

홈통의 설계법

金昌瑞 協和建築研究所

처마홈통의 설계법

1. 流量의 計算에는 KUTTER 公式를 使用하였
다.
2. 最大降雨量으로서는 $i=0.05m/m/sec$.
即 每秒 $0.05m/m$ 1時間當 $180m/m$
3. KUTTER 公式으로 求하여진 値은 理論式
임으로 實際로서는 塵埃의 體積의 變形 重要
性算을 考慮하여 普通建物에는 1.5倍 R. F.
C. 建物에는 4倍 以上の 斷面積이 되게끔 할
것.

GUTTER 公式

$$v = \frac{23 + 1/n + 0.00155/s}{1 + (23 + 0.00155/s) n / \sqrt{R}} \sqrt{R} \text{ S.m/sec}$$

v : 流速 n : 粗度係數 約 $0.015 / sec$

s : 樋勾配 R : 徑깊이 = 斷面積 / 油邊 m

4. 各 홈통의 側面의 立上部를 적어도 $10cm$ 以
上할 것.

선홈통 設計法

1. 流量計算에는 垂直 ORIFICE라고 생각하
는것이 適當함.
2. 最大降雨量은 처마홈통과 같이 $i=0.05m /$
 sec 로 한다.
3. 安全率도 처마홈통과 같음

ORIFICE 公式

$$Q = Ca\sqrt{2gH}$$

Q : 流量 cm^3/sec C : 落口의 形狀定數

普通 $0.5 \sim 0.6$

平均 0.55

a : 斷面積 cm^2 g : 常數 $980cm/sec^2$

- H: 落口의 水深 cm (軒樋깊이)
4. 實홈통의 落差 h 에 比하여 線홈통의 屈典이
 많코, 管長 l 가 길때에는 適當히 斷面積을 增
大시킬 必要가 있다.

$\Sigma l/h$	1.0	1.5	2.0	3.0
增大率	1.0	1.2	1.3	1.6

雨量流出係數

I 種別流出係數

지붕	0.70~0.95	ASPHALT 舖漿	0.85~0.90
자갈길	0.15~0.30	매가담 舖漿	0.25~0.60
間地, 鐵道構內等	0.1~0.30		
公園, 잔디, 牧場	0.05~0.25		
森林地帶	0.01~0.20		

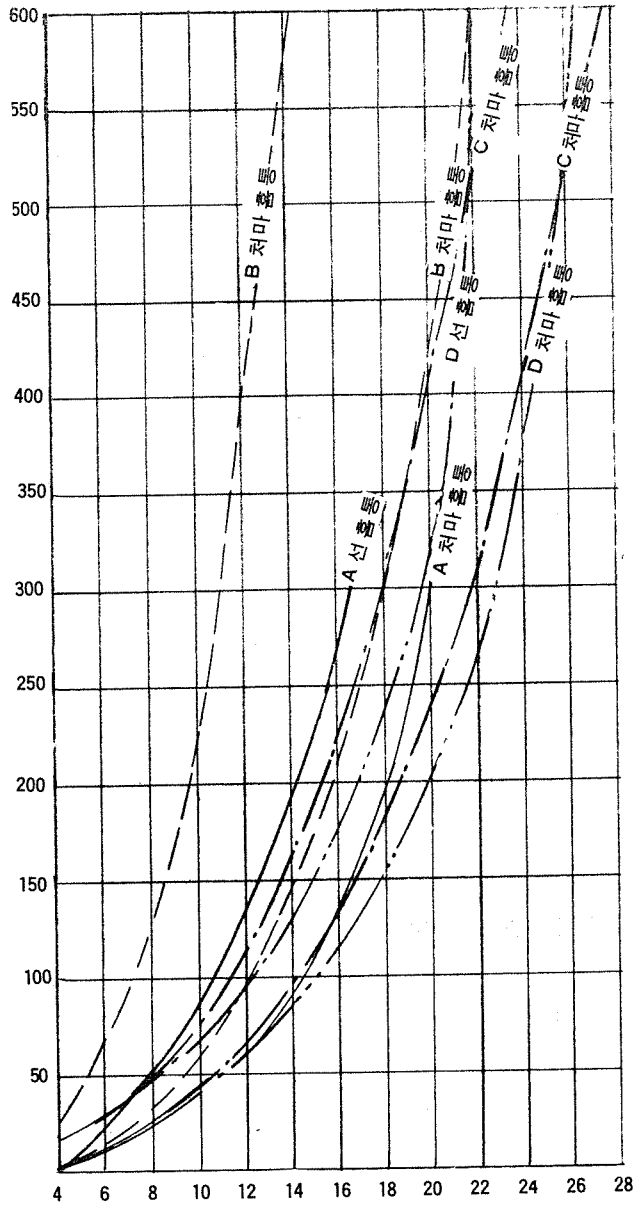
地域別流出係數

市内複雜한地區	0.7~0.9
建物이 많은住宅地區	0.50~0.70
建物이 많지 않은住宅地區	0.25~0.50
公園, 廣場	0.10~0.30
잔디, 庭園, 牧場	0.05~0.25
森 地帶	0.10~0.20

都市計劃地域別 流出係數

商業地區	0.60
住宅地區 (密)	0.50
" (粗)	0.30
工業地區	0.40
公園, 綠地	0.10

지붕面積 M²

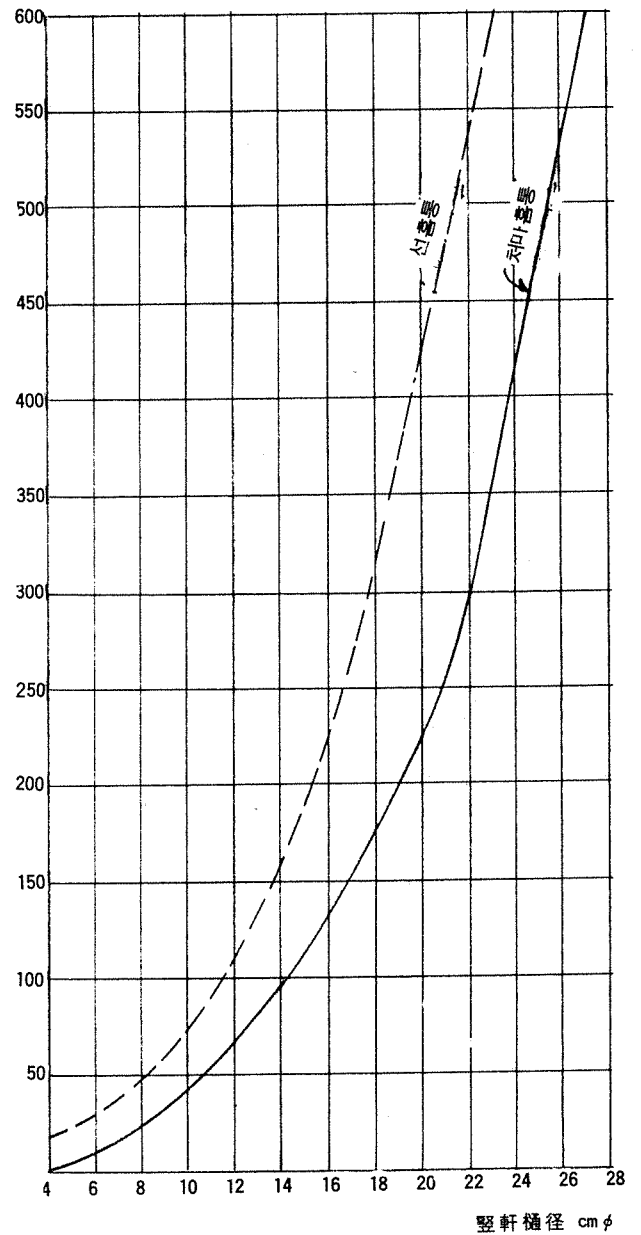


- A : 輕量鉄骨 建築 構
法の解説
(鋼材 俱樂部)
- B : 建築日記
- C : 實用建築構造
(上卷)
- D : 設計資料集成 (3)

선홍통 및 처마홍통의 치수

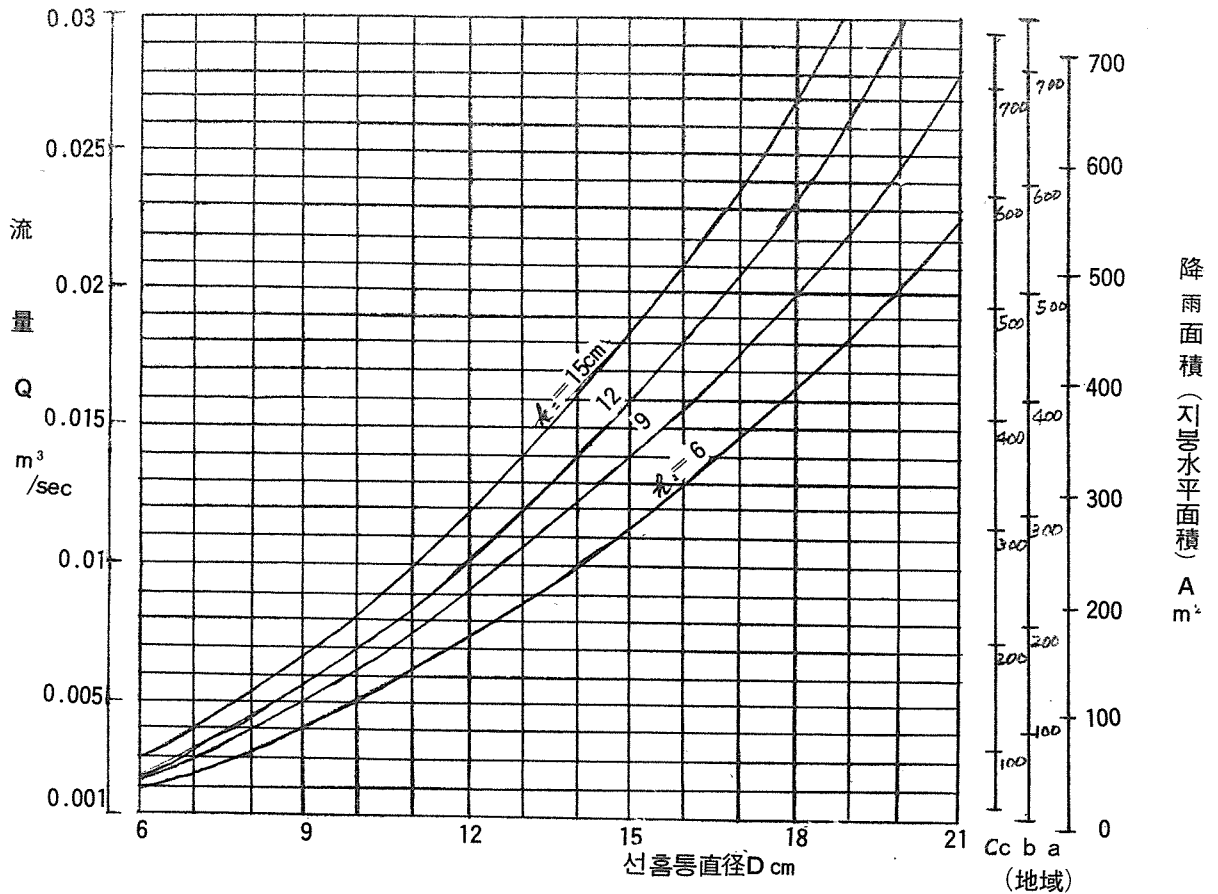
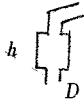
지붕面積 M²

實用建築構造 上卷



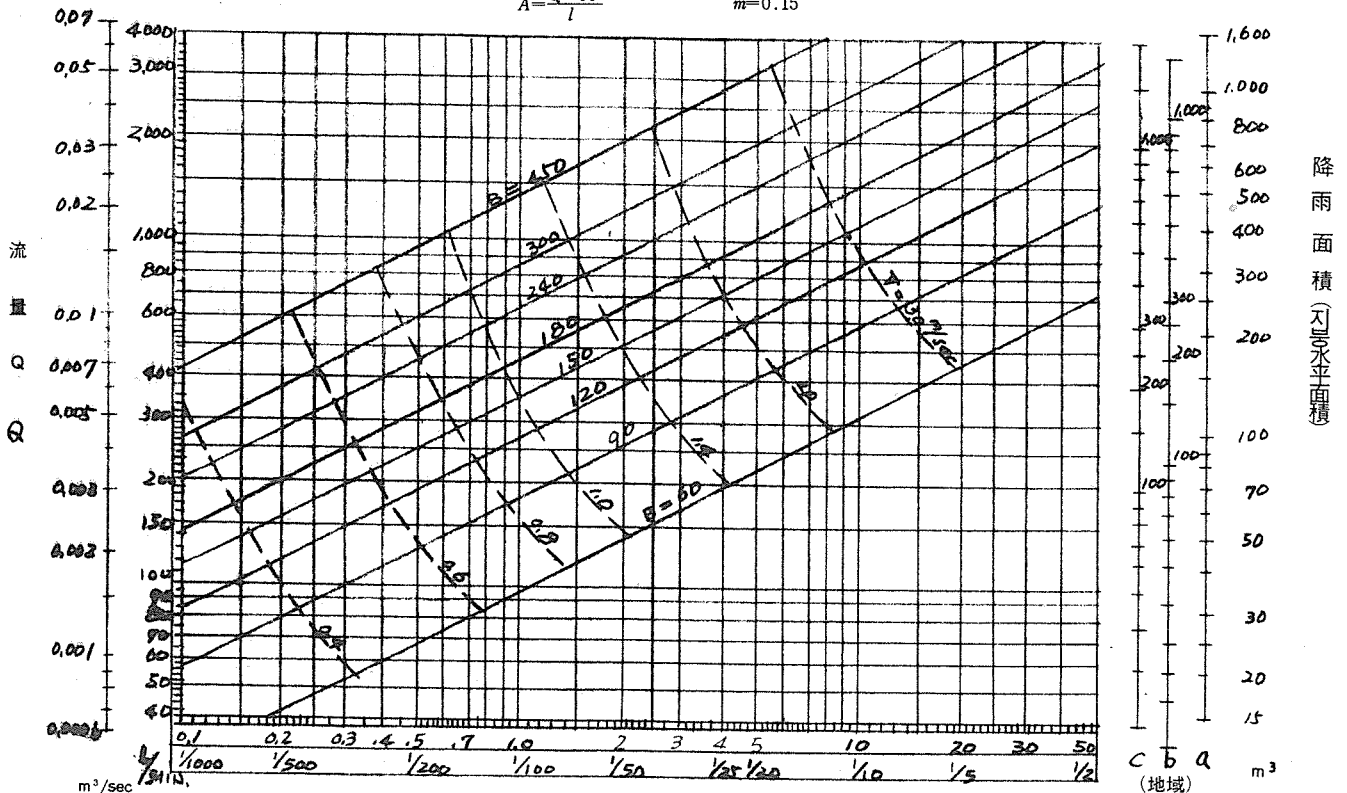
원형선홍통 산정도표

$V = 26.6 / h$
 $Q = aV = \frac{\pi}{4} D^2 V$
 $A = \frac{Q}{i}$
 $Q = \text{流量 } m^3/sec$
 $\lambda = \text{홍통断面積 } m^2$
 $i = \text{降雨量 } m^3/sec$

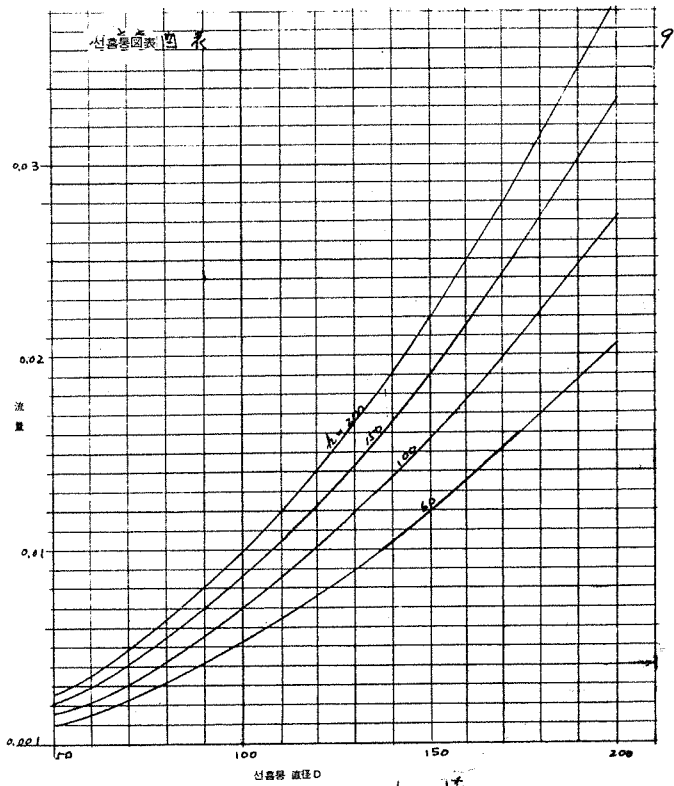


곧홍통 算定圖表

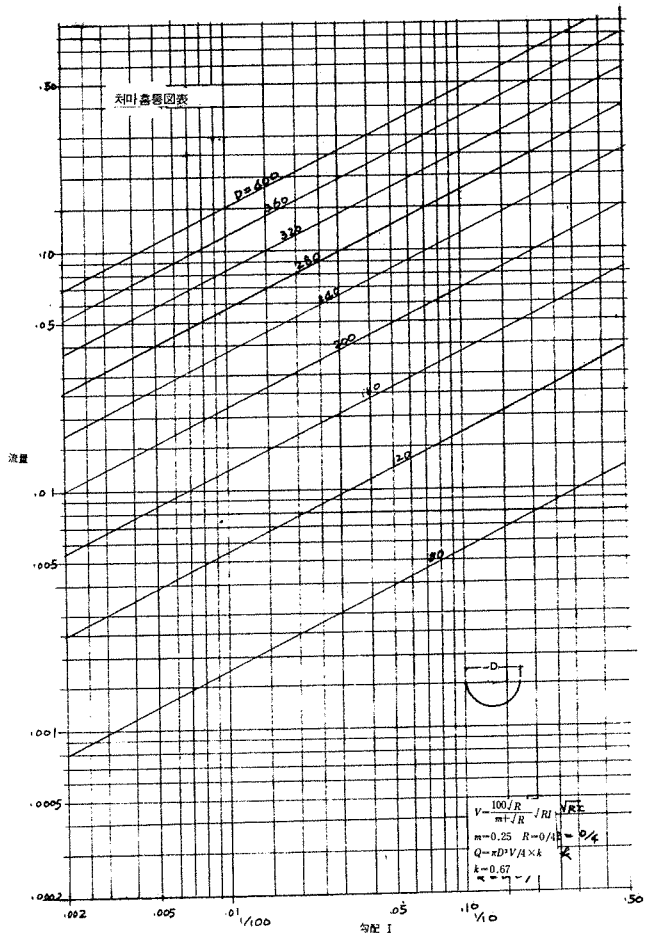
$V = \frac{100 + \sqrt{R}}{m + \sqrt{R}} / RI$
 $Q = av \times 1/k$
 $A = \frac{Q \times 60}{i}$
 $i = \text{降雨量}$
 $k = 1.5$ (安全係數)
 $a = BH = 0.06B$ (홍통断面積)
 $m = 0.15$



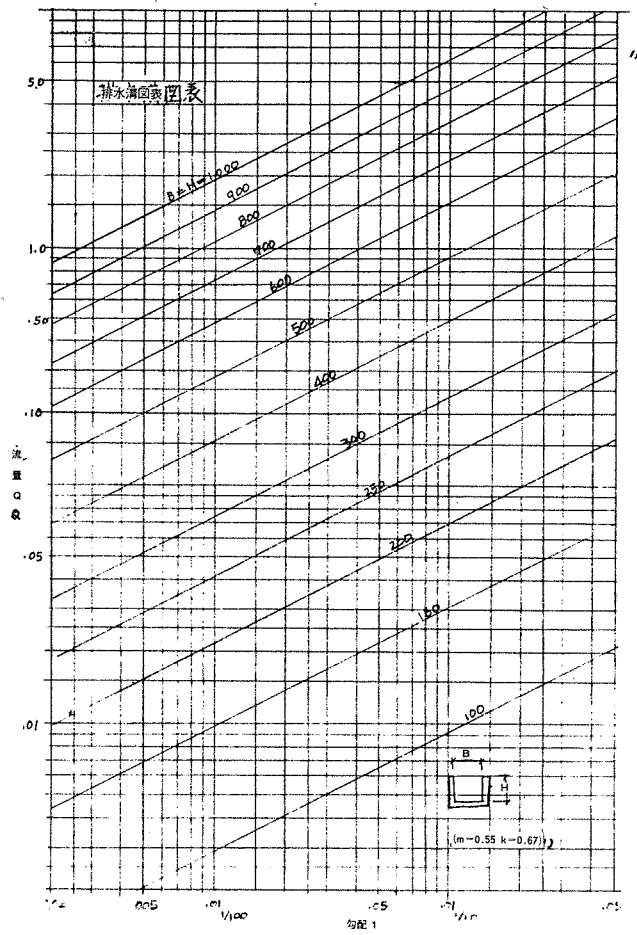
勾 配 (I)



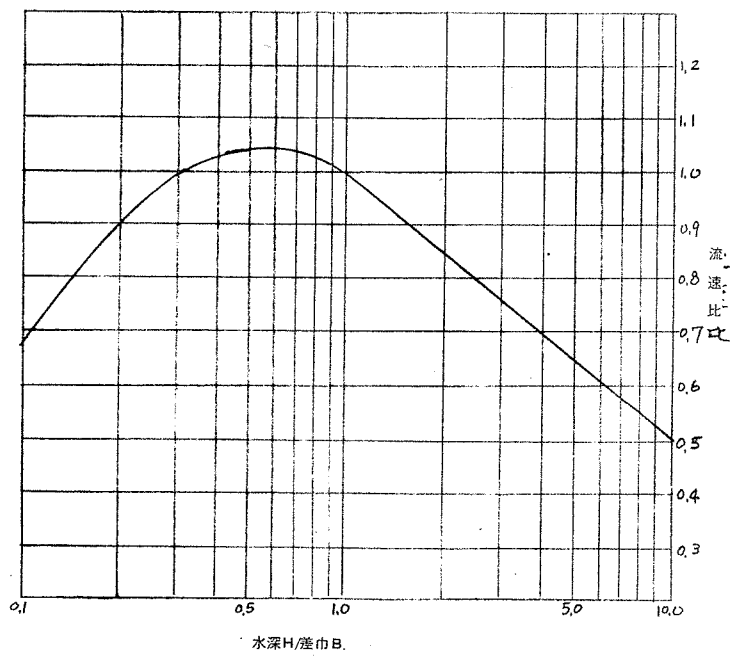
$Q = (a/2g) \sqrt{2gh} \text{ m}^3/\text{s}$
 $C = 0.62 \quad a = \pi D^2/4$



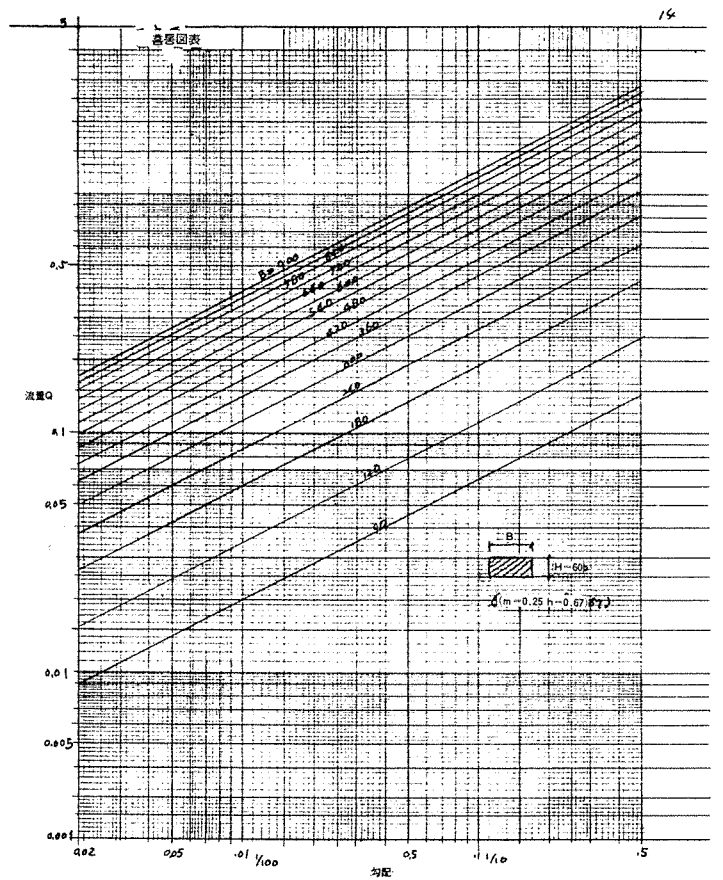
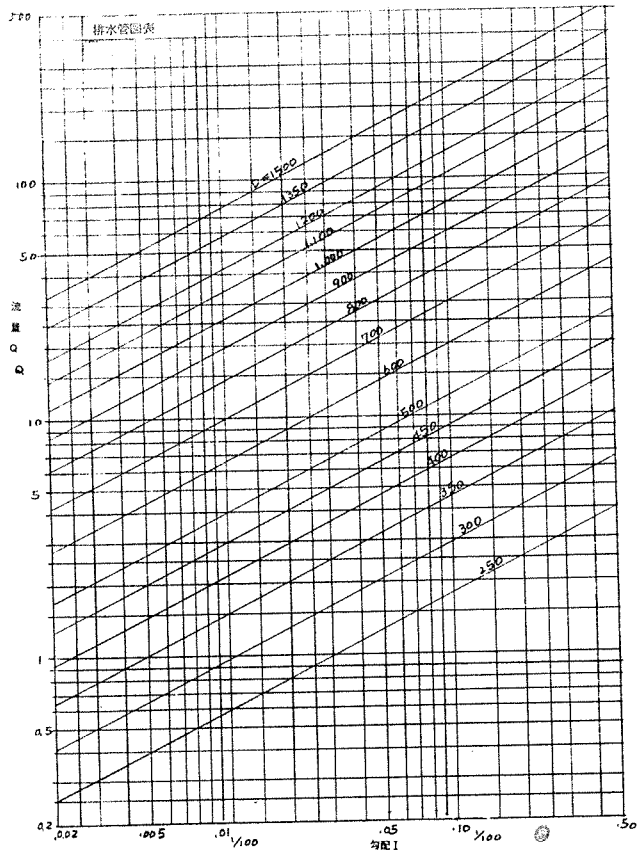
$V = \frac{100/R}{\pi \sqrt{R}} \sqrt{R} = \frac{\sqrt{R}}{\pi}$
 $m = 0.25 \quad R = 0.4R$
 $Q = \pi D^2 V A \times k$
 $k = 0.67$



矩形排水溝修正図表



(註) 水路断面形状에 依한 流速의 变化에서 別回流量을 補正한다.



처마흡통 算定圖表



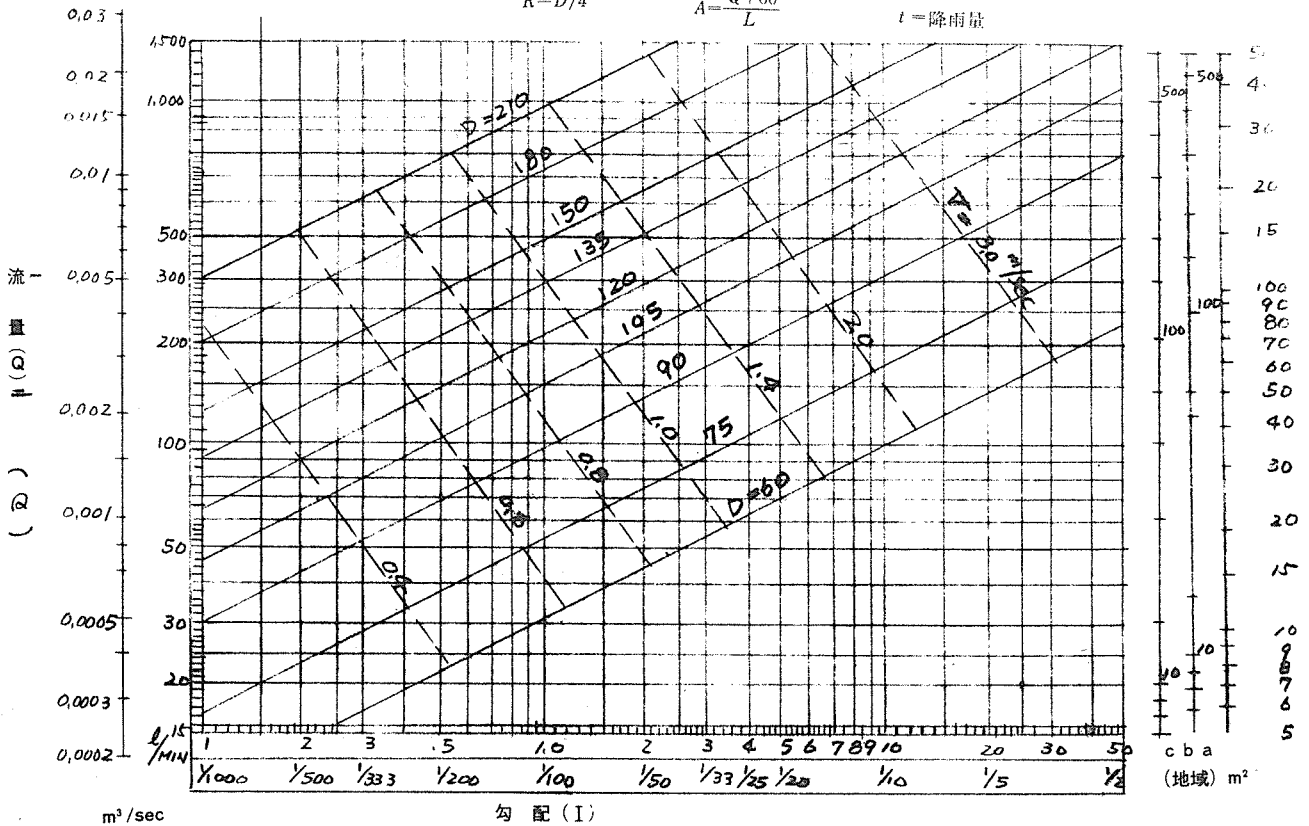
GUTTER公式 (半圓型 溝流)

$$V = \frac{100\sqrt{R}}{m + \sqrt{R}} \sqrt{RI}$$

$$Q = aV \times \frac{1}{k} \quad Q = \frac{\pi D^2}{B}$$

$$A = \frac{Q + 60}{L} \quad t = \text{降雨量}$$

$m = 0.15$
 $k = 1.5$



計算例

§ 1. 概要

1-1 降雨強度 (i)

$$i = \frac{a}{\sqrt{t+b}} \quad (m/m/h)$$

i = 降雨強度 m/m/h t = 降雨繼續時間 (MIN)

a, b = 地域에 依한 特有定數

$$t = 4 \text{ (min)} \quad a = 321.383 \quad b = 2.466$$

$$i = \frac{321.383}{\sqrt{4+2.466}} = 71.96 \rightarrow 72 \text{ min/h}$$

1-2 雨水流出量 (Q)

$$Q = \frac{1}{3600} \times \frac{i}{1,000} \times CA \quad (m^3/sec)$$

C = 流出係數 = 1.0

A = 集水面積 (m²)

$$\therefore Q = \frac{1}{3,600} \times \frac{72}{1,000} \times 1.0 \times A$$

$$= 2 \times 10^{-5} \times A \quad (m^3/sec) \dots \dots \dots (1)$$

1-3 처마흡통·골흡통·橫走管을 흐르는 물의 速度는 Cutler 公式에 依한다.

처마·선흡통의 断面積은 塵埃의 堆積·흡통의 變形等을 考慮하여 假定断面의 1.5 倍 以上으로 한다.

橫引管은 管内의 空氣의 흐름을 考慮하여 実断面積의 80%를 假定断面으로 한다.

1-4 처마·선흡통·橫走管의 許容流量

$$Qa = Ag \times V \quad (m^3/sec) \dots \dots \dots (2)$$

$$V = \frac{\frac{1}{n} + 23 + \frac{0.00155}{I}}{1 + (23 + \frac{0.00155}{I}) \cdot \frac{n}{\sqrt{R}}} \times \sqrt{RI} \quad (m/sec) \dots \dots (3)$$

Qa = 許容流量 (m³/sec)

Ag = 흡통假定断面 (m²)

V = 흡통속을 흐르는 물의 速度 (m/sec)

n = 粗度係數 (0.013)

I = 흡통勾配

R = 徑深 = $\frac{\text{断面積}}{\text{週邊}}$ (m)

1-5 선흡통을 흐르는 물의 速度는 垂直 ORIFFICE 式에 依한다. 但雨水는 水位가 一定한 靜水容器의 바닥부터 圓形断面의 管筒을 通하여 흘러내리는 것으로 생각한다.

1-6 선흡통의 許容流量

$$Qa = Ag \cdot V \quad (m^3/sec) \quad \left. \begin{aligned} & \\ & \end{aligned} \right\} Qa = Ag \times C \times \sqrt{2gH}$$

$$V = c \times \sqrt{2gH} \quad (m/sec) \quad \left. \begin{aligned} & \\ & \end{aligned} \right\}$$

$$(m^3/sec) \dots \dots \dots (4)$$

C=落口의 孔径과 筒長으로 定하여지는 定数
(0.6)

g=重力의 加速度 (9.8m/sec²)

H=落口의 水深 (m)

선홍통의 落差(h)에 對하여 管의 屈曲이 많고 管長(l)가 길때에는 次式에 依하여 線홍통 断面을 增加시킨다.

$\frac{\Sigma l}{h}$	1.0	1.5	2.5	3.0
增加率	1.0	1.2	1.3	1.6


§ 2. 断面算定

2-1 처마홍통

2-1-1 "c"

$$\frac{165}{270} \quad 0.165 \times 0.27 = 0.0446 \text{ (m}^2\text{)}$$

i) 許容流量

假定断面 (Ag)  100 $0.1 \times 0.27 = 0.027 \text{ m}^2$
270

홍통勾配 (I) 1/200=0.005

径深 (R) $\frac{0.027}{0.1+0.1+0.27} = \frac{0.027}{0.47} = 0.057 \text{ (m)}$

I=0.05 R=0.057를 (3)式에 代入

$$V = \frac{\frac{1}{0.013} + 23 + \frac{0.00155}{0.005}}{1 + (23 + \frac{0.00155}{0.005}) \times \frac{0.013}{\sqrt{0.057}}} \times \sqrt{0.057 \times 0.005}$$

$$\frac{1}{0.013} = 76.92$$

$$\frac{0.00155}{0.005} = 0.31$$

$$\frac{0.013}{\sqrt{0.057}} = \frac{0.013}{0.24} = 0.055$$

$$\sqrt{0.057 \times 0.005} = \sqrt{0.000285} = 0.0168$$

$$\therefore V = \frac{76.92 + 23 + 0.31}{1 + (23 + 0.31) \times 0.055} \times 0.0168 = \frac{1.68}{2.28} = 0.74 \text{ (m/sec)}$$

Ag=0.027 V=0.74를 (2)式에 代入

$$Qa = 0.027 \times 0.74 = 0.0206 \text{ (m}^3\text{/sec)}$$

ii) 雨水流出量

처마홍통 "c"의 最大集水面積은 $12.5 \times 15 = 188 \text{ (m}^2\text{)}$

(1)式에 A=188를 代入

$$Q = 2 \times 10^{-5} \times 188 = 0.00376 \text{ (m}^3\text{/sec)}$$


$$Qa/Q = 0.0206/0.00376 = 5.5 \text{ O. K}$$

(Qa > Q)

2-1-2 "b"

$$\frac{127.5}{200} \quad 0.1275 \times 0.2 = 0.0255 \text{ (m}^2\text{)}$$

i) 許容流量

假定断面 (Ag)  80 $0.08 \times 0.2 = 0.0180 \text{ (m}^2\text{)}$

홍통勾配 (I) 1/200=0.005

径深 (R) $\frac{0.018}{0.08+0.08+0.2} = \frac{0.018}{0.36} = 0.05 \text{ (m)}$

I=0.005 R=0.05를 (3)式에 代入

$$1/0.013 = 76.92$$

$$0.00155/0.005 = 0.31$$

$$0.013/\sqrt{0.05} = 0.013/0.223 = 0.058$$

$$\sqrt{0.05 \times 0.005} = \sqrt{0.00025} = 0.0158 \text{ (m/sec)}$$

$$\therefore V = \frac{76.92 + 23 + 0.31}{1 + (23 + 0.31) \times 0.058} \times 0.0158 = \frac{1.58}{2.35} = 0.67$$

Ag=0.0180 V=0.67를 (2)式에 代入

$$Qa = 0.0180 \times 0.67 = 0.0121 \text{ (m}^3\text{/sec)}$$

ii) 雨水流出量

처마홍통 "b"의 最大集水面積은 $14\text{m} \times 10\text{m} = 140\text{m}^2$

(1)式에 A=140을 代入

$$Q = 2 \times 10^{-5} \times 140 = 0.0028 \text{ (m}^3\text{/sec)}$$

$$Qa/Q = 0.0121/0.0028 = 4.3 \text{ O. K}$$


Qa > Q

2-2 골홍통

2-2-1 "x"

$$\frac{180}{1100} \quad 1.1 \times 0.18 = 0.198 \text{ m}^2$$

i) 許容流量

假定断面 (Ag)  110 $1.1 \times 0.11 = 0.121 \text{ m}^2$
1100

홍통勾配 (I) 1/150=0.0067

径深 (R) $\frac{0.121}{0.11+0.11+1.1} = \frac{0.121}{1.32} = 0.092 \text{ m}$

I=0.0067 R=0.092를 (3)式에서 代入

$$1/0.013 = 76.92$$

$$0.00155/0.0067 = 0.23$$

$$0.013/\sqrt{0.092} = \frac{0.013}{0.33} = 0.394$$

$$\sqrt{0.092 \times 0.0067} = \sqrt{0.00062} = 0.025$$

$$\therefore V = \frac{76.92 + 23 + 0.23}{1 + (23 + 0.23) \times 0.0394} \times 0.025 =$$

$$\frac{100.25 \times 0.025}{1.12} = \frac{2.5}{1.92} = 1.3 \text{ (m/sec)}$$

$$A_g = 0.121 \quad V = 1.3 \text{ 을 (2) 式에 代入}$$

$$Q_a = 0.121 \times 1.3 = 0.158 \text{ (m}^3/\text{sec)}$$

i) 雨水流出量

골홈통 "x"에서의 最大集水面積 $25\text{m} \times 30\text{m} = 750\text{m}^2$

(1) 式에 $A=750$ 를 代入

$$Q = 2 \times 10^{-5} \times 750 = 0.015 \text{ (m}^3/\text{sec)}$$

$$Q_a/Q = 0.158/0.015 = 10.5 \quad O. K$$

$$Q_a > Q$$

2-3 선홈통

2-3-1 "B" O 216.3φ×5.8 Ag=0.0329^{m²}

i) 許容流量

$$H = 0.35\text{m} \quad A_g = 0.0329 \text{를 (4)式에 代入}$$

$$Q_a = 0.0329 \times 0.6 \times \sqrt{19.6} \times 0.35 = 0.0198 \times$$

$$\sqrt{6.85} = 0.052 \text{ (m}^3/\text{sec)}$$

ii) 雨水流出量

最大集水面積 $25\text{m} \times 30\text{m} = 750\text{m}^2$

(1) 式에 $A=750$ 를 代入

$$Q = 0.015 \text{ (m}^3/\text{sec)}$$

$$Q_a/Q = 0.052/0.015 = 3.45 \quad O. K$$

2-3-2 "C" O 318.5φ×6.9 Ag=0.073^{m²}

i) 許容流量

$$H = 0.25 \text{ (m)} \quad A_g = 0.073 \text{ 을 (4)式에 代入}$$

$$Q_a = 0.073 \times 0.6 \times \sqrt{19.6} \times 0.25 = 0.044 \times$$

$$\sqrt{4.87} = 0.096 \text{ (m}^3/\text{sec)}$$

ii) 雨水流出量

最大集水面積 $25\text{m} \times 80\text{m} = 2,000\text{m}^2$

$$Q = 2 \times 10^{-5} \times 2000 = 0.04 \text{ m}^3/\text{sec}$$

$$Q_a/Q = 0.096/0.04 = 2.4 \quad O. K$$

2-4 横引管

2-4-1 "X" O 267.4φ×6.5 Ag=0.051^{m²}

i) 許容流量

$$\text{假定断面 (} A_g \text{)} \quad 0.051 \times 0.8 = 0.0408\text{m}^2$$

$$\text{勾配 (} I \text{)} \quad 1/150 = 0.0067$$

$$\text{径深 (} R \text{)} \quad \frac{0.0408}{0.254 \times \pi \times 0.7} = \frac{0.0408}{0.56} = 0.073 \text{ (m)}$$

$$I = 0.0067 \quad R = 0.073 \text{ 을 (3) 式에 代入}$$

$$\frac{1}{0.013} = 76.92$$

$$\frac{0.00155}{0.0067} = 0.23$$

$$\frac{0.013}{\sqrt{0.073}} = \frac{0.013}{0.27} = 0.048$$

$$\sqrt{0.073 \times 0.0067} = \sqrt{0.00049} = 0.022$$

$$V = \frac{76.92 + 23 + 0.23}{1 + (23 + 0.23) \times 0.048} \times 0.022 = \frac{100.25 \times 0.022}{2.12} =$$

$$\frac{2.2}{2.12} = 1.03 \text{ m/sec}$$

$$A_g = 0.0408 \quad V = 1.03 \text{ 을 (2) 式에 代入}$$

$$Q_a = 0.0408 \times 1.03 = 0.042 \text{ m}^3/\text{sec}$$

ii) 雨水流出量

最大集水面積 $25\text{m} \times 30\text{m} = 750\text{m}^2$

(1) 式에 $A=750$ 를 代入

$$Q = 0.015 \text{ (m}^3/\text{sec)}$$

$$Q_a/Q = 0.052/0.015 = 2.45 \quad O. K$$

2-4-2 "Y" O 318.5φ×6.9 断面積 0.073^{m²}

i) 許容流量

$$\text{假定断面 (} A_g \text{)} \quad 0.073 \times 0.8 = 0.058\text{m}^2$$

$$\text{홈통勾配 (} I \text{)} \quad 1/150 = 0.0067$$

$$\text{径深 (} R \text{)} \quad \frac{0.058}{0.304 \times \pi \times 0.7} = \frac{0.058}{0.67} = 0.087\text{m}$$

$$\frac{1}{0.073} = 76.92$$

$$\frac{0.00155}{0.0067} = 0.23$$

$$\frac{0.013}{\sqrt{0.087}} = \frac{0.013}{0.295} = 0.044$$

$$\sqrt{0.087 \times 0.0067} = \sqrt{0.00058} = 0.024$$

$$V = \frac{76.92 + 23 + 0.23}{1 + (23 + 0.23) \times 0.044} \times 0.024 = \frac{100.25 \times 0.024}{2.03} =$$

$$\frac{2.4}{2.03} = 1.18 \text{ m/sec}$$

$$Q_a = 0.058 \times 1.18 = 0.068 \text{ m}^3/\text{sec}$$

ii) 雨水流出量

集水面積 $A = 25 \times 80 = 2,000\text{m}^2$

$$Q = 2 \times 10^{-5} \times 2000 = 0.04\text{m}^3/\text{sec}$$

$$Q_a/Q = 0.068/0.04 = 1.7$$