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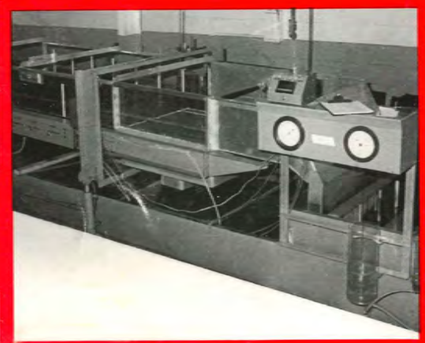

Laboratory and full size flume used to test grates for data appearing in this report.

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KIRSCH

INLET GRATE CAPACITIES

FOR GUTTER FLOW and PONDED WATER

NEENAH

INLET GRATE CAPACITIES

A JOINT RESEARCH PROJECT

BY PERSONNEL FROM

NEENAH FOUNDRY COMPANY

AND

ENGINEERING LABORATORY DESIGN, INC.

NEENAH FOUNDRY COMPANY

Box 729 Neenah, WI 54957-0729

Emergency Phone No. (920) 725-7000

FAX (920) 729-3661

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PART 2 PONDED WATER

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TEST PROGRAM TO DETERMINE INLET GRATE CAPACITIES FOR GUTTER FLOW

The recent effort to provide roadway drainage structures which would assure safe travel for bicycle riders prompted a review of drainage inlet grates directed toward determining a proper design. Those involved in the sale and manufacture of these products at Neenah Foundry were also aware that very little information was available concerning the actual flow capacity of the large variety of grates in production by the company.

Engineering Laboratory Design, Inc. was retained to design and build the necessary test equipment to determine and evaluate the hydraulic characteristics of inlet grates. These facilities were completed in the spring of 1974 and installed in an enclosed area of the pattern storage building located at Plant 2 in Neenah, Wisconsin. Engineering Laboratory Design, Inc. was retained as consultant for the development and implementation of the testing program.

TEST FACILITIES

On consideration of the factors involved in obtaining useful information which would be of value to those engaged in design work, it was concluded that a program of testing or calibrating full size units would be the most desirable. Test studies could have been successfully carried out with hydraulic models but this would have required that scaled-down grates be used. Such models would have been more costly than using prototype castings and would have probably meant delays in the test program. In addition, the test information may have been questioned by those not familiar with model study procedures.

To permit full scale testing, a hydraulic flume (channel) of overall length of 25 feet and four feet wide was constructed. This unit is comprised of a 19 foot length of Plexiglas viewing channel with a three foot inlet section to provide proper uniform flow conditions. The grate under test is placed in the floor of the downstream end of the channel. Flow passing through the grate is returned to the reservoir below the flume while the flow by-passing the grate is measured by a sharp-crested straight weir before returning to the reservoir. The difference between the gutter flow and the by-pass quantity is the capacity of the grate under test. To simulate a wide range of flow conditions the flume is so constructed that it can be tilted both in a longitudinal and transverse direction. This is accomplished by a system of hydraulic cylinders. A maximum slope of 10% in either direction can be obtained.

In order that the surface of the flume would simulate a roughness found in brushed concrete or black top finish, the floor of the flume was lined with a chip surface roofing paper. Calculations of Manning's "n" from test data indicated that this surface has a roughness coefficient of between 0.013 and 0.014. This is close to the accepted values used by other investigators.

The channel width of four feet is thought to represent normal gutter flow conditions for most pavements and is cited as adequate by Guillou.[1]

INSTRUMENTATION

Various flow parameters were obtained both by direct measurement and by several electronic devices. The inflow to the flume was obtained by a differential pressure gage connected to a sharp edged orifice in the supply line. Through a specially calibrated dial the gage reads directly in cubic feet per second. The flow was frequently checked by differential manometer also connected to the orifice. The by-pass quantity, measured by the straight weir, was read from a dial indicator operated by a float connected to the pool behind the weir.

The flow depth upstream of the grate inlet was measured by a standard point gage and also by means of a transducer with read-out by a digital voltmeter.

The slope of the flume could be adjusted to any position within the range with aid of electronic angle measuring units with a resolution to within 1/10 of 1 degree. The slope was rechecked after every change in position.

THEORY:

The velocity of water in a natural or man-made channel is governed principally by the slope along the axis of the channel, the shape of the channel cross-section, and the roughness of the surface in contact with the water, also known as the wetted perimeter.

The most generally used formula or equation is one developed by an early hydraulic investigator by the name of Manning. This expression is familiar to all hydraulic designers and is shown in the following form:

$$V = \frac{1.486}{n} R^{2/3} S^{1/2} \text{ where}$$

V = Velocity of flow in ft./second

n = Roughness coefficient

R = Hydraulic radius—defined as the area/wetted perimeter

S = Slope of the longitudinal axis of channel in ft./ft.

Where the width of the channel cross-section is relatively great in respect to the depth of flow, the depth can be used as the value of R. The depth is considered to be the depth at the curb.

The discharge, Q in cubic feet per second, is obtained by multiplying the area which, for rectangular channels, is width x depth, x the velocity of flow. Thus the equation of discharge becomes Q = AV = WDV where:

$$V = \frac{1.486}{n} D^{2/3} S^{1/2} \text{ then}$$

$$Q = \frac{1.486}{n} WD^{5/3} S^{1/2}$$

When the flow in the gutter takes the shape of a triangular channel the Manning equation has been modified by Izzard[2] to include the transverse slope and has the following form:

$$Q = \frac{.56Z}{n} D^{8/3} S^{1/2} \text{ where Z is the reciprocal of}$$

the cross-slope and D is the depth or head (h) in feet.

The 8/3 power of the depth arises from the flow area being a function of D^2. This form of the equation describes the flow in a triangular section very accurately and computations of discharge for the test flows in the approach channel agree very closely with the actual values.

When the test data are plotted logarithmically for given longitudinal and transverse slopes a relationship between Q and D is observed which closely follows the manning equation.

If the term $\frac{1.486}{n} WS^{1/2}$ is combined to become K′ this relation simplifies to $Q = K'D^{5/3}$. Further consideration of the interception process indicates that the quantity that can be removed is limited to the water flowing in that portion of the gutter equal to the grate width. Minor additions to the grate flow will occur due to inflow from the side of the grate. No attempt was made to include a factor measuring side flow since this would unnecessarily complicate the equation.

The discharge through the gutter section equal to the grate width similarly has a discharge-depth relation which can be expressed by $Q = KD^{5/3}$ where K is unique to the geometry of each grate. Analysis of the test data revealed that the discharge did not follow the slope term ($S^{1/2}$) closely, therefore a general equation for each transverse slope could not be used. Consequently K values for each tested combination of longitudinal and transverse slope for a specific grate installation were evaluated.

The geometry of the inlet grate also governs the capacity of the system. Long narrow bars parallel to the direction of flow are, with one exception, the most efficient arrangement. As cross-bars are added to reduce size of openings or for strength reasons the potential capacity of the grate is reduced. Cross-bars form barriers to the smooth flow of water through the grate and will often deflect the jet upward, further interfering with flow through the grate. For a theoretical analysis of this action see Guillou[1], Fig. 3, page 17. Thick wide bars permit a portion of the flow to reach the far end of the grate. A grate made up entirely of cross-bars whose shape is patterned after an air foil and positioned to turn the flow at an angle with the vertical is the most efficient geometry available.

Tests were run on all grates using a standard procedure. Six rates of gutter flow were run for each of four longitudinal and four different cross-slopes with a total of 96 separate test points for each complete grate test. Values of the grate constant "K" were obtained for each combination of longitudinal and cross-slope. Each test point was computed and compared with the observed value. Comparison of these values indicates that an average accuracy of individual points is about 5% with the maximum deviation being about ±10%. Considering the number of variables involved and the accuracy with which each could be observed, the correlation is quite acceptable.

The data from the grate tests has been compiled in graph form with values of "K" plotted vs. the transverse gutter cross-slope. A series of curves showing the "K" values for each longitudinal slope allows the selection of grate coefficients for most generally used slopes. Values of "K" for slopes between those plotted can be obtained by extrapolation. Slopes less than 1% longitudinal were not tested since this would represent a condition where the pavement would be flooded.

In determining the inlet grate capacity for a specific grate, the value of "K" is chosen from the graph using the proper longitudinal and transverse slope to fit the design case. "Values of K vs S_T are given for each longitudinal slope S_L. These slopes are indicated in percent of slope". The "K" selected is then used in the equation $Q = KD^{5/3}$ where D is the depth upstream of the grate in feet. D can be obtained from rating tables, in Federal or State Highway design manuals, for the proper slope, shape and surface roughness or can also be developed from Izzard's[2] modification of Manning's equation if the rating tables are not available. The equation is given in the preceding part of this discussion. For convenience values of $D^{5/3}$ are given for most commonly used depths.

Table of Values of $D^{5/3}$

D	$D^{5/3}$
.05	.00680
.07	.0119
.08	.0148
.09	.0181
.10	.0215
.12	.0292
.14	.0377
.16	.0471
.18	.0573
.20	.0684
.22	.0801
.24	.0926
.26	.106
.28	.120
.30	.134

SPACING SELECTION

Gutter flow which determines inlet spacing can only be estimated from hydrologic data and with less accuracy than the information derived from the inlet capacity studies. A number of methods may be used to determine the gutter flow and from values obtained, a spacing of the inlets can be determined such that the inlet can accommodate all or the major portion of the discharge. The next interval must then be adjusted so that the flow plus the carry-over will be within acceptable limits. Examples of pavement flow calculations are found in several publications.[1, 3] Allowing some carry-over to occur will result in fewer inlets for a given length of slope; however the inlet at the base of the grade must be spaced so that the area is not flooded.

See Page IV for the solution to a typical inlet spacing problem.

EXPLANATION OF CHARTS

The values shown on the graphs which follow the explanation section of this manual, *are the results of actual testing* on a full size hydraulic testing flume and were not determined by computation.

Each graph has a drawing in the upper right hand corner of the page which shows the overall dimensions of the grate, the grate type and the direction of flow used in testing. These sketches are representative and are not drawn to scale. For flow-through opening size refer to catalog "R".

The catalog number, description and component computer code number are shown in the upper left hand corner of the graph. This information can be used for ordering your casting choice.

Graphs are collated by catalog number in ascending numerical sequence. As additional data becomes available, copies will be sent to you so that you can insert them in your own manual.

BIBLIOGRAPHY

1. Guillou, J. C. "The Use and Efficiency of Some Gutter Inlet Grates," Univ. of Illinois Eng. Experiment Station Bulletin #450.
2. Izzard, C. F. "Tentative Results on Capacity of Curb Opening Inlets," Research Report No. 11-B on Surface Drainage, Highway Research Board, Washington, D. C. 1950.
3. Cassidy, J. J. "Generalized Hydraulic Characteristics of Grate Inlets," Highway Research Record No. 123, Highway Research Board, Washington, D. C.

DETERMINATION OF INLET SPACING

Given: Pavement consists of two 10 ft. lanes with vertical curb

$S_L = 2\%$ $S_T = 2\%$ Two ft. gutter

Permissible spread on pavement 6 ft.

STEP 1

Spread 6 + 2 = 8 ft.

Depth at curb = 8 x .02 = 0.16 ft.

Discharge for depth at curb $Q = \frac{.56}{N} Z(D^{8/3})S^{1/2}$

Solving equation by calculator Q = 1.85 cfs

STEP 2

Determine capacity and spacing of first inlet on the slope.

Pavement area which will produce equivalent discharge from equation:

Q=CIA

Assume C = 0.9 I = 4"/HR.

$A = \frac{Q}{IC} = \frac{1.85}{4 \times 0.9} = 0.51$ acres

Length to first inlet

$L = \frac{A}{W} = \frac{0.51 \times 43560}{22} = 1010$ ft.

STEP 3

Using Neenah inlet R-3246-A, Type C K = 26

Substituting in the formula $Q = KD^{5/3}$

$Q = 26 \times (.16)^{5/3} = 26 \times .047 = 1.23$ CFS

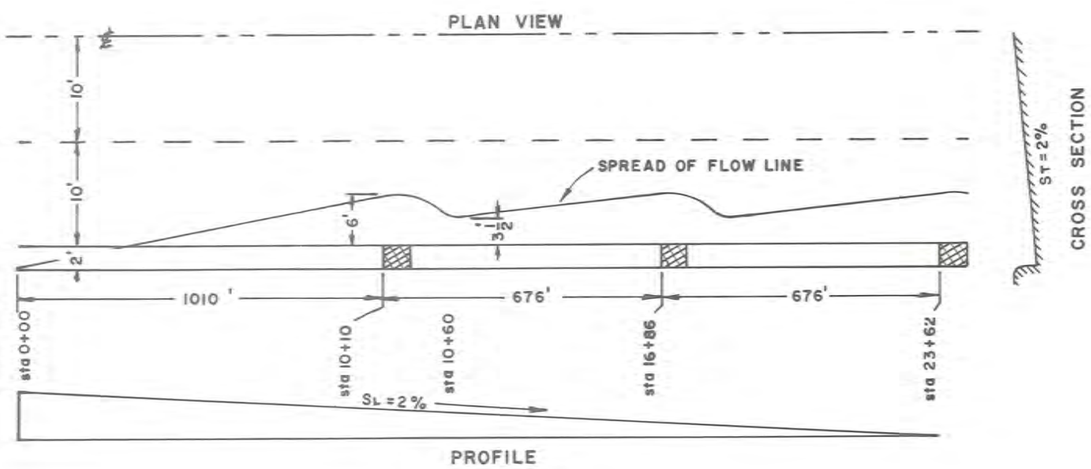
By-pass 1.85 - 1.23 = 0.62 CFS

STEP 4

Length to next inlet

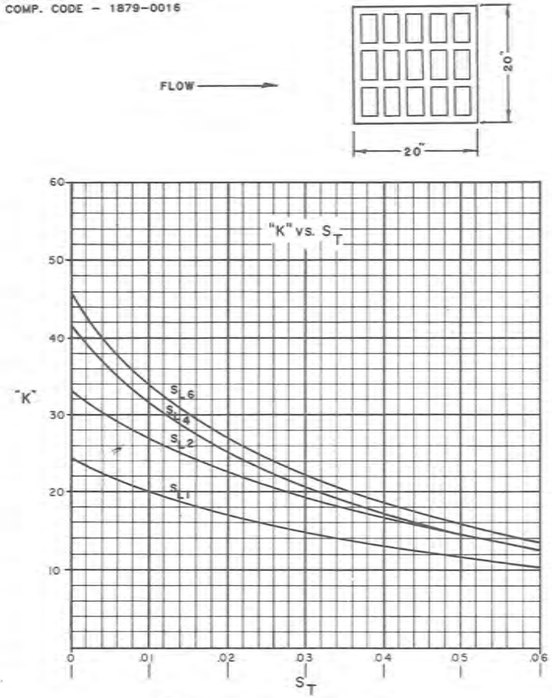
$\frac{Q}{ICW} = \frac{1.23 \times 43560}{4 \times 0.9 \times 22} = 676$ ft.

SOLUTION



Station	Q Gutter	Depth Gutter	Q Grate	Q Bypass	Spread on pavement
10 + 10	1.85 cfs	0.16'	1.23 cfs	0.62 cfs	6.0' + 2' gutter
10 + 60	0.62+ cfs	0.11'	N.A.	N.A.	3.5' + 2' gutter
16 + 86	1.85 cfs	0.16'	1.23 cfs	0.62 cfs	6.0' + 2' gutter
23 + 62	1.85 cfs	0.16'	1.23 cfs	0.62 cfs	6.0' + 2' gutter

CAT. NO. – 1879–A3G
DESCRIPTION – TYPE A
COMP. CODE – 1879–0016



S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

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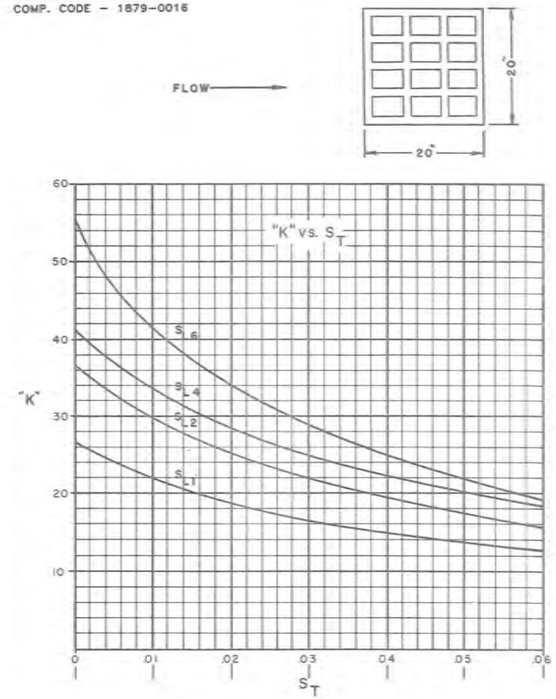

S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

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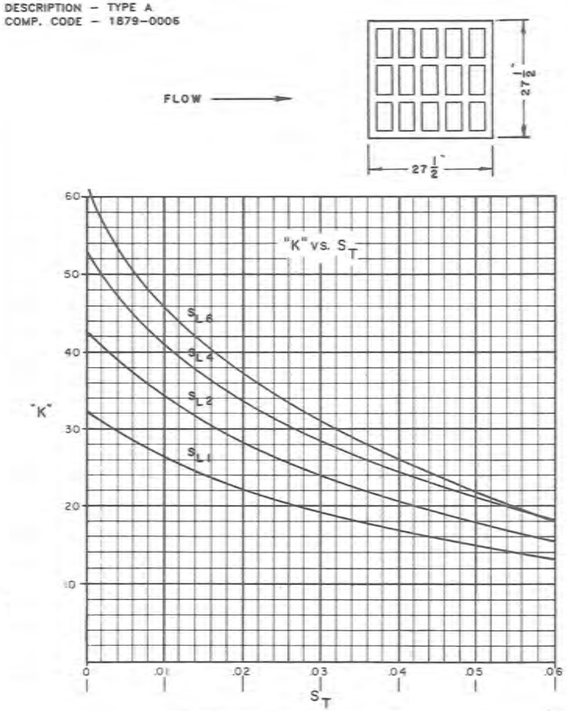

S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

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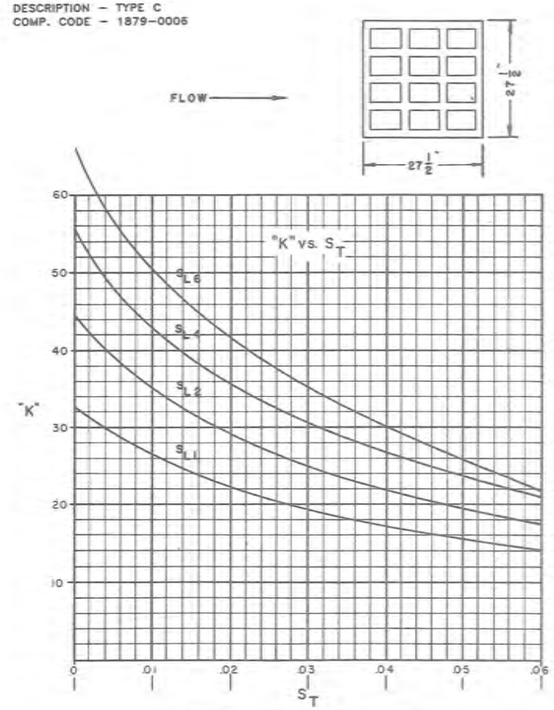

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K = GRATE INLET COEFFICIENT

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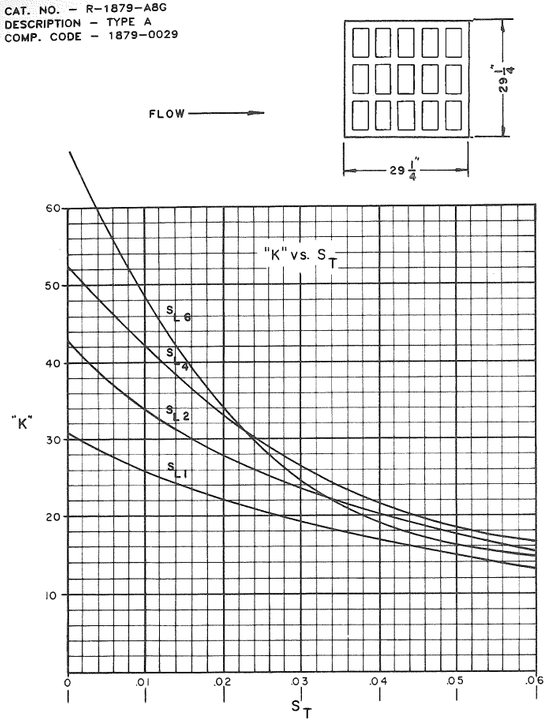

S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

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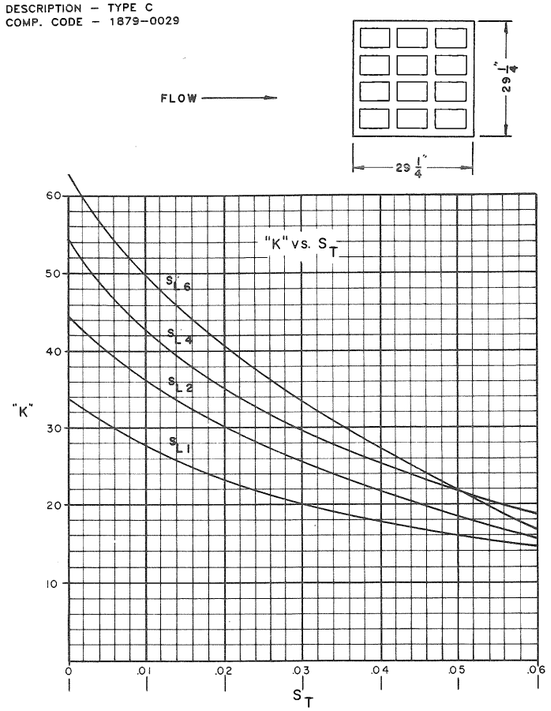

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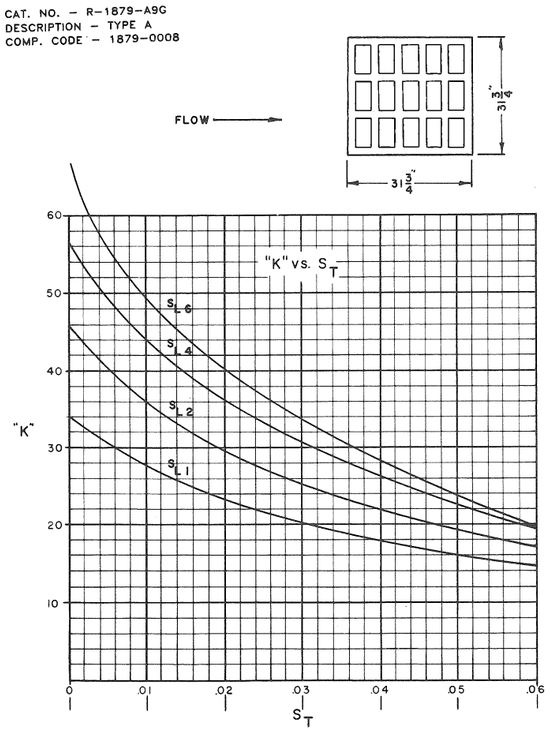

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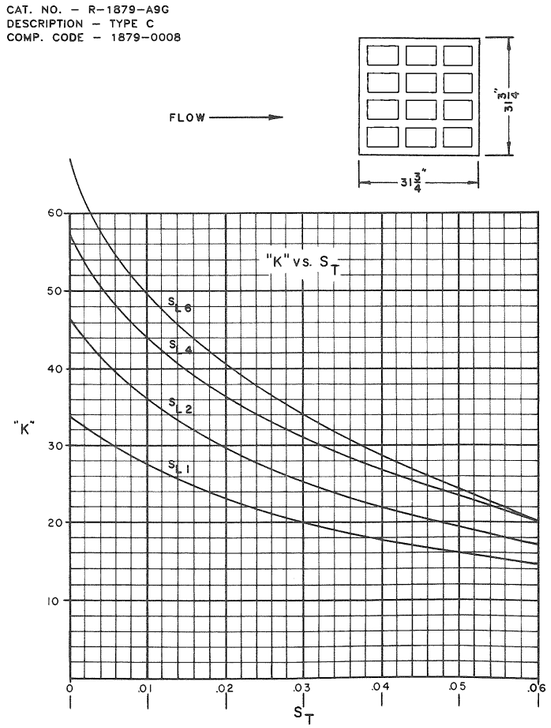

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K = GRATE INLET COEFFICIENT

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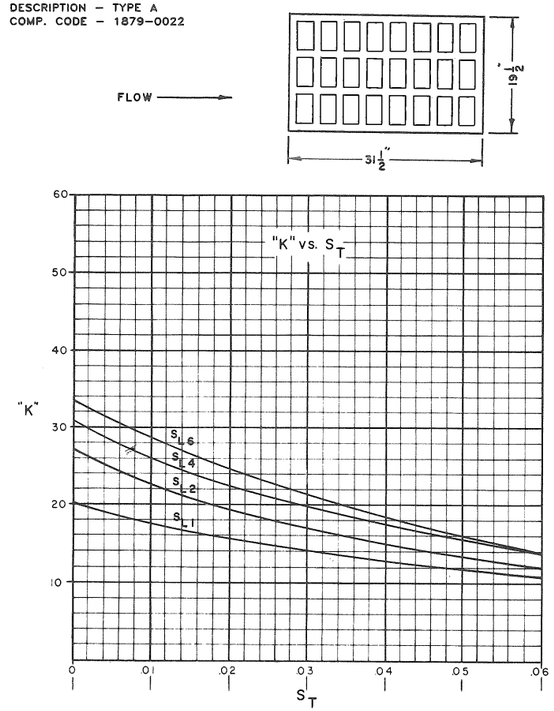

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K = GRATE INLET COEFFICIENT

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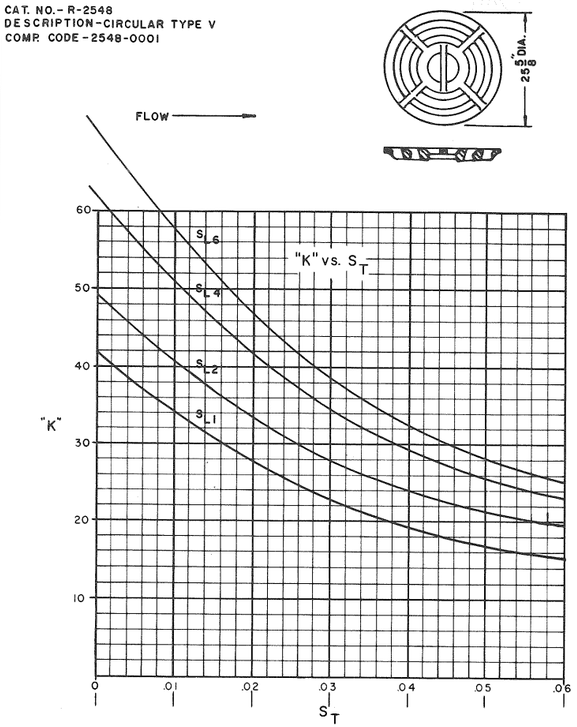

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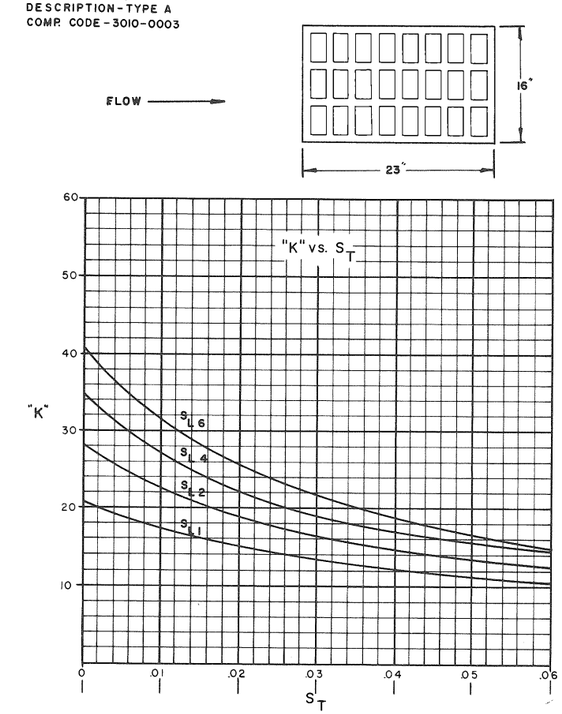

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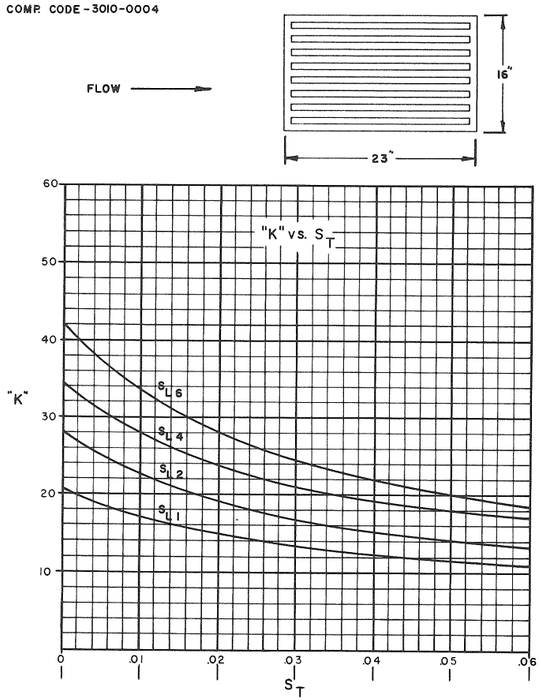

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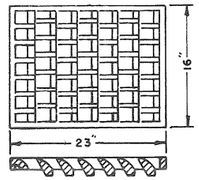
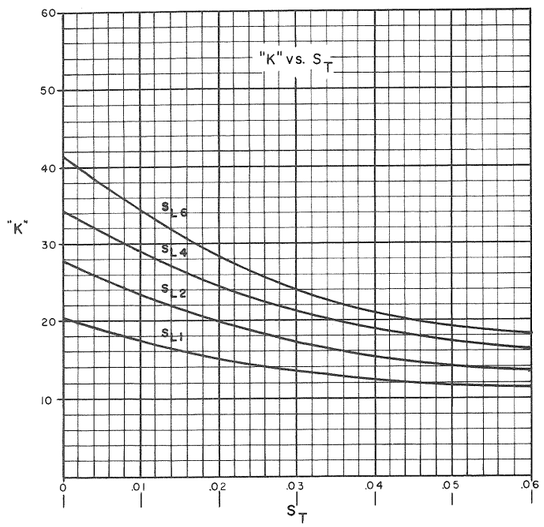
FLOW →





S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

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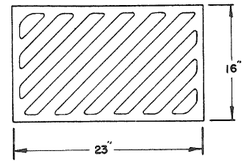
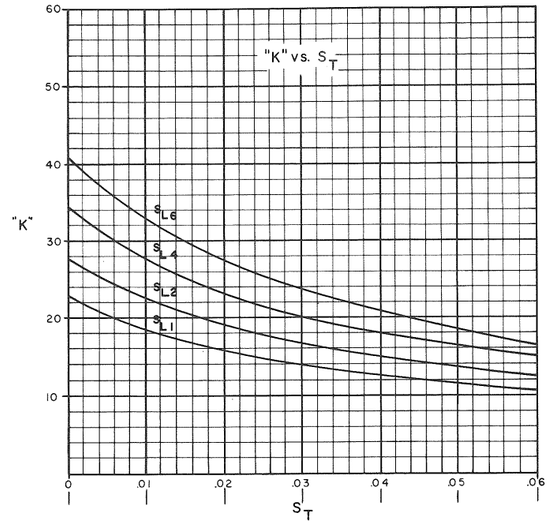
FLOW →





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S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

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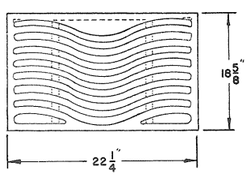
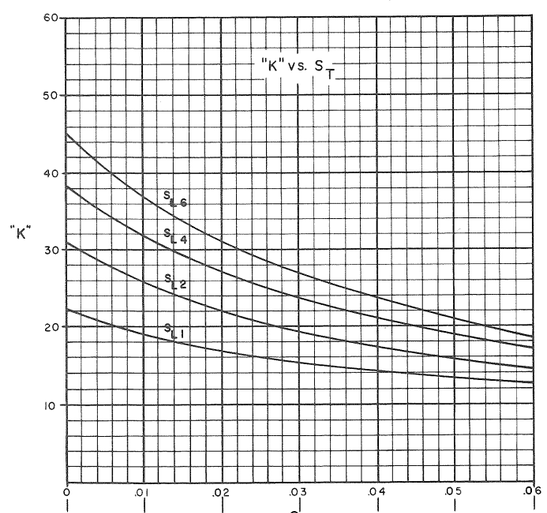
COMP. CODE - 3031-0002

FLOW →





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S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

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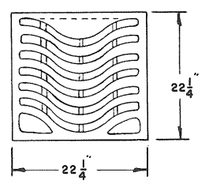

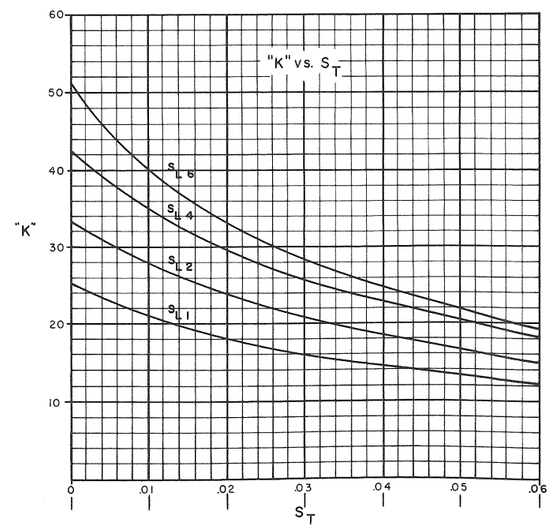

S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

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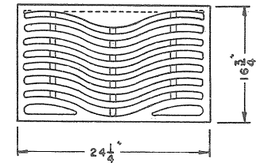
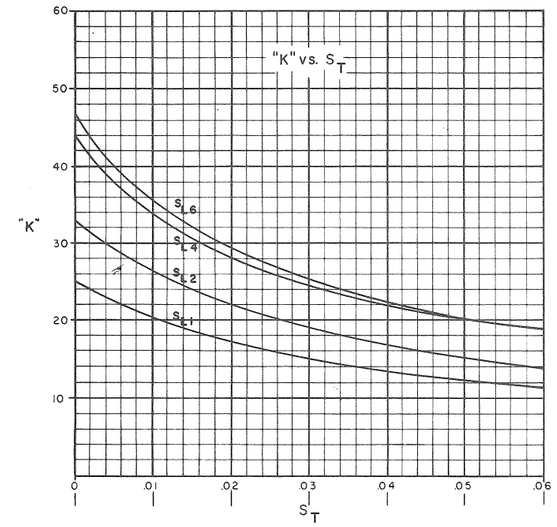
FLOW →





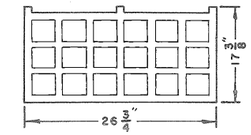
S_T = TRANSVERSE GUTTER SLOPE

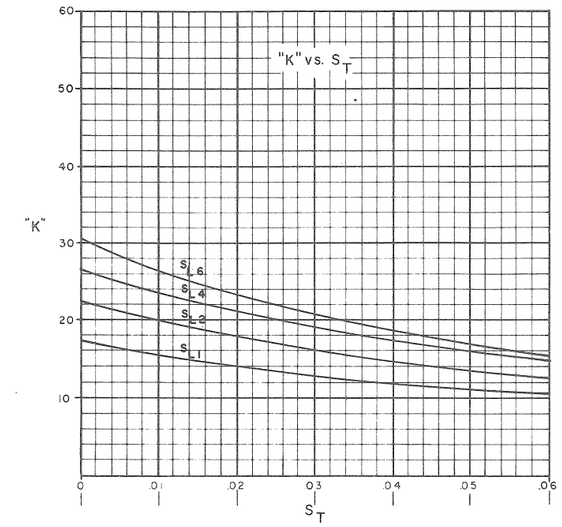
S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3042
DESCRIPTION-TYPE A
COMP. CODE - 3042-0002

FLOW →





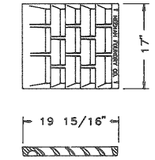
S_T = TRANSVERSE GUTTER SLOPE

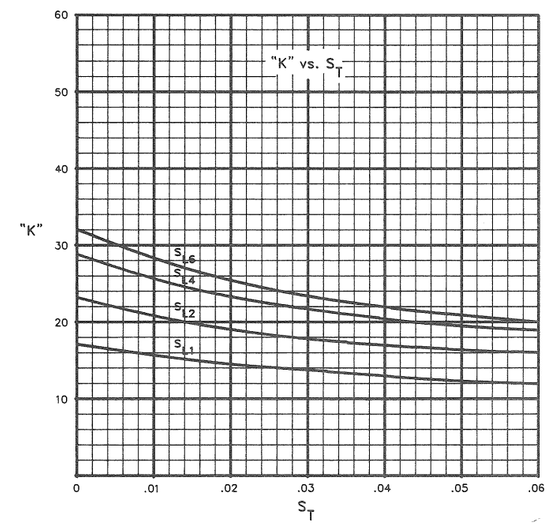
S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO. - R-3065-LL
DESCRIPTION - TYPE L
COMP. CODE - 3065-0003

FLOW →





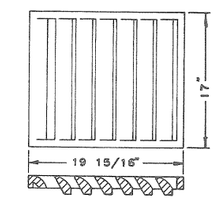
S_T = TRANSVERSE GUTTER SLOPE

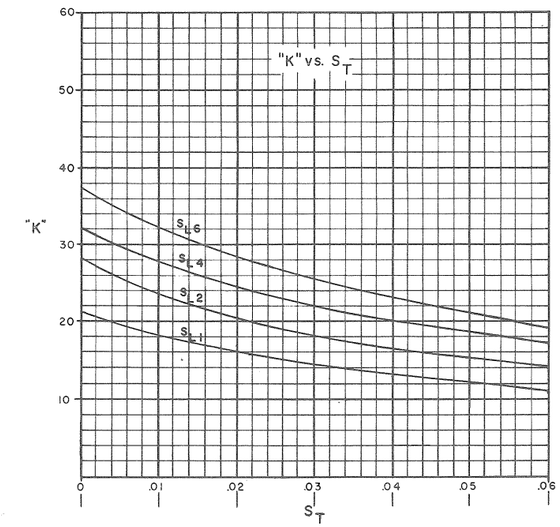
S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3065-V
DESCRIPTION- TYPE V
COMP. CODE - 3065-0002

FLOW →





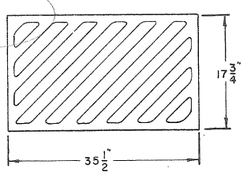
S_T = TRANSVERSE GUTTER SLOPE

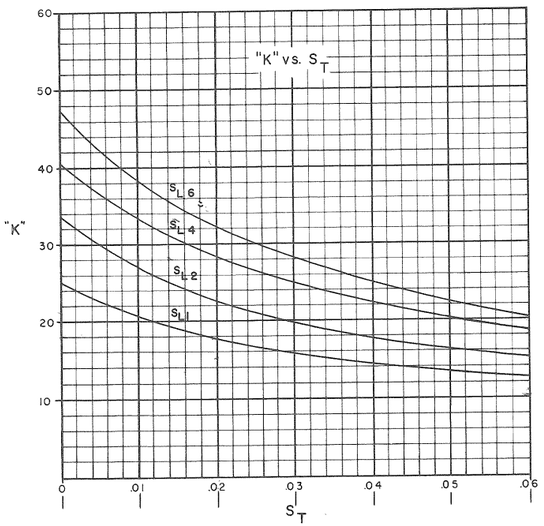
S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3067
DESCRIPTION- DIAGONAL REVERSIBLE
COMP. CODE - 3067-0004

Standard



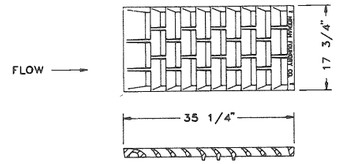


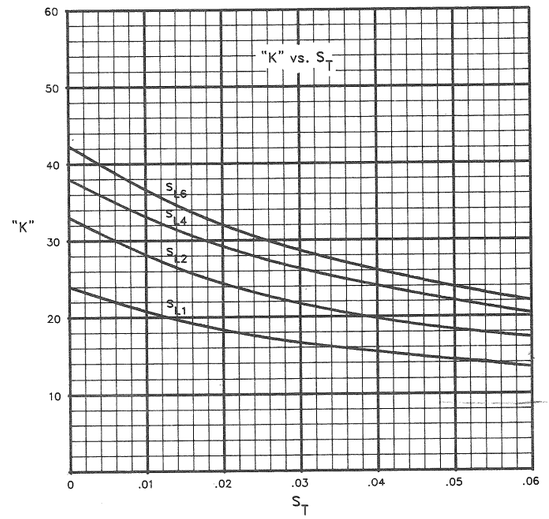
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO. - R-3067-LL
DESCRIPTION - TYPE L
COMP. CODE - 3067-0011



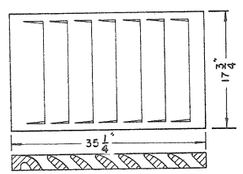


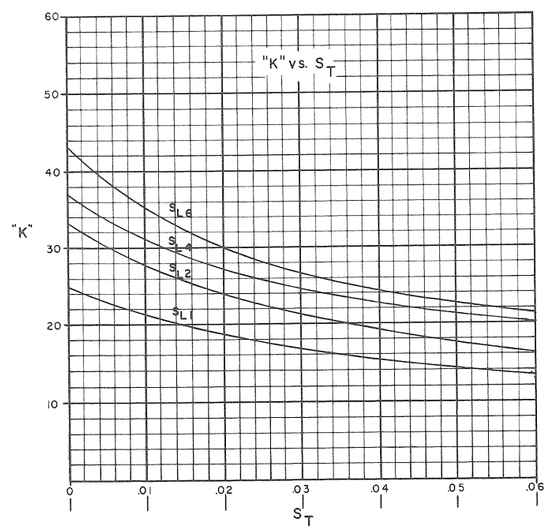
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3067-V
DESCRIPTION- TYPE V
COMP. CODE - 3067-0008



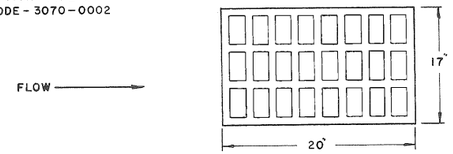


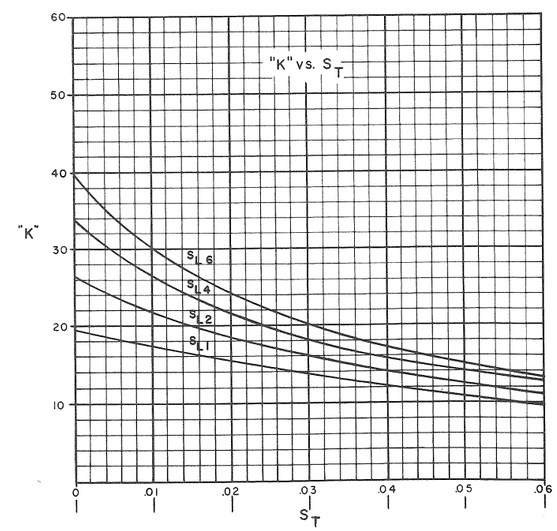
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.-R-3070
DESCRIPTION- TYPE A
COMP. CODE - 3070-0002



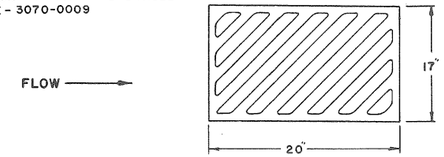


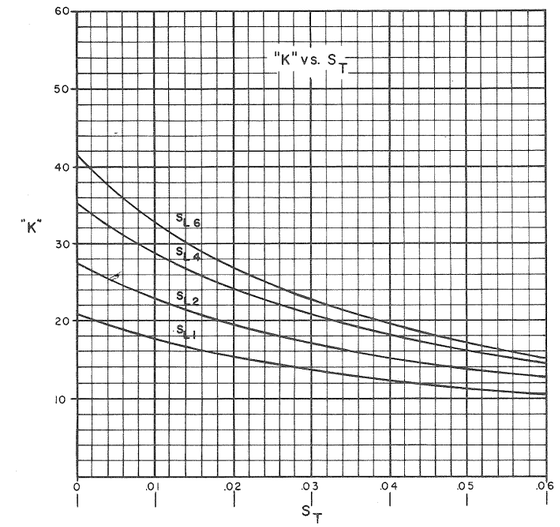
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3070
DESCRIPTION- DIAGONAL REVERSIBLE
COMP. CODE - 3070-0009



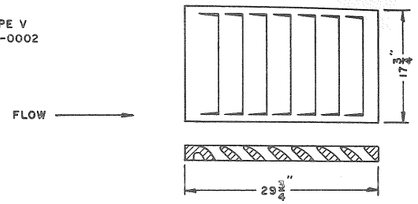


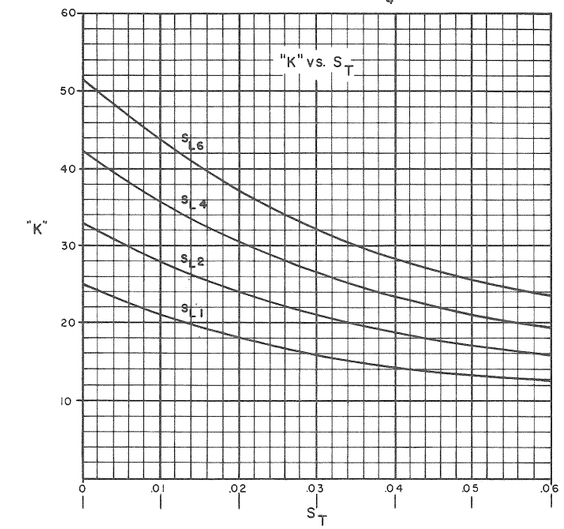
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3076
DESCRIPTION- TYPE V
COMP. CODE - 3076-0002



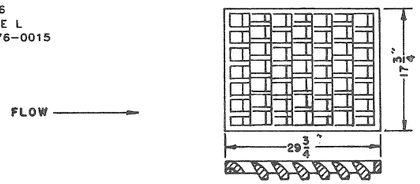


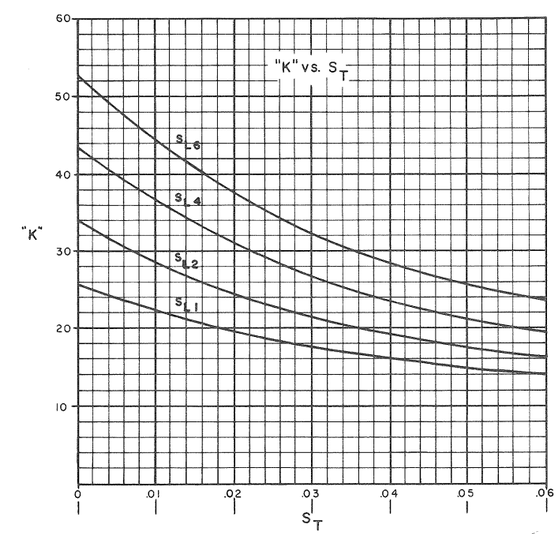
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO. - R-3076
DESCRIPTION - TYPE L
COMP. CODE - 3076-0015



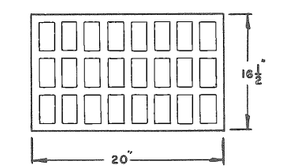


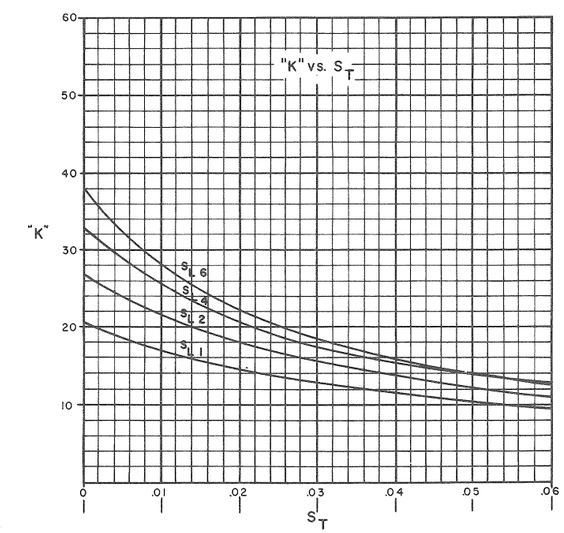
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.-R-3080
DESCRIPTION-TYPE A
COMP. CODE - 3080-0002



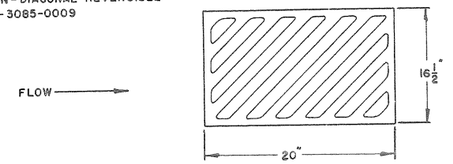


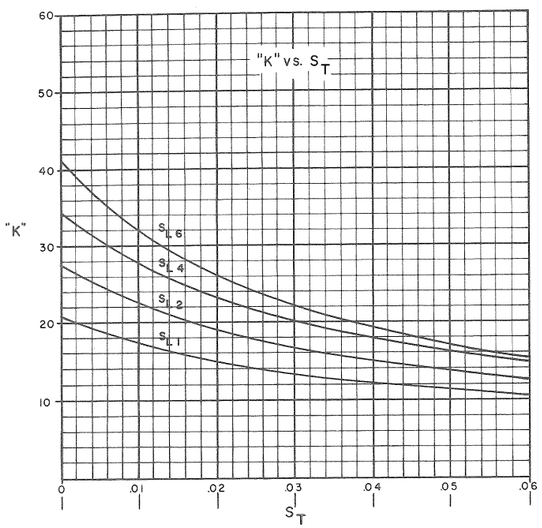
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R 3085
DESCRIPTION- DIAGONAL REVERSIBLE
COMP. CODE - 3085-0009



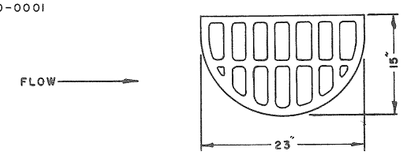


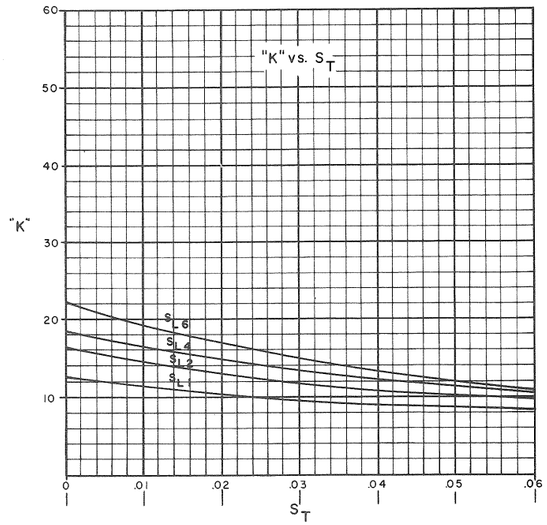
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3120
DESCRIPTION- TYPE A SPECIAL
COMP. CODE - 3110-0001



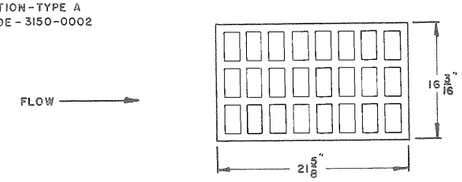


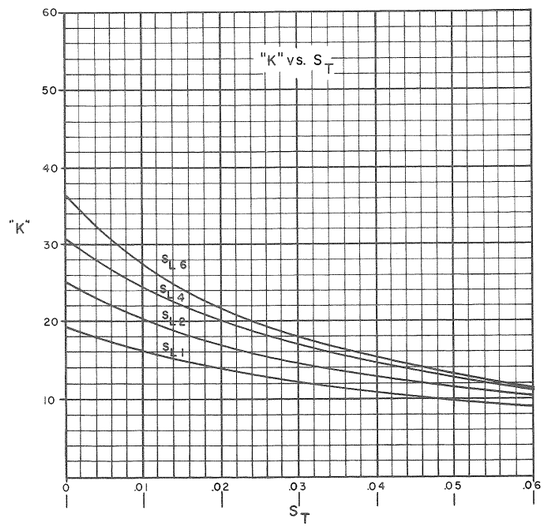
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3150
DESCRIPTION- TYPE A
COMP. CODE - 3150-0002



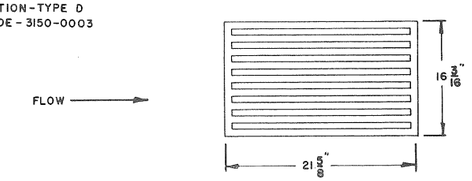


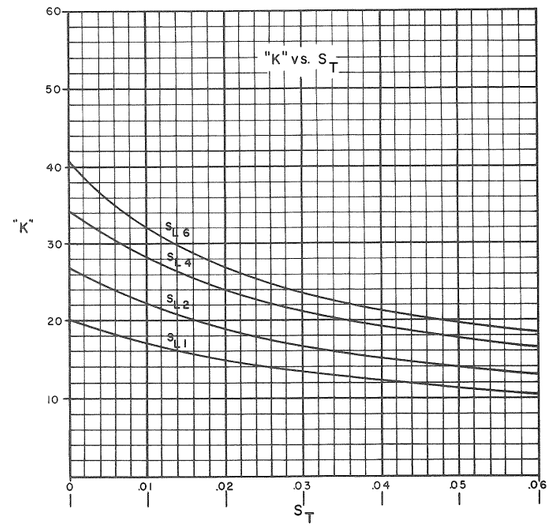
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3150
DESCRIPTION- TYPE D
COMP. CODE - 3150-0003



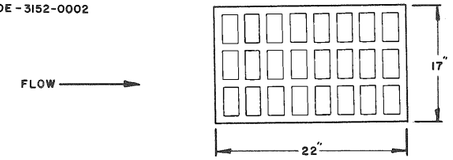


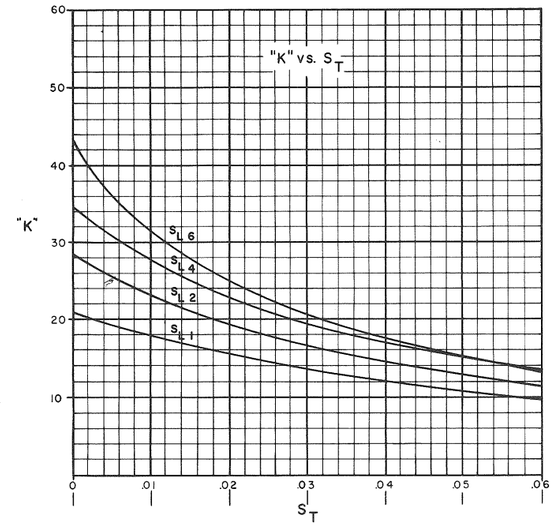
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3152
DESCRIPTION- TYPE A
COMP. CODE - 3152-0002



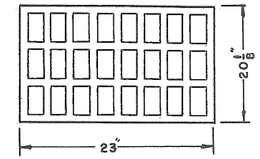


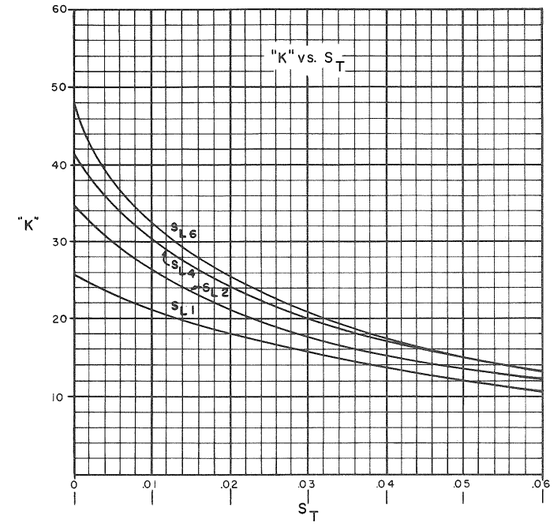
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3157-1
DESCRIPTION- TYPE A
COMP. CODE - 3157-0002



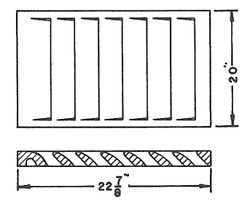


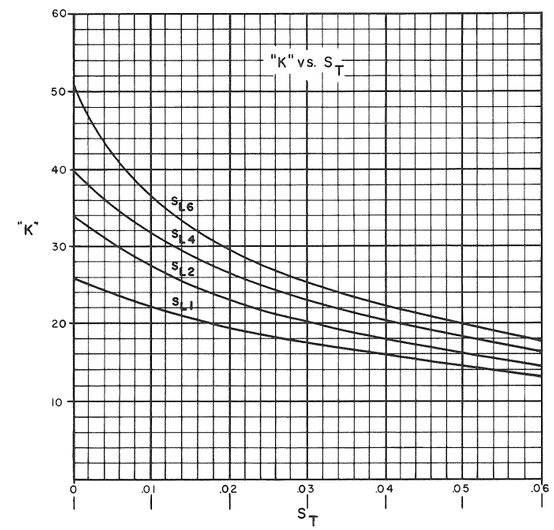
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3157-2
DESCRIPTION- TYPE V
COMP. CODE - 3157-0007



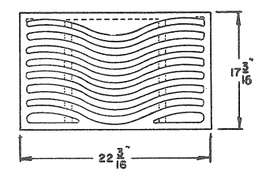


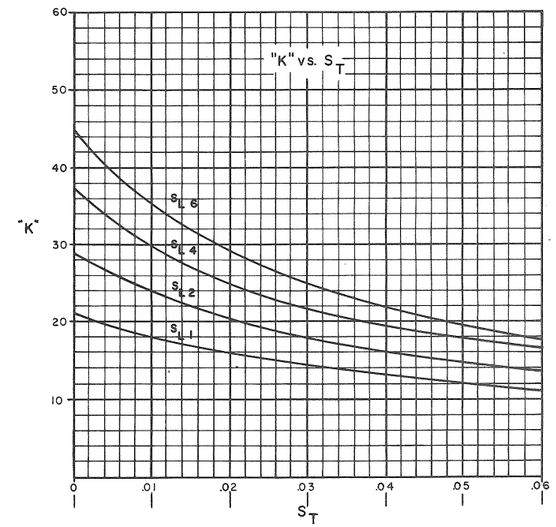
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3161
DESCRIPTION- TYPE S
COMP. CODE - 3161-0001



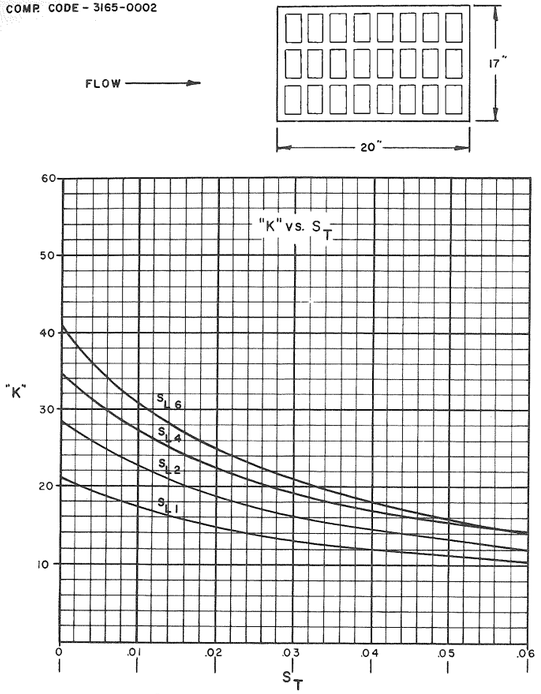


S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

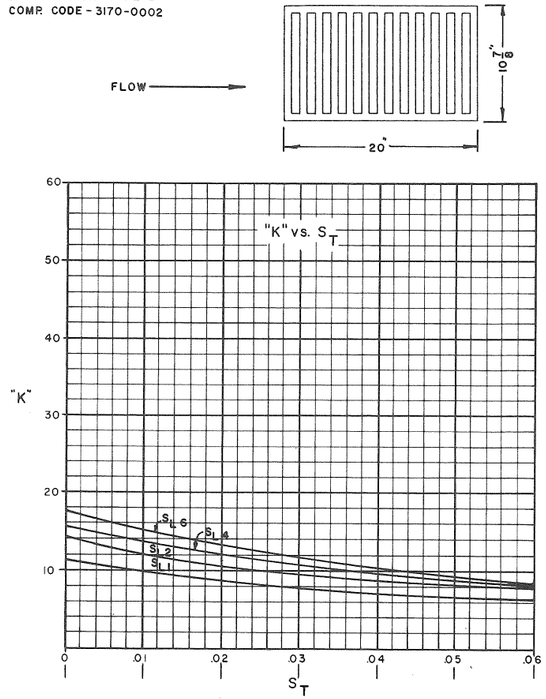
K = GRATE INLET COEFFICIENT

CAT. NO.- R-3165
DESCRIPTION- TYPE A
COMP. CODE - 3165-0002



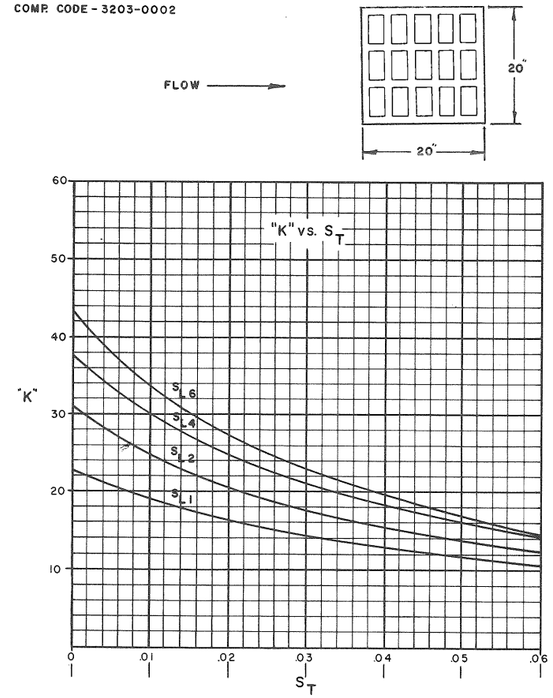
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.- R-3170
DESCRIPTION- TYPE B
COMP. CODE - 3170-0002



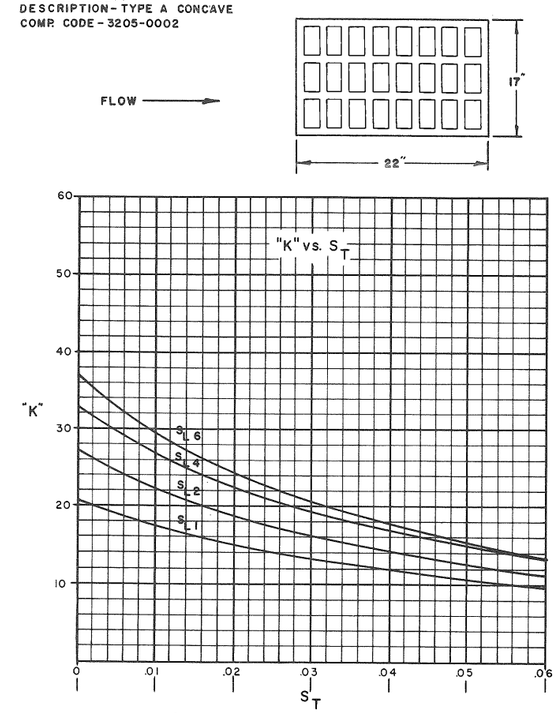
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.- R-3203A
DESCRIPTION- TYPE A
COMP. CODE - 3203-0002



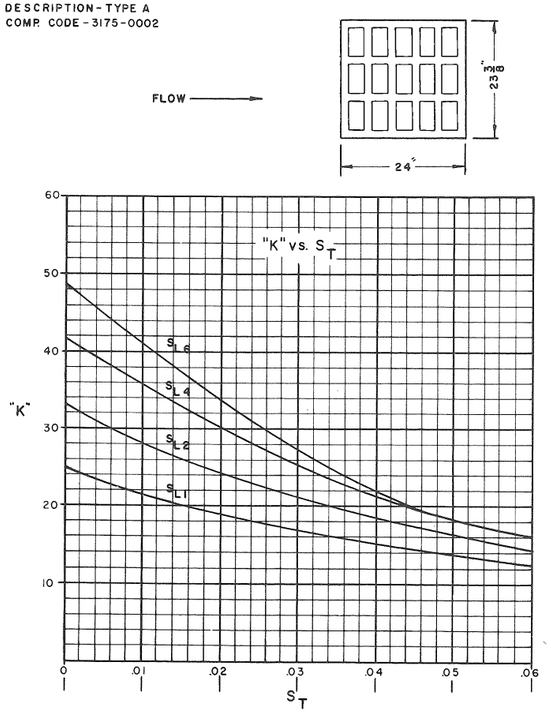
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.- R-3205
DESCRIPTION- TYPE A CONCAVE
COMP. CODE - 3205-0002



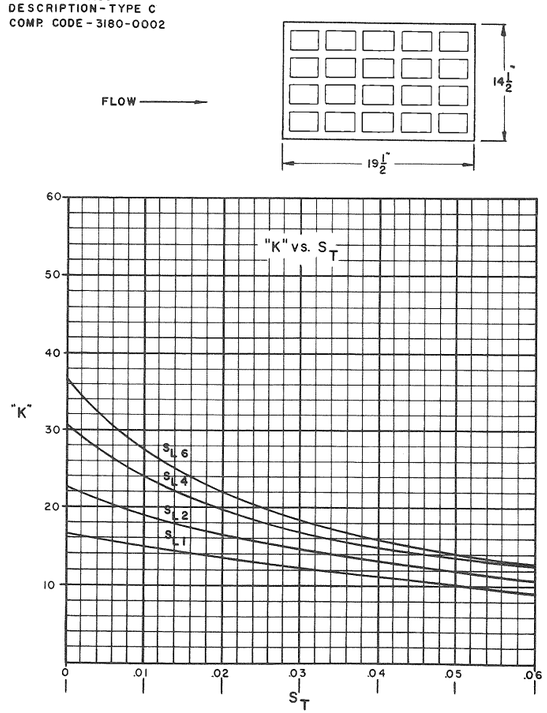
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.- R-3175
DESCRIPTION- TYPE A
COMP. CODE - 3175-0002



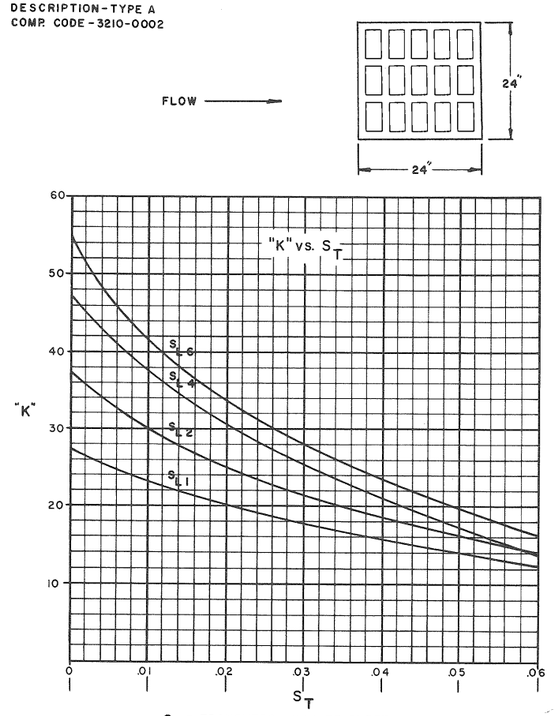
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.- R-3180
DESCRIPTION- TYPE C
COMP. CODE - 3180-0002



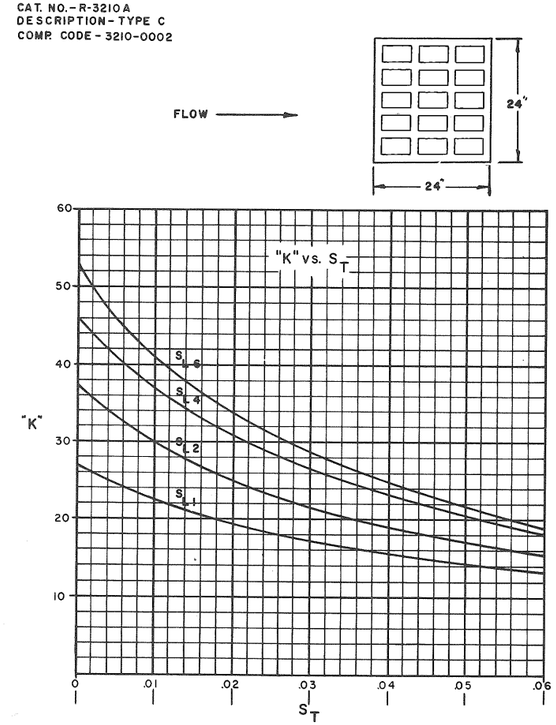
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.- R-3210A
DESCRIPTION- TYPE A
COMP. CODE - 3210-0002



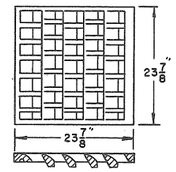
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

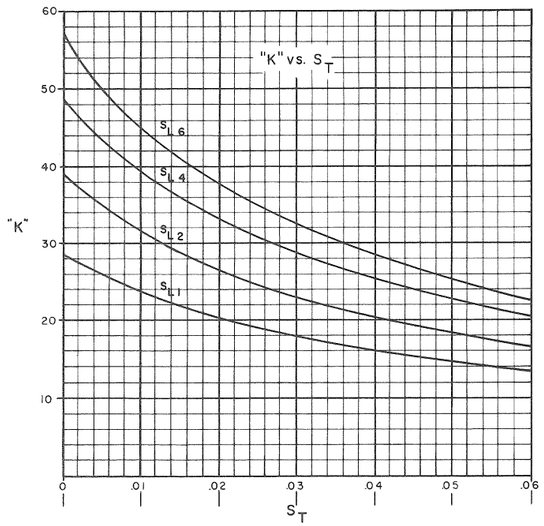
CAT. NO.- R-3210A
DESCRIPTION- TYPE C
COMP. CODE - 3210-0002



S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO. - R-3210-L
DESCRIPTION - TYPE L
COMP. CODE - 3405-0006



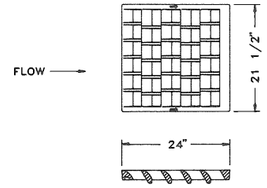


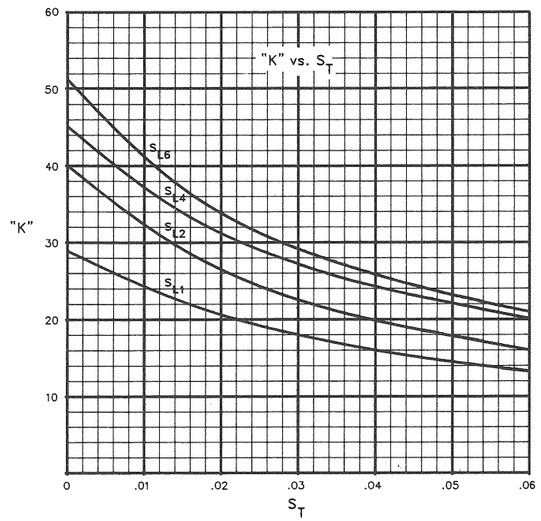
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO. - R-3222-LA
DESCRIPTION - TYPE L
COMP. CODE - 3222-0015



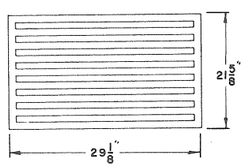


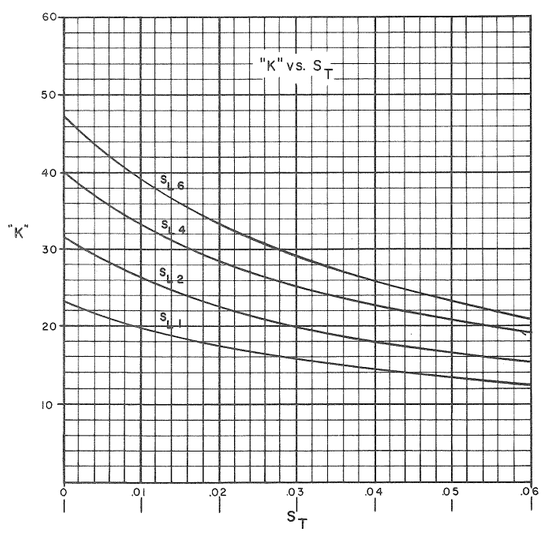
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO. - R-3227
DESCRIPTION - TYPE D
COMP. CODE - 3227-0002



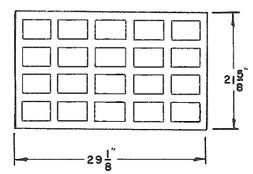


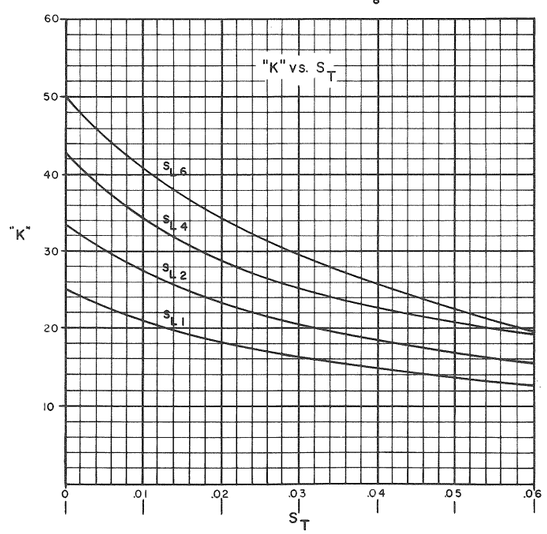
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO. - R-3227C
DESCRIPTION - TYPE C
COMP. CODE - 3227-0003



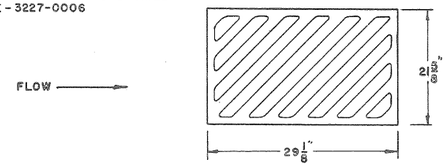


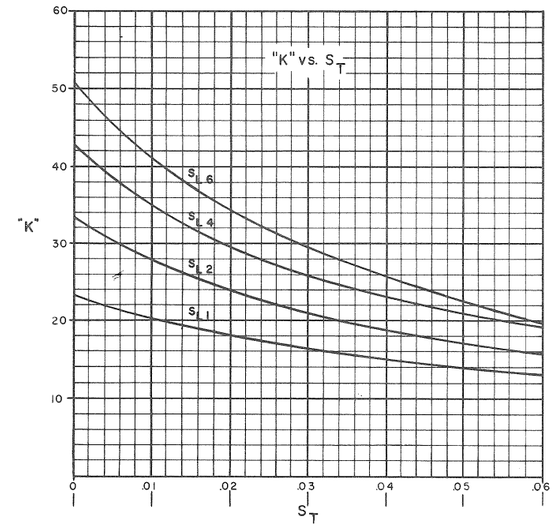
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO. - R-3227-D
DESCRIPTION - DIAGONAL REVERSIBLE
COMP. CODE - 3227-0006



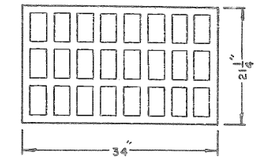


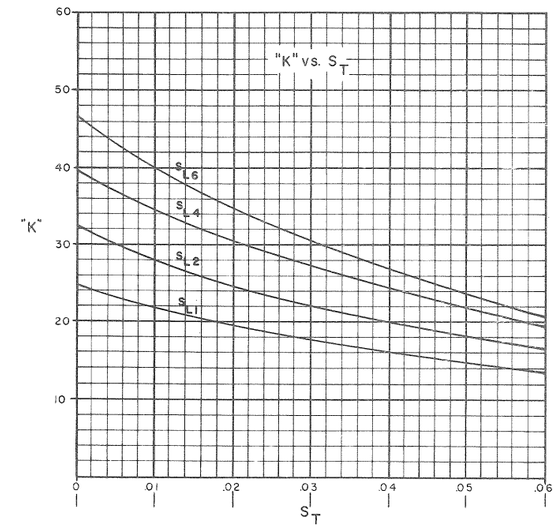
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO. - R-3233D
DESCRIPTION - TYPE A
COMP. CODE - 3233-0005



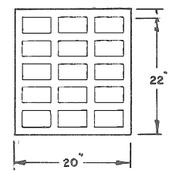


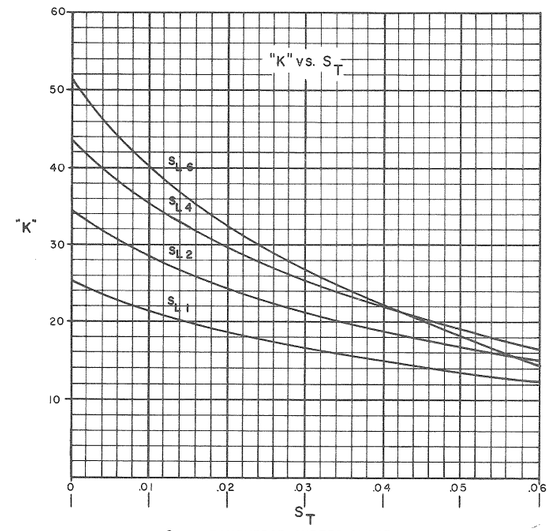
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO. - R-3234-B1
DESCRIPTION - TYPE C
COMP. CODE - 3234-0003



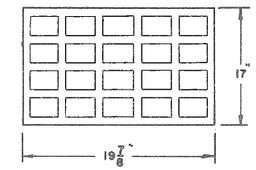


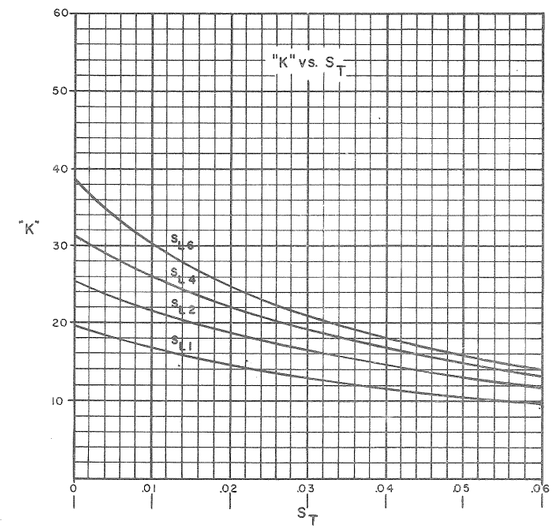
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO. - R-3235
DESCRIPTION - TYPE C
COMP. CODE - 3235-0002



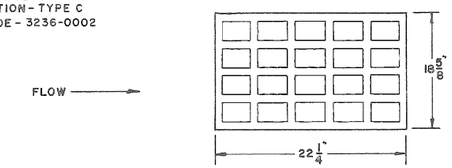


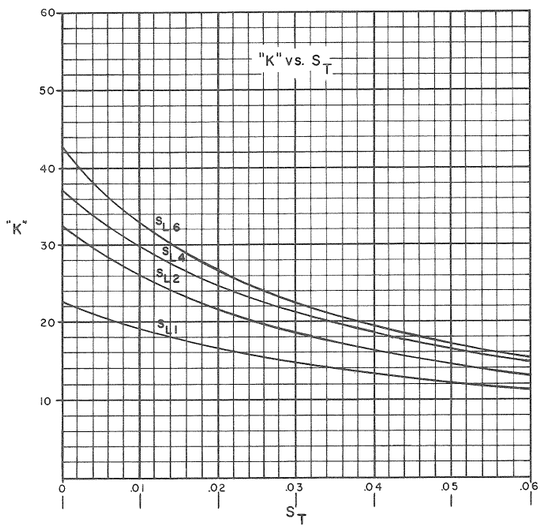
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3236
DESCRIPTION- TYPE C
COMP. CODE - 3236-0002



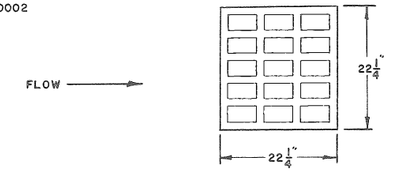


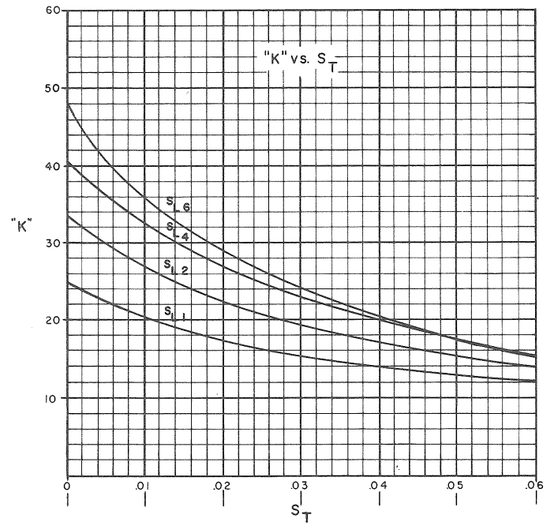
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3238
DESCRIPTION- TYPE C
COMP. CODE - 3238-0002



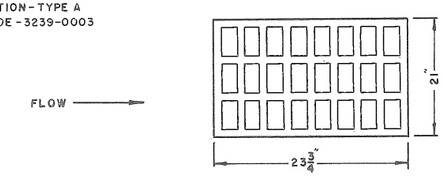


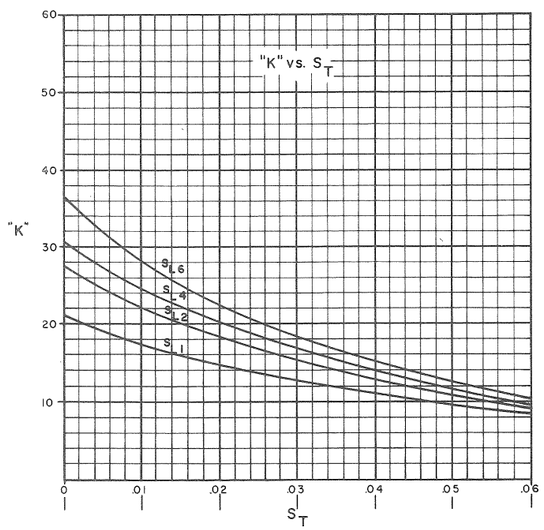
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3239A
DESCRIPTION- TYPE A
COMP. CODE - 3239-0003



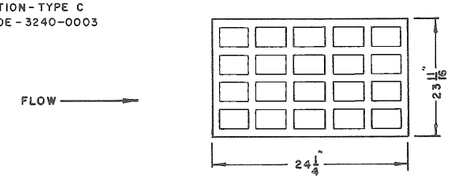


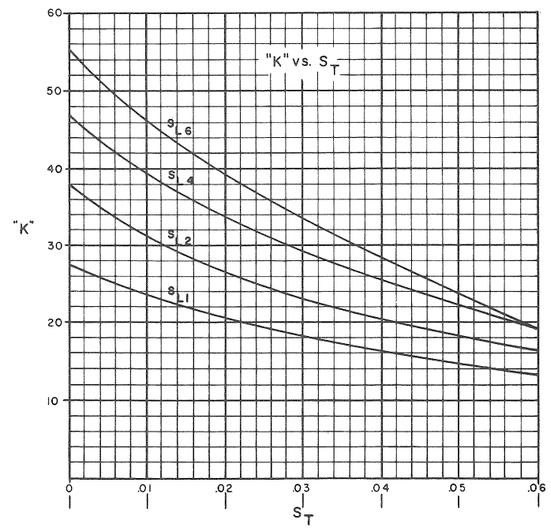
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3240
DESCRIPTION- TYPE C
COMP. CODE - 3240-0003



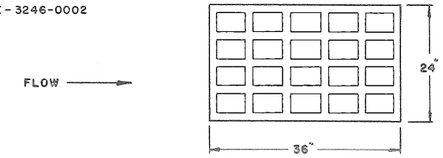


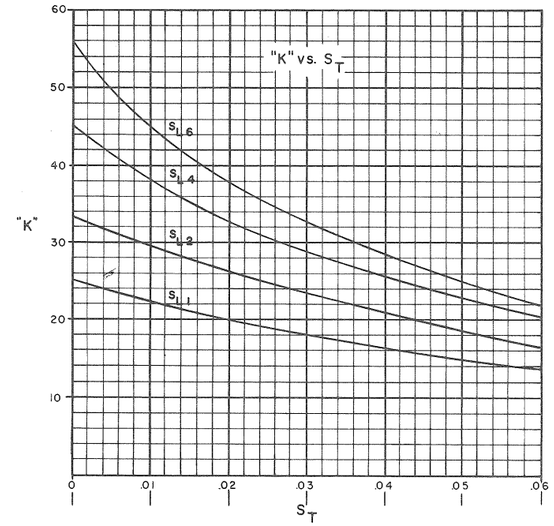
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3246A
DESCRIPTION- TYPE C
COMP. CODE - 3246-0002



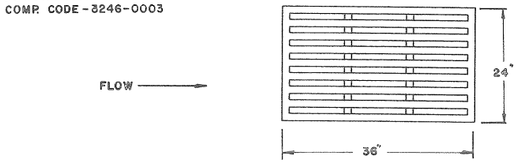


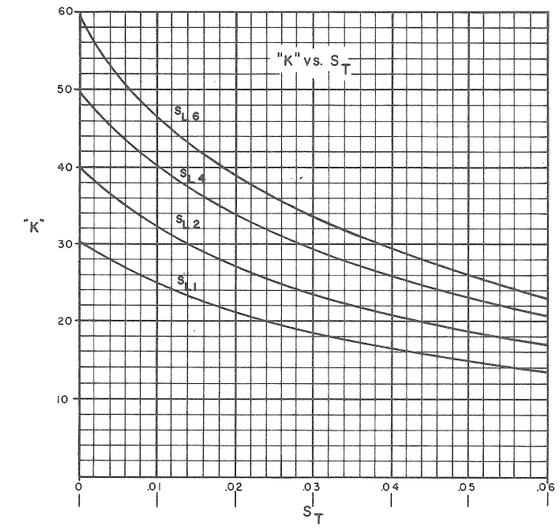
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3246-A
DESCRIPTION- TYPE 'D' WITH TWO DEPRESSED BARS 2" BELOW TOP OF GRATE
COMP. CODE - 3246-0003



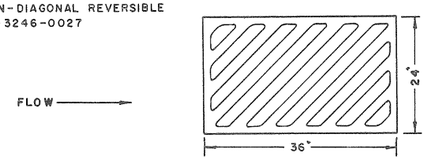


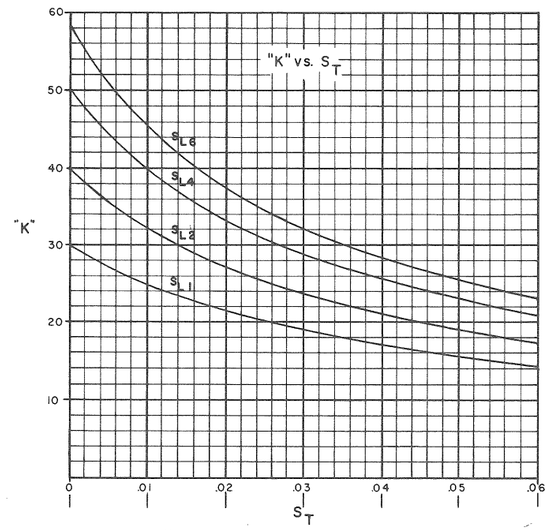
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3246-A
DESCRIPTION- DIAGONAL REVERSIBLE
COMP. CODE - 3246-0027



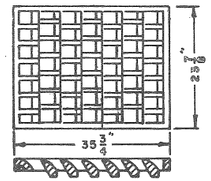


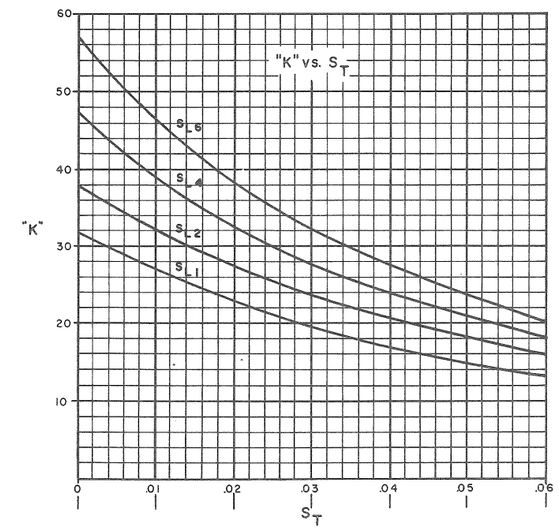
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3246-AL
DESCRIPTION- TYPE L
COMP. CODE - 3246-0034 FLOW LEFT
3246-0035 FLOW RIGHT



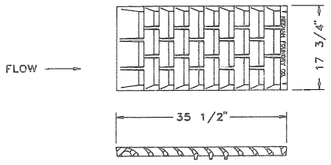


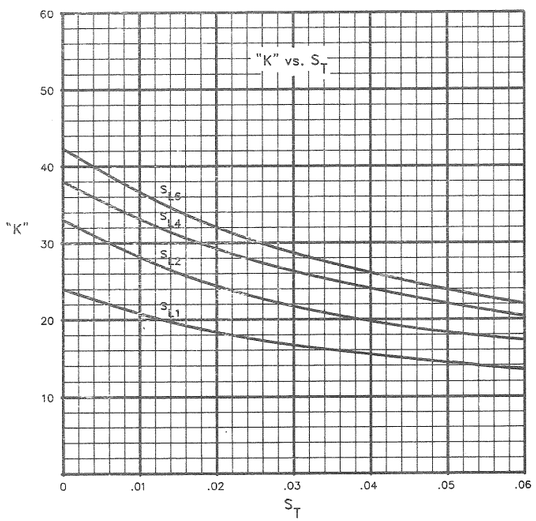
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

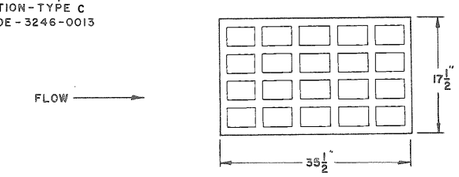
CAT. NO. – R-3246-CL
DESCRIPTION – TYPE L
COMP. CODE – 3246-0041

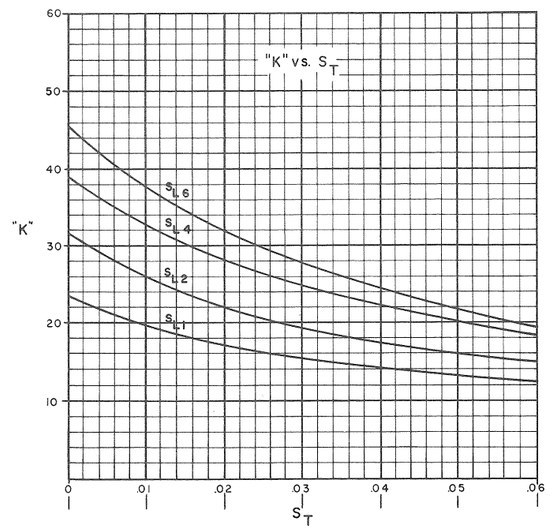




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

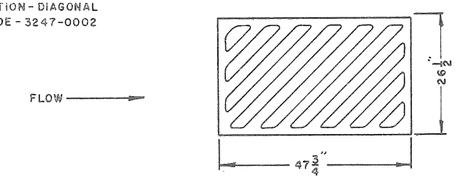
CAT. NO.-R-3246-E,F
DESCRIPTION-TYPE C
COMP. CODE-3246-0013

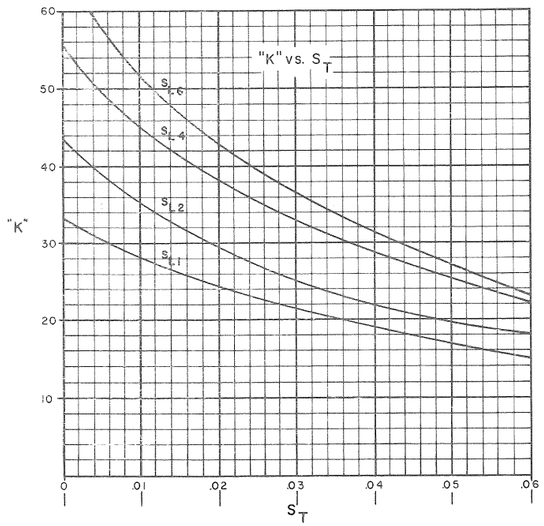




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

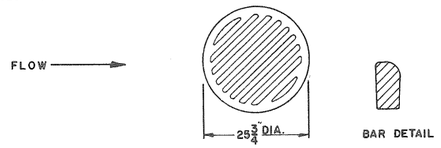
CAT. NO.-R-3247A
DESCRIPTION-DIAGONAL
COMP. CODE-3247-0002

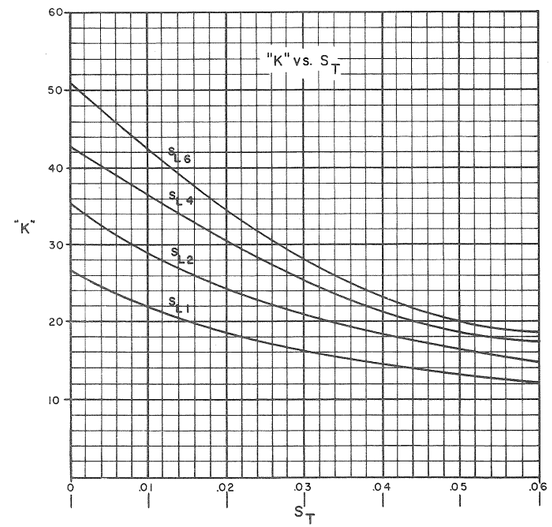




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

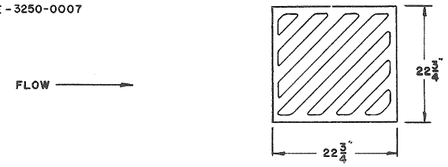
CAT. NO.-R-3250A
DESCRIPTION-SPECIAL DIAGONAL
COMP. CODE-3250-0005

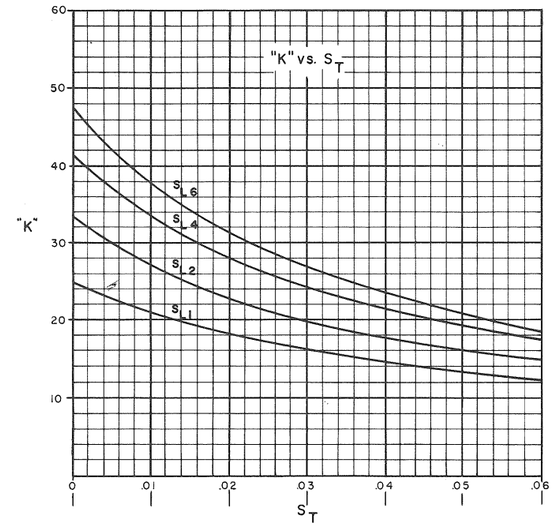




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

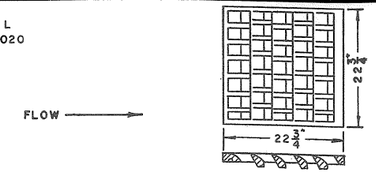
CAT. NO.-R-3250-B
DESCRIPTION-DIAGONAL
COMP. CODE-3250-0007

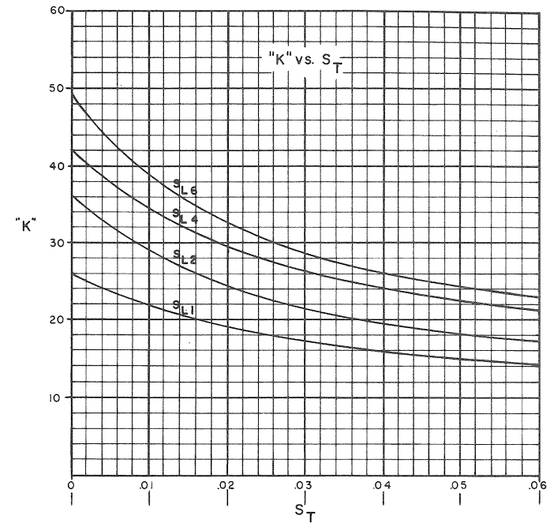




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

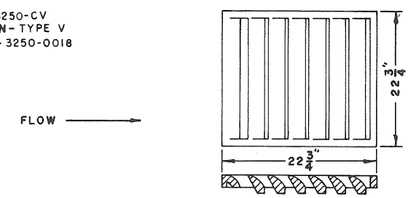
CAT. NO.-R-3250-CL
DESCRIPTION-TYPE L
COMP. CODE-3250-0020

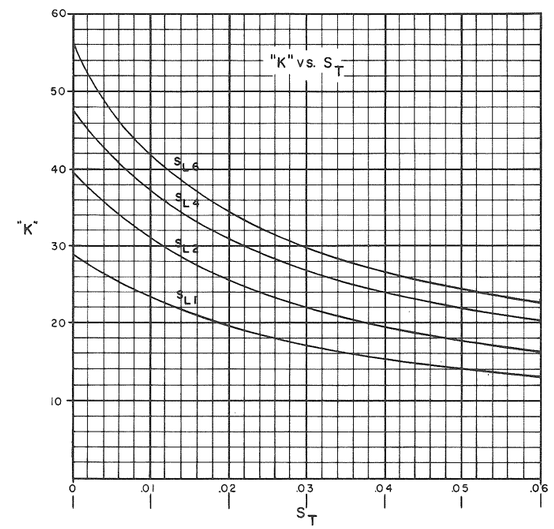




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

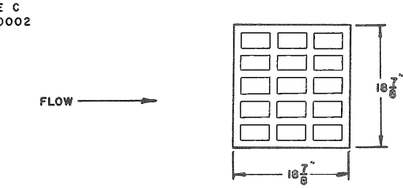
CAT. NO.-R-3250-CV
DESCRIPTION-TYPE V
COMP. CODE-3250-0018

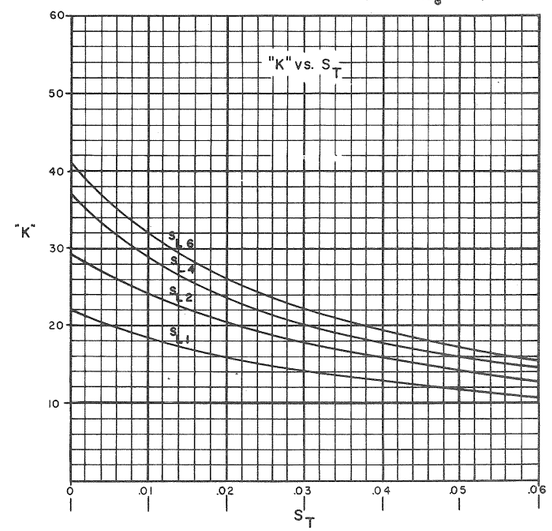




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

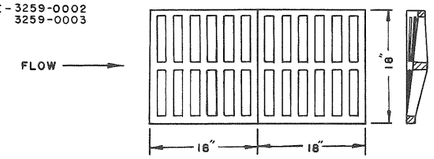
CAT. NO.-R-3251
DESCRIPTION-TYPE C
COMP. CODE-3251-0002

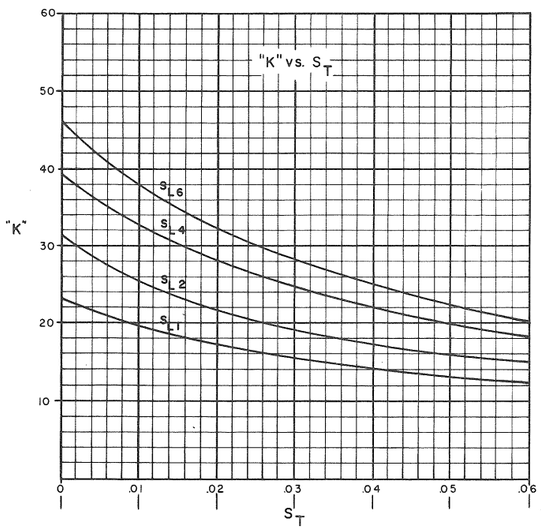




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

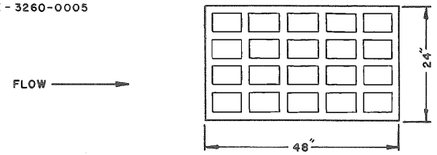
CAT. NO.-R-3259
DESCRIPTION-TYPE A
COMP. CODE-3259-0002
3259-0003

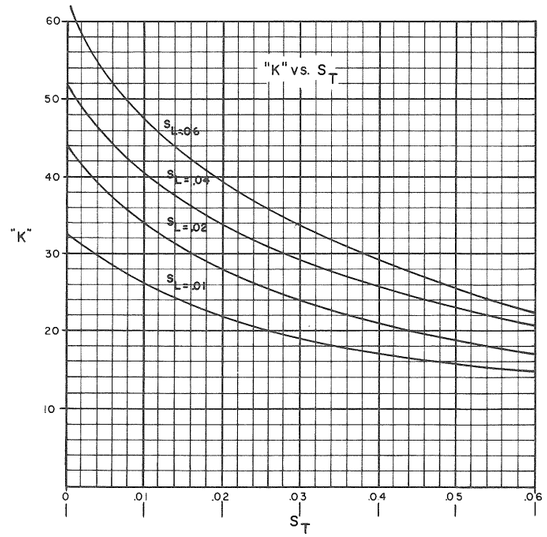




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

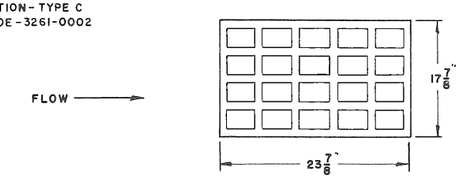
CAT. NO.-R-3260A
DESCRIPTION-TYPE C
COMP. CODE-3260-0005

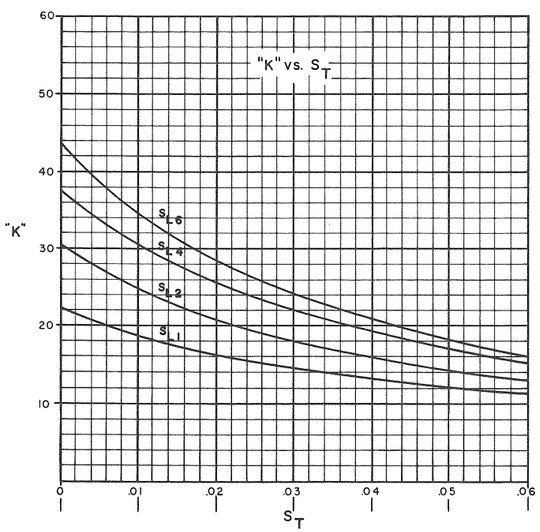




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

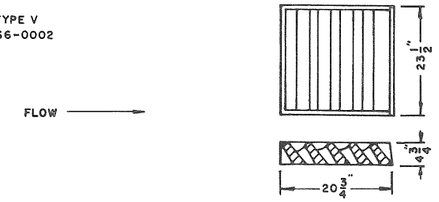
CAT. NO.-R-3261-A
DESCRIPTION-TYPE C
COMP. CODE-3261-0002

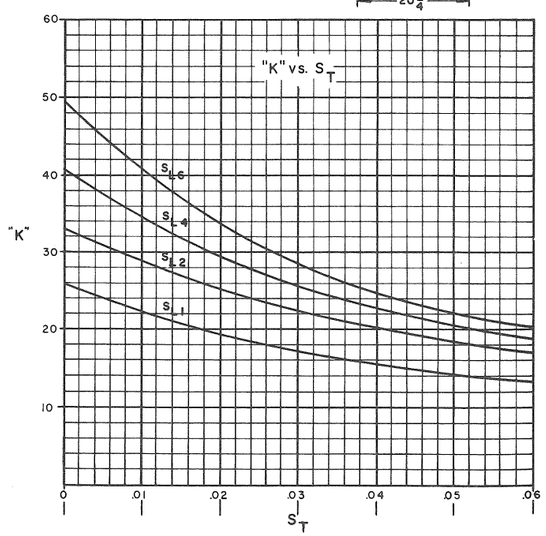




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

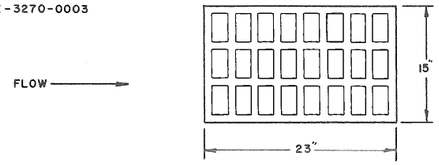
CAT. NO.-R-3266
DESCRIPTION-TYPE V
COMP. CODE-3266-0002

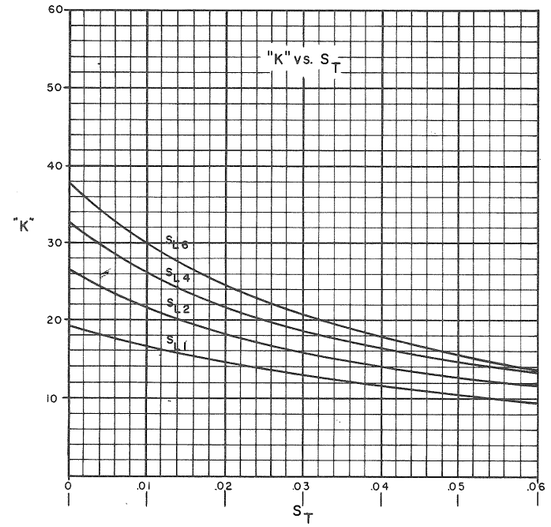




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

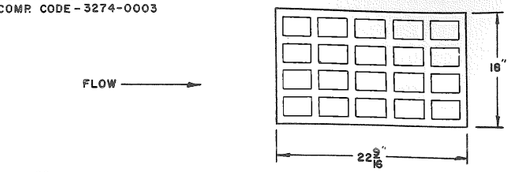
CAT. NO.-R-3270
DESCRIPTION-TYPE A
COMP. CODE-3270-0003

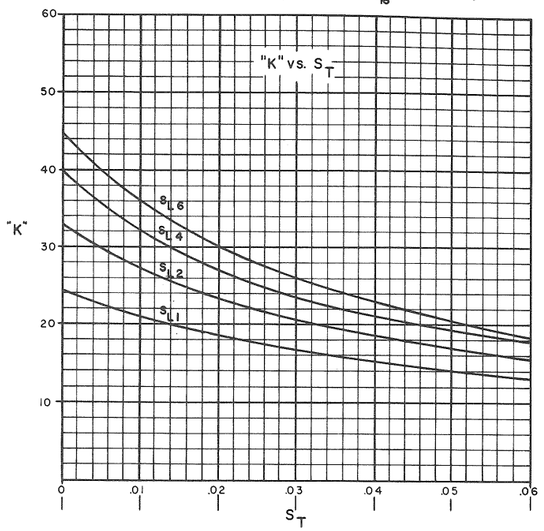




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

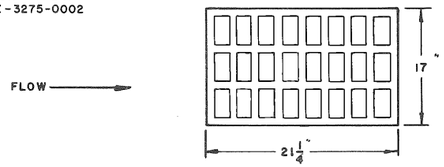
CAT. NO.-R-3274
DESCRIPTION-TYPE C
COMP. CODE-3274-0003

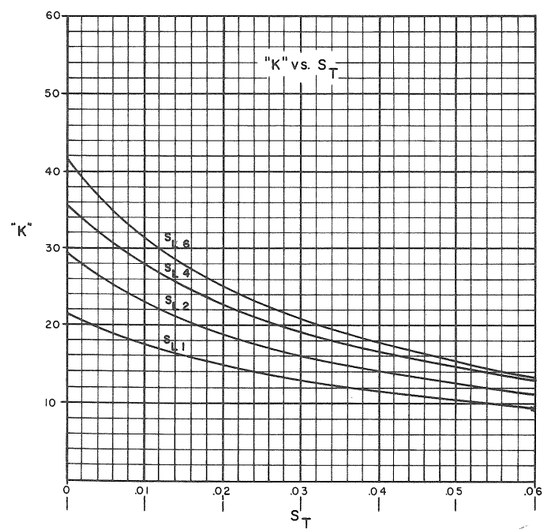




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

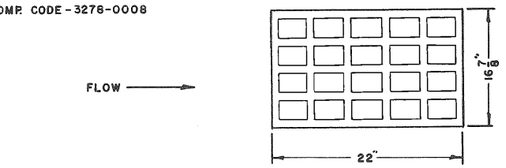
CAT. NO.-R-3275
DESCRIPTION-TYPE A
COMP. CODE-3275-0002

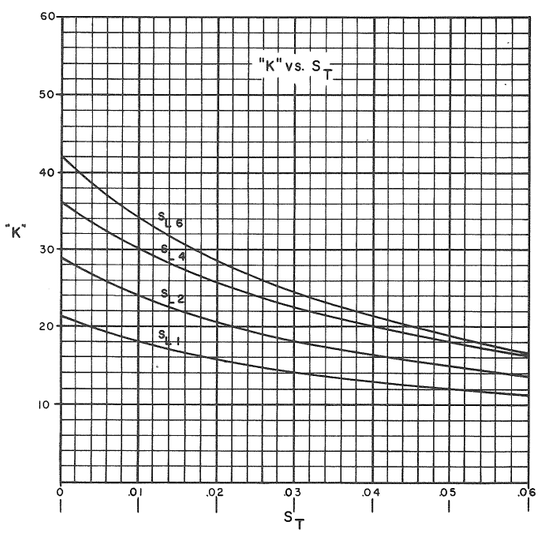




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

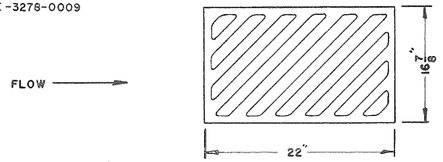
CAT. NO.-R-3278-1
DESCRIPTION-TYPE C
COMP. CODE-3278-0008

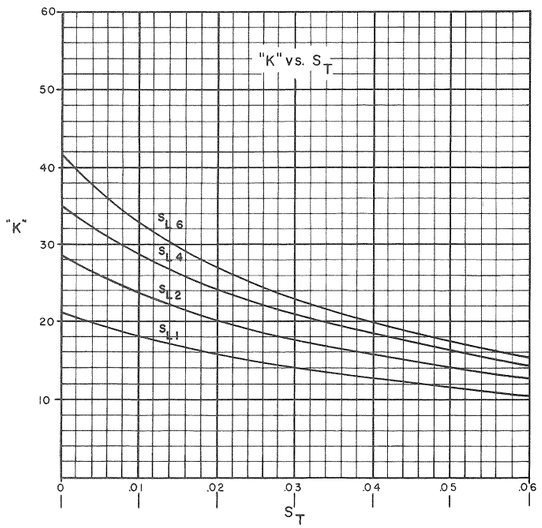




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

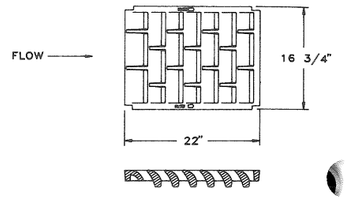
CAT. NO.-R-3278-I
DESCRIPTION-DIAGONAL REVERSIBLE
COMP. CODE-3278-0009

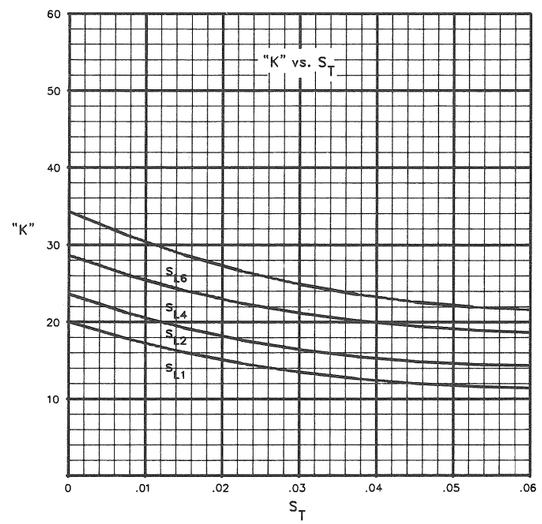




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

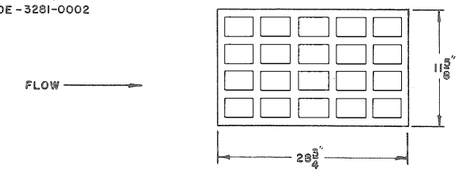
CAT. NO. - R-3278-AL
DESCRIPTION - GRATE TYPE L
COMP. CODE - 3278-0014

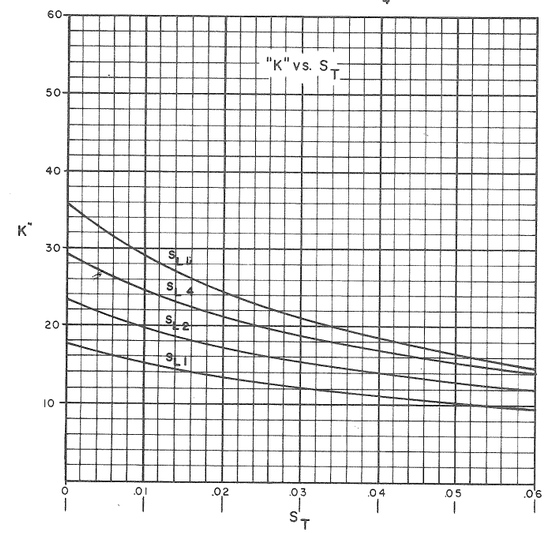




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

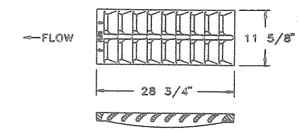
CAT. NO.-R-3281-A
DESCRIPTION-TYPE C
COMP. CODE-3281-0002

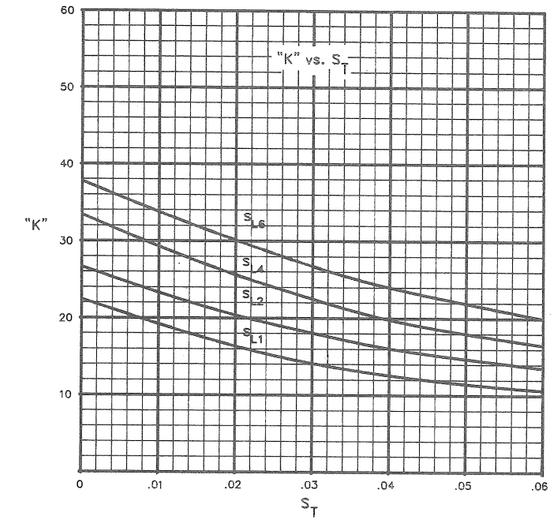




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

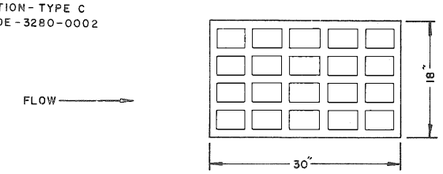
CAT. NO. - R-3281-AL
DESCRIPTION - TYPE L
COMP. CODE - 3281-0008

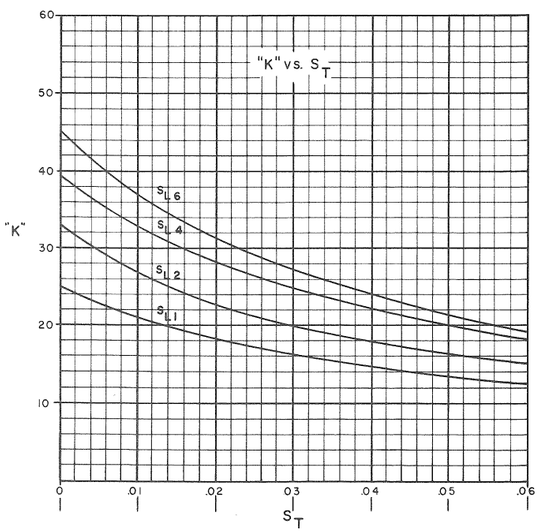




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

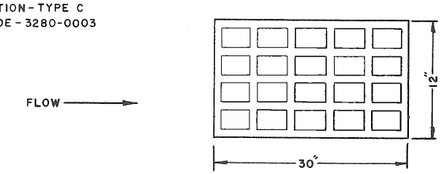
CAT. NO.-R-3280A
DESCRIPTION- TYPE C
COMP. CODE-3280-0002

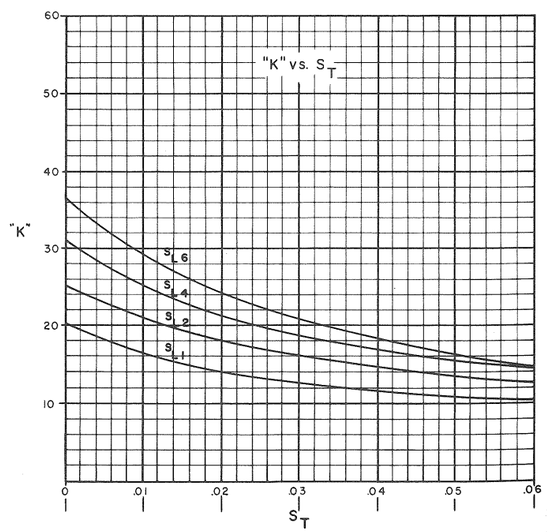




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

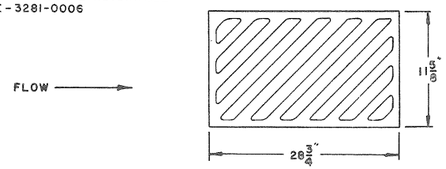
CAT. NO.-R-3280B
DESCRIPTION-TYPE C
COMP. CODE-3280-0003

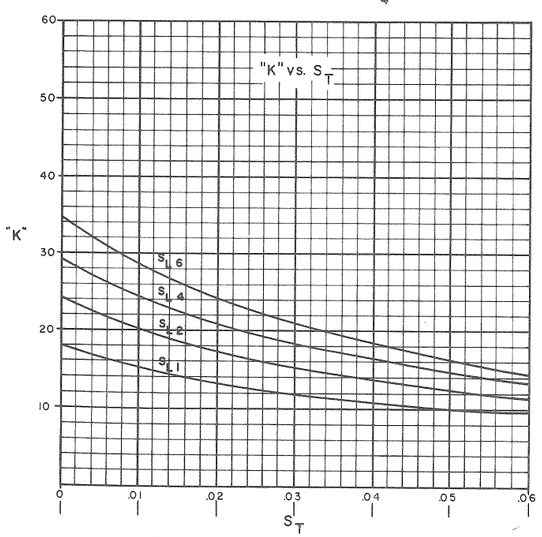




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

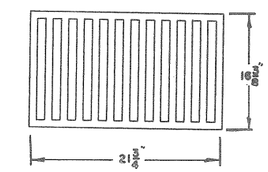
CAT. NO.-R-3281-B
DESCRIPTION-DIAGONAL REVERSIBLE
COMP. CODE-3281-0006

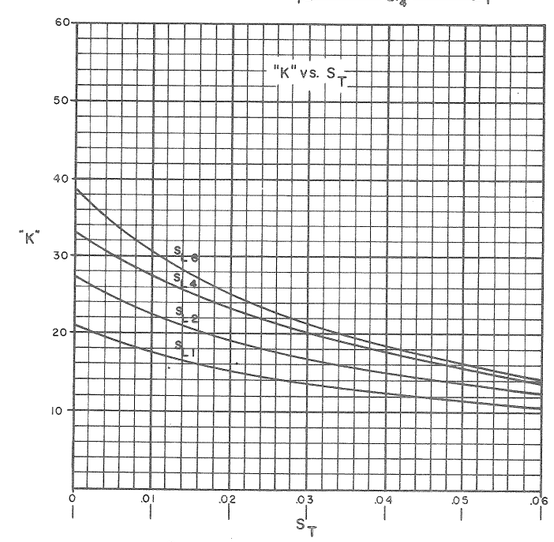




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

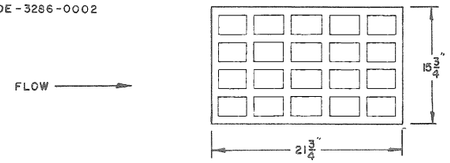
CAT. NO.-R-3283A
DESCRIPTION-TYPE B
COMP. CODE-3283-0002

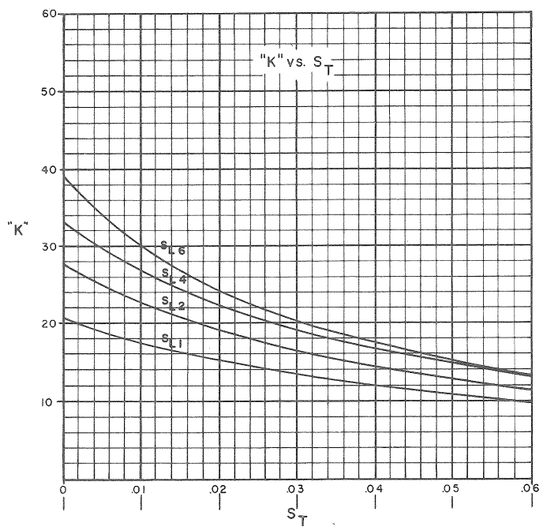




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

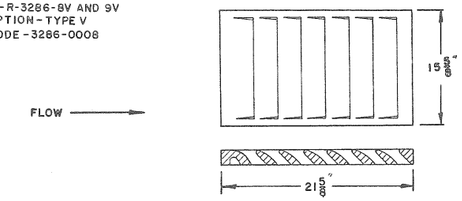
CAT. NO.-R-3286
DESCRIPTION-TYPE C
COMP. CODE-3286-0002

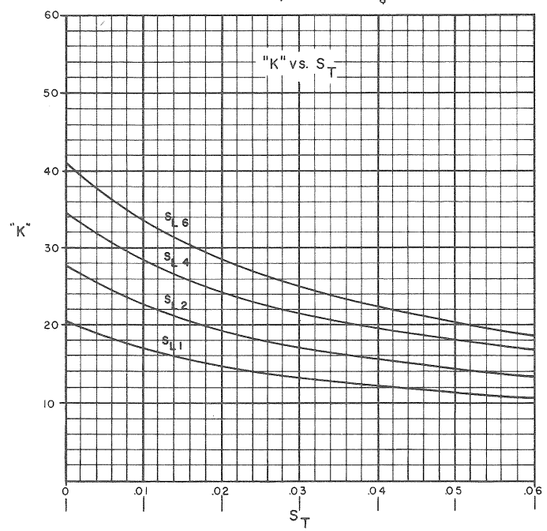




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

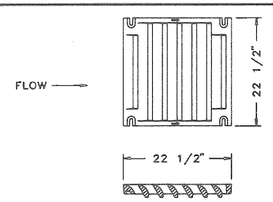
CAT. NO.-R-3286-8V AND 9V
DESCRIPTION-TYPE V
COMP. CODE-3286-0008

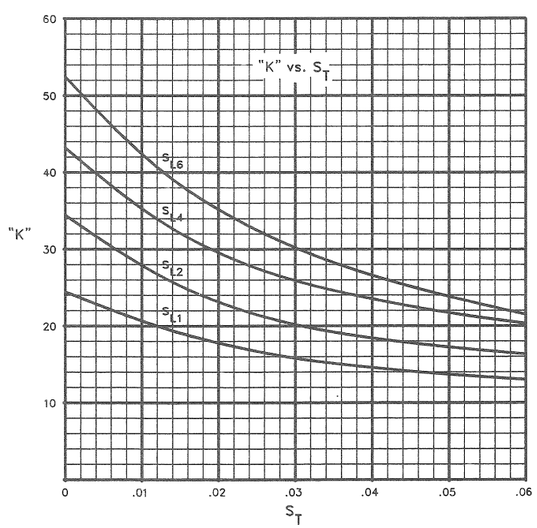




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

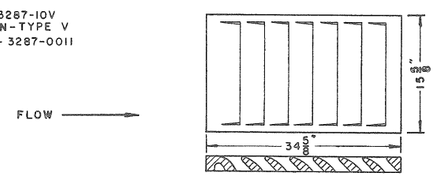
CAT. NO. - R-3287-5
DESCRIPTION - TYPE V
COMP. CODE - 3287-0018

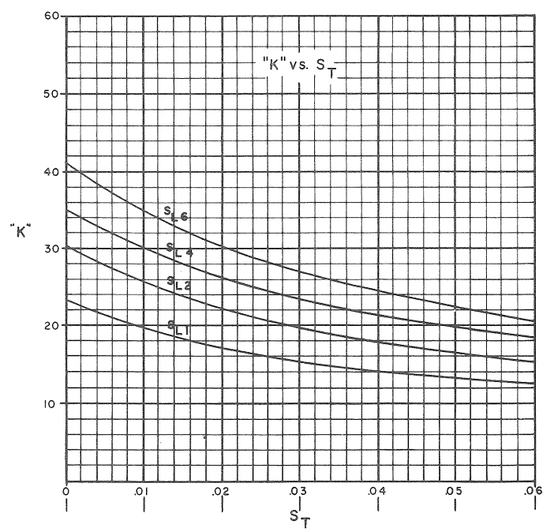




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

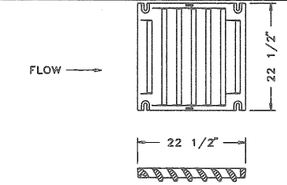
CAT. NO.- R-3287-10V
DESCRIPTION-TYPE V
COMP. CODE-3287-0011

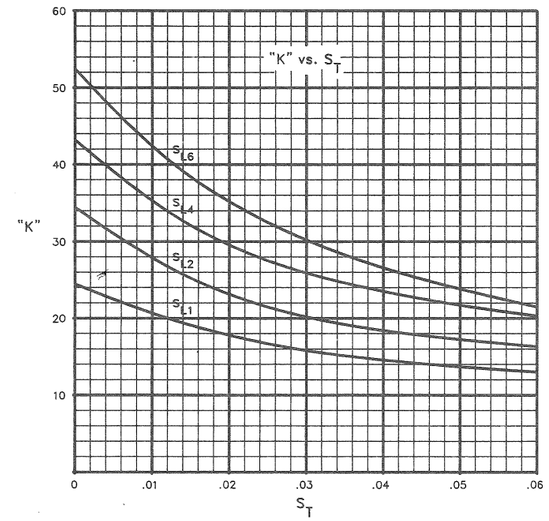




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

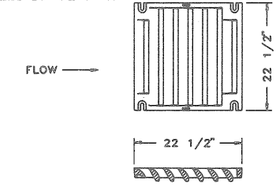
CAT. NO. - R-3287-15
DESCRIPTION - TYPE V
COMP. CODE - 3287-0018

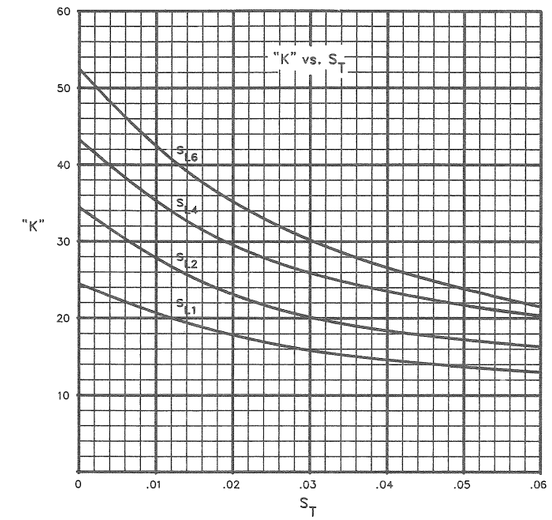




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

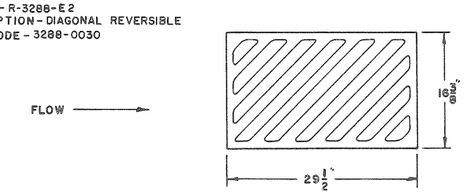
CAT. NO. - R-3287-16
DESCRIPTION - TYPE V
COMP. CODE - 3287-0018

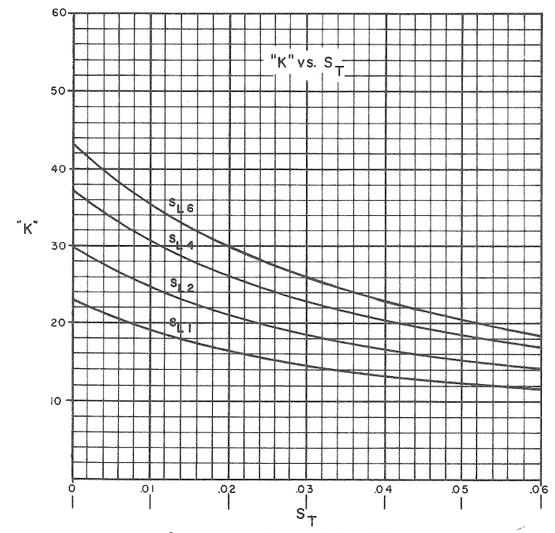




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

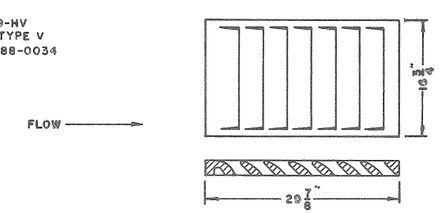
CAT. NO.-R-3288-E2
DESCRIPTION-DIAGONAL REVERSIBLE
COMP. CODE-3288-0030

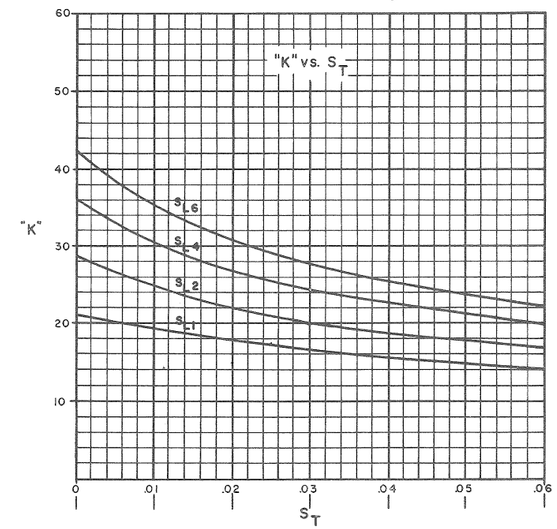




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

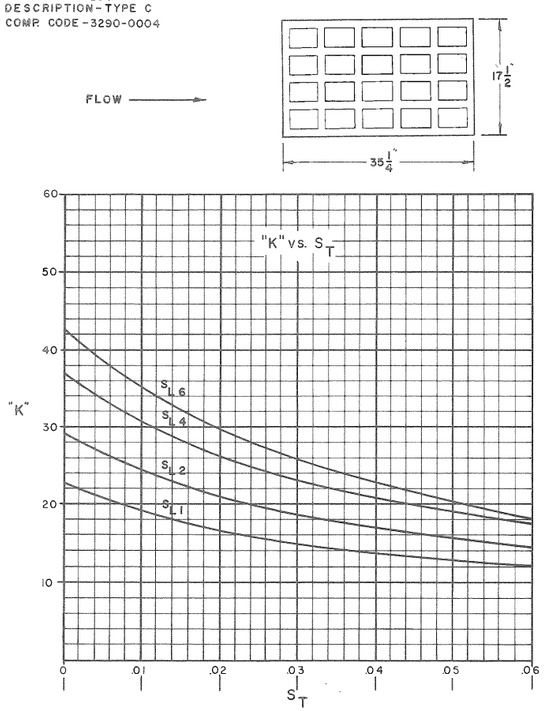
CAT. NO.-R-3289-HV
DESCRIPTION-TYPE V
COMP. CODE-3288-0034





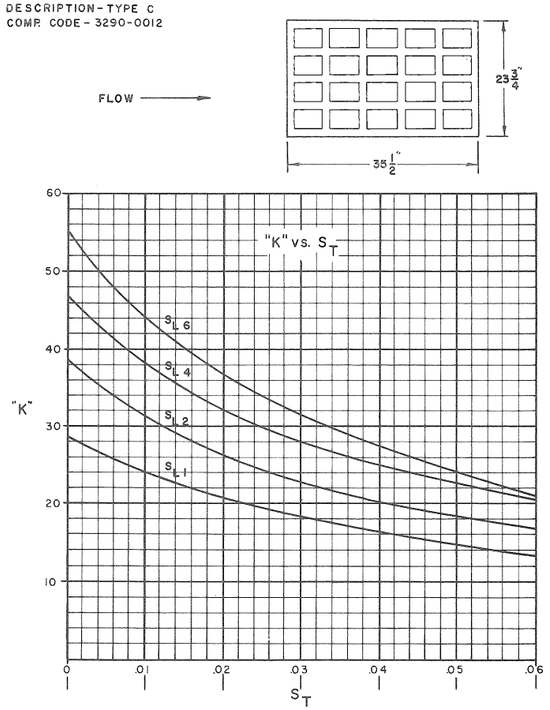
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.-R-3290
DESCRIPTION-TYPE C
COMP. CODE-3290-0004



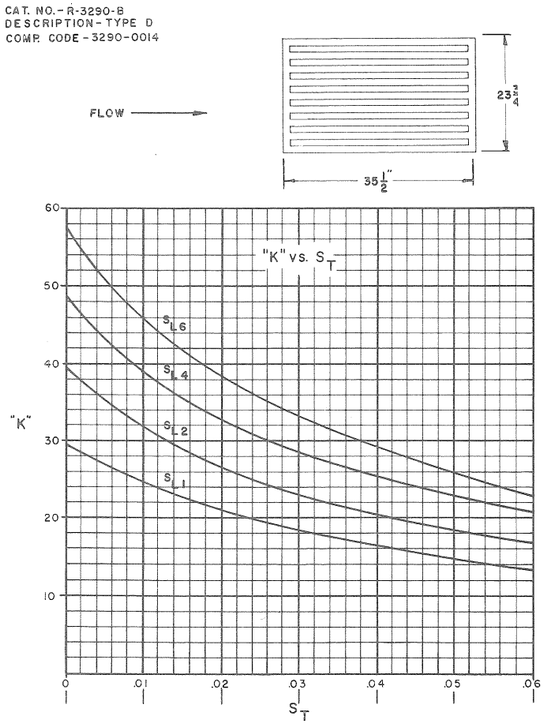
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.-R-3290-A
DESCRIPTION-TYPE C
COMP. CODE-3290-0012



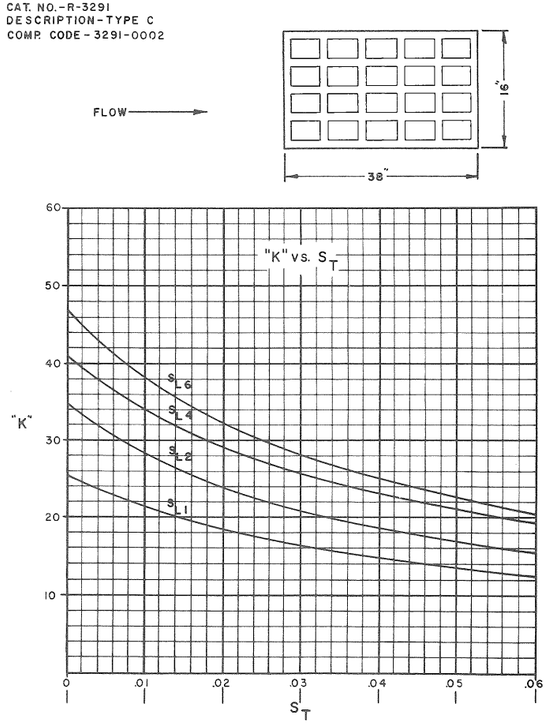
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.-R-3290-B
DESCRIPTION-TYPE D
COMP. CODE-3290-0014



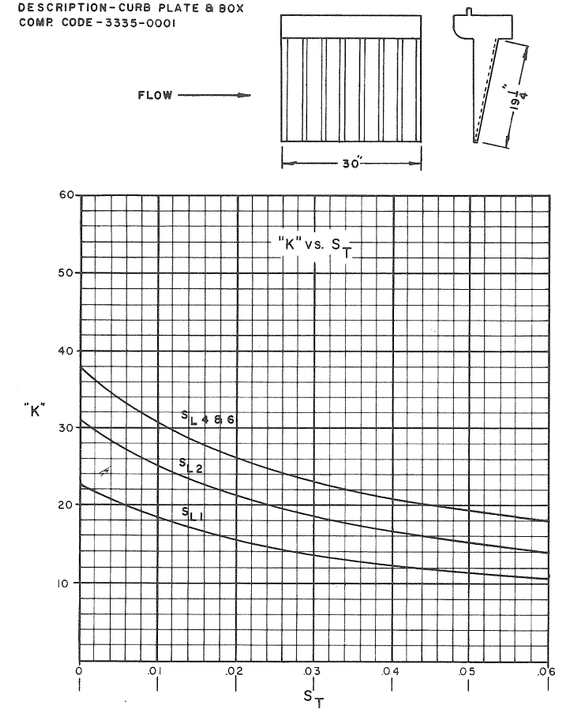
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.-R-3291
DESCRIPTION-TYPE C
COMP. CODE-3291-0002



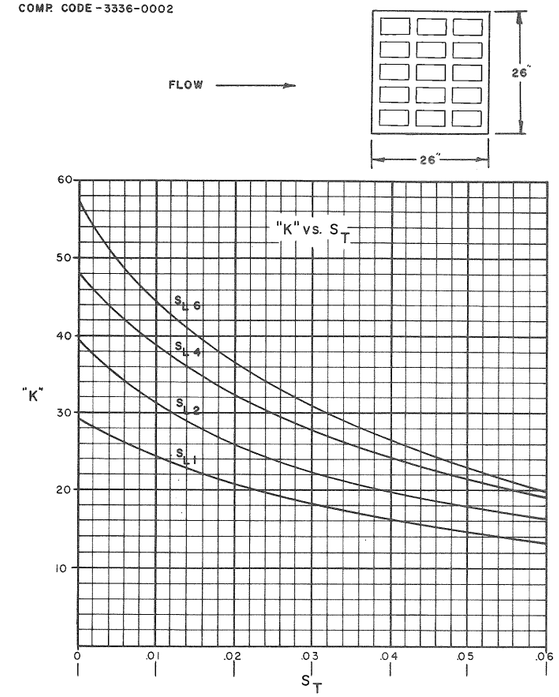
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.-R-3335-1
DESCRIPTION-CURB PLATE & BOX
COMP. CODE-3335-0001



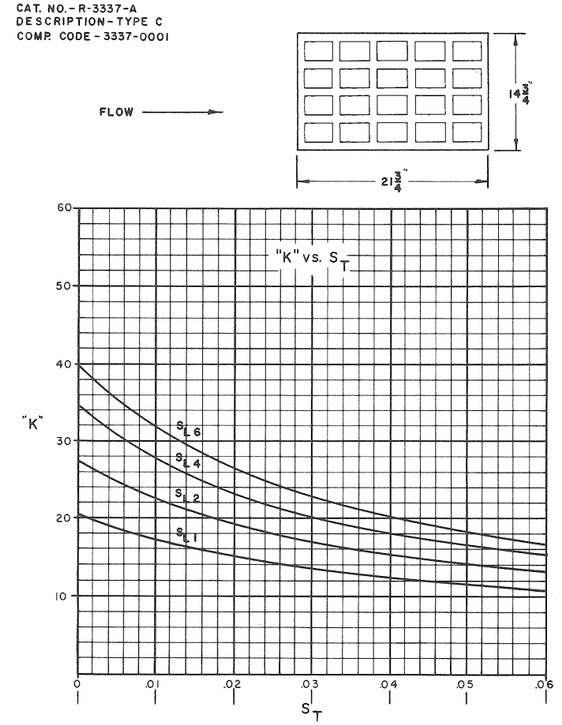
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.-R-3336
DESCRIPTION-TYPE C
COMP. CODE-3336-0002



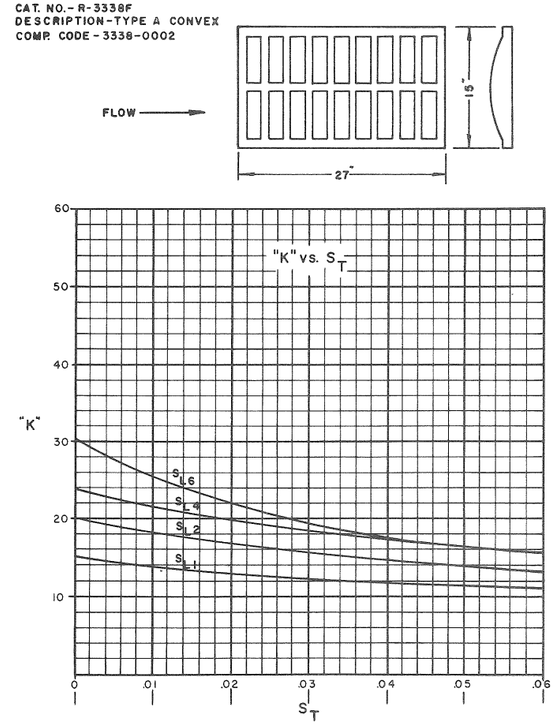
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.-R-3337-A
DESCRIPTION-TYPE C
COMP. CODE-3337-0001



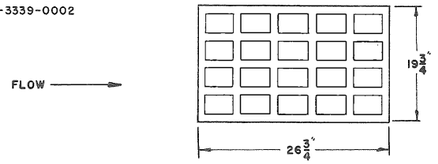
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

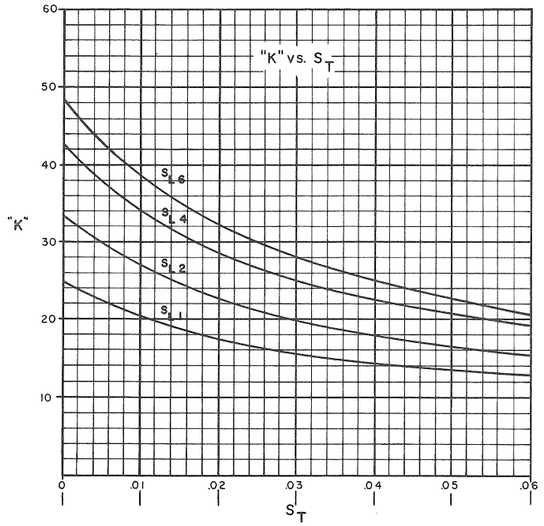
CAT. NO.-R-3338F
DESCRIPTION-TYPE A CONVEX
COMP. CODE-3338-0002



S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.-R-3339
DESCRIPTION-TYPE C
COMP. CODE-3339-0002



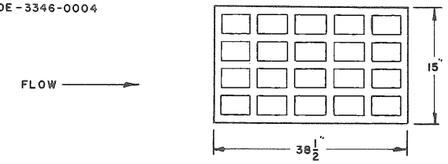


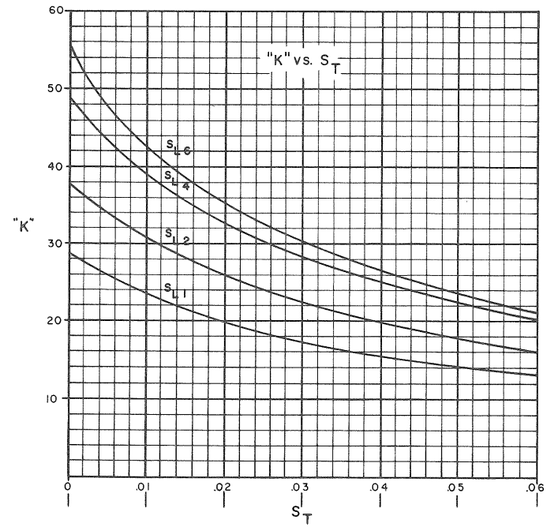
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.-R-3346
DESCRIPTION-TYPE C
COMP. CODE-3346-0004



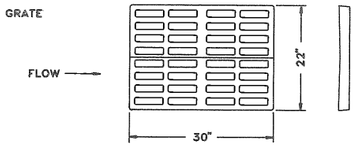


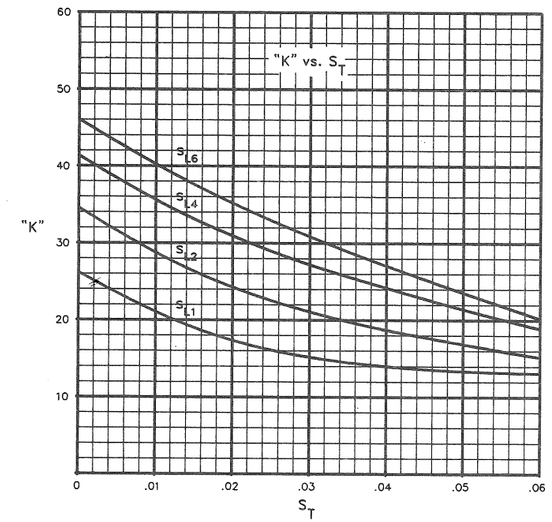
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO. - R-3357-A
DESCRIPTION - TYPE C CONCAVE GRATE
COMP. CODE - 3357-0002



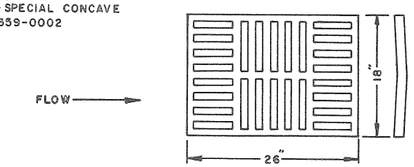


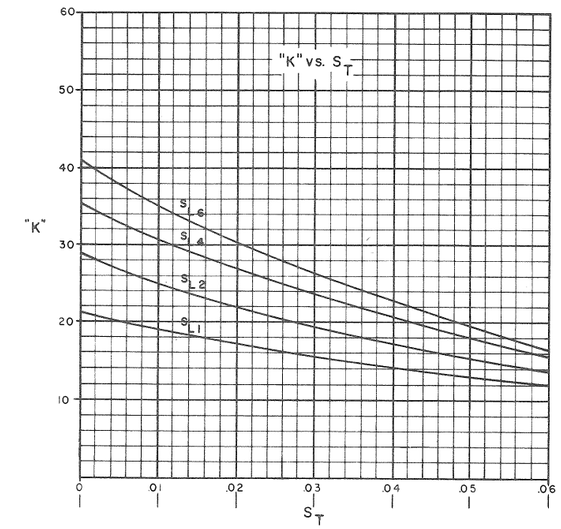
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.-R-3359
DESCRIPTION-SPECIAL CONCAVE
COMP. CODE-3359-0002



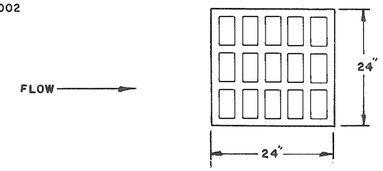


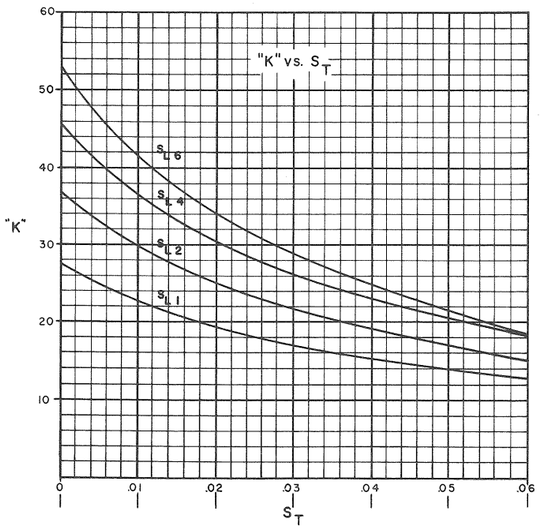
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.-R-3348
DESCRIPTION-TYPE A CONCAVE
COMP. CODE-3348-0002



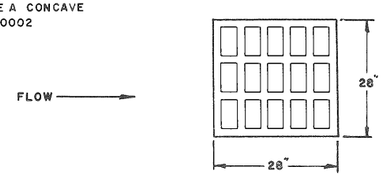


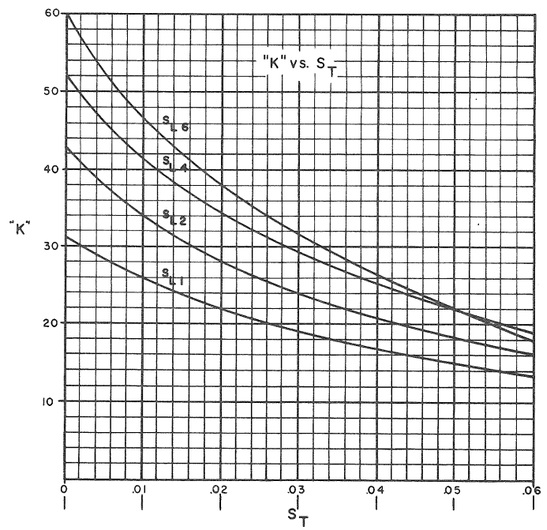
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.-R-3350
DESCRIPTION-TYPE A CONCAVE
COMP. CODE-3350-0002



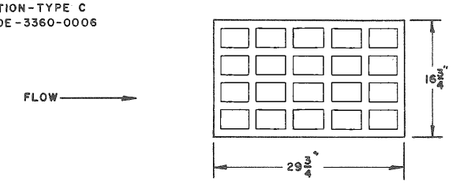


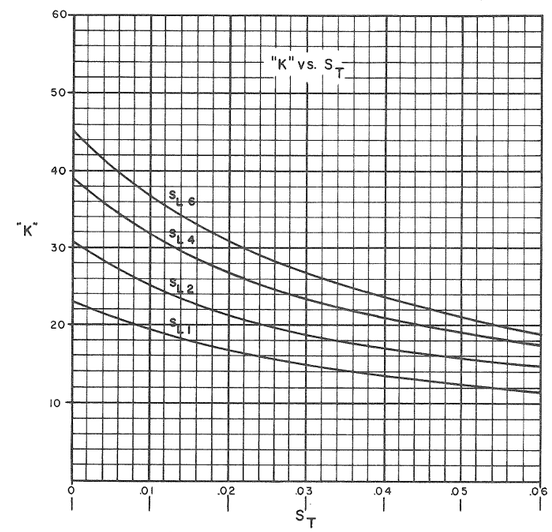
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.-R-3360-A
DESCRIPTION-TYPE C
COMP. CODE-3360-0006



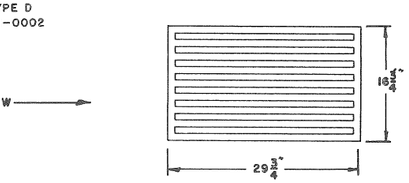


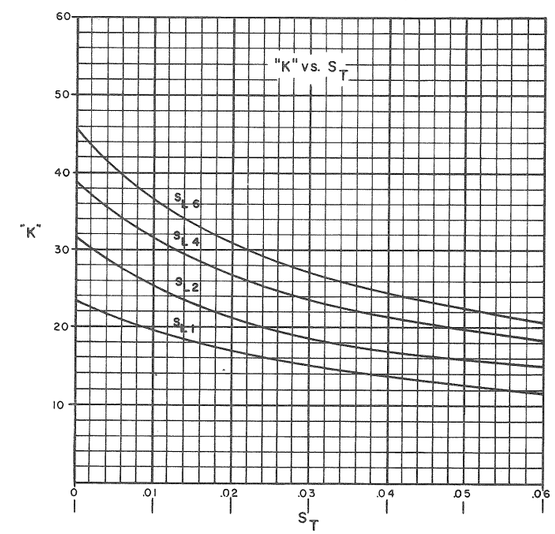
S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.-R-3361
DESCRIPTION-TYPE D
COMP. CODE-3361-0002



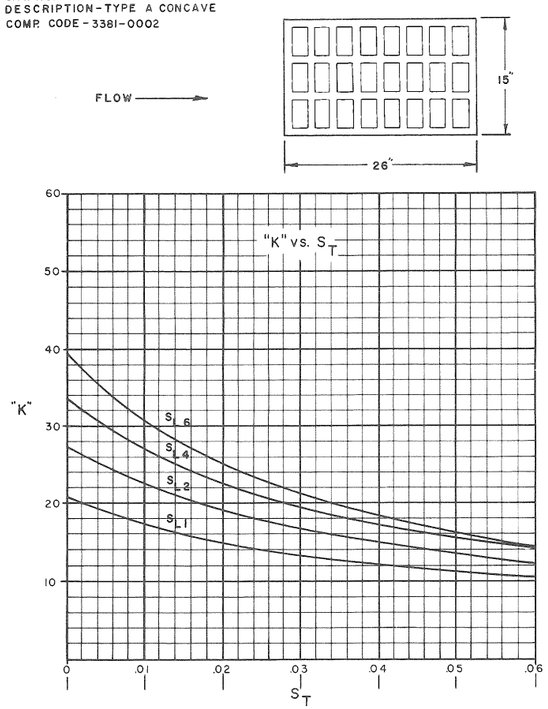


S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3381
DESCRIPTION- TYPE A CONCAVE
COMP. CODE - 3381-0002

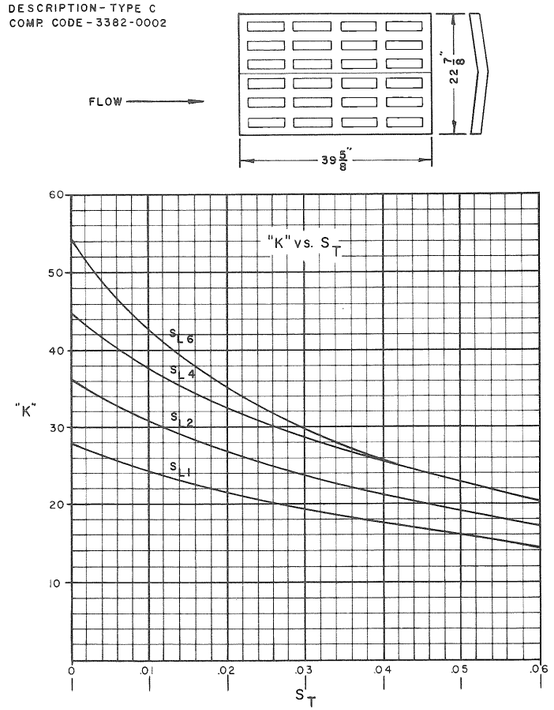


S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3382
DESCRIPTION- TYPE C
COMP. CODE - 3382-0002

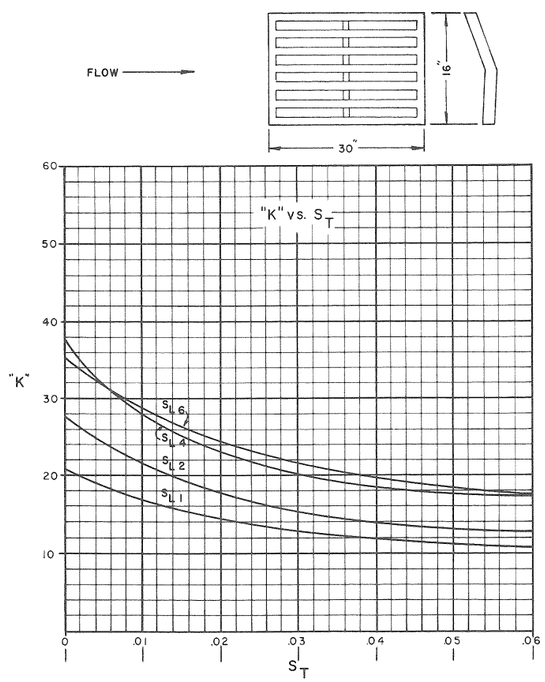


S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3392
DESCRIPTION- TYPE D WITH ONE DEPRESSED BAR
COMP. CODE - 3392-0002

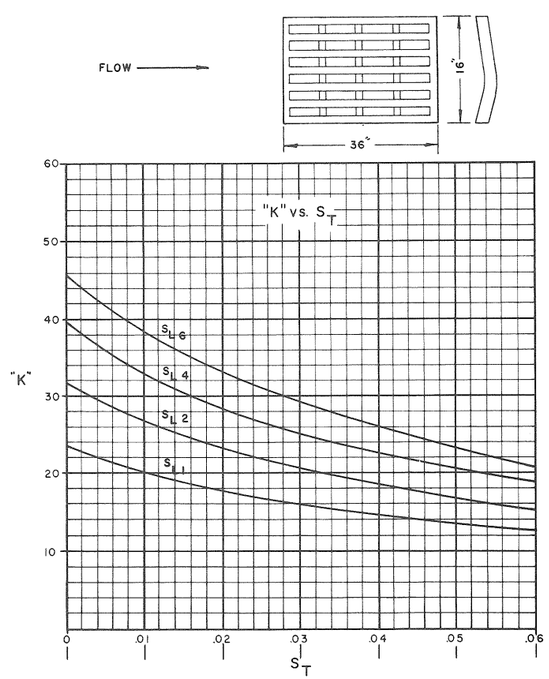


S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3393-A
DESCRIPTION- TYPE D WITH THREE DEPRESSED BARS
COMP. CODE - 3393-0004

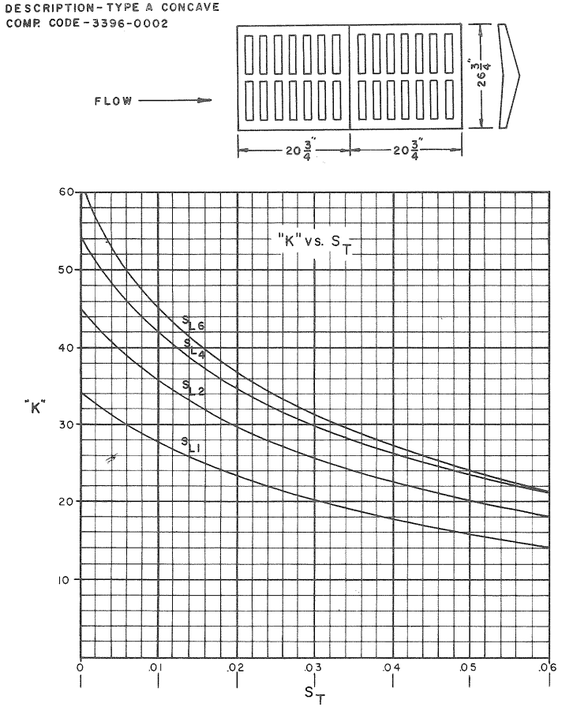


S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3396
DESCRIPTION- TYPE A CONCAVE
COMP. CODE - 3396-0002

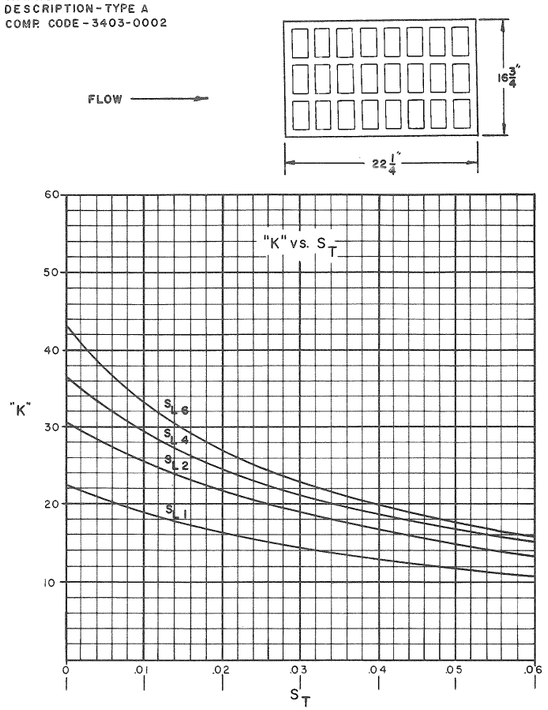


S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3403
DESCRIPTION- TYPE A
COMP. CODE - 3403-0002

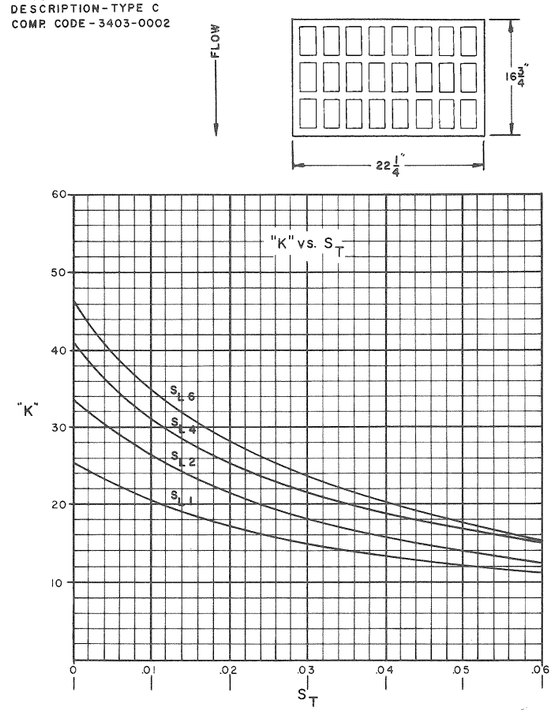


S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3403
DESCRIPTION- TYPE C
COMP. CODE - 3403-0002

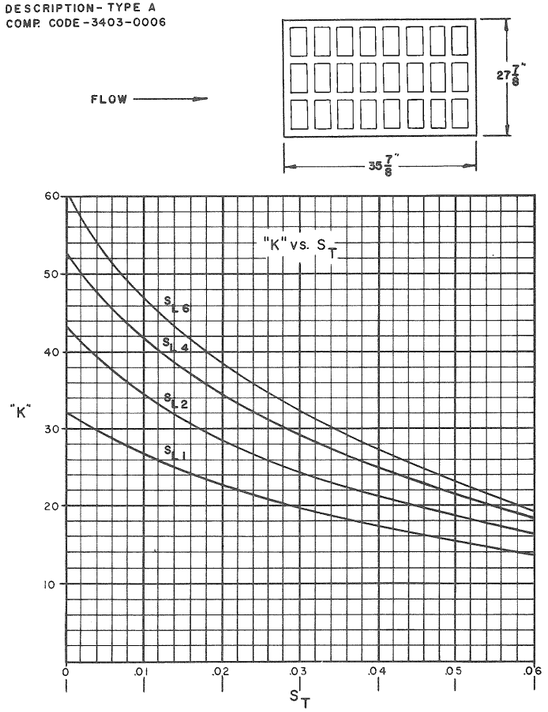


S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

CAT. NO.- R-3403F
DESCRIPTION- TYPE A
COMP. CODE - 3403-0006

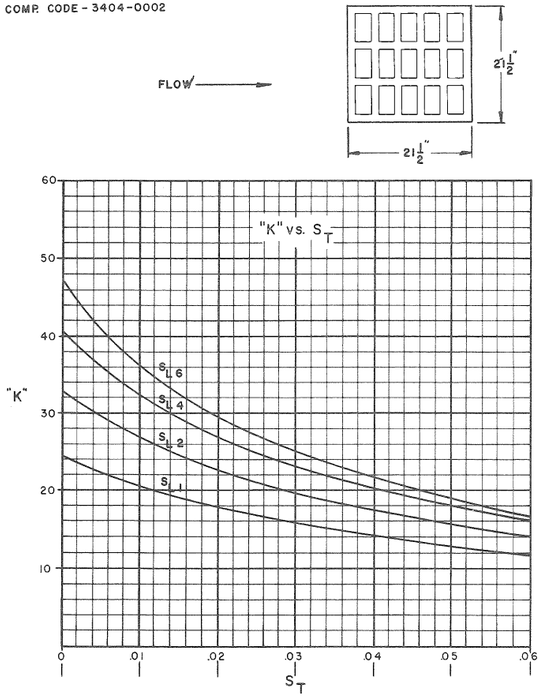


S_T = TRANSVERSE GUTTER SLOPE

S_L = LONGITUDINAL GUTTER SLOPE

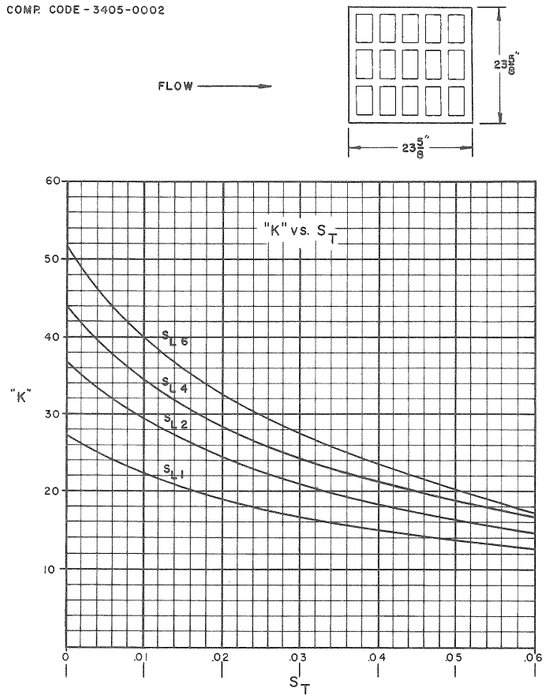
K = GRATE INLET COEFFICIENT

CAT. NO.- R-3404
DESCRIPTION- TYPE A
COMP. CODE - 3404-0002



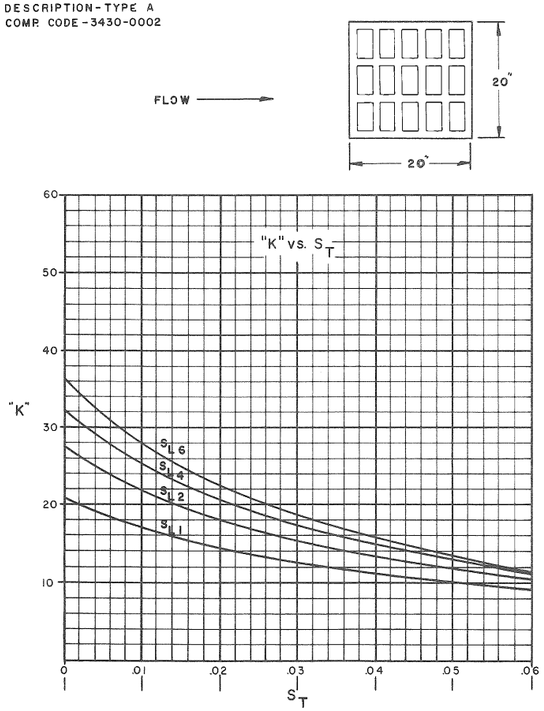
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.- R-3405
DESCRIPTION- TYPE A
COMP. CODE - 3405-0002



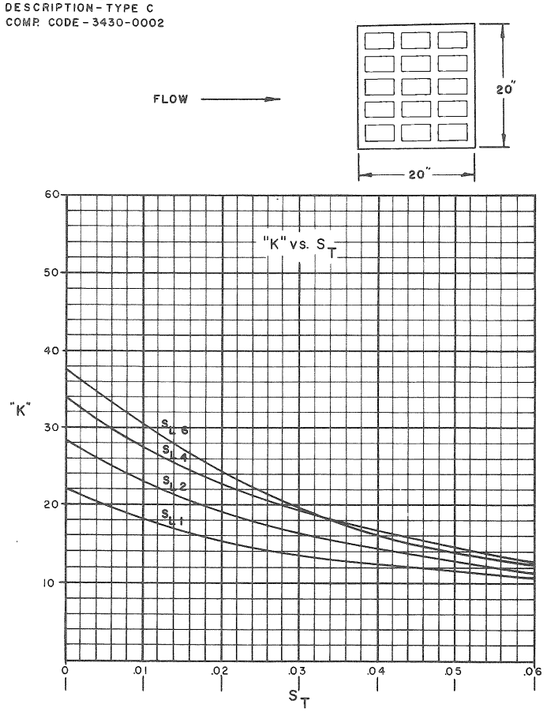
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.- R-3430
DESCRIPTION- TYPE A
COMP. CODE - 3430-0002



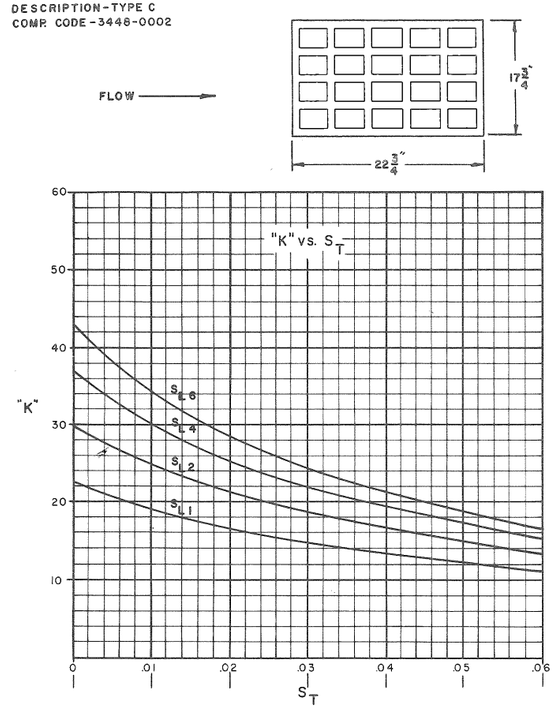
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.- R-3430
DESCRIPTION- TYPE C
COMP. CODE - 3430-0002



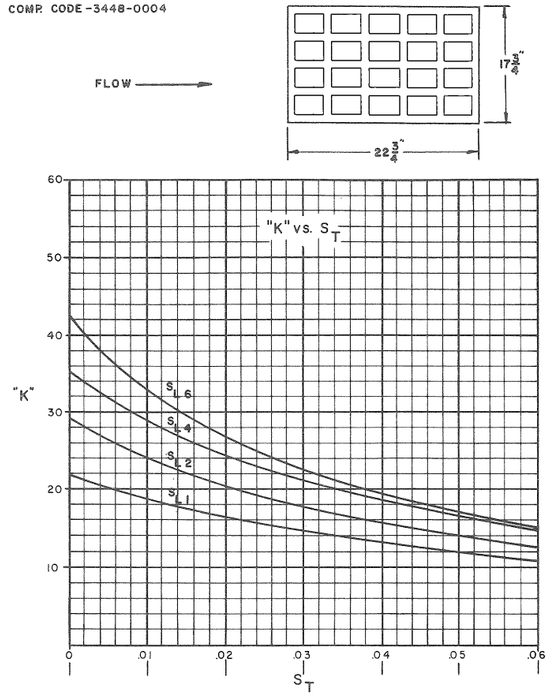
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.- R-3448 B
DESCRIPTION- TYPE C
COMP. CODE - 3448-0002



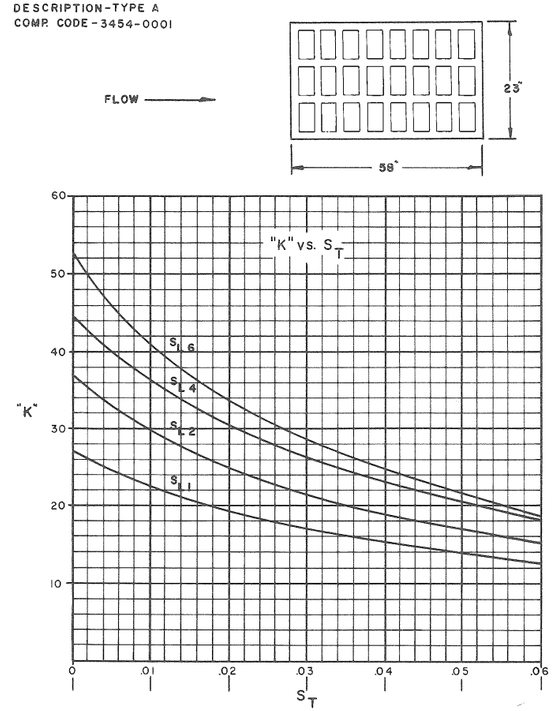
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.- R-3448C
DESCRIPTION- TYPE C
COMP. CODE - 3448-0004



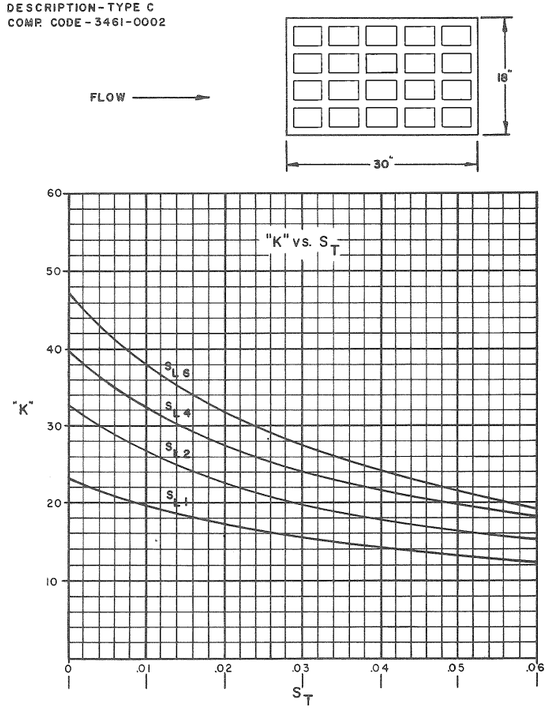
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.- R-3454
DESCRIPTION- TYPE A
COMP. CODE - 3454-0001



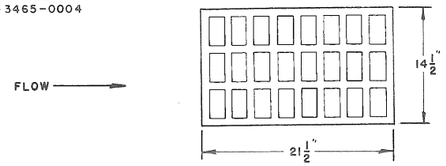
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

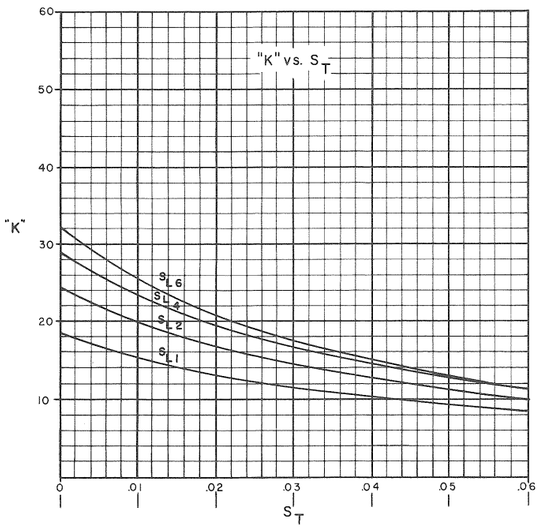
CAT. NO.- R-3461
DESCRIPTION- TYPE C
COMP. CODE - 3461-0002



S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

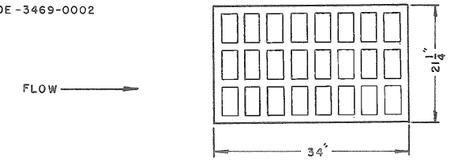
CAT. NO.-R-3465
DESCRIPTION-TYPE A
COMP. CODE-3465-0004

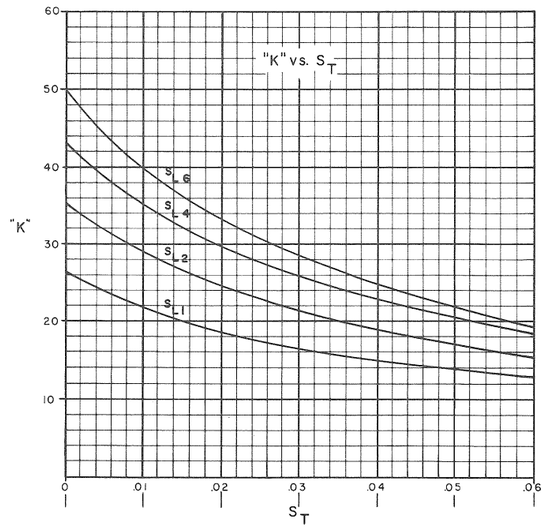




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

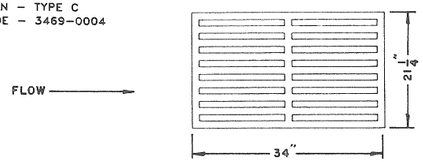
CAT. NO.-R-3469
DESCRIPTION-TYPE A
COMP. CODE-3469-0002

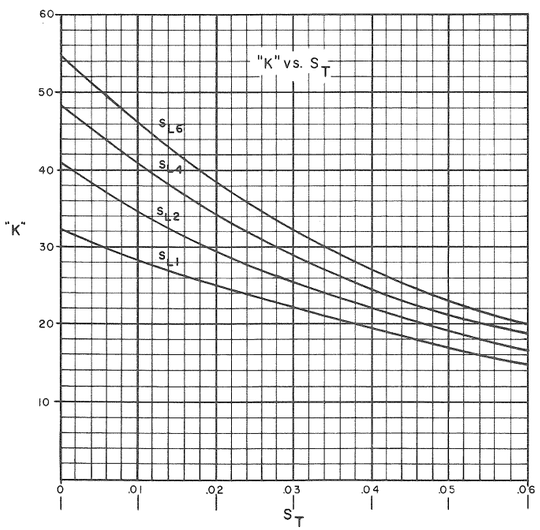




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

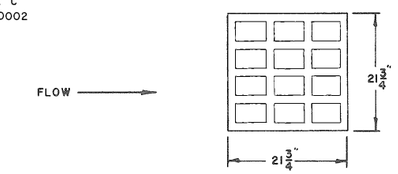
CAT. NO. - R-3469-E2
DESCRIPTION - TYPE C
COMP. CODE - 3469-0004

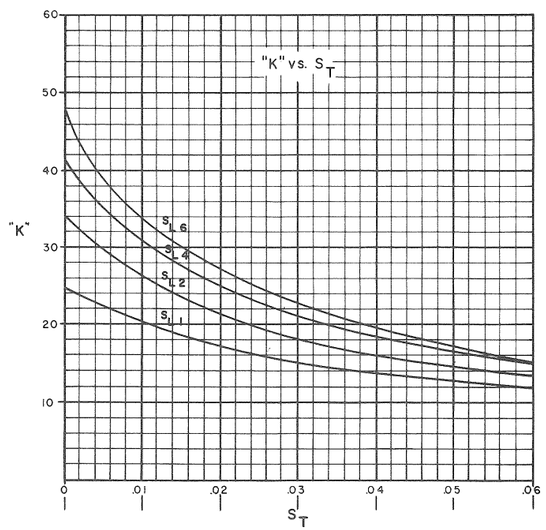




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

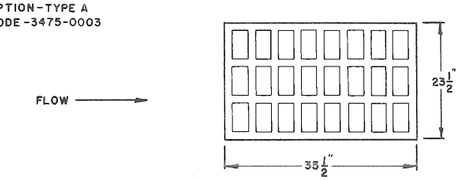
CAT. NO.-R-3472
DESCRIPTION-TYPE C
COMP. CODE-3472-0002

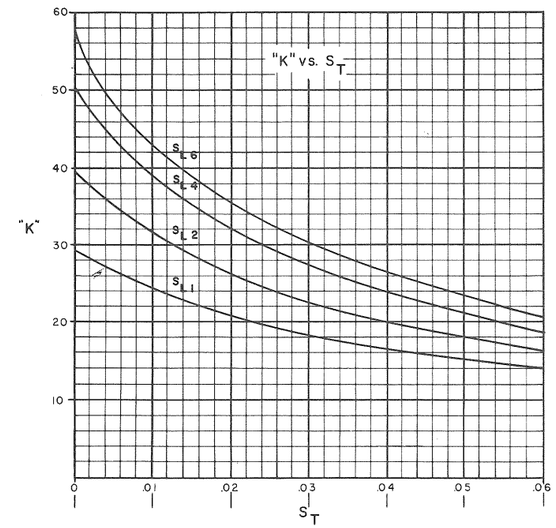




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

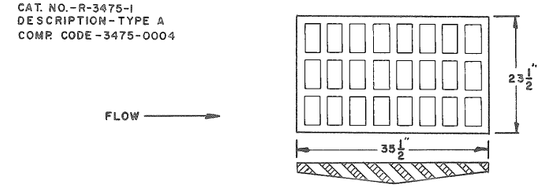
CAT. NO.-R-3475
DESCRIPTION-TYPE A
COMP. CODE-3475-0003

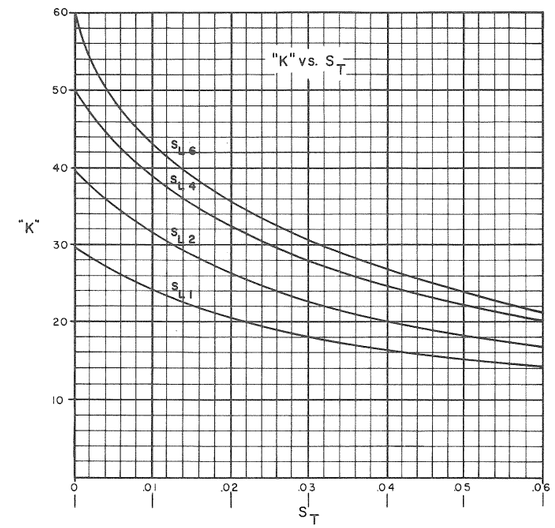




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

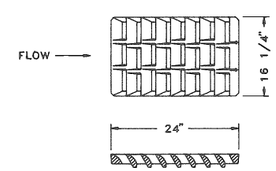
CAT. NO.-R-3475-I
DESCRIPTION-TYPE A
COMP. CODE-3475-0004

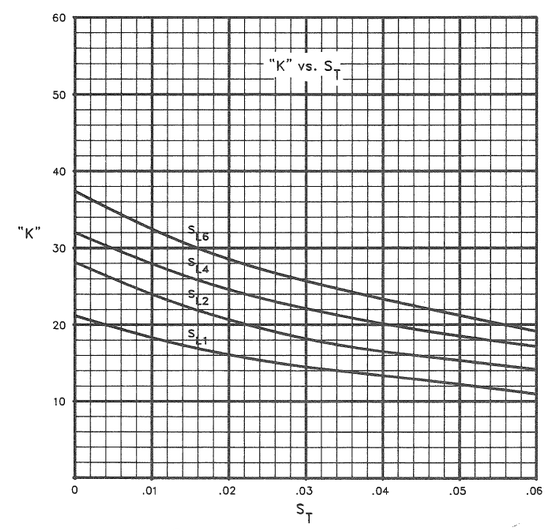




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

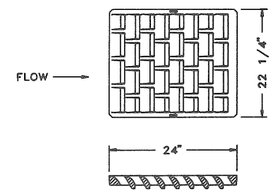
CAT. NO. - R-3525-L
DESCRIPTION - TYPE L
COMP. CODE - 3525-0003

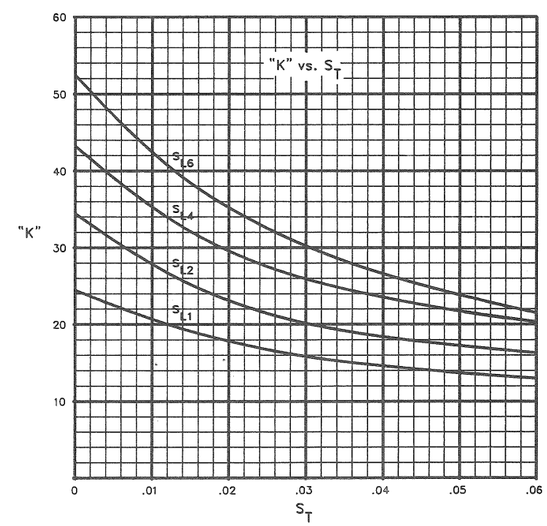




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

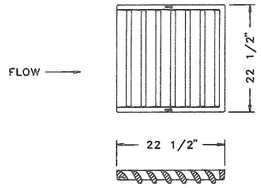
CAT. NO. - R-3526-L
DESCRIPTION - TYPE L
COMP. CODE - 3526-0003

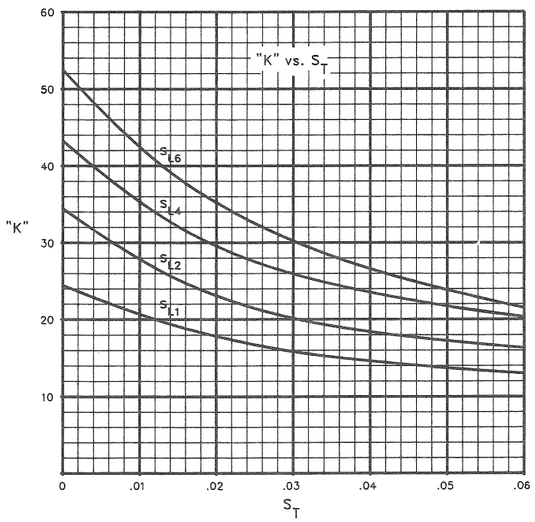




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

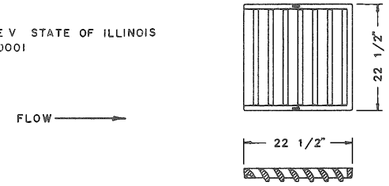
CAT. NO. – R-3527-M
DESCRIPTION – TYPE V
COMP. CODE – 3527-0001

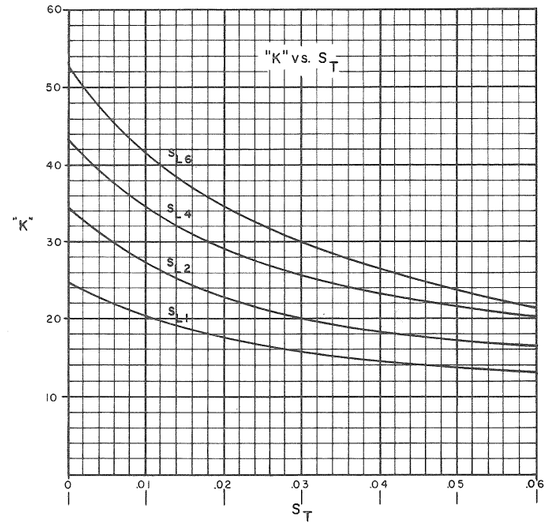




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

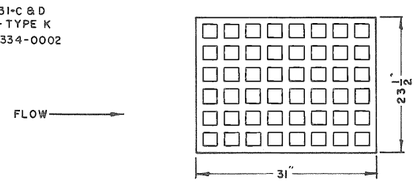
CAT. NO.- R-3527-V
DESCRIPTION-TYPE V STATE OF ILLINOIS
COMP. CODE - 3527-0001

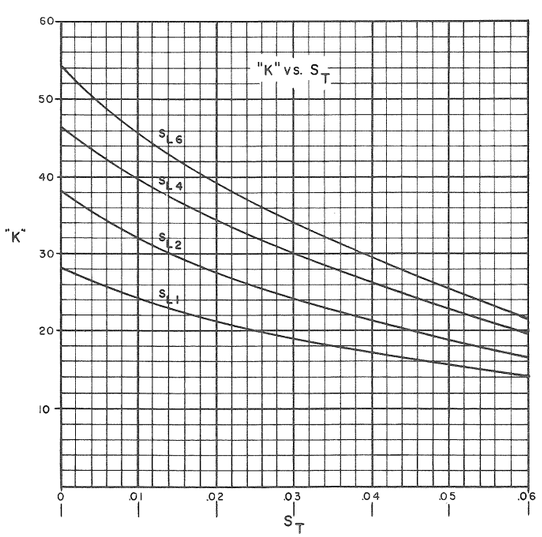




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

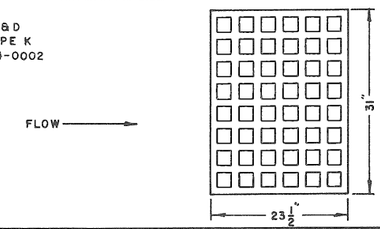
CAT. NO.- R-3531-C & D
DESCRIPTION- TYPE K
COMP. CODE - 3334-0002

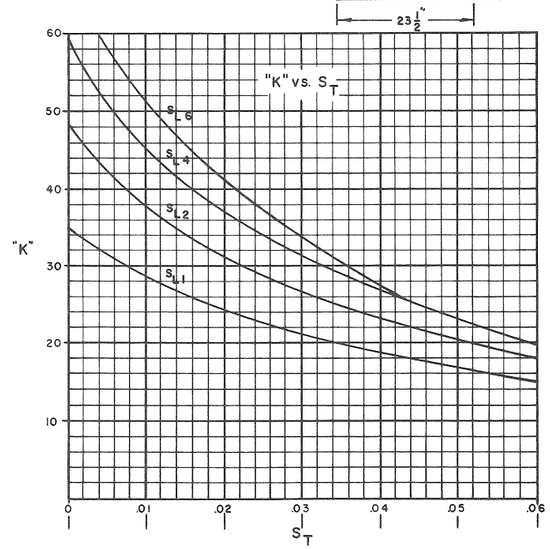




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

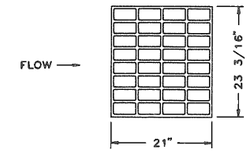
CAT. NO.- R-3531-C & D
DESCRIPTION- TYPE K
COMP. CODE - 3334-0002

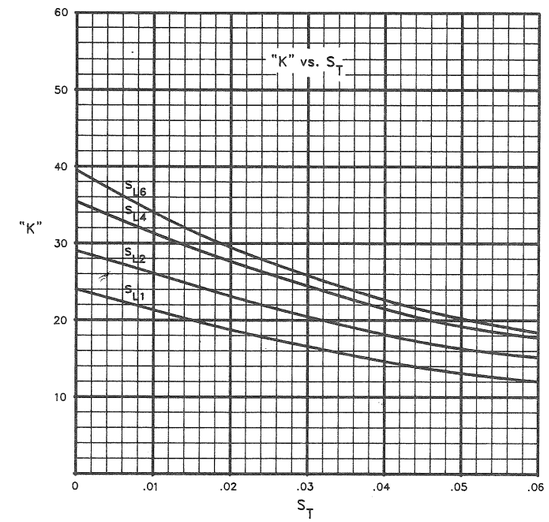




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

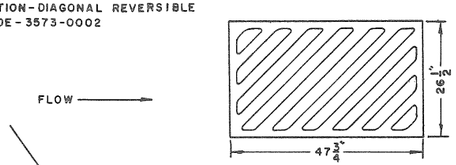
CAT. NO. – R-3570
DESCRIPTION – TYPE A
COMP. CODE – 3570-0002

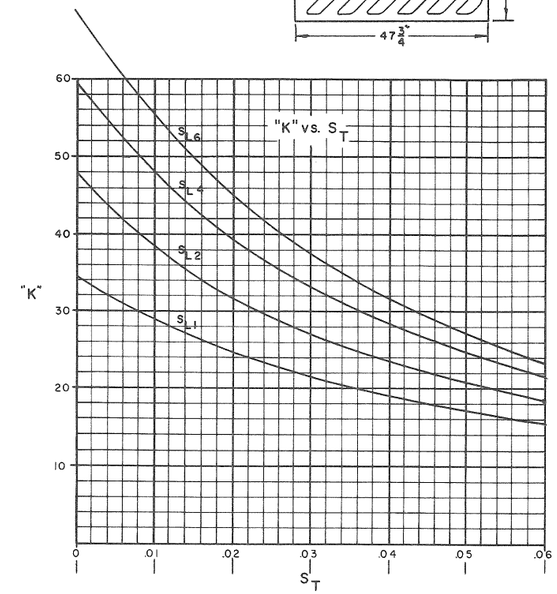




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

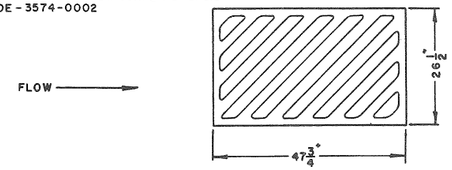
CAT. NO.- R-3573
DESCRIPTION-DIAGONAL REVERSIBLE
COMP. CODE-3573-0002

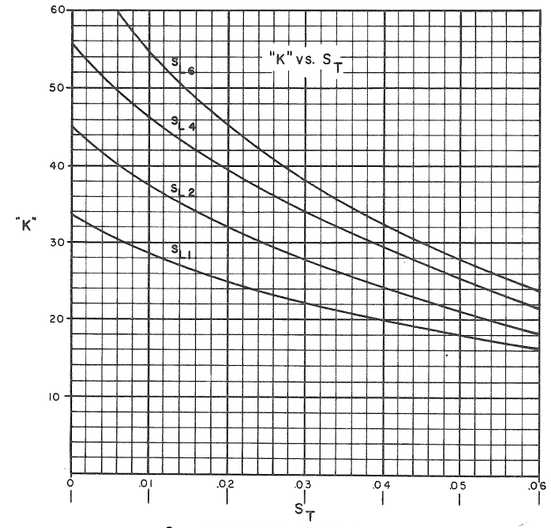




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

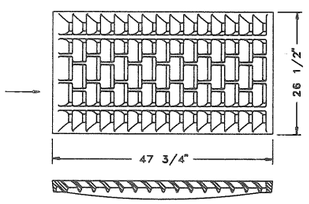
CAT. NO.-R-3574
DESCRIPTION-TYPE R DIAGONAL REVERSIBLE
COMP. CODE-3574-0002

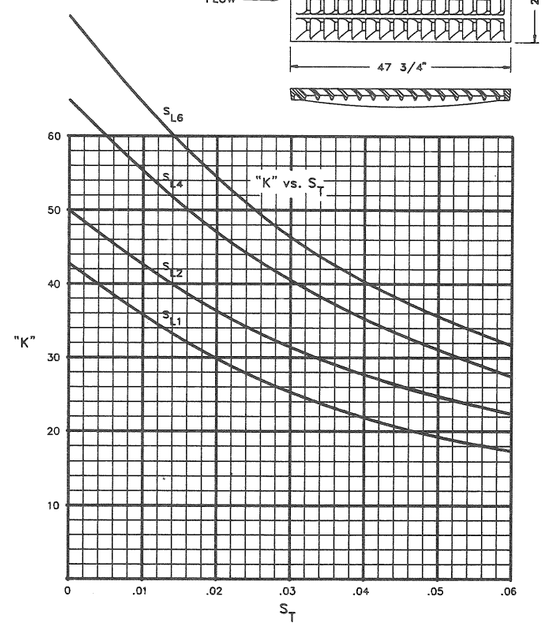




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

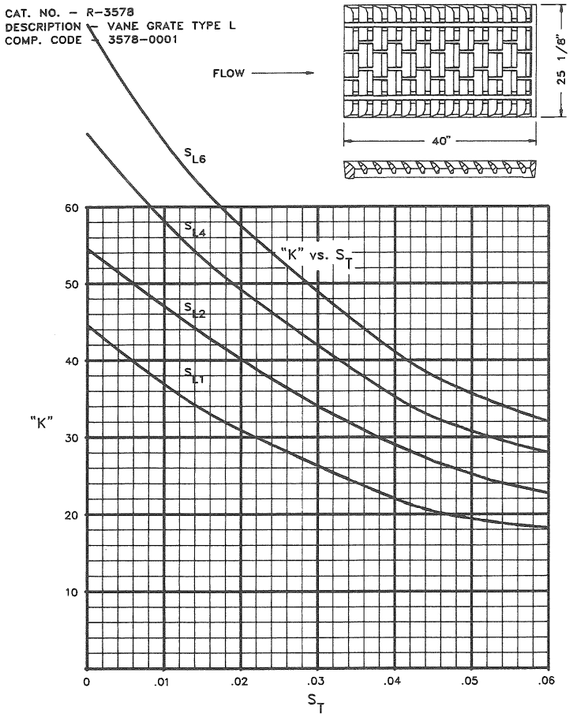
CAT. NO. – R-3574-L
DESCRIPTION – PENN. DOT TYPE L
COMP. CODE – 3573-0006





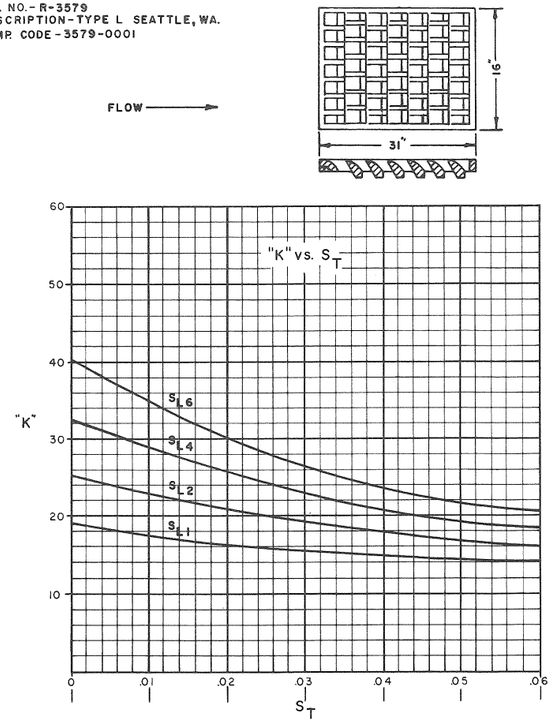
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO. – R-3578
DESCRIPTION – VANE GRATE TYPE L
COMP. CODE – 3578-0001



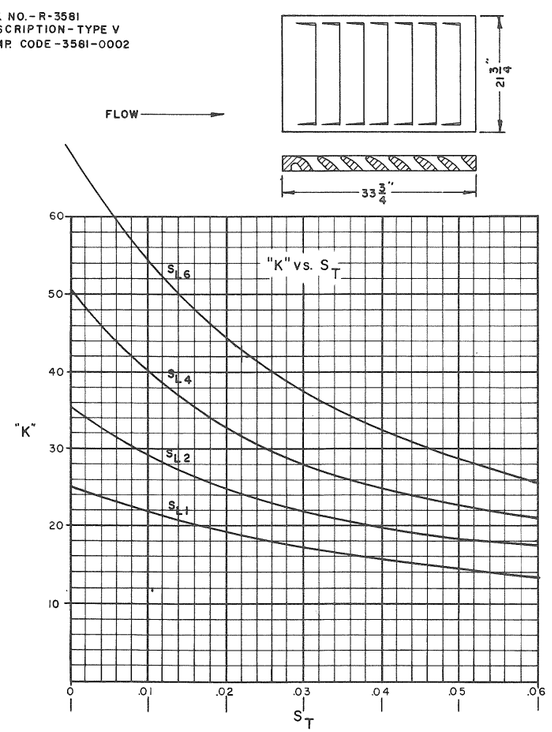
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.- R-3579
DESCRIPTION-TYPE L SEATTLE, WA.
COMP. CODE-3579-0001



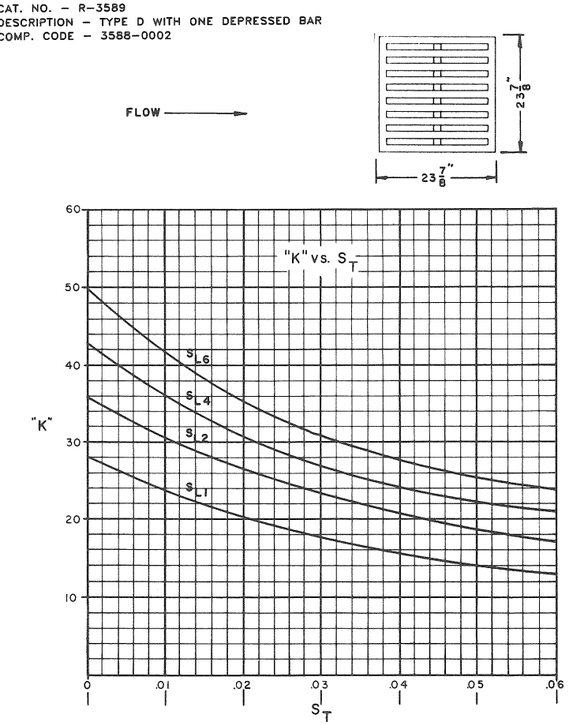
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.-R-3581
DESCRIPTION-TYPE V
COMP. CODE-3581-0002



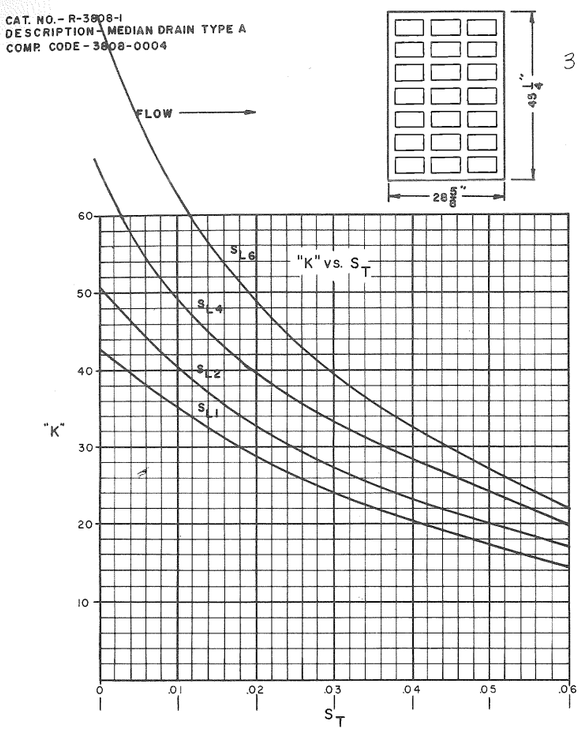
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO. – R-3589
DESCRIPTION – TYPE D WITH ONE DEPRESSED BAR
COMP. CODE – 3588-0002



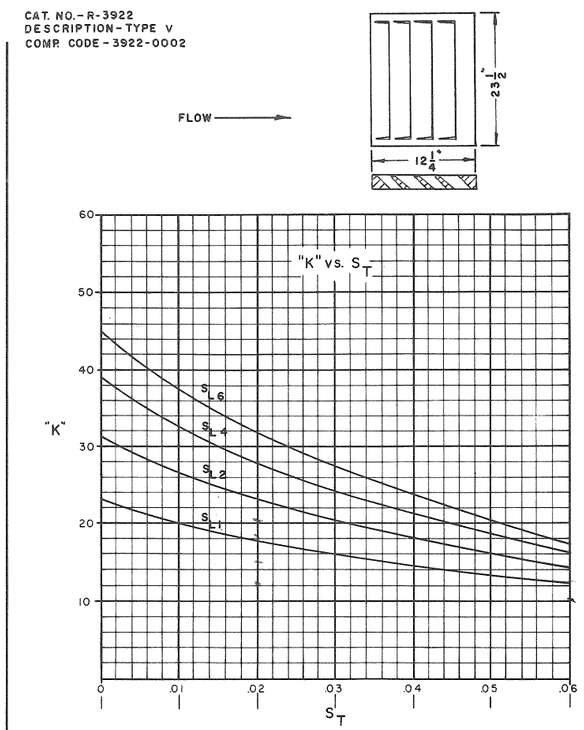
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.- R-3808-1
DESCRIPTION-MEDIAN DRAIN TYPE A
COMP. CODE-3808-0004



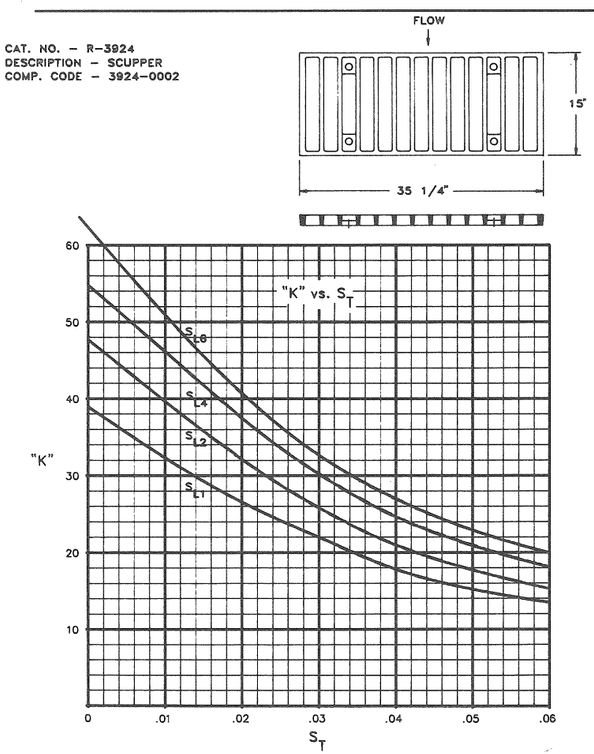
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.-R-3922
DESCRIPTION-TYPE V
COMP. CODE-3922-0002



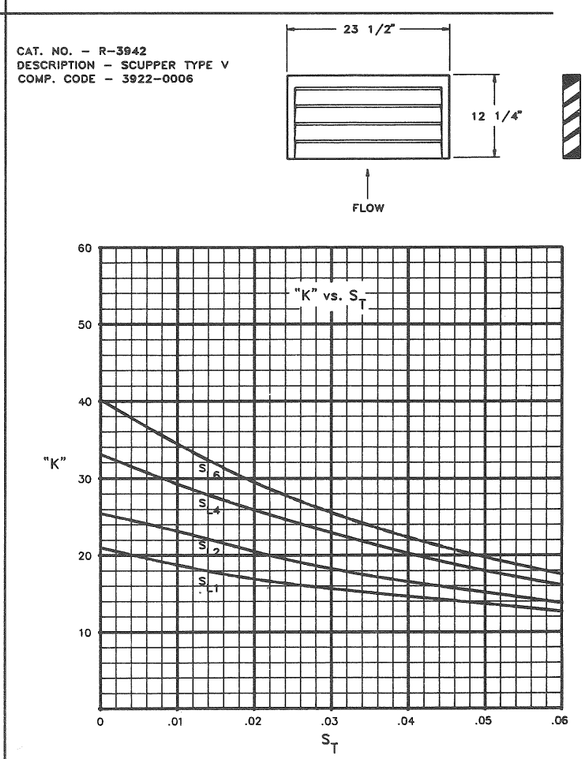
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO. – R-3924
DESCRIPTION – SCUPPER
COMP. CODE – 3924-0002



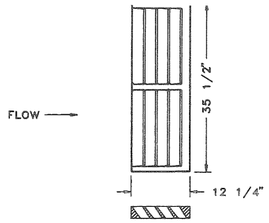
S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

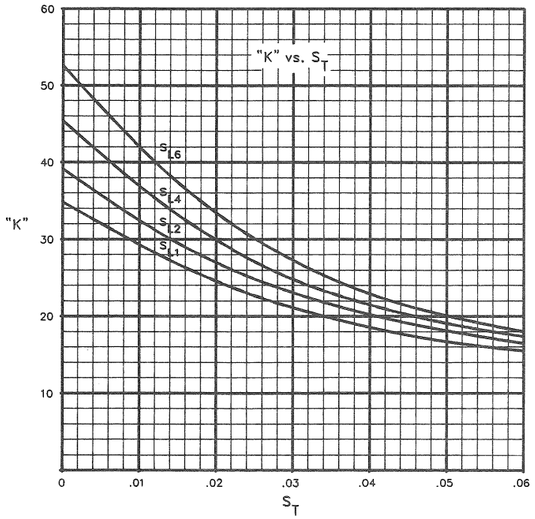
CAT. NO. – R-3942
DESCRIPTION – SCUPPER TYPE V
COMP. CODE – 3922-0006



S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

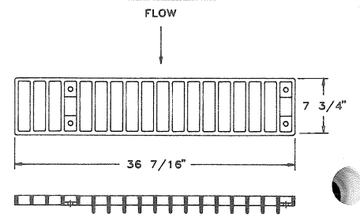
CAT. NO. – R-3943
DESCRIPTION – DAN RYAN SCUPPER (LARGE)
COMP. CODE – 3943-0002

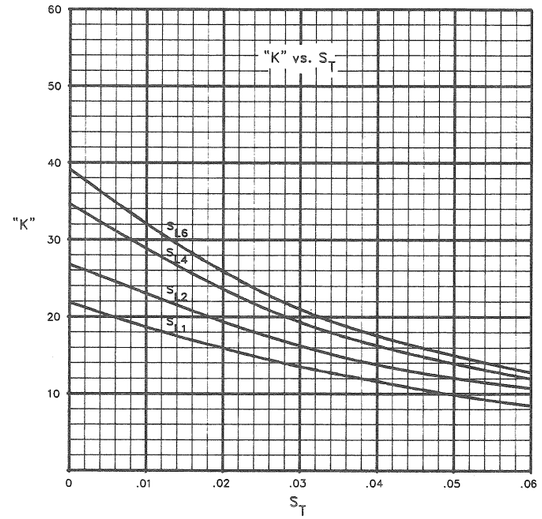




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

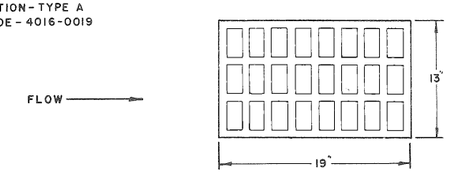
CAT. NO. – R-4014-T
DESCRIPTION – TYPE B
COMP. CODE – 4014-0042

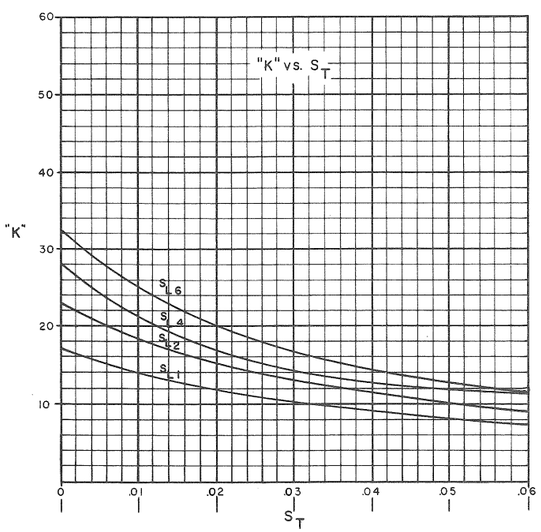




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

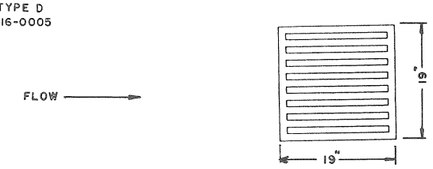
CAT. NO.-R-4016-HI
DESCRIPTION-TYPE A
COMP. CODE-4016-0019

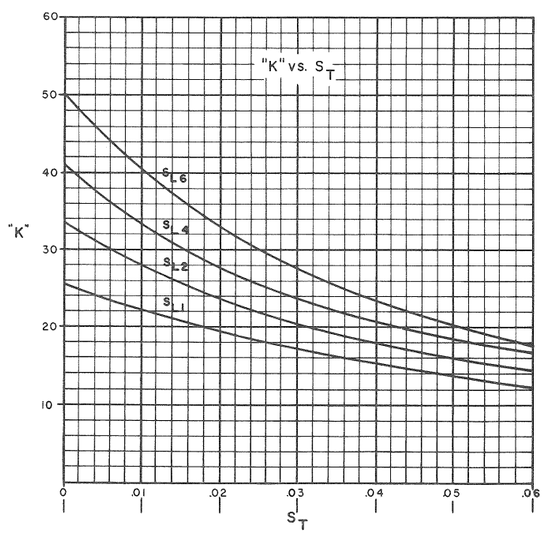




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

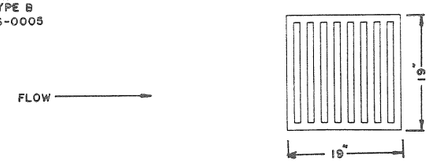
CAT. NO.-R-4016-K
DESCRIPTION-TYPE D
COMP. CODE-4016-0005

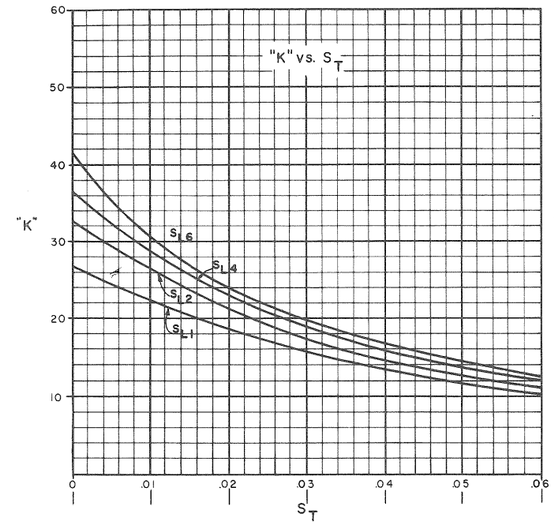




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

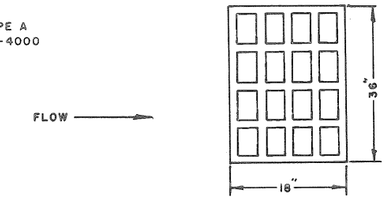
CAT. NO.-R-4016-K
DESCRIPTION-TYPE B
COMP. CODE-4016-0005

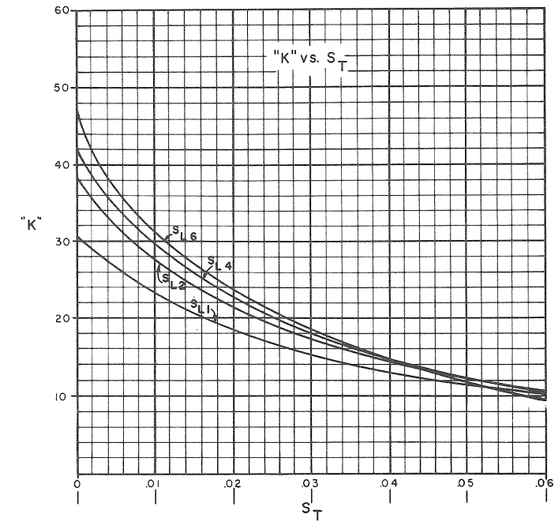




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

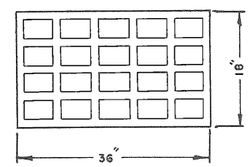
CAT. NO.- R-4710
DESCRIPTION- TYPE A
COMP. CODE - 4710-4000

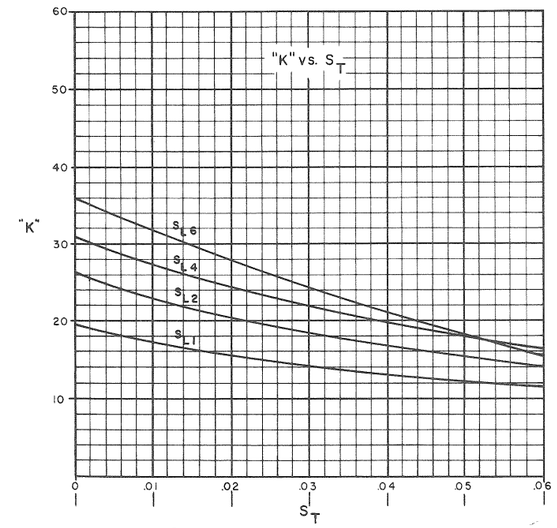




S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

CAT. NO.-R-4710
DESCRIPTION-TYPE C
COMP. CODE-4710-4000





S_T = TRANSVERSE GUTTER SLOPE
S_L = LONGITUDINAL GUTTER SLOPE
K = GRATE INLET COEFFICIENT

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	TYPE D	3010-0004	3
	TYPE R	3015-0003	4
R-3030	TYPE A	3010-0003	3
	TYPE D	3010-0004	3
	TYPE R	3015-0003	4
R-3031-B	TYPE S	3031-0002	4
R-3032-B	TYPE S	3031-0002	4
R-3033-B	TYPE S	3031-0002	4
R-3034-B	TYPE S	3031-0002	4
R-3035-A	TYPE S	3031-0002	4
R-3036-B	TYPE S	3036-0004	4
R-3038-A	TYPE K	3038-0002	5
R-3039-A	TYPE S	3031-0002	4
R-3040	TYPE A	3010-0003	3
	TYPE D	3010-0004	3
	TYPE R	3015-0003	4
R-3042	TYPE K	3042-0002	5
R-3065	TYPE A	3070-0002	6
	TYPE C	3235-0002	13
	TYPE R	3070-0009	7
R-3065-LL	TYPE L	3065-0003	5
R-3065-V	TYPE V	3065-0002	5
R-3067	TYPE C	3290-0004	24
	TYPE R	3067-0004	6
R-3067-LL	TYPE L	3067-0011	6
R-3067-SP	TYPE R	3067-0004	6
R-3067-V	TYPE V	3067-0008	6
R-3070	TYPE A	3070-0002	6
R-3070	TYPE R	3070-0009	7
R-3070-V	TYPE V	3065-0002	5
R-3075	TYPE R	3070-0009	7
R-3075-V	TYPE V	3065-0002	5
R-3076	TYPE L	3076-0015	7
	TYPE V	3076-0002	7
R-3077	TYPE V	3076-0002	7
R-3077-L	TYPE V	3076-0002	7
R-3077-R	TYPE V	3076-0002	7
R-3077-4M	TYPE V	3076-0002	7
R-3077-6B	TYPE V	3076-0002	7
R-3077-6M	TYPE V	3076-0002	7
R-3077-8B	TYPE V	3076-0002	7
R-3078	TYPE V	3076-0002	7
R-3078-4M	TYPE V	3076-0002	7
R-3078-6B	TYPE V	3076-0002	7
R-3078-6M	TYPE V	3076-0002	7
R-3078-8B	TYPE V	3076-0002	7
R-3079	TYPE L	3076-0015	7
R-3080	TYPE A	3080-0002	7
	TYPE R	3085-0009	8
R-3081	TYPE A	3080-0002	7
	TYPE R	3085-0009	8
R-3085	TYPE R	3085-0009	8
R-3090	TYPE A	3080-0002	7
	TYPE R	3085-0009	8
R-3120	TYPE K	3110-0001	8
R-3130	TYPE K	3110-0001	8
R-3141	TYPE K	3110-0001	8
R-3150	TYPE A	3150-0002	8
	TYPE B	3283-0002	21
	TYPE D	3150-0003	8
R-3151	TYPE A	3150-0002	8
	TYPE B	3283-0002	21
	TYPE D	3150-0003	8
R-3152	TYPE A	3152-0002	9
R-3157-1	TYPE A	3157-0002	9
R-3157-2	TYPE V	3157-0007	9
R-3161	TYPE S	3161-0001	9
R-3165	TYPE A	3165-0002	10
R-3169	TYPE B	3170-0002	10
R-3170	TYPE B	3170-0002	10
R-3175	TYPE A	3175-0002	10
R-3180	TYPE C	3180-0002	10
R-3203-A	TYPE A	3203-0002	11
R-3203-B	TYPE A	3203-0002	11

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CATALOG NUMBER	GRATE TYPE	COMPONENT NUMBER	PAGE NUMBER
R-3203-C	TYPE A	3203-0002	11
R-3205	TYPE K	3205-0002	11
R-3210	TYPE C	3210-0002	11
R-3210-A	TYPE C	3210-0002	11
R-3210-AL	TYPE L	3405-0006	12
R-3210-L	TYPE L	3405-0006	12
R-3220	TYPE L	3405-0006	12
R-3220-L	TYPE L	3405-0006	12
R-3222-LA	TYPE L	3222-0015	12
R-3222-1	TYPE L	3222-0015	12
R-3222-1A	TYPE L	3222-0015	12
R-3227	TYPE D	3227-0002	12
R-3227-C	TYPE C	3227-0003	12
R-3227-D	TYPE R	3227-0006	13
R-3228-BC	TYPE C	3227-0003	12
R-3228-BD	TYPE R	3227-0006	13
R-3228-G	TYPE D	3227-0002	12
R-3228-GD	TYPE R	3227-0006	13
R-3228-H	TYPE C	3227-0003	12
R-3228-J	TYPE D	3227-0002	12
R-3228-JD	TYPE R	3227-0006	13
R-3228-K	TYPE C	3227-0003	12
R-3229-L	TYPE L	3405-0006	12
R-3233	TYPE A	3469-0002	32
R-3233-D	TYPE A	3233-0005	13
R-3234-B1	TYPE A	3234-0003	13
R-3235	TYPE A	3070-0002	6
	TYPE C	3235-0002	13
	TYPE R	3070-0009	7
R-3235-V	TYPE V	3065-0002	5
R-3236	TYPE C	3236-0002	14
R-3236-A	TYPE C	3236-0002	14
R-3236-B	TYPE C	3236-0002	14
R-3236-1	TYPE C	3236-0002	14
R-3237	TYPE C	3236-0002	14
R-3237-A	TYPE C	3236-0002	14
R-3237-B	TYPE C	3236-0002	14
R-3237-1	TYPE C	3236-0002	14
R-3238	TYPE C	3238-0002	14
R-3239-A	TYPE A	3239-0003	14
R-3240	TYPE C	3240-0003	14
R-3246	TYPE C	3290-0004	24
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	TYPE R	3246-0027	15
R-3246-AL	TYPE L	3246-0034	15
	TYPE L	3246-0035	15
R-3246-AP	TYPE C	3246-0002	15
	TYPE D	3246-0003	15
R-3246-C	TYPE C	3246-0013	16
R-3246-CL	TYPE L	3246-0041	16
R-3246-E	TYPE C	3246-0013	16
R-3246-F	TYPE C	3246-0013	16
R-3246-G	TYPE R	3067-0004	6
R-3246-GB	TYPE R	3067-0004	6
R-3246-V	TYPE V	3067-0008	6
R-3246-1	TYPE C	3290-0004	24
R-3247	TYPE R	3573-0002	35
R-3247-A	TYPE R	3247-0002	16
R-3250	TYPE K	3250-0005	16
R-3250-A	TYPE K	3250-0005	16
R-3250-B	TYPE K	3250-0007	17
R-3250-BL	TYPE L	3250-0020	17
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R-3250-C	TYPE K	3250-0007	17
R-3250-CL	TYPE L	3250-0020	17
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R-3250-1	TYPE K	3250-0005	16
R-3251	TYPE C	3251-0002	17
R-3252-A	TYPE V	3250-0018	17
R-3259	TYPE K	3259-0002	18
	TYPE K	3259-0003	18
R-3260-A	TYPE C	3260-0005	18
R-3261-A	TYPE C	3261-0002	18
R-3266	TYPE K	3266-0002	18
R-3270	TYPE A	3270-0003	19
R-3273-A	TYPE S	3161-0001	9
R-3274	TYPE C	3274-0003	19
R-3274-A	TYPE C	3274-0003	19

ORIFICE FLOW

(Determines how much water flows through the grate)

CAPACITY OF NEENAH GRATES FOR PONDING CONDITIONS

For flow through a grate under ponding conditions, orifice type flow occurs. If the net open area is used as the orifice area, the discharge can be computed using the orifice equation $Q = CA\sqrt{2gh}$ where C has a value of 0.60, A = area in square feet, g = the constant value 32.2, and h = depth in feet of water over the grate.

The orifice equation is most accurate when large depths of ponding are encountered. At shallower depths, the equation loses its accuracy. The determining factor is the grate's free open area. The orifice equation remains accurate for grates of smaller area when depths are in the .4 to .3 foot range. Grates of larger free open area are not able to sustain ponding conditions at shallow depths, and therefore flow reverts to weir or one directional flow.

Since this equation contains three variables, two must be known to make a determination of the third. To facilitate rapid solution of the equation a nomograph (see page 45) is used. Please note the nomograph is limited to depths of .3 foot.

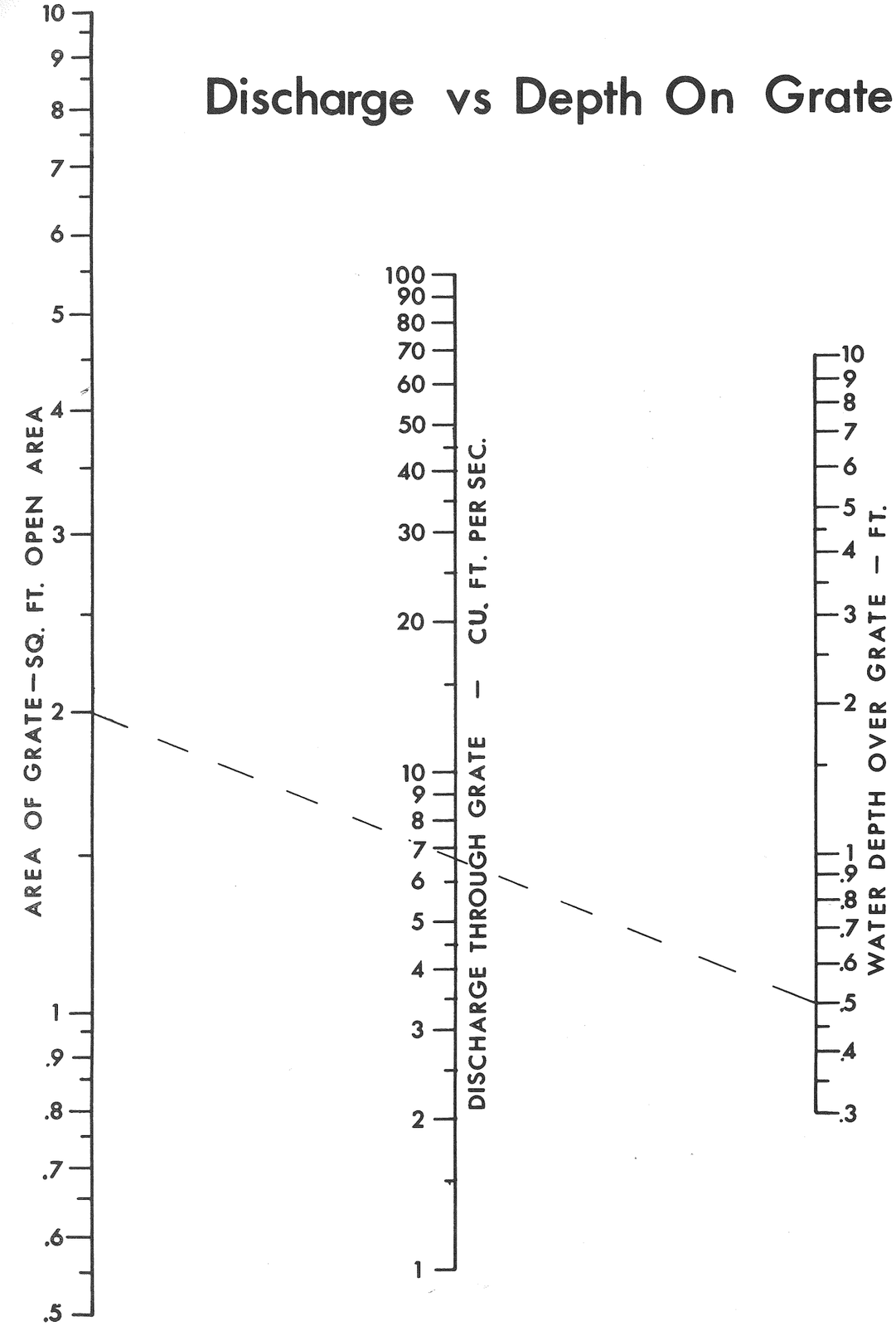
To use the nomograph, a line is drawn through the two known values on their respective axis. The third value will be obtained at the intersection of this line with the third axis. For example, if the area of a grate required to pass 6.7 cubic feet/second under a .5 feet head is desired, a line is projected from the .5 unit point on the right axis through the 6.7 unit point on the center axis. This line intersects the left axis at approximately 2.0 units indicating that a grate with a net open area of 2.0 square feet is required. Selection of this grate can be made by referring to the size table for the various Neenah grates.

It should be left to the designer to make any necessary reductions in the discharge due to trash accumulation or clogging.

For an example of the relationship between the weir and orifice equations and the expected flow through a grate under varying conditions see page 53.

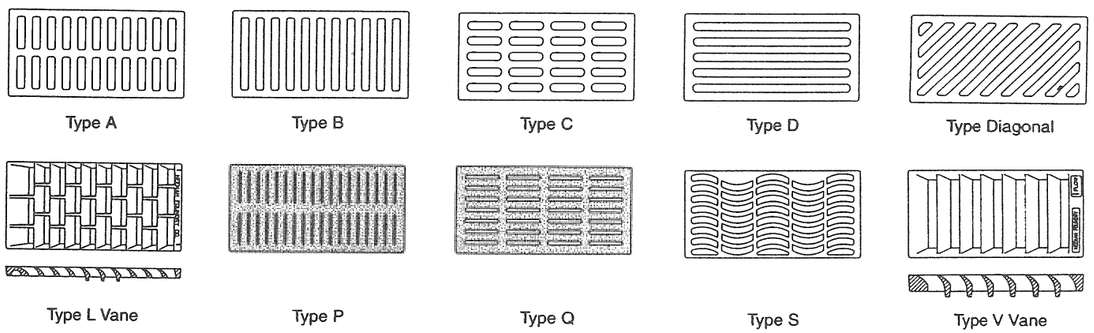
Note on BEEHIVE grates:
To determine orifice flow capacities for beehive grates, the ponding depth is zero at the top of the grate. This is conservative, but it is usually better to underestimate than overestimate the grate capacity.

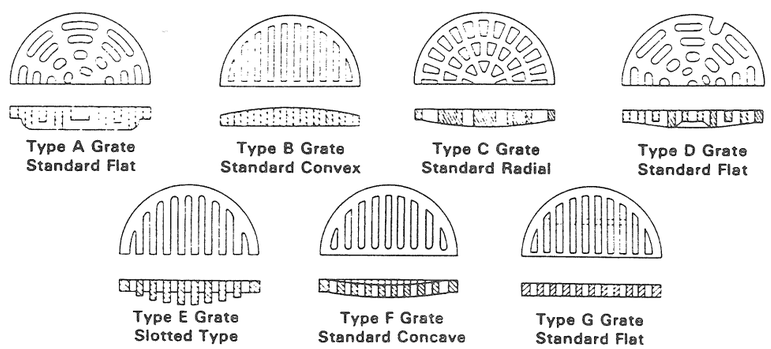
Discharge vs Depth On Grate



The following pages list the Neenah catalog designs furnished with grates. In addition to the free opening areas which are necessary to determine the discharge, the tables also show the grate type or style which are shown below for easy identification.

Grate Types





Special notes on Neenah grate types.

1. Type K indicates "Special" grate design and is not among standard types as illustrated.

2. Inlet grate type A or C can vary depending on how it is installed. If grate is installed with long side of openings perpendicular to flow, it is a type A grate, and if grate is installed with long side of openings parallel to flow, it is a type C grate.

3. Inlet grate type B or D can vary depending on how it is installed. If grate is installed with long slots perpendicular to flow, it is a type B grate, and if grate is installed with long slots parallel to flow, it is a type D grate.

FREE OPEN AREAS AND WEIR PERIMETERS OF NEENAH GRATES

CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-1792-AG	G	0.2	2.7
R-1792-BG	G	0.3	3.5
R-1792-CG	G	0.5	4.3
R-1792-DG	G	0.7	4.8
R-1792-EG	G	1.0	5.8
R-1792-FG	G	1.7	6.6
R-1792-GG	G	2.0	7.4
R-1792-HG	G	2.7	9.0
R-1792-JG	G	3.7	10.5
R-1792-KG	G	4.8	12.1
R-1878-A1G	A or C	0.5	4.6
R-1878-A2G	A or C	0.8	6.0
R-1878-A3G	A or C	1.0	6.7
R-1878-A4G	A or C	1.1	7.3
R-1878-A5G	A or C	1.8	7.8
R-1878-A6G	A or C	2.7	8.6
R-1878-A7G	A or C	2.1	9.2
R-1878-A8G	A or C	2.3	9.8
R-1878-A9G	A or C	2.5	10.6
R-1878-A10G	A or C	3.0	12.3
R-1878-B1G	A	0.6	5.7
R-1878-B2G	A	0.9	6.5
R-1878-B3G	A	1.2	7.5
R-1878-B4G	A	2.1	8.5
R-1878-B5G	A	2.5	9.6
R-1878-B6G	C	2.6	9.5
R-1878-B7G	A	2.6	10.5
R-1878-B8G	A	3.7	12.6
R-1878-B9G	C	3.3	11.6
R-1878-B10G	C	4.9	13.5
R-1878-B11G	A	5.0	14.7
R-1879-A1G	A or C	0.4	4.6
R-1879-A2G	A or C	0.8	6.0
R-1879-A3G	A or C	1.2	6.7
R-1879-A4G	A or C	1.4	7.3
R-1879-A5G	A or C	1.9	7.8
R-1879-A6G	A or C	2.0	8.6
R-1879-A7G	A or C	1.7	9.2
R-1879-A8G	A or C	2.2	9.8
R-1879-A9G	A or C	2.8	10.6
R-1879-A10G	A or C	3.7	12.3
R-1879-B1G	A	0.6	5.7
R-1879-B2G	C	0.9	6.5
R-1879-B3G	C	1.0	7.5
R-1879-B4G	A	1.4	8.5
R-1879-B5G	A	1.9	9.6
R-1879-B6G	A	2.4	9.5
R-1879-B7G	A	3.0	10.6
R-1879-B8G	A	3.2	12.6
R-1879-B9G	A	3.2	11.6
R-1879-B10G	C	4.2	13.5
R-2014	C	1.1	6.0
R-2014	E	1.3	6.0
R-2015	D	0.9	6.0
R-2015	C	1.1	6.0
R-2015	G	1.2	6.0
R-2030	D	1.1	6.0
R-2030	C	1.1	6.0
R-2031	D	1.1	6.0
R-2031	E	1.1	6.0
R-2040	D	0.9	6.0
R-2040	C	1.1	6.0
R-2040	E	1.1	6.0
R-2040	F	0.7	6.0
R-2050	D	0.9	6.0
R-2050	C	1.1	6.0
R-2050	E	1.1	6.0
R-2050	F	0.7	6.0
R-2060	A	1.1	6.0
R-2060	B	1.2	6.0
R-2060	C	1.1	6.0
R-2060	E	1.1	6.0
R-2070	D	0.9	6.0
R-2070	B	1.2	6.0
R-2070	E	1.1	6.0
R-2077	B	1.2	6.0
R-2077	C	1.1	6.0
R-2077	D	1.0	6.0
R-2077	E	1.1	6.0
R-2077	F	0.6	6.0

CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-2080	D	1.0	5.9
R-2080	C	1.2	5.9
R-2090	A	1.1	5.0
R-2090	B	1.2	5.8
R-2090	C	1.2	5.8
R-2090	D	1.0	5.8
R-2090	E	1.1	5.8
R-2090	G	1.0	5.8
R-2100	A	1.1	5.8
R-2100	C	1.1	5.8
R-2100	E	1.1	5.8
R-2100	F	0.6	5.8
R-2110	A	1.1	5.8
R-2110	E	1.1	5.8
R-2112	A	1.1	5.8
R-2112	B	1.2	5.8
R-2112	C	1.1	5.8
R-2112	E	1.1	5.8
R-2112	F	0.6	5.8
R-2112	G	0.6	5.8
R-2120	A	1.1	5.8
R-2120	C	1.1	5.8
R-2120	F	0.6	5.8
R-2120	G	1.1	5.8
R-2250	G	3.0	9.9
R-2251	G	2.9	9.4
R-2255	C	1.4	8.4
R-2255	G	1.9	8.4
R-2270	G	1.9	8.4
R-2275	G	1.9	8.4
R-2290	K	1.2	7.6
R-2290-A	K	1.2	7.6
R-2290-B	K	1.0	7.5
R-2293	G	1.6	7.2
R-2296	B	1.2	6.7
R-2296	F	1.2	6.7
R-2297	B	1.2	6.7
R-2297	F	1.2	6.7
R-2298	B	1.2	6.7
R-2298	F	1.2	6.7
R-2299	B	1.2	6.7
R-2299	F	1.2	6.7
R-2300	G	1.2	6.8
R-2300	C	1.6	6.8
R-2370	B	1.2	6.8
R-2370	F	1.3	6.8
R-2370	A	1.1	6.8
R-2370	G	1.2	6.8
R-2371	G	1.2	6.7
R-2390	G	1.4	6.7
R-2390	C	1.5	6.7
R-2392	C	1.4	6.7
R-2392	G	1.4	6.7
R-2394	G	1.2	6.8
R-2395-1	G	1.6	6.6
R-2398	G	1.4	6.7
R-2401	G	1.4	6.8
R-2401	C	1.6	6.8
R-2401-A	G	1.2	6.5
R-2401-B	E	0.9	6.2
R-2402	G	0.7	6.5
R-2402	C	1.1	6.5
R-2404	G	1.1	6.7
R-2405	A	1.0	6.5
R-2405	C	1.6	6.5
R-2410	K	0.9	6.1
R-2411-A	G	0.7	6.6
R-2412-A	G	1.0	6.2
R-2412-A1	E	1.0	6.3
R-2412-A2	G	0.7	6.5
R-2412-A3	C	1.1	6.3
R-2412-A3	E	1.0	6.3
R-2412-A4	C	1.0	6.5
R-2412-A5	K	0.8	6.3
R-2412-A6	G	1.1	6.3
R-2414	D	1.0	6.1
R-2418	G	1.0	6.2
R-2418-A	K	1.0	6.3
R-2420-A	A	1.0	6.4
R-2420-B	G	1.1	5.9
R-2421-A	A	1.0	6.1

CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-2422-A	K	1.0	6.2
R-2422-C	G	1.0	6.2
R-2423	G	1.0	6.2
R-2424-A	G	0.9	5.9
R-2427	D	0.9	6.0
R-2427-A	G	1.0	6.2
R-2428	D	1.0	6.0
R-2428	C	1.1	6.0
R-2428	F	0.6	6.0
R-2429	D	1.0	5.9
R-2429	E	1.3	5.9
R-2429	G	1.2	5.9
R-2435	G	0.9	5.8
R-2437	D	1.0	5.9
R-2437	E	1.3	5.9
R-2437-B	G	0.9	5.8
R-2438	D	1.0	5.9
R-2438	E	1.3	5.9
R-2453	K	0.8	6.2
R-2461-A	A	1.1	5.8
R-2461-A	B	1.2	5.8
R-2461-A	C	1.1	5.8
R-2464	D	1.0	6.0
R-2466-A	B	1.2	5.8
R-2466-A	E	1.1	5.8
R-2467	C	1.1	5.9
R-2467	D	0.9	5.9
R-2471	D	0.9	5.9
R-2471-B	D	0.9	5.9
R-2474	A	1.1	5.7
R-2474	G	1.2	5.7
R-2475	A	1.1	5.8
R-2481	A	1.1	5.7
R-2494	G	0.8	5.1
R-2496	G	0.6	4.7
R-2498	G	0.4	4.1
R-2498-A	G	0.4	4.1
R-2498-B	G	0.4	4.1
R-2499	G	0.2	3.1
R-2500	G	0.9	6.2
R-2501	G	1.1	6.8
R-2502	D	0.9	6.0
R-2502	G	1.3	6.0
R-2504	G	1.3	6.0
R-2504	D	0.9	6.0
R-2510	C	1.3	5.8
R-2510-1	G	0.4	4.1
R-2510-2	G	1.6	7.2
R-2510-A	C	1.1	5.8
R-2525-A	E	0.2	3.1
R-2525-C	G	0.4	4.1
R-2525-D	G	0.4	4.1
R-2525-E	E	0.6	4.7
R-2525-F	G	0.8	5.4
R-2525-G	G	0.8	5.1
R-2533	A	1.1	5.8
R-2534	C	0.9	6.0
R-2535	C	1.1	5.8
R-2535-A	C	1.1	5.8
R-2540	D	1.1	5.9
R-2540-A	D	1.1	5.9
R-2545	K	0.4	4.7
R-2546	K	0.4	3.5
R-2548	V	0.8	6.7
R-2549	D	0.9	6.0
R-2552	K	0.8	6.2
R-2552-A	K	0.8	6.2
R-2552-B	K	0.8	6.2
R-2553	G	1.1	6.3
R-2554	G	1.1	6.3
R-2555	G	1.1	6.3
R-2556	G	1.5	6.7
R-2556-A	F	1.4	6.8
R-2557	G	2.0	8.4
R-2558	G	2.0	8.4
R-2559	F	1.4	6.8
R-2560-A	BEEHIVE	0.3	3.1
R-2560-B	BEEHIVE	0.2	4.1
R-2560-C	BEEHIVE	0.7	4.7
R-2560-C1	BEEHIVE	0.7	5.8
R-2560-C2	BEEHIVE	0.7	5.8

Type K indicates "Special" grate style and is not among standard types as illustrated.

For BEEHIVE grates, see note on page 44.

FREE OPEN AREAS AND WEIR PERIMETERS OF NEENAH GRATES (Continued)

CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-2560-D	BEEHIVE	1.0	5.1
R-2560-D1	BEEHIVE	1.2	5.8
R-2560-D2	BEEHIVE	1.2	5.8
R-2560-D3	BEEHIVE	1.2	5.8
R-2560-D5	BEEHIVE	1.0	5.1
R-2560-D6	BEEHIVE	1.0	5.1
R-2560-D7	BEEHIVE	1.3	5.3
R-2560-D8	BEEHIVE	1.3	5.3
R-2560-E	BEEHIVE	1.2	6.0
R-2560-EA	BEEHIVE	1.2	6.7
R-2560-EB	BEEHIVE	1.8	6.7
R-2560-E1	BEEHIVE	1.4	6.7
R-2560-E2	BEEHIVE	2.0	6.7
R-2560-E5	BEEHIVE	1.2	6.7
R-2560-E6	BEEHIVE	1.8	6.7
R-2560-E7	BEEHIVE	1.2	6.7
R-2560-E8	BEEHIVE	1.8	6.7
R-2560-E9	BEEHIVE	1.2	6.7
R-2560-E10	BEEHIVE	1.8	6.7
R-2560-G	BEEHIVE	1.5	8.4
R-2561	BEEHIVE	2.0	6.7
R-2561-A	BEEHIVE	1.2	6.7
R-2563	BEEHIVE	1.2	5.8
R-2564	BEEHIVE	1.0	5.8
R-2565-A	G	0.9	5.5
R-2565-C	G	1.2	6.0
R-2565-E	G	1.8	7.1
R-2565-F	G	1.8	7.1
R-2565-G	G	1.7	7.1
R-2565-H	G	1.2	7.6
R-2565-J	G	1.8	8.5
R-2569	A	0.6	5.3
R-2570	G	0.8	5.4
R-2571-A	F	0.9	5.8
R-2571-B	F	1.1	5.8
R-2571-C	F	0.9	5.8
R-2571-D	F	0.7	6.0
R-2571-D1	F	1.2	6.7
R-2571-D2	F	1.2	6.7
R-2571-D3	F	1.2	6.7
R-2571-D4	F	1.2	6.7
R-2571-E	F	1.2	6.8
R-2572	F	1.3	6.7
R-2573	F	1.3	6.7
R-2574	B	0.9	6.2
R-2577	B	1.0	6.7
R-2578	C	1.0	6.0
R-2579	B	1.3	5.8
R-2580-A1	C	1.1	8.4
R-2580-A	G	1.9	8.4
R-2580-C	G	3.0	9.9
R-2586-A	E	0.4	3.8
R-2586-B	G	0.5	4.2
R-2586-C	E	0.6	4.7
R-2586-D	G	0.8	5.2
R-2586-E	G	0.8	5.1
R-2586-F	G	0.8	5.4
R-2586-G	G	1.0	5.8
R-2586-H	E	1.3	6.0
R-2586-K	G	1.3	6.3
R-2586-M	G	1.8	7.0
R-2586-N	G	1.7	7.9
R-2586-O	G	1.9	8.4
R-2588-A	G	1.1	5.8
R-2588-B	G	1.0	6.5
R-2588-C	G	1.9	7.6
R-2595-A	D	1.2	6.0
R-2600	K	1.1	6.8
R-2650	G	1.1	6.7
R-2668	C	0.9	6.2
R-2680	G	1.1	6.2
R-2682	A	1.5	7.3
R-2750	Q	1.8	8.3
R-3010	S	1.0	4.6
R-3010	A	1.0	4.6
R-3010	L	0.9	4.6
R-3010	DIAGONAL	1.1	4.6
R-3010	D	1.3	4.6
R-3015	L	0.9	4.6
R-3015	DIAGONAL	1.1	4.6

CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-3030	A	1.0	4.6
R-3030	D	1.3	4.6
R-3030	DIAGONAL	1.1	4.6
R-3030	L	0.9	4.6
R-3031-B	S	0.8	4.8
R-3032-B	S	0.8	4.8
R-3033-B	S	0.8	4.8
R-3034-B	S	1.1	4.8
R-3035-A	S	1.1	4.8
R-3036-B	S	1.1	7.4
R-3037-A	S	1.6	5.8
R-3038-A	S	1.5	4.8
R-3039-A	S	1.5	5.0
R-3065	DIAGONAL	0.9	4.9
R-3065-L	L	0.8	4.5
R-3065-V	V	1.3	4.5
R-3066	DIAGONAL	1.4	5.3
R-3067	DIAGONAL	1.9	5.9
R-3067-C	C	2.1	5.8
R-3067-L	L	1.6	5.9
R-3067-V	V	1.8	5.9
R-3070	A	0.9	4.5
R-3070	D	1.0	4.5
R-3070	L	0.8	4.5
R-3070	DIAGONAL	0.9	4.5
R-3070	V	1.3	4.5
R-3075	DIAGONAL	0.9	4.5
R-3075-L	L	0.8	4.5
R-3075-V	V	1.3	4.5
R-3076	V	1.5	5.4
R-3077	V	3.0	12.9
R-3077-L	V	1.5	7.9
R-3077-R	V	1.5	7.9
R-3078	V	1.5	2.5
R-3079	L	1.4	5.5
R-3157-1	A	1.1	5.2
R-3157-2	V	1.5	5.2
R-3157-A	K	2.1	6.0
R-3159-A	S	1.3	4.9
R-3161	S	1.3	4.7
R-3165	A	1.4	4.5
R-3169	B	0.7	3.5
R-3170	B	0.7	3.5
R-3203-A	A OR C	1.0	6.6
R-3203-B	A OR C	1.0	6.6
R-3203-C	A OR C	1.0	6.6
R-3205	K	0.9	6.5
R-3210-A	C	1.5	8.0
R-3210-L	L	1.5	7.9
R-3210-Q	Q	0.8	8.0
R-3220	C	1.5	8.0
R-3220-L	L	1.5	6.0
R-3222-C	C	1.4	5.6
R-3222-LA	L	1.0	5.6
R-3222-1A	L	1.0	7.6
R-3227	D	2.3	8.5
R-3227-C	C	1.9	8.5
R-3227-D	DIAGONAL	2.3	8.5
R-3228-BD	DIAGONAL	2.3	6.0
R-3228-G	D	2.2	6.0
R-3228-H	C	1.9	6.0
R-3228-J	D	2.2	6.0
R-3228-K	C	1.9	6.0
R-3229-A	C	1.5	8.0
R-3229-L	L	1.5	6.0
R-3233	A	2.8	6.4
R-3233-D	A	2.8	6.4
R-3234-B1	C	1.3	5.3
R-3235	C	0.7	4.4
R-3236	C	1.2	5.0
R-3236-1	C	1.2	5.0
R-3236-A	C	1.2	4.9
R-3236-B	C	1.2	4.9
R-3237	C	1.3	4.9
R-3237-1	C	1.3	4.9
R-3237-A	C	1.3	4.9
R-3237-B	C	1.3	4.9
R-3238	C	1.3	7.4
R-3246	C	1.6	5.8
R-3246-A	C	2.2	6.9
R-3246-A	DIAGONAL	2.7	7.0

CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-3246-AL	L	3.1	7.0
R-3246-CC	C	1.8	5.9
R-3246-CL	L	1.6	5.9
R-3246-E	C	1.8	5.9
R-3246-F	C	1.8	5.9
R-3247-2D	DIAGONAL	3.8	12.3
R-3249-F	S	1.1	4.7
R-3250-A	K	1.5	6.7
R-3250-1	K	1.5	7.8
R-3250-B	K	1.4	7.1
R-3250-C	K	1.4	7.1
R-3250-BL	L	1.0	7.1
R-3250-BSP	V	1.3	7.1
R-3250-CL	L	1.0	7.1
R-3250-BV	V	1.3	7.1
R-3250-CV	V	1.3	7.1
R-3250-DV	V	1.3	7.1
R-3251	C	1.0	6.3
R-3252-A	V	1.3	5.7
R-3260-A	A	3.2	8.0
R-3261-A1	C	1.1	5.0
R-3266	V	0.6	7.3
R-3270	A	0.9	4.4
R-3273-A	C	1.2	4.7
R-3274	C	1.2	4.9
R-3274-A	C	1.4	4.9
R-3274-B	C	1.4	4.9
R-3275	A	1.0	4.6
R-3278-A	C	1.2	4.6
R-3278-AL	L	0.7	4.6
R-3280-A	C	1.8	5.5
R-3280-B	C	1.2	4.5
R-3281-A	C	1.0	4.3
R-3281-AL	L	0.5	4.3
R-3286-8V	V	0.7	4.4
R-3287-5	V	3.6	10.6
R-3287-10V	V	2.1	5.5
R-3287-15	V	3.6	6.9
R-3287-SB10	S	1.5	5.5
R-3288-E2	DIAGONAL	2.6	7.6
R-3288-HV2	V	2.8	7.6
R-3289-HV	V	1.4	5.2
R-3289-C	DIAGONAL	1.3	5.2
R-3290	C	1.6	5.8
R-3290-A	C	2.6	9.9
R-3290-B	D	3.5	9.9
R-3290-C	D	3.7	11.0
R-3291	C	1.7	9.0
R-3292	C	1.6	5.8
R-3295	L	2.1	5.9
R-3295-2	L	4.2	8.8
R-3295-3	L	6.4	11.8
R-3297-1	C	2.3	7.5
R-3337-A	C	1.1	6.0
R-3338-F	A	1.4	6.5
R-3338-G	A	2.8	9.5
R-3339	C	1.6	7.8
R-3339-A	A or C	1.8	8.5
R-3340-B	C	1.3	6.8
R-3340-D	C	1.2	7.5
R-3341	K	0.3	3.2
R-3342	K	0.5	4.4
R-3344	K	1.1	6.2
R-3345	K	1.1	6.8
R-3346	K	1.4	8.9
R-3347	K	1.3	7.4
R-3347-A	K	2.3	10.4
R-3348	K	1.9	8.0
R-3349-A	K	1.8	7.7
R-3350	K	2.2	9.3
R-3351	K	2.7	9.3
R-3356-A	K	1.5	7.6
R-3357-A	K	2.0	8.7
R-3359	K	1.1	7.3
R-3360-A	K	1.6	7.8
R-3361	K	3.4	12.7
R-3362	C	2.3	10.3
R-3362-L	L	2.9	10.3
R-3362-1	C	2.3	7.0
R-3363-1	C	4.6	10.3
R-3381	K	1.0	6.8

Type K indicates "Special" grate style and is not among standard types as illustrated.

For BEEHIVE grates, see note on page 44.

FREE OPEN AREAS AND WEIR PERIMETERS OF NEENAH GRATES (Continued)

CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-3382	K	2.3	10.4
R-3393-A	K	2.0	8.7
R-3396	K	3.2	11.4
R-3397	A	1.1	7.2
R-3397-1	V	1.5	7.2
R-3401	D	1.9	7.6
R-3401-B	B	3.8	11.2
R-3401-C	B	5.7	14.7
R-3402	A or C	0.4	4.0
R-3402-E	A or C	2.1	8.0
R-3403	A or C	1.1	6.5
R-3403-A1	A	1.5	8.3
R-3403-F	A	3.2	10.6
R-3404	A or C	1.4	7.2
R-3405	A or C	1.5	7.9
R-3405-A	A or C	1.3	8.0
R-3405-B	A or C	1.3	8.0
R-3406	C	1.8	9.8
R-3406-A	C	1.8	9.8
R-3406-2	C	3.7	15.9
R-3406-A2	C	3.7	15.9
R-3408-L	L	1.2	7.3
R-3408-AL	L	2.4	9.7
R-3408-BL	L	2.4	12.5
R-3409	C	1.5	7.6
R-3413	C	1.5	9.0
R-3415	A	4.1	13.5
R-3416	A	1.4	9.8
R-3420	A	1.2	10.0
R-3423	B	1.6	9.9
R-3425-A	K	2.1	9.4
R-3425-B	K	2.1	9.4
R-3429-A	A or C	1.0	6.0
R-3430	A or C	0.9	6.6
R-3433	A or C	1.5	8.0
R-3437	C	3.3	12.0
R-3438-A	A or C	7.0	16.6
R-3448-B	C	1.1	6.8
R-3448-C	C	0.9	6.8
R-3448-D	S	1.2	6.8
R-3449	C	0.9	6.8
R-3451	C	1.5	7.3
R-3451-B	C	1.7	7.8
R-3454	A	4.1	13.2
R-3454-B	D	2.5	9.9
R-3454-BL	L	3.1	7.0
R-3455-A	A	2.6	9.8
R-3455-C	A	2.6	10.0
R-3457-C2	B	6.0	14.0
R-3460-A	A	0.8	6.0
R-3460-D	C	0.8	6.0
R-3461	C	1.5	8.0
R-3462-B	DIAGONAL	1.8	7.6
R-3463-B	DIAGONAL	3.5	12.6
R-3465	A	0.8	6.0
R-3466-A	A	0.8	6.0
R-3469	A	2.7	9.2
R-3469-E2	B or D	2.3	9.2
R-3470	L	2.2	8.4
R-3470-2	L	4.4	12.4
R-3471	C	0.6	5.8
R-3472	A or C	1.3	7.3
R-3473	C	0.9	6.3
R-3475	A	2.7	9.8
R-3475-1	A	2.7	9.8
R-3475-3	A	4.1	13.7
R-3475-E	A	2.4	9.8
R-3475-F	C	4.8	13.8
R-3475-G	C	7.2	17.8
R-3475-H	C	9.6	21.8
R-3477-A	C	3.3	12.3
R-3480	C	3.3	12.7
R-3480-A	A	1.6	8.5
R-3491-A	G	0.9	5.5
R-3491-G	G	1.7	7.1
R-3491-H	G	1.2	7.6
R-3491-J	G	1.8	8.5
R-3492-1	G	0.8	7.0
R-3492-BG	G	2.6	9.9
R-3492-CG	G	2.6	9.9
R-3493-C	G	0.6	6.2

CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-3501-D2A	M	1.0	3.4
R-3501-E2	M	1.4	4.2
R-3501-HL	M	3.3	5.8
R-3501-H4	M	3.0	5.8
R-3501-L1A	M	1.2	4.4
R-3501-M	M	2.3	5.6
R-3501-N	M	1.6	4.3
R-3501-P	M	1.5	4.3
R-3501-R	M	2.6	5.5
R-3501-TL	M	1.4	4.6
R-3501-TR	M	1.4	4.6
R-3502-A	M	1.4	4.1
R-3502-B	M	1.4	4.2
R-3502-D2	M	1.9	4.2
R-3503-A	M	1.3	4.1
R-3503-B	M	2.0	4.1
R-3504-F	M	2.8	5.1
R-3506-A2	M	1.4	2.9
R-3506-B	M	1.2	2.9
R-3507-C	M	1.6	3.7
R-3507-D	M	1.6	3.7
R-3508-A2	M	1.7	3.8
R-3508-B	M	1.8	3.8
R-3508-B1	M	1.9	3.8
R-3508-B2	M	1.4	7.5
R-3508-C	M	1.4	3.8
R-3509	M	0.9	2.8
R-3510	M	2.9	4.1
R-3511	M	2.0	2.9
R-3513	M	1.4	4.7
R-3514-F	M	2.6	5.5
R-3514-F2	M	5.1	7.7
R-3516	M	4.0	6.2
R-3516-1	M	2.0	4.3
R-3517	M	1.8	3.7
R-3526-1	K	1.8	6.7
R-3527-M	V	1.6	11.3
R-3527-V	V	0.8	5.6
R-3528-V	V	0.8	7.5
R-3529-V	V	1.6	11.3
R-3531-A	A or C	6.0	13.0
R-3531-B	A or C	6.0	13.0
R-3531-C	A or C	3.0	9.1
R-3531-D	A or C	3.0	9.1
R-3531-E	A or C	4.7	12.7
R-3540	L	3.2	10.6
R-3540-2	L	6.4	16.3
R-3541	L	1.6	7.3
R-3541-2	L	3.2	11.3
R-3550-2	L	5.8	15.2
R-3560	L	1.5	8.4
R-3561	L	2.3	10.4
R-3562	L	1.5	8.7
R-3570	A	2.4	7.4
R-3570-A	A	2.4	7.4
R-3571	A	2.4	7.4
R-3571-A	A	2.4	7.4
R-3572-A	DIAGONAL	4.4	12.4
R-3572-2D	DIAGONAL	3.8	12.3
R-3573-2D	DIAGONAL	3.8	12.3
R-3573-2L	L	4.6	12.3
R-3573-2Q	Q	1.8	12.3
R-3574-2D	DIAGONAL	3.8	12.3
R-3574-2L	L	4.6	12.3
R-3574-2Q	Q	1.8	12.3
R-3575	B	2.6	9.5
R-3576	DIAGONAL	2.4	9.3
R-3577	D	1.8	9.2
R-3578	L	2.3	10.9
R-3580	L	1.4	7.9
R-3580-1	L	2.8	12.9
R-3581	V	2.2	9.3
R-3588	D	1.8	7.9
R-3588-A	A	1.2	7.9
R-3588-LL	L	1.6	7.9
R-3588-LL4	L	1.6	7.9
R-3588-LR	L	1.6	7.6
R-3588-LR4	L	1.6	7.6
R-3589	D	1.8	7.9
R-3589-A	A	1.2	7.9
R-3589-LL	L	1.5	7.9

CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-3589-LL4	L	1.5	7.9
R-3589-LR	L	1.5	7.9
R-3589-LR4	L	1.5	7.9
R-3591	A	1.5	8.0
R-3593	C	2.5	12.3
R-3599-A	L	0.1 per ft.	6.0
R-3807	K	6.0	13.4
R-3808-1	C	5.2	12.3
R-3808-2	C	10.3	19.9
R-3900-B	L	1.9	7.7
R-3900-C	L	3.8	11.8
R-3900-D	L	5.7	16.0
R-3919	DIAGONAL	1.4	6.9
R-3920-V	V	0.9	4.2
R-3921-V	V	1.0	5.0
R-3922	V	0.8	5.9
R-3922-A	V	0.8	5.0
R-3924	B	2.3	8.4
R-3928	B	0.5	1.9
R-3930	B or D	0.3	3.0
R-3931	B or D	0.3	3.0
R-3935	A or C	0.6	5.3
R-3936-A	C	1.0	6.5
R-3940	A	1.0	6.1
R-3942	V	0.8	5.1
R-3943	V	1.2	6.9
R-3945	L	2.4	13.0
R-3948-A	C	1.1	5.1
R-3948-V	V	1.5	5.1
R-3951	L	1.6	9.0
R-3952	D	1.1	6.3
R-3954	B	1.8	8.1
R-3961	D	0.7	5.2
R-3976	B	0.2	3.3
R-3977	B	0.1	2.6
R-4001-B	C	0.3	2.5
R-4003-A	A	0.9	6.1
R-4003-B	A	0.9	6.1
R-4003-C	A	0.9	6.1
R-4004-A	C	1.3	6.8
R-4004-B	B	1.5	7.4
R-4004-C	B	1.5	7.4
R-4004-G1	D	1.9	7.3
R-4005-A2	B or D	0.4	4.3
R-4006	B or D	0.3	3.1
R-4007	B or D	0.4	4.3
R-4007-A6	B or D	0.4	4.3
R-4008-B	B or D	0.4	4.3
R-4014-B1	C	2.8	9.7
R-4014-C1	C	2.4	8.4
R-4014-T	D	1.3	7.4
R-4014-TL	L	0.5	7.3
R-4014-T1	D	0.8	5.0
R-4015-A	B	0.2	3.3
R-4015-A1	B	0.2	3.3
R-4015-B	C	0.4	3.3
R-4015-C	B	0.2	3.3
R-4015-D	B	0.2	3.3
R-4016-B	C	0.5	4.8
R-4016-H1	A	0.6	5.3
R-4016-K	D	1.1	6.3
R-4018	B	0.2	3.8
R-4030-4	G	0.1	1.4
R-4030-6	G	0.1	2.1
R-4030-8	G	0.2	2.7
R-4030-10	G	0.3	3.3
R-4030-12	G	0.4	3.7
R-4030-15	G	0.8	4.8
R-4030-18	B	1.1	5.8
R-4030-21	B	1.3	6.7
R-4030-24	B	2.1	7.6
R-4030-27	G	2.8	3.0
R-4030-30	G	3.5	3.3
R-4040-6	E	0.1	2.1
R-4040-8	E	0.2	2.7
R-4040-10	E	0.3	3.3
R-4040-12	E	0.4	3.7
R-4040-15	E	0.7	4.8
R-4040-18	E	1.2	5.8
R-4040-21	G	1.4	6.7

Type K indicates "Special" grate style and is not among standard types as illustrated.
Type M indicates roll-type or mountable curb.

For BEEHIVE grates, see note on page 44.

FREE OPEN AREAS AND WEIR PERIMETERS OF NEENAH GRATES (Continued)

CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-4040-24	G	1.6	7.6
R-4040-27	G	2.3	3.0
R-4040-30	G	2.9	3.3
R-4215-A	BEEHIVE	2.0	9.0
R-4215-C	BEEHIVE	3.3	11.3
R-4216-B	BEEHIVE	2.2	4.1
R-4216-D	BEEHIVE	3.0	3.8
R-4340-A	BEEHIVE	1.5	6.2
R-4340-B	BEEHIVE	1.1	6.0
R-4340-C	BEEHIVE	1.2	6.0
R-4340-F	BEEHIVE	1.6	6.5
R-4340-F1	BEEHIVE	0.7	4.5
R-4340-G	BEEHIVE	0.6	5.0
R-4340-H	BEEHIVE	0.5	4.5
R-4341-A	BEEHIVE	2.5	6.0
R-4342	BEEHIVE	2.0	6.0
R-4343	BEEHIVE	2.4	8.4
R-4344	BEEHIVE	0.2	2.9
R-4345	BEEHIVE	2.0	8.6
R-4346	BEEHIVE	2.0	8.6
R-4349-A	BEEHIVE	2.4	11.1
R-4349-B	BEEHIVE	5.4	15.5
R-4349-C	BEEHIVE	2.4	6.9
R-4349-D	BEEHIVE	5.4	10.2
R-4350-1	BEEHIVE	0.3	2.7
R-4350-A	BEEHIVE	0.3	3.1
R-4350-B	BEEHIVE	0.4	3.9
R-4350-C	BEEHIVE	0.6	4.8
R-4350-D	BEEHIVE	1.0	5.8
R-4350-E	BEEHIVE	1.7	7.6
R-4351-B	BEEHIVE	0.5	3.9
R-4351-D	BEEHIVE	1.6	5.8
R-4351-E	BEEHIVE	1.5	5.8
R-4352	BEEHIVE	1.3	5.8
R-4353	BEEHIVE	1.8	6.7
R-4360-A	BEEHIVE	0.6	4.3
R-4360-B	BEEHIVE	0.8	4.7
R-4360-C	BEEHIVE	1.4	4.5
R-4360-D	BEEHIVE	0.7	6.3
R-4370-1	C	0.1	1.7
R-4370-2	G	0.2	2.5
R-4370-3	E	0.4	3.9
R-4370-4	G	0.6	3.9
R-4370-5	G	0.8	4.7
R-4370-6	G	0.8	5.1
R-4370-7	G	0.8	5.2
R-4370-8	E	1.0	5.5
R-4370-9	C	1.3	5.8
R-4370-10	G	1.1	5.8
R-4370-12	F	0.9	5.8
R-4370-13	G	1.3	5.8
R-4370-15	D	1.0	5.9
R-4370-17	D	0.9	6.0
R-4370-18	E	1.3	6.0
R-4370-21	D	0.9	6.0
R-4370-22	D	1.1	6.0
R-4370-23	G	0.9	6.3
R-4370-25	G	2.0	7.6
R-4370-26	G	1.7	8.6
R-4370-27A	G	2.4	9.9
R-4373-2	K	1.0 sq. in.	0.7
R-4373-3	K	1.0 sq. in.	1.0
R-4373-4	K	3.0 sq. in.	1.2
R-4373-6	K	3.0 sq. in.	1.8
R-4373-8	K	4.0 sq. in.	2.4
R-4373-10	K	5.0 sq. in.	2.9
R-4373-12	K	8.0 sq. in.	3.4
R-4373-15	K	20.0 sq. in.	4.2
R-4380-AA1	E	2.8 sq. in.	1.0
R-4380-A	E	3.7 sq. in.	1.1
R-4380-A1	E	6.0 sq. in.	1.2
R-4380-B1	E	4.8 sq. in.	1.3
R-4380-1	E	5.4 sq. in.	1.4
R-4380-3	E	6.0 sq. in.	1.6
R-4380-4	E	0.1	2.1
R-4380-4A1	E	0.1	2.2
R-4380-4A	E	0.2	2.6
R-4380-6	G	0.2	2.8
R-4380-7	G	0.3	3.1
R-4380-8	E	0.3	3.3
R-4380-9	E	0.4	3.7

CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-4380-10	E	0.5	3.9
R-4380-11	E	0.5	3.9
R-4380-12	E	0.6	4.0
R-4380-13	G	0.7	4.2
R-4380-13A	E	0.9	4.7
R-4380-14	E	0.7	4.7
R-4380-15	E	0.6	4.7
R-4380-16	E	0.8	5.0
R-4380-17	E	0.8	5.0
R-4380-18	G	0.7	5.2
R-4380-21	G	1.3	6.3
R-4380-22	G	1.5	7.0
R-4380-23	G	1.1	7.3
R-4380-24	G	1.7	7.9
R-4380-25	G	2.5	8.4
R-4380-26	G	2.7	8.8
R-4385-B	E	0.1	2.1
R-4385-C	E	0.3	2.7
R-4385-E	E	0.5	3.9
R-4385-F	E	0.5	4.8
R-4385-G	E	1.0	5.8
R-4385-H	G	1.6	7.6
R-4385-J	G	2.5	8.6
R-4385-K	G	2.7	9.4
R-4389-O	B	0.2	3.0
R-4390	B	0.3	5.0
R-4400	B	0.1	2.7
R-4401	A	0.1	2.7
R-4403	A	0.3	3.7
R-4404-C	B	0.5	5.3
R-4406	B	0.5	5.3
R-4406-C	A	0.4	5.5
R-4406-1	A	0.5	5.3
R-4406-2	C	0.6	5.3
R-4407-2A	B	0.6	5.6
R-4408	B	0.3	3.4
R-4409	A	0.4	4.6
R-4409-A	C	0.7	5.7
R-4409-C	B	0.5	5.7
R-4409-E	A	0.5	5.7
R-4409-G	B	0.8	5.7
R-4410	B	0.8	6.5
R-4421	C	1.0	8.3
R-4423-A	A	1.2	9.7
R-4424	A	0.6	5.6
R-4430-A	A	0.6	6.0
R-4430-B	C	0.7	5.9
R-4435-1	C	0.8	4.3
R-4441-1	Q	0.2	4.0
R-4443	A	0.4	4.3
R-4449	A	0.8	6.0
R-4450	A	0.8	6.0
R-4450-A	A	0.6	6.0
R-4451	C	0.7	6.0
R-4454	C	0.9	6.3
R-4460	A	0.8	7.0
R-4462	B	0.9	7.8
R-4470	A	1.5	10.0
R-4511	A	0.5	4.7
R-4525	A	0.8	6.3
R-4530	A	0.8	6.1
R-4531	A	0.8	6.4
R-4540	C	1.0	6.8
R-4541	A	1.0	7.1
R-4544	A	1.8	8.7
R-4545	A	1.6	10.4
R-4548	A	1.0	5.9
R-4550	C	0.8	5.0
R-4552	A	0.6	5.3
R-4557	A	0.8	5.3
R-4558	C	1.1	5.9
R-4570-1	A	0.9	6.3
R-4570-2	A	0.9	6.5
R-4573	A	1.1	7.5
R-4575-A	A	1.7	8.5
R-4579	A	0.8	6.4
R-4583	A	0.9	6.3
R-4584	A	1.3	4.3
R-4585	A	1.9	9.1
R-4586	A	1.5	8.6
R-4600	A	0.9	6.5

CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-4603-A	A	0.8	6.7
R-4604	C	1.3	6.7
R-4604-C	A	0.7	6.7
R-4604-D	A	1.5	6.7
R-4608	A	0.8	6.0
R-4610	A	1.0	6.4
R-4620	A	0.8	6.0
R-4630	C	0.9	6.2
R-4632	C	1.1	6.3
R-4640	A	1.3	6.4
R-4641-A	A	1.2	6.8
R-4641-C	C	1.1	6.8
R-4641-F	A	1.8	8.5
R-4649	A	1.1	6.9
R-4649-1	C	2.2	10.0
R-4652	A	1.5	7.9
R-4660	C	1.1	6.0
R-4662	A	1.3	6.6
R-4670-A	A	1.1	7.0
R-4671	A	1.1	7.0
R-4672	C	1.1	7.0
R-4689	C	1.4	7.5
R-4692-A	D	2.0	8.7
R-4698	A	1.7	9.0
R-4710	C	1.5	9.0
R-4711	C	1.1	9.5
R-4718	A	2.7	9.3
R-4720	C	0.9	6.7
R-4721-A	A	1.2	7.0
R-4725	C	1.6	7.0
R-4730	A	2.0	8.6
R-4731	A	2.5	9.8
R-4732	A	2.0	9.8
R-4736	C	1.1	7.3
R-4738	A	1.1	7.3
R-4739	C	1.3	7.3
R-4740	C	2.1	8.0
R-4750	C	2.4	8.3
R-4750-1	A	2.8	11.3
R-4751	C	1.9	7.9
R-4752	C	2.3	9.4
R-4755-B	A	2.8	10.5
R-4755-C	C	2.9	10.5
R-4759	C	1.5	7.5
R-4760	C	1.7	7.3
R-4762	C	2.4	8.7
R-4765	A	1.4	7.7
R-4780	C	3.1	9.8
R-4781	C	3.0	11.7
R-4795	A	3.2	11.3
R-4798	C	2.4	9.9
R-4808-A	Q	0.8	8.0
R-4810	C	1.5	8.0
R-4820	C	1.5	8.0
R-4821-A	C	1.7	8.3
R-4825	C	1.8	9.0
R-4825-A	A	2.1	9.0
R-4825-B	C	2.0	9.0
R-4826	A	1.3	8.0
R-4828	A	1.9	9.5
R-4829	C	2.2	9.5
R-4832	C	1.5	8.0
R-4832-B	C	1.8	8.7
R-4833	A	2.3	8.7
R-4837	A	2.2	9.8
R-4839	A	2.1	9.9
R-4840	C	2.8	10.0
R-4843	A	2.6	10.0
R-4850	C	2.7	9.0
R-4852	C	2.0	9.0
R-4852-A	Q	1.8	9.0
R-4853	A	2.5	10.5
R-4853-A	A	3.1	11.5
R-4853-B1	C	3.3	12.5
R-4855	A	2.0	9.3
R-4856	C	3.1	9.7
R-4857	A	3.1	12.3
R-4859-C	A	2.4	9.1
R-4871	B	2.7	9.2
R-4880	C	2.5	9.3
R-4880-C	C	2.2	10.0

Type K indicates "Special" grate style and is not among standard types as illustrated.

For BEEHIVE grates, see note on page 44.

FREE OPEN AREAS AND WEIR PERIMETERS OF NEENAH GRATES (Continued)

CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-4882	A	4.0	11.3
R-4882-A	A	2.8	11.3
R-4884-A	C	3.3	6.0
R-4890	C	3.4	10.8
R-4891	A	3.5	13.0
R-4893	C	6.0	18.0
R-4893-B	C	1.9	11.0
R-4894	C	3.3	11.5
R-4895-2	A	6.6	17.0
R-4938	A	0.8	6.9
R-4938-1	A	1.5	8.2
R-4938-B	A	0.2	3.2
R-4939-B	K	4.7 sq. in.	3.0
R-4941-A	B	0.4	4.7
R-4942-A	A	0.7	6.5
R-4943	K	0.3	5.4
R-4943-A	K	0.3	5.4
R-4943-B	K	0.3	5.4
R-4976-1	A	0.9	3.1
R-4976-1	B	0.9	3.1
R-4976-2	A	1.5	4.2
R-4976-2	B	1.5	4.2
R-4976-3	A	2.5	5.2
R-4976-3	B	2.5	5.2
R-4976-4	A	3.7	6.3
R-4976-4	B	3.7	6.3
R-4976-5	B	5.2	8.1
R-4977-1	A	1.5	4.0
R-4977-1	B	1.5	4.0
R-4977-2	A	2.0	5.0
R-4977-2	B	2.0	5.0
R-4977-3	A	3.7	10.0
R-4977-3	B	3.7	10.0
R-4977-4	A	5.3	12.0
R-4977-4	B	5.3	12.0
R-4977-5	A	8.0	15.0
R-4977-5	B	8.0	15.0
R-4990-AA	A	0.2 ·	2.0
R-4990-AX	A	0.2 ·	2.0
	C	0.3 ·	2.0
	P	0.1 ·	2.0
R-4990-BA	A	0.3 ·	2.0
R-4990-BX	A	0.3 ·	2.0
	C	0.3 ·	2.0
	P	0.1 ·	2.0
R-4990-CA	A	0.4 ·	2.0
R-4990-CX	A	0.4 ·	2.0
	C	0.4 ·	2.0
	P	0.1 ·	2.0
R-4990-DA	A	0.4 ·	2.0
R-4990-DX	A	0.4 ·	2.0
	C	0.5 ·	2.0
	P	0.2 ·	2.0
R-4990-EA	A	0.5 ·	2.0
R-4990-EX	A	0.6 ·	2.0
	C	0.5 ·	2.0
	P	0.2 ·	2.0
R-4990-FA	A	0.6 ·	2.0
R-4990-FX	A	0.7 ·	2.0
	C	0.8 ·	2.0
	P	0.5 ·	2.0
R-4990-GX	A	0.8 ·	2.0
	C	0.7 ·	2.0
R-4990-HA	A	0.9 ·	2.0
R-4990-HX	A	0.9 ·	2.0
	C	0.9 ·	2.0
R-4990-JX	A	1.0 ·	2.0
	C	1.1 ·	2.0
R-4990-KA2	A	0.6 ·	2.0
R-4990-KX	A	1.1 ·	2.0
	C	0.9 ·	2.0
R-4990-LX	A	1.2 ·	2.0
	C	1.2 ·	2.0
R-4990-MX	A	1.3 ·	2.0
	C	1.3 ·	2.0
R-4990-NX	A	1.5 ·	2.0
	C	1.6 ·	2.0
R-4990-OA	A	2.7 ·	2.0
R-4990-OX	A	1.7 ·	2.0
	C	NA ·	2.0

CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-4995-A1	B	0.2 ·	2.0
	C	0.3 ·	2.0
R-4995-A2	B	0.2 ·	2.0
R-4996-A1	Diagonal Convex	0.3 ·	2.0
	C	0.3 ·	2.0
R-4996-A2	B	0.2 ·	2.0
R-4996-A3	C	0.3 ·	2.0
R-4999-Series Same as R-4990 Series.			
R-4999-L2	L	0.7 ·	2.0
R-4999-L3	L	0.3 ·	2.0
R-4999-L6	L	0.8 ·	2.0
R-4999-L9	L	0.9 ·	2.0
R-5901-A	G	0.2	2.7
R-5901-B	G	0.3	3.5
R-5901-C	G	0.5	4.3
R-5901-D	G	0.7	4.8
R-5901-E	G	1.1	5.8
R-5901-F	G	1.6	6.6
R-5901-G	G	2.0	7.4
R-5901-H	G	2.5	8.9
R-5901-J	G	3.7	10.5
R-5901-K	G	4.8	12.1
R-6020	G	1.0	5.6
R-6040	G	1.3	6.2
R-6070	G	1.5	6.9
R-6077	G	2.5	8.3
R-6080	G	2.7	8.7
R-6110	G	0.9	5.5
R-6111	G	1.2	6.0
R-6112	G	1.3	6.0
R-6113	G	0.9	6.3
R-6114	G	1.8	7.0
R-6115	G	1.7	7.0
R-6116	G	1.2	7.6
R-6117	G	1.8	8.5
R-6118	G	2.6	9.9
R-6130	G	0.8	5.4
R-6131	G	1.0	5.6
R-6132	G	1.3	6.3
R-6133	G	1.3	6.5
R-6134	G	1.5	6.9
R-6136	G	2.5	8.3
R-6137	G	2.7	8.8
R-6352-A	G	0.4	3.4
R-6352-B	G	0.8	4.2
R-6352-D	G	0.7	4.9
R-6352-E	G	0.8	5.5
R-6352-G	G	1.3	6.5
R-6400-AO	G	0.3	3.1
R-6400-BO	G	0.8	5.0
R-6400-CO	G	1.8	7.0
R-6400-DO	G	1.2	7.6
R-6450-AG	G	0.2	2.4
R-6450-BG	G	0.2	3.1
R-6450-CG	G	0.4	3.4
R-6450-DG	G	0.5	4.2
R-6450-EG	G	0.7	5.4
R-6450-FG	G	0.1	5.6
R-6450-GG	G	1.3	6.3
R-6450-HG	G	1.3	6.9
R-6450-JG	G	1.9	8.3
R-6450-KG	G	2.7	8.8
R-6672-1	A or C	0.4	3.9
R-6672-A	A or C	0.8	4.1
R-6672-B	A or C	0.5	4.6
R-6672-C	A or C	0.8	6.0
R-6672-D	A or C	1.1	7.3
R-6672-E	A or C	1.8	7.9
R-6672-F	A or C	2.7	8.6
R-6672-G	A or C	2.2	9.0
R-6672-H	A or C	2.1	9.2
R-6672-J	A or C	2.4	10.0
R-6672-K	A or C	2.5	10.6
R-6672-M	A or C	3.0	12.3
R-6672-Q	A or C	9.3	18.8

CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-6673-A	A	0.6	5.7
R-6673-B	A	0.9	6.5
R-6673-C	A	1.2	7.5
R-6673-D	A	2.1	8.6
R-6673-E	A	2.5	9.6
R-6673-J	A	2.6	9.5
R-6673-K	A	2.9	10.6
R-6673-L	A	3.7	12.6
R-6673-N	A	3.3	11.6
R-6673-O	A	4.9	13.5
R-6673-Q1	A	5.0	14.7
R-7511	BEEHIVE	1.1	5.5

· **NOTE:** On catalog #'s R-4990-AA thru R-4999-L9, SQ.FT.OPEN and WEIR PERIMETER are per lineal foot.

Type K indicates "Special" grate style and is not among standard types as illustrated.

For BEEHIVE grates, see note on page 44.

WEIR FLOW

(Determines how much water flows to the grate)

One of the most accurate methods of measuring water is by use of a weir. Many weir configurations are around with just about as many equations. They are all adaptations of the general weir equation $Q = 3.33\ L\ (h^{1.5})$ where Q = flow in cubic feet per second, L = length of crest of weir in feet, and h = feet of head observed where there is negligible flow velocity.

When using the Neenah Slide Rule Calculator, a slightly modified form is employed, namely:

$$Q = 3.3\ P(h)^{1.5}$$

where Q = Capacity CFS
P = Perimeter of grate in feet
h = Head in feet

When determining inlet perimeter, add only the footage of the sides subject to flow.

For a circular grate: πD (where D = diameter)
For a circular grate next to a curb: $1/2\ (\pi D) + D$
For a square grate: 4 x length of one side
For a square grate against a curb: 3 x length of one side
For a rectangular grate: 2 (Width + Length)
For a rectangular grate with one length up against a curb: (2 x Width) + Length

To maximize effective weir perimeter with two grates against a curb at a sag, place the grates (2 x Width) apart.

It's always wise to compare the weir flow expected with the orifice equation results. The equation with the lower flow value predominates. A graphic illustration of both equations is on the following page. When both flow rates are approximately the same, physically a vortex appears over the grate. This type of flow, due to its rotation, is not as efficient as either the weir or orifice equations imply. Using 80% of the expected flow in this situation should be a conservative estimate.

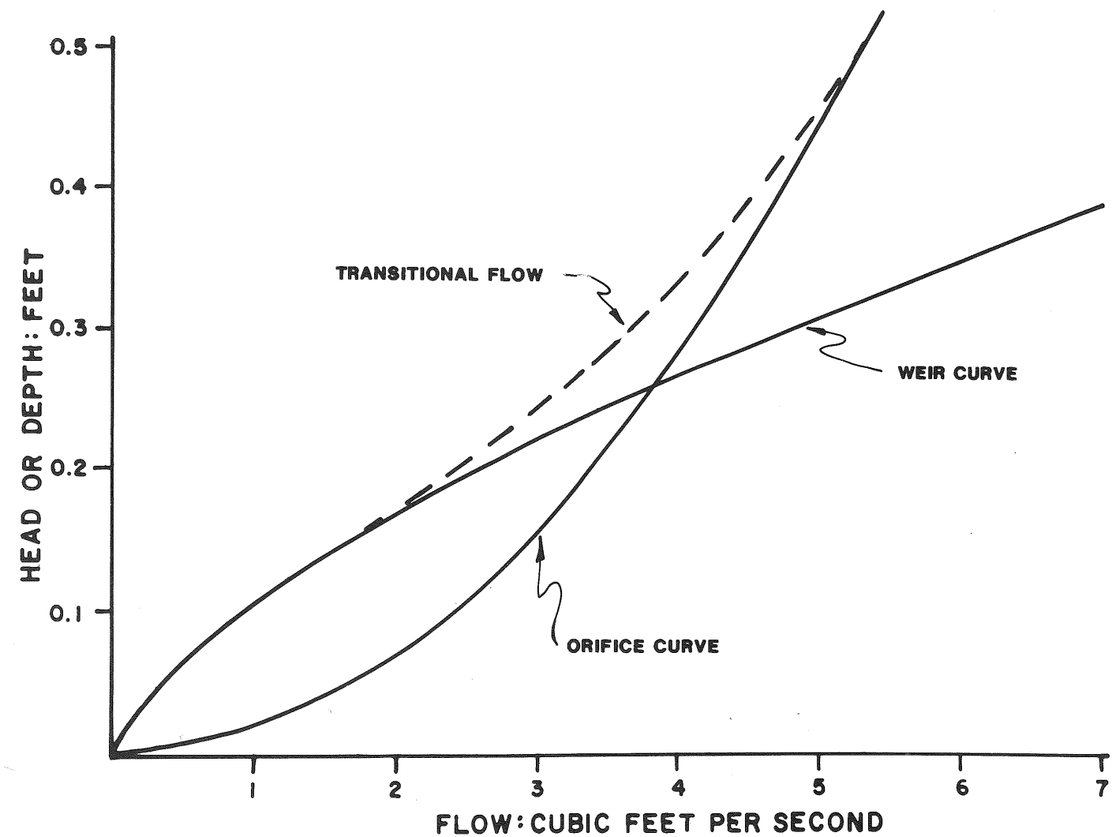
This example shows the relationship between the weir and orifice equations and the expected flow through a grate under varying conditions.

Given: R-4990-HA Type A Grate 2 Feet Long

Free open area 1.65 sq. ft. - - Q Orifice = $0.6\ (1.6)\ \sqrt{2GH}$

Perimeter 100", 8.33' - - Q Weir - $3.33\ (8.33)\ H^{3/2}$

Depth	Q Orifice	Q Weir
0.01	0.77	0.03
0.04	1.54	0.22
0.08	2.18	0.63
0.12	2.67	1.15
0.16	3.08	1.78
0.20	3.45	2.48
0.24	3.77	3.26
0.28	4.08	4.11
0.32	4.36	5.02
0.36	4.62	5.99
0.40	4.87	7.02
0.44	5.11	8.10
0.48	5.34	-
0.52	5.56	-
0.56	5.76	-

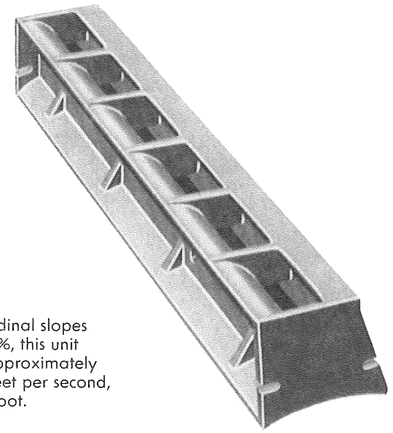


R-3599-A Slotted Vane Drain

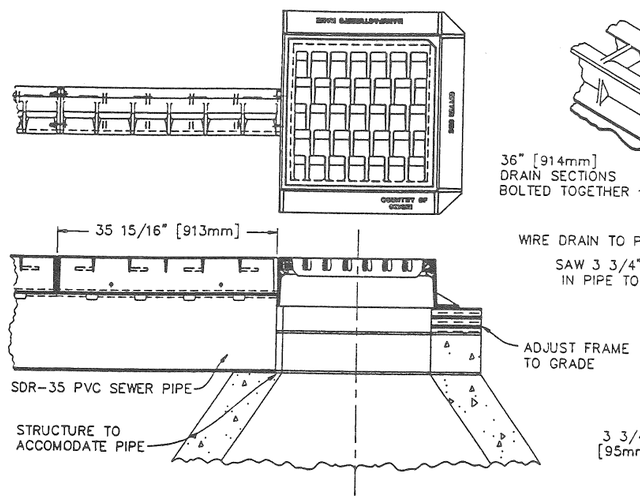
SHEET FLOW

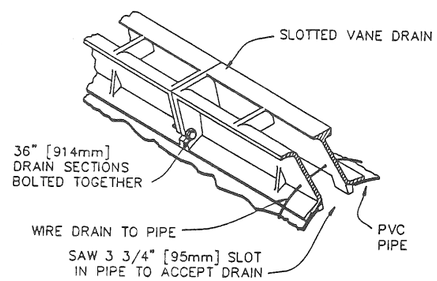
NEENAH's Cast Iron Slotted Vane Drain offers ease of installation along with the superior vaned configuration to capture previously unexpected quantities of water when placed perpendicular to the flow. Installation is accomplished by sawing a slot in the top of conventional PVC pipe, placing the pipe on grade, installing the Cast Iron Slotted Vane Drain in place and pouring the concrete. When used in conjunction with a vane grate inlet, virtually all of the water in the street, which would normally bypass the catch basin, can be captured. This permits the spacing between inlets to be increased. An additional benefit is the added safety factor obtained should the catch basin be plugged or covered with snow. The unit may also be installed at entrances and exits of parking areas to capture sheet flow before it enters a commercial street.

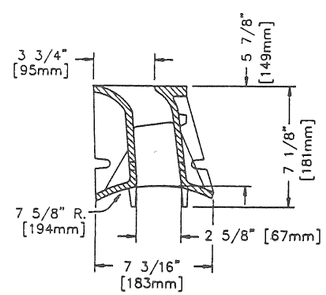
Feel free to contact our field personnel or our Product Engineering Department at Neenah for further detailed information.

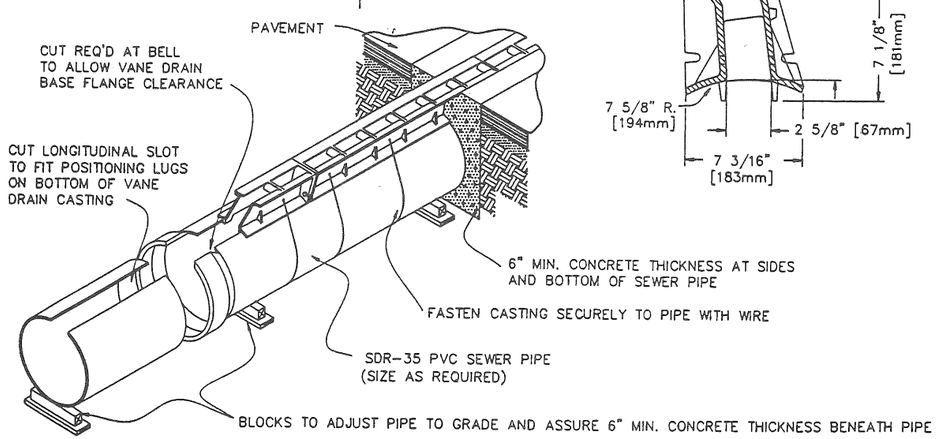


On longitudinal slopes of 0% to 6%, this unit captures approximately 0.5 cubic feet per second, per lineal foot.



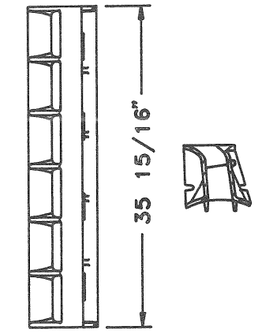




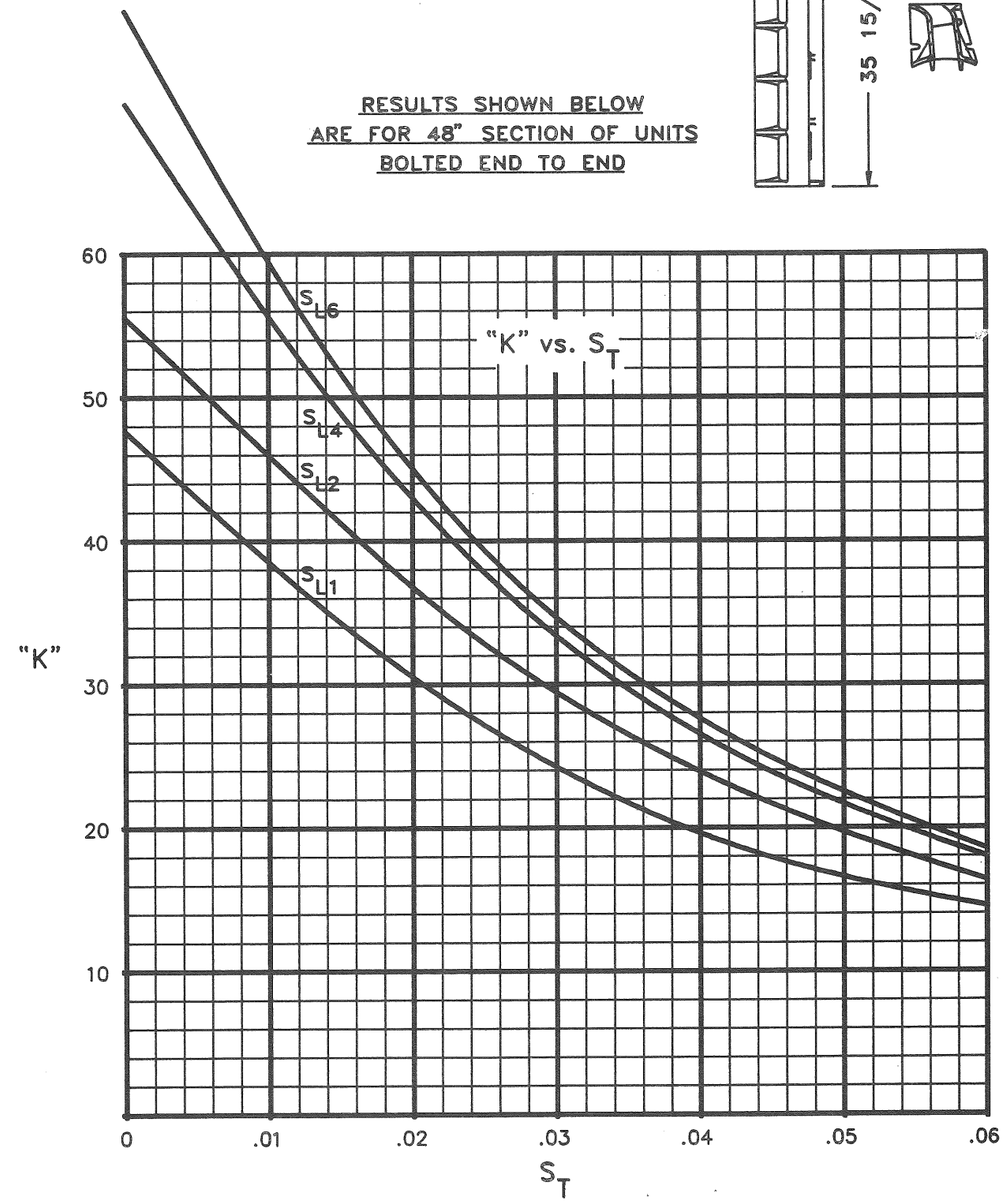


CAT. NO. – R-3599-A
DESCRIPTION – SLOTTED VANE DRAIN
COMP. CODE – 3599-0002

FLOW →



RESULTS SHOWN BELOW ARE FOR 48" SECTION OF UNITS BOLTED END TO END

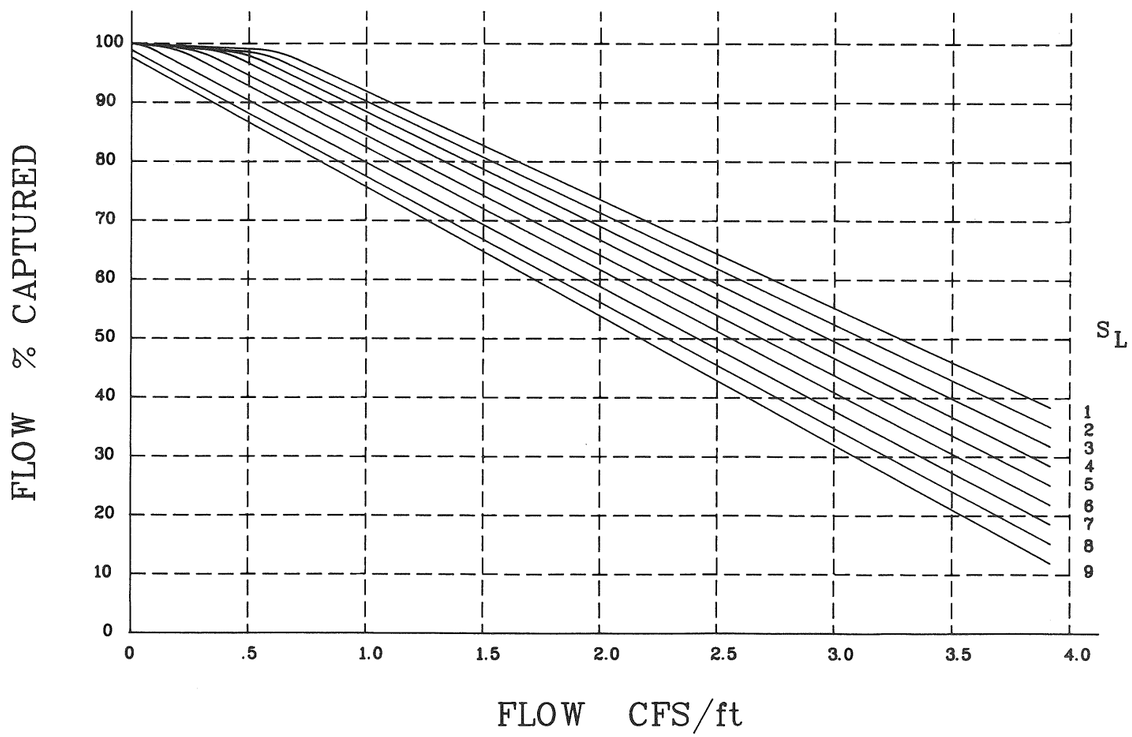


S_T = TRANSVERSE GUTTER SLOPE

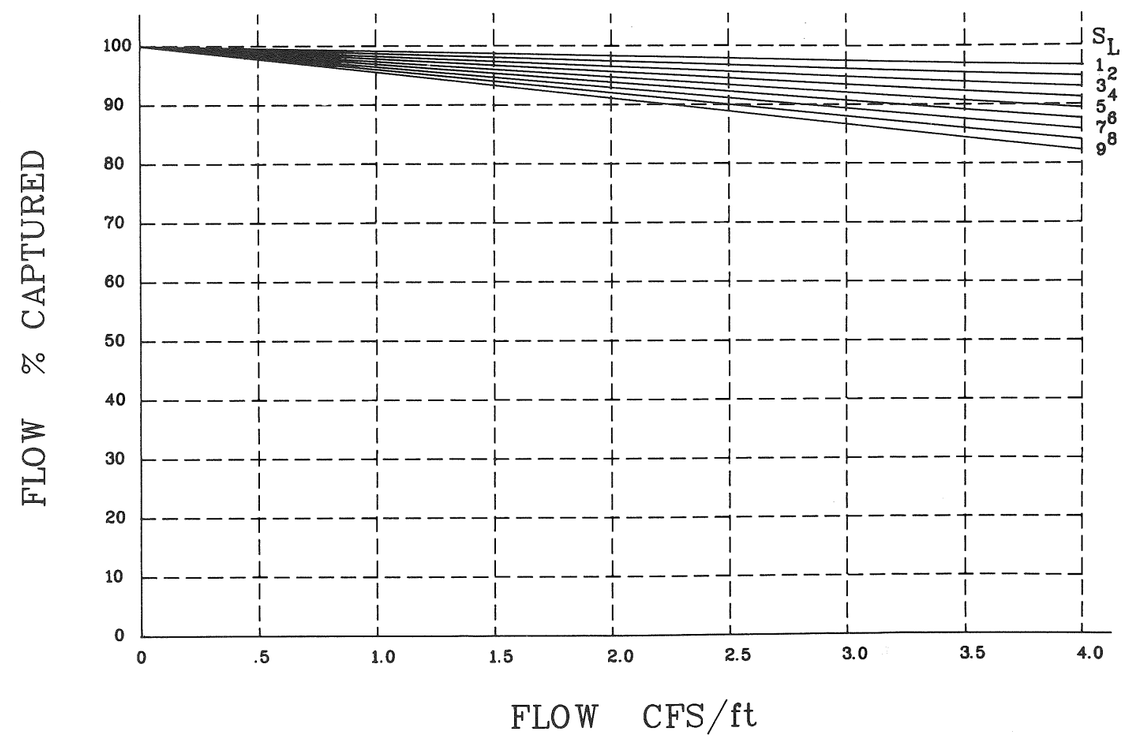
S_L = LONGITUDINAL GUTTER SLOPE

K = GRATE INLET COEFFICIENT

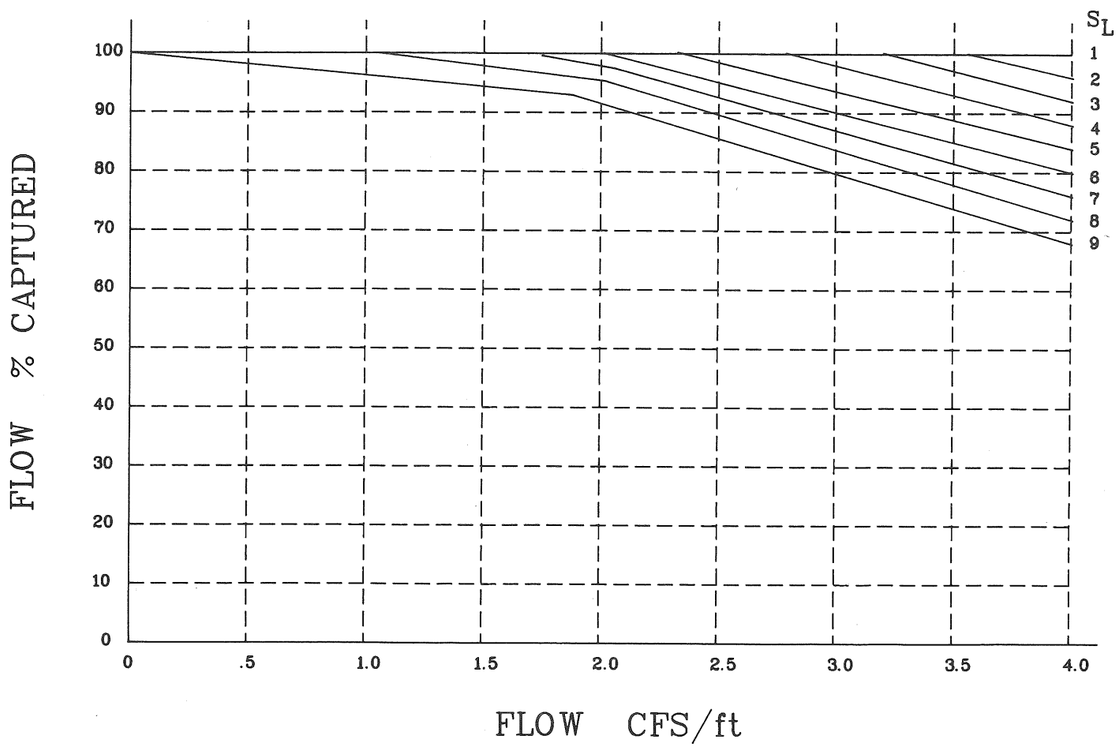
R-4999-L3



R-4999-L6



R-4999-L9



With the Neenah Inlet Grate Capacity and Flow Rate Calculator, you can quickly and easily solve your storm water drainage problems. Here are four sample problems using the equations described on the calculator.

Example 1: Calculate flow in CFS "Q" in a triangular channel using the modified Manning equation.

Given: Transverse slope 0.01 ft./ft.; longitudinal slope 0.02 ft./ft.; depth of flow 0.15 ft.

Step 1: Set longitudinal slope 0.02 opposite depth 0.15 feet.
Step 2: Locate 0.01 on transverse slope scale.
Step 3: Opposite 0.01 on the transverse slope scale, read 3.1 on the CFS scale. Answer: Q = 3.1 CFS.

Example 2: (Assume you have computed runoff using rational formula Q = CIA.) Calculate a depth of flow "D" in a triangular channel using the modified Manning equation.

Given: Q = 1.0 CFS; longitudinal slope .01; transverse slope .02.

Step 1: Place 1.0 CFS opposite 0.02 on the transverse slope scale.
Step 2: Opposite 0.01 on the longitudinal slope scale, read 0.144 on the depth scale. Answer: D = 0.144 feet.

Example 3: Using the depth of flow from example above, calculate an inlet grate capacity for gutter flow "Q" using Neenah Equation. Use R-3246-A diagonal grate (3246-0027) to determine the K-value.

Step 1: On the K Chart (3246-0027), locate the intersection of transverse gutter slope .02 and longitudinal gutter slope (SL1).
Step 2: Read the K-value of 21 by moving directly left to the K scale.
Step 3: Set arrow at a depth of 0.144 on slide rule calculator.
Step 4: Opposite 21 on the K scale, read 0.83 on the Neenah grate capacity-CFS scale. Answer: "Q" = 0.83 CFS.

Example 4: Weir & Orifice flow comparison.

Given: R-4990-HA Type A grate (2 lineal feet long). Free open area 1.6 sq. ft. Grate perimeter 100" or 8.33 feet.

Step 1: Set head 0.3 feet opposite arrow.
Step 2: Opposite Weir perimeter of 8.33 feet read 4.5 grate capacity-CFS.
Step 3: Opposite Orifice free open area of 1.6 square feet read Grate-CFS 4.25.
*Step 4: Compare Weir and Orifice flow values, and use the lower of the two.

*Note: In this example the values are nearly the same, meaning the flow is in transition between Weir and Orifice flow. In the transitional phase, flow is less than the indicated Weir or Orifice flow. Neenah suggests using a value of approximately 80% of the lower value, about 3.4 CFS.

If further clarification is required, contact Neenah Foundry Company.