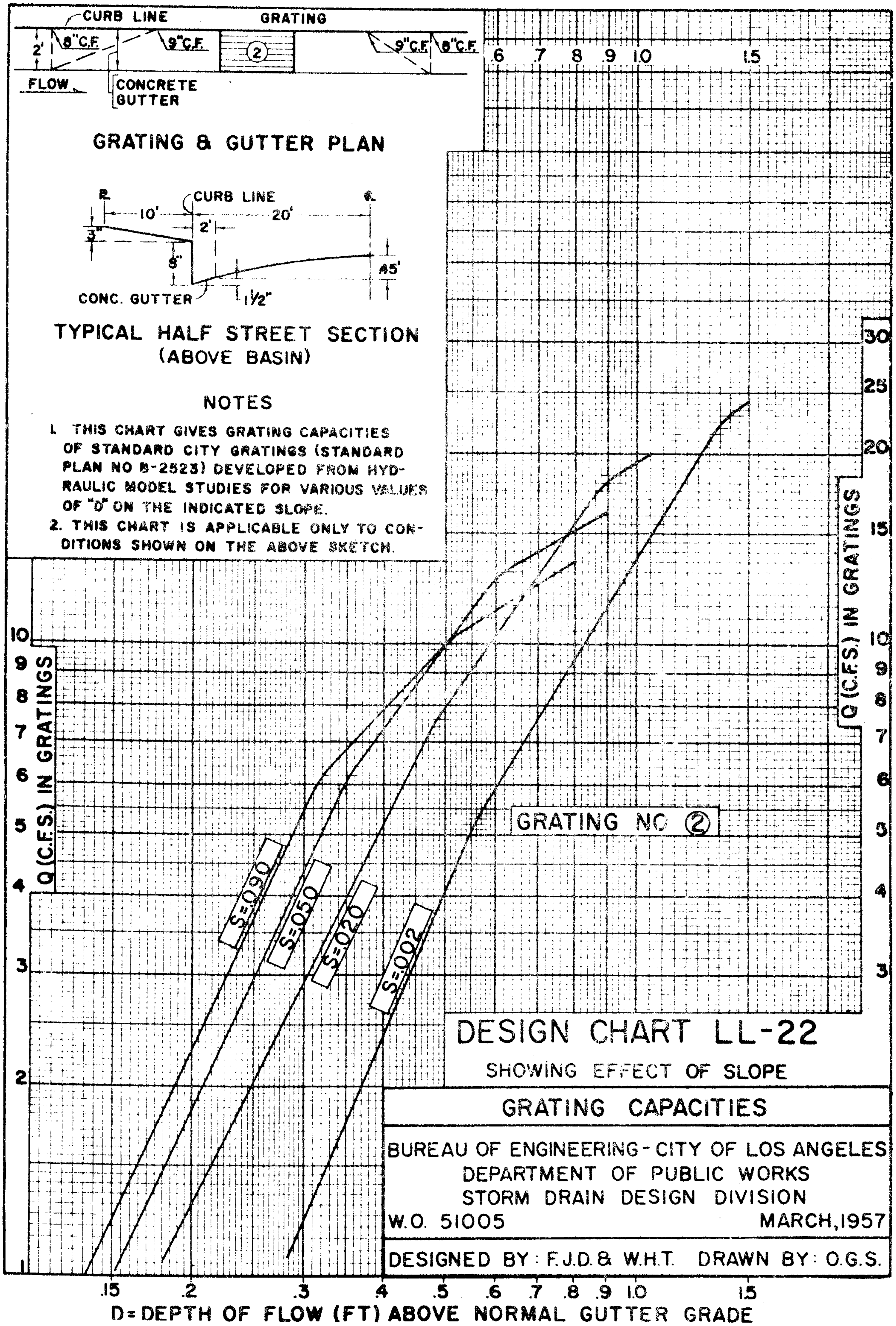
GRATING CAPACITIES

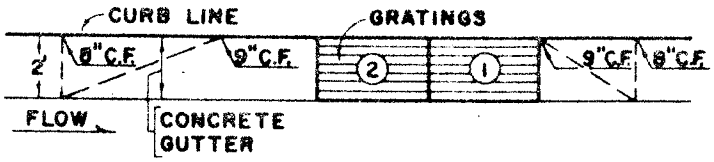
BUREAU OF ENGINEERING - CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION

W.O. 51005 MARCH, 1957

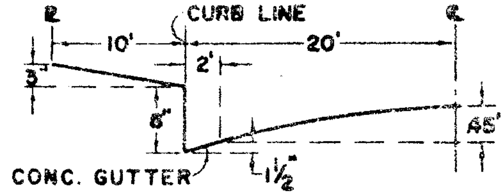
DESIGNED BY: F.J.D. & W.H.T. DRAWN BY: O.G.S.


CURB LINE
GRATINGS
8"C.F.
9"C.F.
9"C.F.
8"C.F.
2'
FLOW
CONCRETE GUTTER
1
2
3
4
GRATING & GUTTER PLAN
NOTES
1. THIS CHART GIVES GRATING CAPACITIES OF STANDARD CITY GRATINGS (STANDARD PLAN NO B-2523) DEVELOPED FROM HYDRAULIC MODEL STUDIES FOR VARIOUS VALUES OF "D" ON THE INDICATED SLOPE.
2. THIS CHART IS APPLICABLE ONLY TO CONDITIONS SHOWN ON THE ABOVE SKETCH.
3. THIS IRREGULARITY RESULTS FROM THE HYDRAULIC INTERFERENCE OF THE H BEAM SUPPORTING THE ADJOINING GRATINGS.
CURB LINE
10'
20'
2'
3"
8"
.45'
CONC. GUTTER
1½"
TYPICAL HALF STREET SECTION
(ABOVE BASIN)
SEE NOTE NO 3
LIMIT OF TESTS
S=.090
Q(C.F.S.) IN GRATINGS
D=DEPTH OF FLOW (FT) ABOVE NORMAL GUTTER GRADE
.15
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.5
DESIGN CHART LL-21
GRATING CAPACITIES
BUREAU OF ENGINEERING-CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION
W.O. 51005
MARCH,1957
DESIGNED BY: F.J.D. & W.H.T.
DRAWN BY: O.G.S.


CURB LINE
GRATING
2'
8" C.F.
9" C.F.
(2)
9" C.F.
8" C.F.
FLOW
CONCRETE GUTTER
GRATING & GUTTER PLAN
℄
CURB LINE
℄
10'
20'
3"
2'
8"
.45'
CONC. GUTTER
1½"
TYPICAL HALF STREET SECTION
(ABOVE BASIN)
NOTES
1. THIS CHART GIVES GRATING CAPACITIES OF STANDARD CITY GRATINGS (STANDARD PLAN NO B-2523) DEVELOPED FROM HYDRAULIC MODEL STUDIES FOR VARIOUS VALUES OF "D" ON THE INDICATED SLOPE.
2. THIS CHART IS APPLICABLE ONLY TO CONDITIONS SHOWN ON THE ABOVE SKETCH.
.6
.7
.8
.9
1.0
1.5
30
25
20
15
10
9
8
7
6
5
4
3
2
1
Q (C.F.S.) IN GRATINGS
S=.090
S=.050
S=.020
S=.002
GRATING NO (2)
DESIGN CHART LL-22
SHOWING EFFECT OF SLOPE
GRATING CAPACITIES
BUREAU OF ENGINEERING - CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION
W.O. 51005
MARCH, 1957
DESIGNED BY: F.J.D. & W.H.T.
DRAWN BY: O.G.S.
.15
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.5
D = DEPTH OF FLOW (FT) ABOVE NORMAL GUTTER GRADE



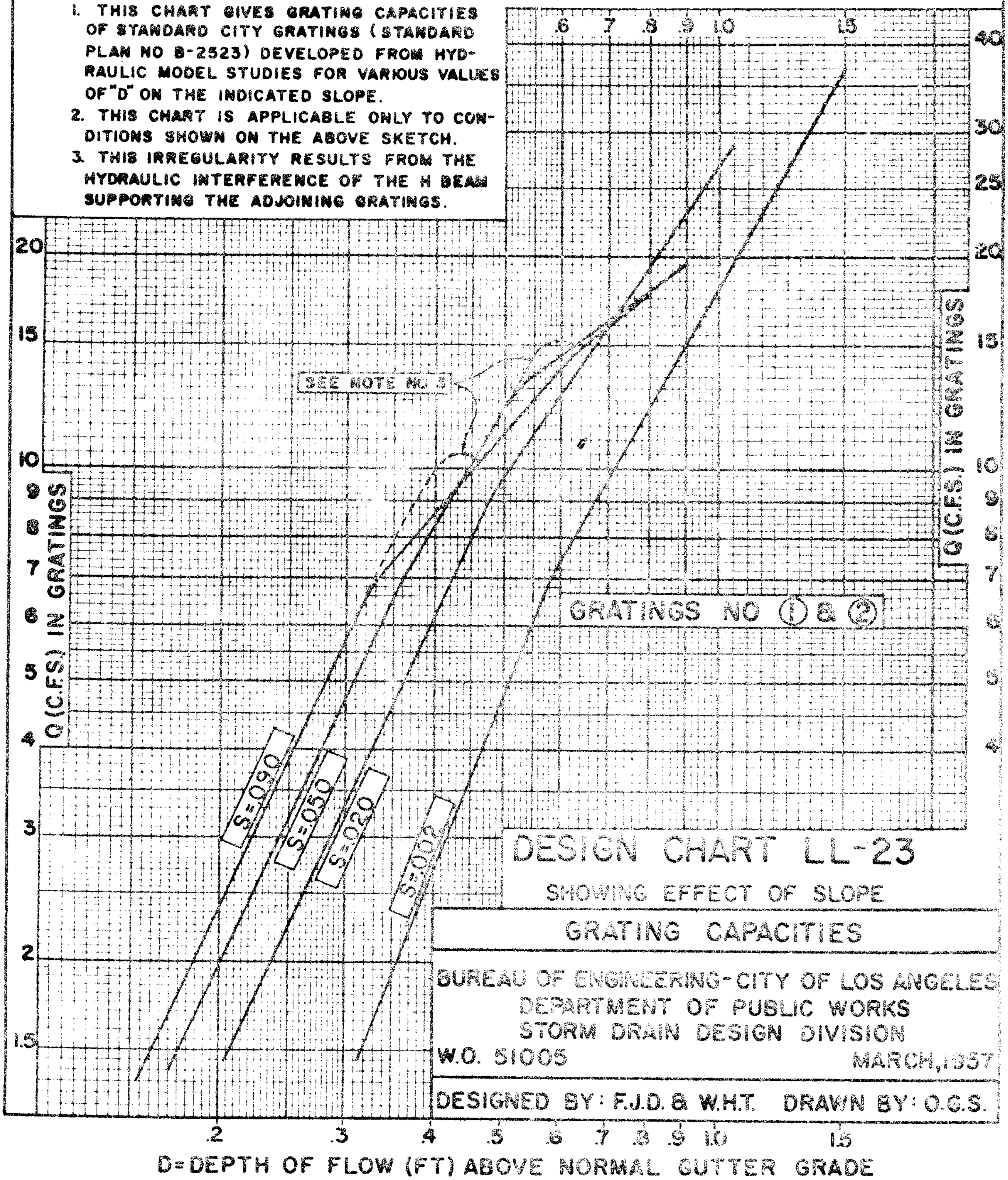
GRATING & GUTTER PLAN



TYPICAL HALF STREET SECTION
(ABOVE BASIN)

NOTES

1. THIS CHART GIVES GRATING CAPACITIES OF STANDARD CITY GRATINGS (STANDARD PLAN NO B-2523) DEVELOPED FROM HYDRAULIC MODEL STUDIES FOR VARIOUS VALUES OF "D" ON THE INDICATED SLOPE.
2. THIS CHART IS APPLICABLE ONLY TO CONDITIONS SHOWN ON THE ABOVE SKETCH.
3. THIS IRREGULARITY RESULTS FROM THE HYDRAULIC INTERFERENCE OF THE H BEAM SUPPORTING THE ADJOINING GRATINGS.



DESIGN CHART LL-23

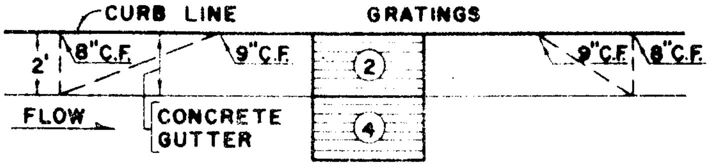
SHOWING EFFECT OF SLOPE

GRATING CAPACITIES

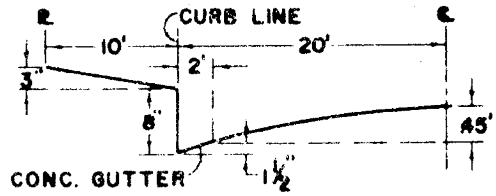
BUREAU OF ENGINEERING - CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION

W.O. 51005 MARCH, 1957

DESIGNED BY: F.J.D. & W.H.T. DRAWN BY: O.G.S.



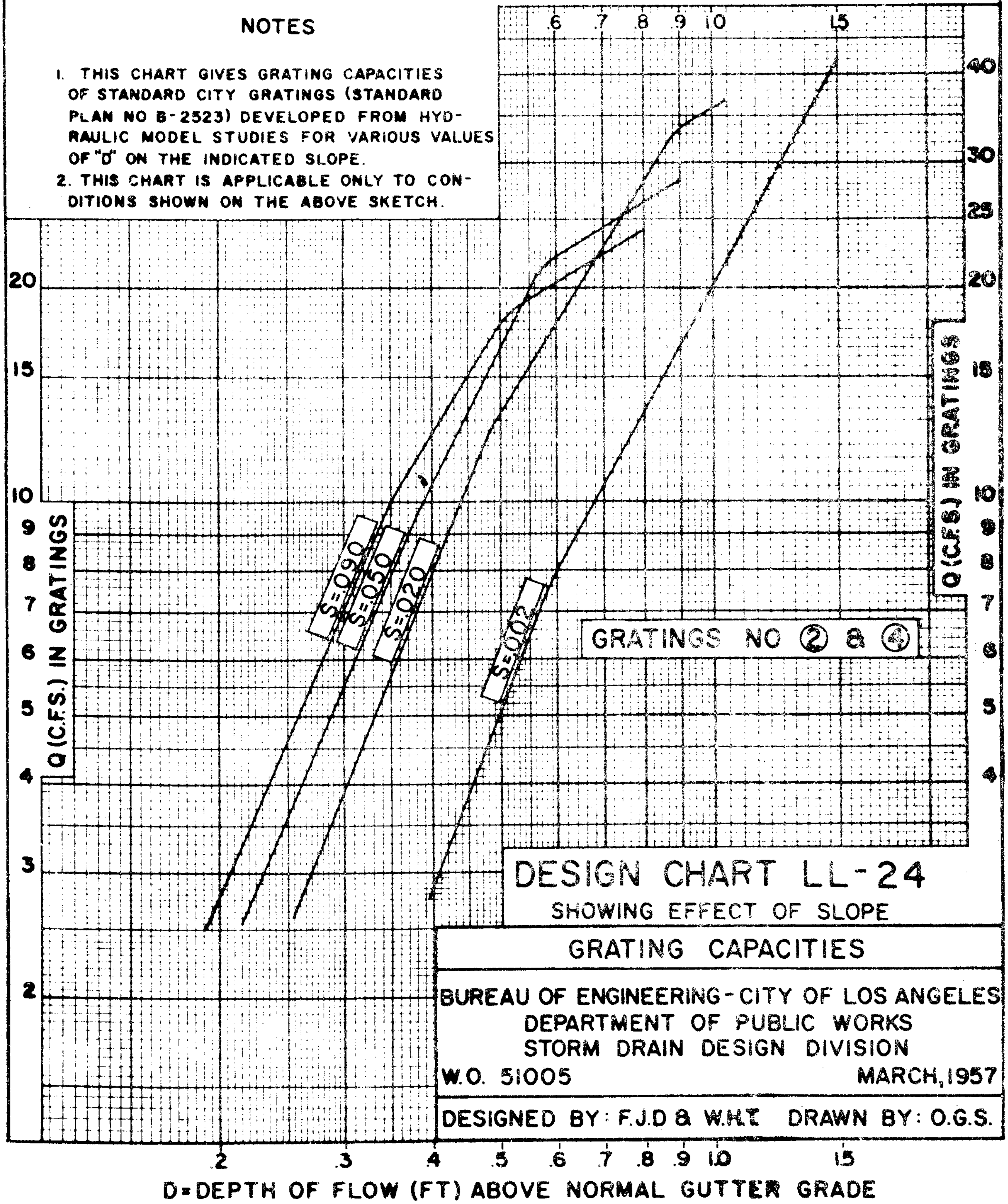
GRATING & GUTTER PLAN



TYPICAL HALF STREET SECTION
(ABOVE BASIN)

NOTES

1. THIS CHART GIVES GRATING CAPACITIES OF STANDARD CITY GRATINGS (STANDARD PLAN NO B-2523) DEVELOPED FROM HYDRAULIC MODEL STUDIES FOR VARIOUS VALUES OF "D" ON THE INDICATED SLOPE.
2. THIS CHART IS APPLICABLE ONLY TO CONDITIONS SHOWN ON THE ABOVE SKETCH.



DESIGN CHART LL-24

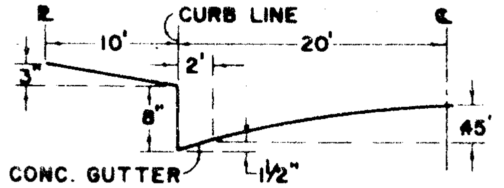
SHOWING EFFECT OF SLOPE

GRATING CAPACITIES

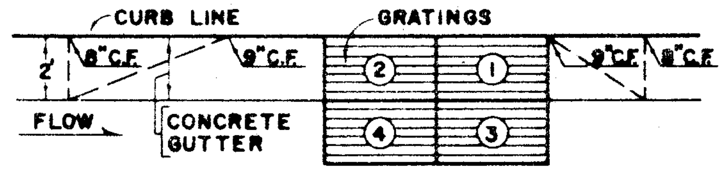
BUREAU OF ENGINEERING - CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION

W.O. 51005 MARCH, 1957

DESIGNED BY: F.J.D & W.H.T. DRAWN BY: O.G.S.



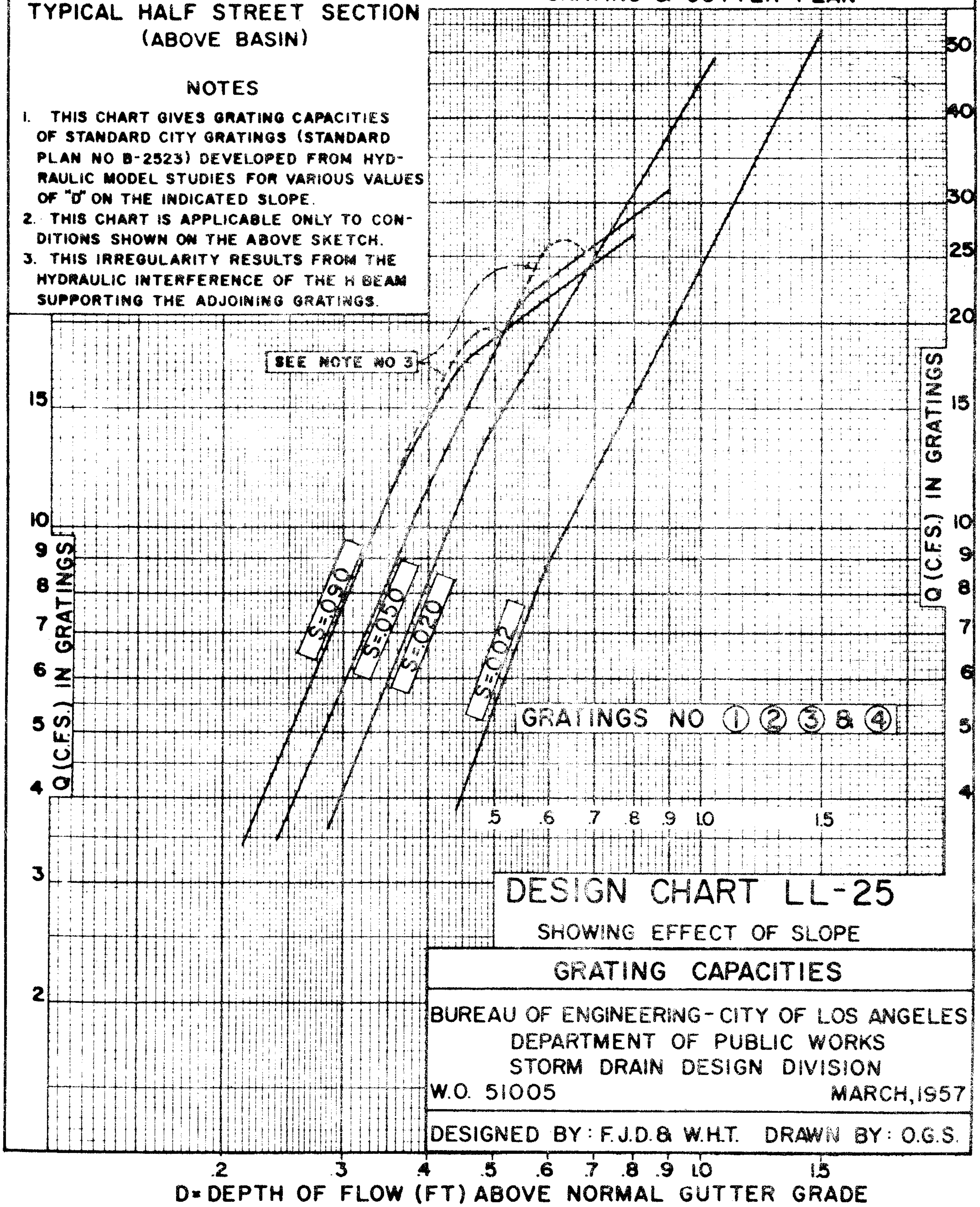
TYPICAL HALF STREET SECTION
(ABOVE BASIN)



GRATING & GUTTER PLAN

NOTES

1. THIS CHART GIVES GRATING CAPACITIES OF STANDARD CITY GRATINGS (STANDARD PLAN NO B-2523) DEVELOPED FROM HYDRAULIC MODEL STUDIES FOR VARIOUS VALUES OF "D" ON THE INDICATED SLOPE.
2. THIS CHART IS APPLICABLE ONLY TO CONDITIONS SHOWN ON THE ABOVE SKETCH.
3. THIS IRREGULARITY RESULTS FROM THE HYDRAULIC INTERFERENCE OF THE H BEAM SUPPORTING THE ADJOINING GRATINGS.



DESIGN CHART LL-25

SHOWING EFFECT OF SLOPE

GRATING CAPACITIES

BUREAU OF ENGINEERING - CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION

W.O. 51005 MARCH, 1957

DESIGNED BY: F.J.D. & W.H.T. DRAWN BY: O.G.S.

PART VII

DESCRIPTION AND USE OF CATCH BASIN CONNECTING PIPE CAPACITY CHARTS

These charts were developed from original studies conducted by the Bureau of Engineering in its Experimental Hydraulic Laboratory and apply specifically to Catch Basins Nos. 45, 46, and 47 developed by the Laboratory, combined with standard "Catch Basin Outlet Transition Structure" also developed by the Laboratory. These studies, using connecting pipe from 15 to 30 inches, inclusive, in prototype diameter, were based upon the following references:

"Flow of Water Through Culverts," University of Iowa Bulletin No. 1, New Series No. 3.

"The Hydraulics of Culverts" by F. T. Mavis (Pennsylvania State College, Engineering Experiment Station Series Bulletin No. 56).

"Hydraulics of Short Pipes - Hydraulic Connection Commonly Used Pipe Entrances," John L. French (National Bureau of Standards Report No. 4444).

CHART I is based on the hypothesis that the catch basin connecting pipe flows entirely full, and for a given pipe, the discharge is a function of "h", the difference in elevation between the headwater and tailwater levels.

CHART II is based on the hypothesis that the maximum discharge of the catch basin connecting pipe is controlled at the inlet and is a function of "H"/"d" (headwater depth above inlet invert and diameter of the catch basin connecting pipe). Figure 2 of Chart II gives a graphical picture of the controlling elements.

Figure 3 of Chart II shows comparative curves of "H"/"d" "Control at Inlet" discharge for (1) Square-edge inlet (Mavis); (2) Rounded inlet, r = 0.25 d (French); and (3) City of Los Angeles Design Curve developed from Catch Basins Nos. 45, 46, and 47 in conjunction with "Catch Basin Outlet Transition Structure."

LEGEND

d = diameter of catch basin connecting pipe, in feet.

f = freeboard (depth of water surface in catch basin below gutter).

g = acceleration due to gravity = 32.16.

h = difference in elevation of headwater and tailwater levels, in feet.

H = height of water in catch basin above invert of outlet pipe, in feet.

h_v = velocity head = $v^2/2_g$.

L = length of catch basin connecting pipe, in feet.

Q = discharge in second feet.

V = depth of catch basin (difference in elevation between top of curb and catch basin outlet). (= H + f + curb face)

v = average velocity in feet per second.

1. DISCUSSION

a. A catch basin connecting pipe may flow either full or partly full, depending upon the specific hydraulic conditions under which it must operate. In part-full flow, the pipe behaves as an open channel with a free surface. In full-flow, the hydraulic gradient does not necessarily coincide with the soffit of the pipe. The headwater level, however, must be above the soffit of the pipe a distance of at least equal to the velocity head. The complete range of hydraulic relationships, between discharge and head on the catch basin connecting pipe, includes both full-flow and part-full conditions.

b. When a catch basin connecting pipe is short, the flow characteristics which are influenced by the length become comparatively unimportant. Consequently, the control section is essentially at the inlet for all conditions. Between the part-full phase and full-flow phase, there is a transition zone of pulsating flow in which the pipe is alternately full and partly full. This condition exists when the discharge from "H"/"d" and "h" are identical.

c. Chart II, when used in connection with Chart I, takes into consideration the complete range of hydraulic relationships from a practical standpoint under average field conditions, and gives the required "H" for a specified "Q" and "d" from which a minimum "V" may be readily determined by the addition of the 6-inch value of "f" and the 9-inch curb face.

d. As previously stated, the maximum discharge capacity of the catch basin connecting pipe may be a function of either "h" or "H"/"d." The discharge, using "h", may be less than, or equal to, but never greater than, that obtained from using "H"/"d". After computing the discharge using "h" and "H"/"d", select the smaller of the two values as the design capacity of the catch basin connecting pipe.

2. GENERAL RULES

The following general rules are intended for use as a guide in determining values of "d" and "V" when used in connection with Catch Basin Nos. 45, 46, and 47 combined with standard "Catch Basin Outlet Transition Structure." (See Fig. 1, Chart I and Fig. 2, Chart II for typical layout.)

a. Water surface (W.S.) elevation in the catch basin should not be less than 6 inches below the gutter.

b. Soffit elevation of the upstream end of the "Catch Basin Outlet Transition Structure" should not be less than 6 inches below the gutter.

c. The minimum "V" (depth of catch basin) is determined as follows:

(1) For full pipes, Chart I

"V" = d + h_v + 6" + 9" or d + 12" + 6" + 9", whichever gives the greater value of "V".

(2) For control at inlet, Fig. 3, Chart II

"V" = "H" + 6" + 9" or d + 12" + 6" + 9", whichever gives the greater value of "V".

(3) For control at inlet, Fig. 1, Chart II (full and partly full pipes)

For values of "H" above Line A-A
"V" = "H" + 6" + 9"

For values of "H" below Line A-A
"V" = d + 12" + 6" + 9"

d. Water surface elevation (hydraulic grade) in the main line conduit at the time of flow from the catch basin connecting pipe may vary from a full pipe at the upper end of the system to a partly full pipe at the lower end of the system. This data can be computed from Table 6 of "Runoff Instructions of 1939" (Office Standard No. 71).

e. The catch basin connecting pipe should have a minimum construction slope of 0.015 and a velocity of 5 fps. or greater.

f. The recommended <u>minimum</u> diameter for catch basin connecting pipes is 18 inches for City construction.

3. <u>SAMPLE PROBLEM</u>

a. <u>Design Problem</u> (Case 1).

The discharge from a Catch Basin No. 46 with 9-inch curb face and "Catch Basin Outlet Transition Structure" is <u>28 cfs</u>. The top of curb elevation is 100.00, hydraulic grade elevation at the main line 93.75, and the catch basin connecting pipe is <u>50</u> feet long. Determine the following:

(1) "d" (diameter of catch basin connecting pipe)

(2) "V" (depth of catch basin)

Procedure

W.S. elev. in C.B. = 100.00' - (9" + 6") = 98.75

Hydraulic grade of main line = 93.75 (given)

"h" = 98.75 - 93.75 = 5.00'

Step 1. Determine "d" from Chart I

When Q = 28 cfs., L = 50' and h = 5.0' "d" = 21"

Step 2. Determine "H" from Chart II

When Q = 28 cfs. and "d" = 21", "H" = 3.85'
"V" = 3.85 + 6" + 9" = 5.10 (See Par. 2.c.(3) above)

Solution

"d" = 21" and "V" = 5.10'

Alternate Method (Design Problem, Case 1)

Step 1. From Chart I, d = 21" when Q = 28 cfs.,

L = 50', and h = 5.00'

v (velocity) = $Q/.785\ d^2$ = 28/2.405 = 11.64 fps.

hv (velocity head) = $v^2/2g$ = $(11.64)^2/64.4$ = 2.10

"V" = d + hv + 6" + 9" = 1.75 + 2.10 + 0.50 +
0.75 = 5.10'

"V" = d + 12" + 6" + 9" = 4.00 (Use 5.10, see
Par. 2.c.(1) above)

Step 2. From Fig. 3, Chart II, determine if

"H"/"d" limits the discharge

H = V - (f + curb face) = 5.10 - (0.50 + 0.75) = 3.85

"H"/"d" = 3.85/1.75 = 2.20

When "H"/"d" = 2.20, $Q/d^{\frac{5}{2}}$ = 6.95 (Fig. 3, Chart II)

Q = 6.95 x $d^{\frac{5}{2}}$ = 6.95 x 4.05 = 28.15 cfs. (See
Par. 1.d. above)

Solution

"d" = 21" and "V" = 5.10'

b. Design Problem (Case 2)

Because of substructure interference, the catch basin "V" is changed to 6.10', making "H" = 4.85'. All other data the same as in Case 1. Determine "d".

Procedure

Q = 28 cfs.)
L = 50 feet) Given (See Case 1)
"h"= 5.00 feet)

"H"= 6.10 - (9" + 6") = 4.85'

Step 1. Determine "d" from Chart I.

When Q = 28 cfs., L = 50' and "h" = 5.00' "d" = 21"

Step 2. From Chart II

When "H" = 4.85' and "d" = 21", Q = 34 cfs.

c. Design Problem (Case 3)

Because of substructure interference, the catch basin "V" is changed to 4.65', making "H" = 3.40'. All other data the same as in Case 1. Determine "d".

Procedure

Q = 28 cfs.)
L = 50 feet) Given (See Case 1)
h = 5.00 feet)

"H" = 4.65' - (9" + 6") = 3.4'

Step 1. Determine "d" from Chart I.

When Q = 28 cfs., L = 50', and h = 5.00' "d" = 21"

Step 2. From Chart II

When "H" = 3.4' and "d" = 21", Q = 25 cfs.

Since "H"/"d" limits the discharge from "h" to 25 cfs., a larger pipe is necessary. (See Par. 1.d. above)

Step 3. From Chart II

When "H" = 3.4' and "d" = 24", Q = 30 cfs.

d. Investigation Problem (Case 1)

Determine the maximum discharge (Q) from an existing Catch Basin No. 46 with 9-inch curb face and "Catch Basin Outlet Transition Structure." The top of curb elevation is 100.00, elevation of catch basin outlet = 94.90, hydraulic grade elevation at the main line = 93.75, and the 21-inch catch basin connecting pipe is 50 feet long on a slope of 7.6%.

Procedure

W.S. elev. in C.B. = 100.00' - (9" + 6") = 98.75

Hydraulic grade of main line = 93.75 (given)

"h" = 98.75 - 93.75 = 5.00'

Elev. at C.B. outlet = 94.90 (given)

"H" = 98.75 - 94.90 = 3.85'

Step 1. From Chart I

When "h" = 5.0, "d" = 21", and L = 50', Q = 33 cfs.

Step 2. From Chart II

When "H" = 3.85 and "d" = 21", Q = 28 cfs.

Solution

Q (max.) = 28 cfs. because "H"/"d" gives a smaller discharge than that obtained by using "h". (See Par. 1.d. above)

e. Investigation Problem (Case 2)

Use the same data as in Case 1 above except that the hydraulic grade of the main line is 95.75, making h = 3.00'. Determine the maximum discharge (Q) from the catch basin.

Procedure

W.S. elev. in C.B. = 100.00' - (9" + 6") = 98.75

Hydraulic grade of main line = 95.75 (given)

h = 98.75 - 95.75 = 3.00'

Elev. of C.B. outlet = 94.90 (given)

"H" = 98.75 - 94.90 = 3.85'

Step 1. From Chart I

When L = 50', "d" = 21", and "h" = 3.00, Q = 25 cfs.

Step 2. From Chart II

When "H" = 3.85 and "d" = 21", Q = 28 cfs.

Solution

Q (max.) = 25 cfs. because "h" gives a smaller discharge than that obtained by using "H"/"d". (See Par. 1.d. above)

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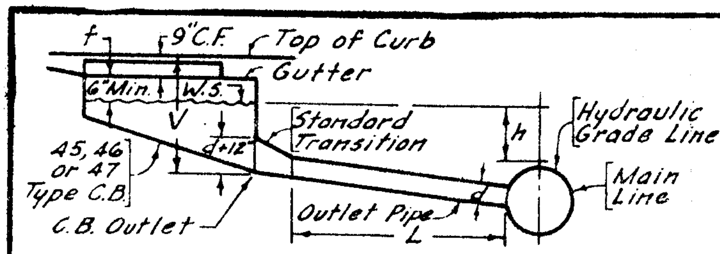

FIGURE 1

NOTES

1. This chart is based on the equation

$$Q = A\left(\frac{2gh}{1.0 + \frac{.026L}{D^{1.2}}}\right)^{1/2}$$

and primarily is for use with C.B. No's 45, 46 & 47 in connection with Std. "C.B. Outlet Transition Structure."

2. This chart may also be used for C.B. No's 39 & 40 when said basins are modified by a steep floor sloping to the Std. "C.B. Outlet Transition Structure" located at the end of the basin.

3. For normal installation of C.B. No's 39 & 40 use chart III of part VIII, Office Std. No. 108.

INSTRUCTIONS

GIVEN	REQD.	SOLUTION			
		PROCEED VERTICALLY FROM	TO	THEN HORIZONTALLY TO	AND READ
Q,h,L	d	Q	h	A VERTICAL FROM L	d
h,d,L	Q	L	d	h	VERTICALLY TO Q
Q,d,L	h	L	d	A VERTICAL FROM Q	h

TYPICAL EXAMPLE

Given: L = 50', Q = 28 c.f.s., h = 5.0'
Required: d
Solution: Begin at bottom of chart with Q = 28 c.f.s. (Pt. A). Proceed vertically to intersect the h = 5' line (Pt. B) thence horizontally to L = 50' (Pt. C) between d = 18" and d = 21". Use the larger size pipe (d = 21").

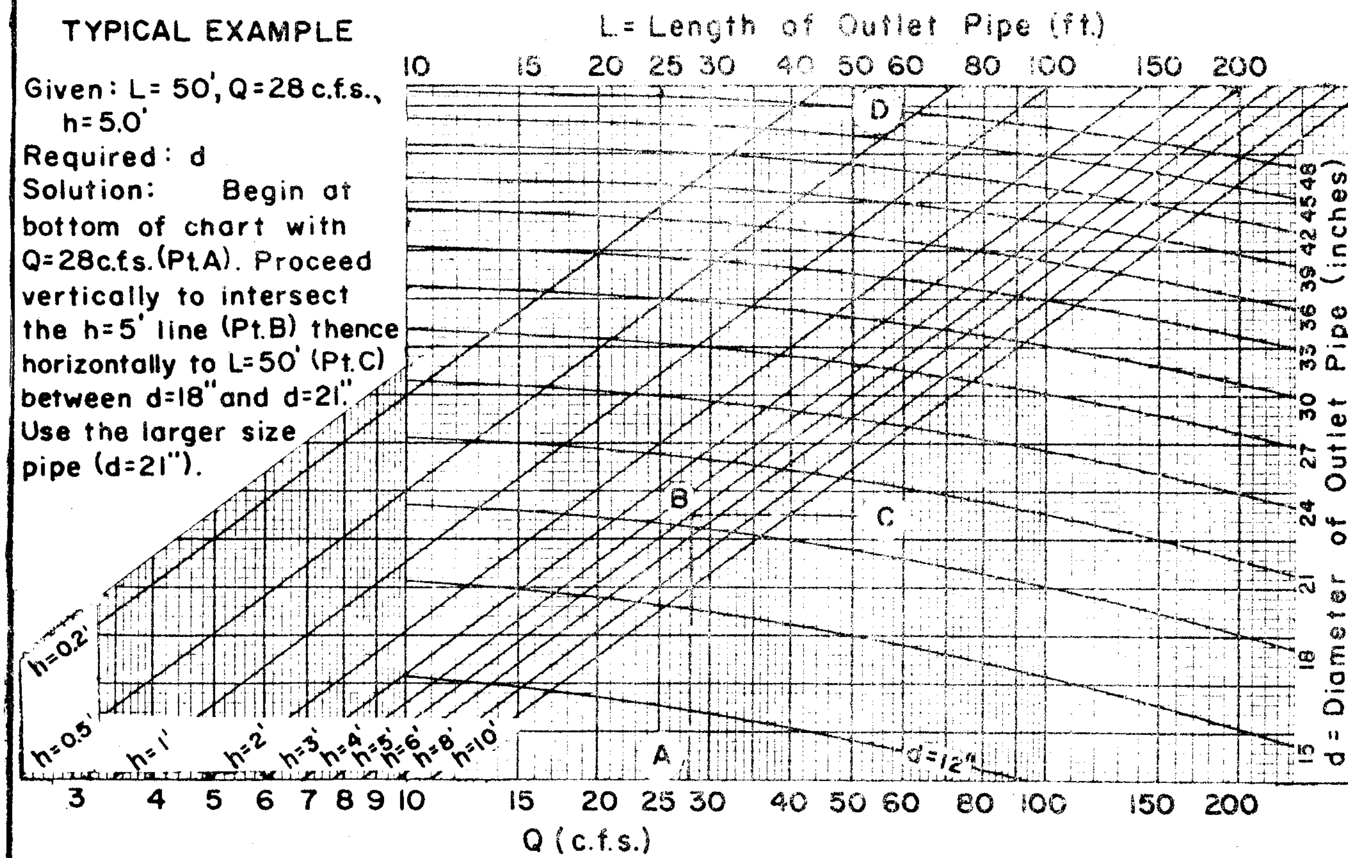

CHART I FULL PIPE

CATCH BASIN OUTLET PIPE CAPACITIES

BUREAU OF ENGINEERING-CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION
W.O. 51005 JAN., 1959

DESIGNED BY: F.J.D. & W.H.T. DRAWN BY: O.G.S.

Note 3 Revised May 1961

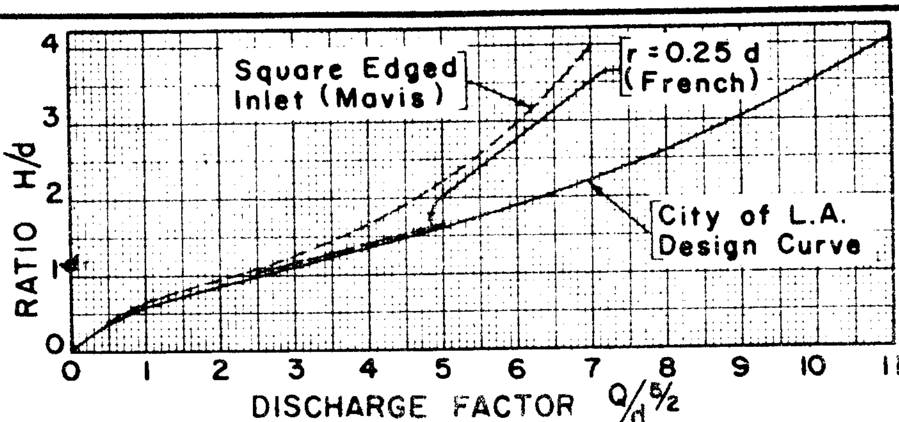

FIGURE 3

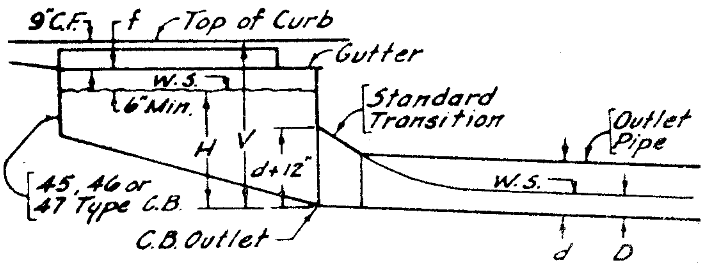

FIGURE 2

LEGEND

D = Normal depth
d = Diameter of outlet pipe

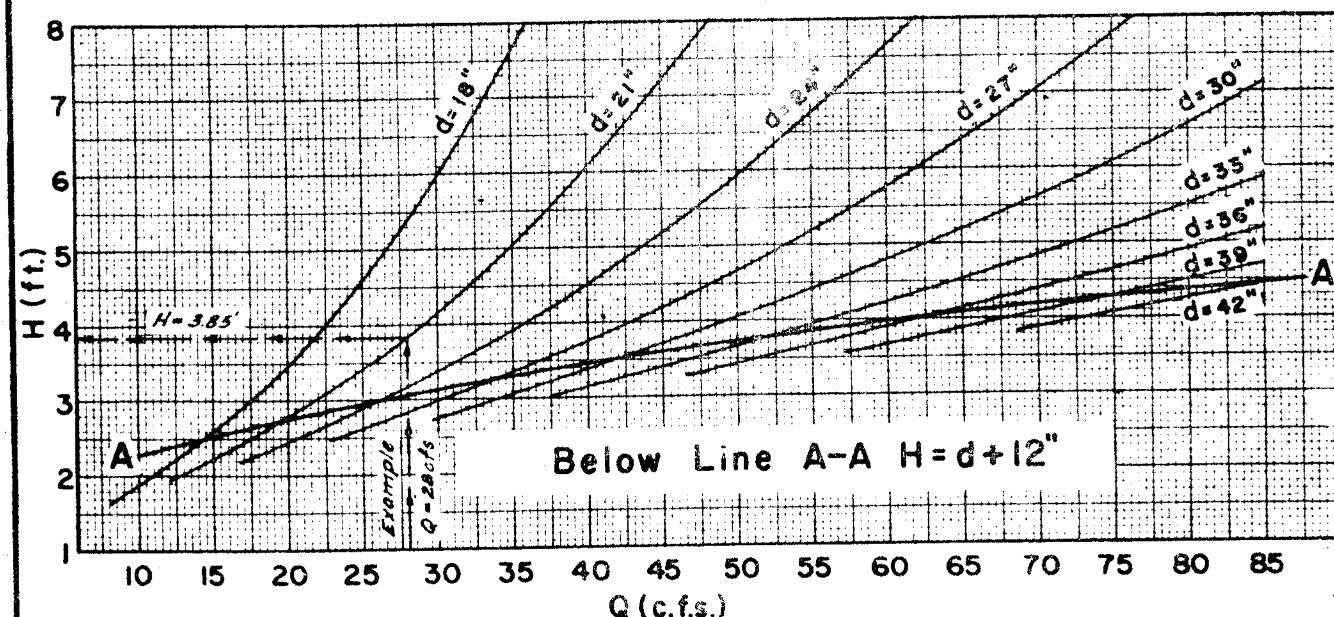

FIGURE 1

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 = 3.85'.

CHART II
CONTROL AT INLET

INSTRUCTIONS

GIVEN	REQ'D.	PROCEED	TO	THEN
Q,d	H	VERTICALLY FROM Q	d	HORIZONTALLY TO H
H,d	Q	HORIZONTALLY FROM H	d	VERTICALLY TO Q

CATCH BASIN OUTLET PIPE CAPACITIES

BUREAU OF ENGINEERING-CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION

W.O. 51005 JAN., 1959

DESIGNED BY: F.J.D. & W.H.T. DRAWN BY: O.G.S.

OFFICE STANDARD NO. 108
Storm Drain Design Division
Bureau of Engineering
City of Los Angeles
May 25, 1961

PART VIII

DESCRIPTION AND USE OF CATCH BASIN CONNECTING PIPE CAPACITY CHARTS (With 3" Radius of Rounding at the Catch Basin Outlet)

These charts may be used as guides for computing the capacity of "Catch Basin Connecting Pipes" for all catch basins with the standard 3-inch radius of rounding at the junction of the catch basin and the catch basin connecting pipe. These charts are similar to Charts I and II of Part VII but were basically conceived and developed for use with standard Catch Basins Nos. 38, 39 and 40 having side inlet openings. These charts are not applicable for use with curb side opening type standard Catch Basins Nos. 45, 46 and 47 when combined with the standard "Catch Basin Outlet Transition Structure."

Chart III is similar to Chart I of Office Standard No. 7, which was originally developed from studies based upon (a) University of Iowa (Bulletin No. 1), New Series No. 103, titled "Flow of Water Through Culverts"; and (b) the results of experiments and tests conducted at the California Institute of Technology by Carl Hague (1927) and as recalculated and extended by G. S. Tapley (1946) of the Storm Drain Design Division, Bureau of Engineering, City of Los Angeles.

Chart IV, which was developed at the Hydraulic Research Laboratory of the Storm Drain Design Division, was based upon the reference data listed in Part VII.

1. LEGEND AND DISCUSSION.

   The Legend and Discussion contained in Part VII are applicable to Part VIII.

2. GENERAL RULES.

   The General Rules established in Part VII are applicable to Part VIII, with the following exceptions and additions:

   a. The soffit of the catch basin outlet pipe should be at least 9 inches below the designed water surface in the catch basin (minimum "H" = "d" + 9").
   b. The minimum "V" should be "H" + 6" + curb face.

3. DESIGN FOR SINGLE BASINS.

In the design or investigation for single basins, the procedure for the use of Charts III and IV herein is similar to the procedure outlined for Charts I and II, respectively, of Part VII. The smaller value of discharge, as determined from Charts III and IV, shall be the applicable discharge.

4. DESIGN FOR MULTIPLE BASINS IN SERIES.

There are many combinations of "d" and "V" which will satisfy a given set of conditions. Several trials may be necessary to find the most economical system. The following sample problem is intended for use as a guide to illustrate the determination of the catch basin outlet depths "V" and the catch basin outlet connecting pipe sizes.

a. Sample Problem.

(1) Conditions and Assumptions

	C.B. No. 1	C.B. No. 2	C.B. No. 3
Elev. top of curb (T.C.)	100.00	99.70	99.20
Curb face (C.F.)	9"	9"	9"
Length of outlet pipe (L)	32'	40'	85'
Flow intercepted by catch basin (Q)	16 cfs.	12 cfs.	8 cfs.
Flow in outlet pipe	16 cfs.	28 cfs.	36 cfs.

Elevation of hydraulic grade line at the main line storm drain = 93.04.

Determine the following for each catch basin:

(a) "d" (diameter of outlet pipe in inches)
(b) "V" (depth of catch basin in feet)

(2) Procedure and Solution

A simple approximation is to assume that, in the reach between Catch Basin No. 1 and Catch Basin No. 2 (see Fig. 2, Chart IV) with the freeboard (f) = 6 inches, "h1" is approximately equal to the total available head (h_t) divided by the number of catch basins in the series. The minimum value of "h_1" is $(TC_1-CF_1-f) - (TC_2-CF_2-f)$

Catch Basin No. 1.

Step 1. Determine W.S. elev. in C.B.

$(W.S.\ elev.)_1 = 100.00 - 9" - 6" = 98.75$

Step 2. Determine h_t.

$h_t = (W.S.\ elev.)_1 - (H.G.L.\ elev.\ in\ main\ line)$

$= 98.75 - 93.04 = 5.71'$

Step 3. Set approximate h_1.

$h_1 = h_t \div 3 = 5.71 \div 3 = 1.90'$ or

$(TC_1-CF_1-f) - (TC_2-CF_2-f)$, whichever value is larger

Step 4. Determine d_1.

$Q_1 = 16$ cfs., $L_1 = 32'$, $h_1 = 1.90'$

From Chart III, d_1 falls between 18" and 21"

Use the larger, $d_1 = 21"$

Step 5. Determine actual h_1.

$Q_1 = 16$ cfs., $L_1 = 32'$, $d_1 = 21"$

From Chart III, $h_1 = 1.30'$

Step 6. Determine H_1.

$Q_1 = 16$ cfs., $d_1 = 21"$

From Chart IV, $H_1 = d_1 + 9"$ (below Line A-A)

$H_1 = 2.50'$

Step 7. Determine V_1.

$(\text{Outlet elev.})_1 = (\text{W.S. elev.})_1 - H_1 = 98.75 -$

$2.50 = 96.25$

$V_1 = TC_1 - (\text{Outlet elev.})_1 = 100.00 - 96.25 = 3.75'$

Solution

$d_1 = 21"$, $V_1 = 3.75'$

Catch Basin No. 2.

Step 1. Determine $(\text{W.S. elev.})_2$.

$(\text{W.S. elev.})_2 = (\text{W.S. elev.})_1 - h_1 = 98.75 - 1.30$

$= 97.45$ (or TC_2 - 9"-6", whichever elevation is lower)

Step 2. Set approximate h_2.

$h_2 = (h_t - h_1) \div 2 = (5.71 - 1.30) \div 2 = 2.20'$ or

$(TC_2 - CF_2 - f) - (TC_3 - CF_3 - f)$, whichever value is larger.

Step 3. Determine d_2.

$Q_2 = 28$ cfs., $L_2 = 40'$, $h_2 = 2.20'$

From Chart III, $d_2 = 27"$

Step 4. Determine actual h_2.

$Q_2 = 28$ cfs., $L_2 = 40'$, $d_2 = 27"$

From Chart III, $h_2 = 1.40'$

Step 5. Determine H_2.

$Q_2 = 28$ cfs., $d_2 = 27"$

From Chart IV, $H_2 = 3.00'$

Step 6. Determine V_2.

$(\text{Outlet elev.})_2 = (\text{W.S. elev.})_2 - H_2 = 97.45 - 3.00 = 94.45$

$V_2 = TC_2 - (\text{Outlet elev.})_2 = 99.70 - 94.45 = 5.25'$

Solution

$d_2 = 27''$, $V_2 = 5.25'$

Catch Basin No. 3

Step 1. Determine $(\text{W.S. elev.})_3$.

$(\text{W.S. elev.})_3 = 97.45 - 1.40 = 96.05$ or

$(TC_3 - 9'' - 6''$, whichever elevation is lower).

Step 2. Find available h_3.

$h_3 = 96.05 - 93.04 = 3.01'$

Step 3. Determine d_3.

$Q_3 = 36$ cfs., $L_3 = 85'$, $h_3 = 3.01'$

From Chart III, $d_3 = 27''$

Step 4. Determine H_3.

$Q_3 = 36$ cfs., $d_3 = 27''$

From Chart IV, $H_3 = 3.93'$

Step 5. Determine V_3.

$(\text{Outlet elev.})_3 = (\text{W.S. elev.})_3 - H_3 = 96.05 - 3.93 = 92.1$

$V_3 = TC_3 - (\text{Outlet elev.})_3 = 99.20 - 92.12 = 7.08'$

Solution

$d_3 = 27''$, $V_3 = 7.08'$

b. Discussion.

The depths "V" computed in the foregoing problem are minimum values required for the system to operate at design capacity. A catch basin may be designed with a greater depth if necessary for substructure clearance or for other reasons, if the design meets the requirements of Section 2e of Part VI

Where interference limits the depth of any basin to a value less than that computed by the method shown, a larger pipe diameter must be provided in order to satisfy the condition. It is essential that the value of "H" be great enough to provide design flow.

5. ANALYSIS FOR EXISTING CATCH BASINS IN SERIES.

In general, the analysis for existing catch basins in series is similar to the foregoing problem, except that the values of "d" and "V" are known. The value of either "H", or "h", or the inlet capacity of the catch basin will control, whichever provides the smallest discharge in the analysis and solution.

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INSTRUCTIONS

GIVEN	REQ'D	SOLUTION: PROCEED VERTICALLY FROM	TO	THEN HORIZONTALLY TO	AND READ
Q,h,L	d	Q	h	A VERTICAL FROM L	d
h,d,L	Q	L	d	h	VERTICALLY TO Q
Q,d,L	h	L	d	A VERTICAL FROM Q	h

NOTES:

This chart is based on the equation

$$Q = A\left(\frac{2gh}{1.43+\frac{.026L}{d^{1.2}}}\right)^{\frac{1}{2}}$$

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=28 c.f.s., h=1.0' L=50'
Required: d
Solution: Begin at bottom of chart with Q=28 c.f.s. (Pt. A). Proceed vertically to intersect the h=1.0' line (Pt. B) thence horizontally to L=50' (Pt. C) between d=27" and d=30". Use the larger size pipe (d=30").

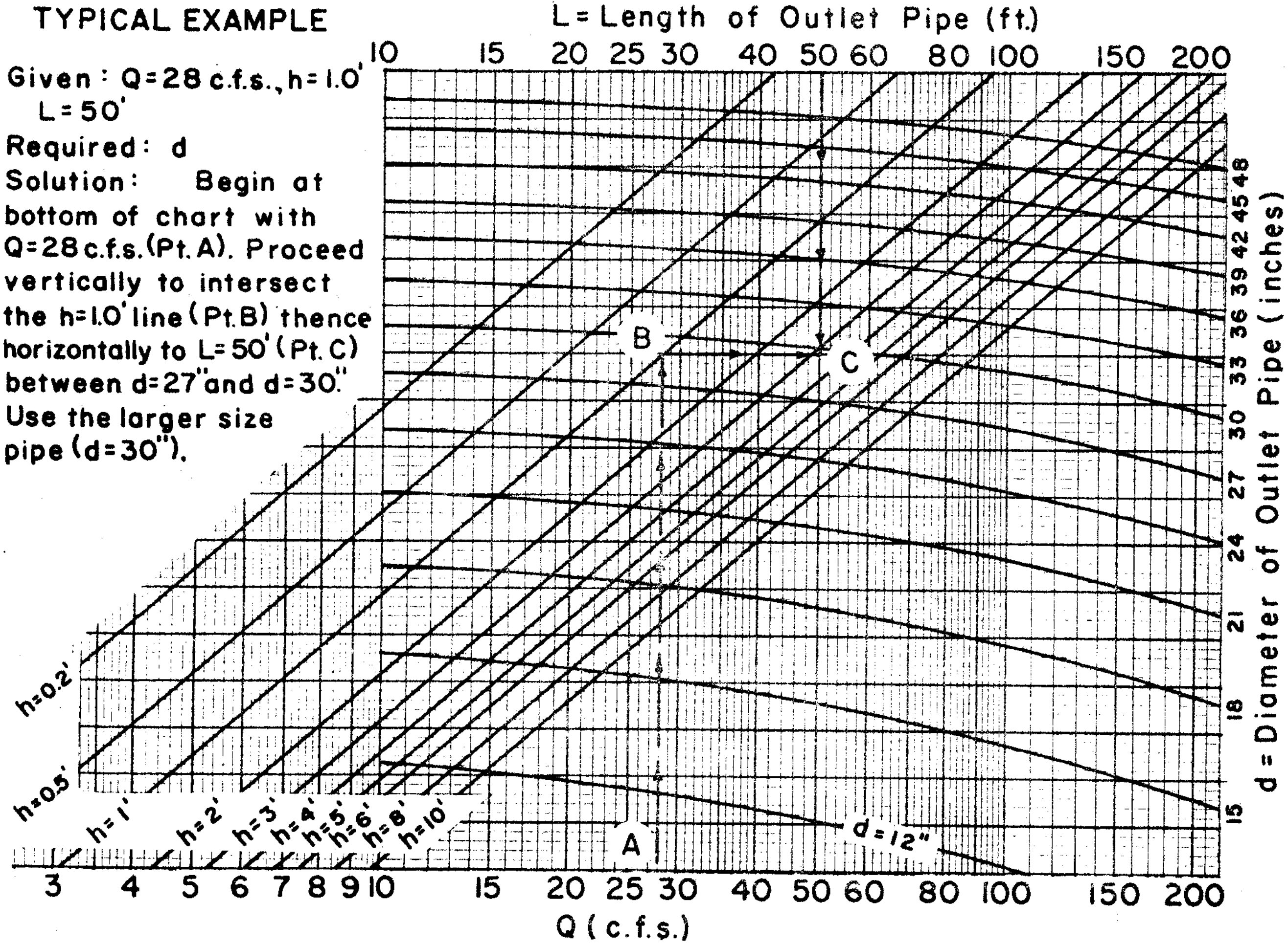

CHART III FULL PIPE

CATCH BASIN CONNECTING PIPE CAPACITIES

BUREAU OF ENGINEERING-CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
STORM DRAIN DESIGN DIVISION

W.O. 51005 MAY 1961

DESIGNED BY: H.D.H. & S.F. DRAWN BY: O.G.S.

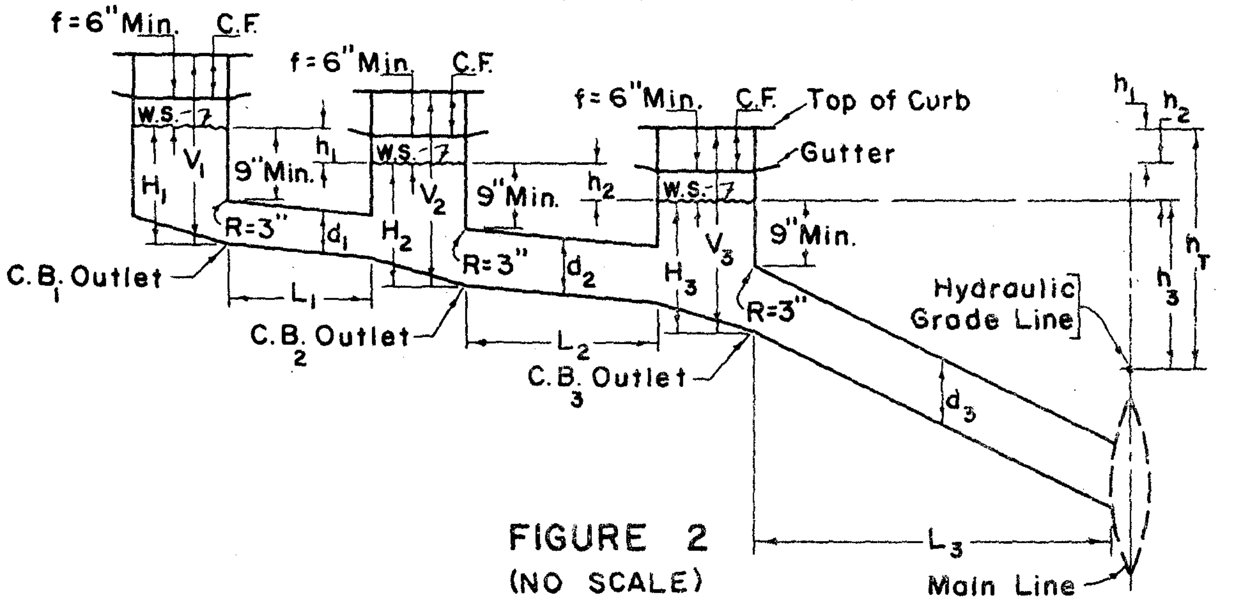

FIGURE 2
(NO SCALE)

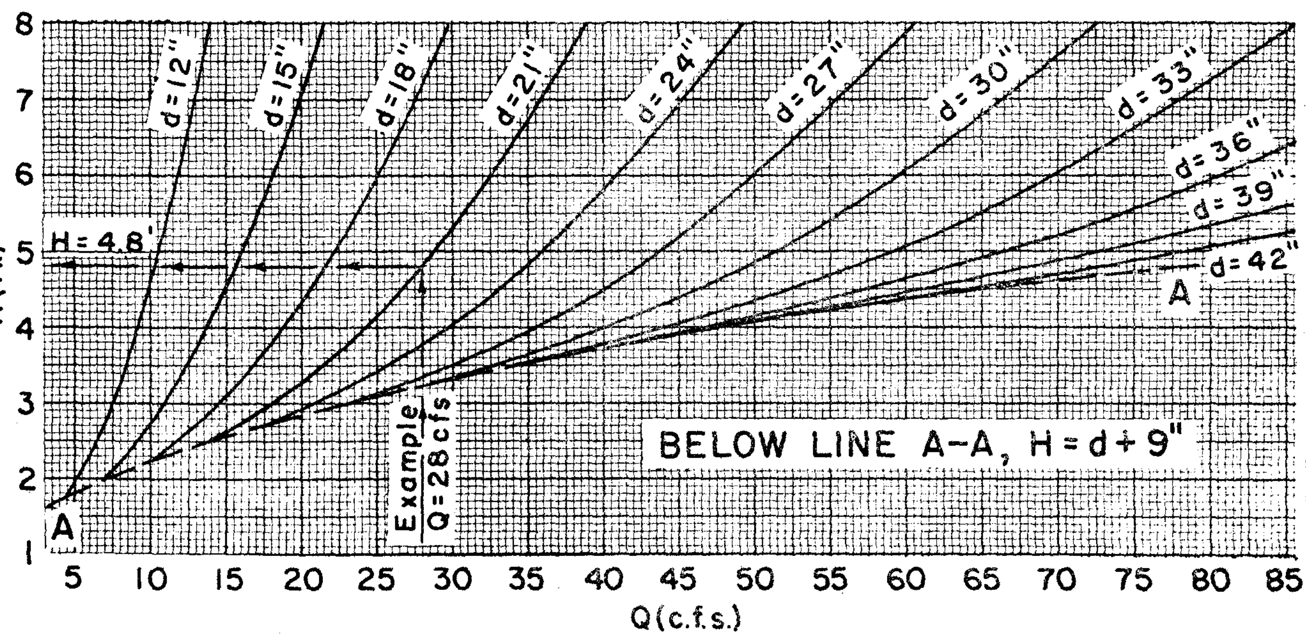

FIGURE I

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

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'

CHART IV
CONTROL AT C.B. OUTLET

INSTRUCTIONS

GIVEN	REQ'D	SOLUTION PROCEED	TO	THEN
Q,d	H	VERTICALLY FROM Q	d	HORIZONTALLY TO H
H,d	Q	HORIZONTALLY FROM H	d	VERTICALLY TO Q

CATCH BASIN CONNECTING PIPE CAPACITIES

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DEPARTMENT OF PUBLIC WORKS
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