

HYDROLOGICAL CALCULATION RATIONAL METHOD (HP # 5 - 1989)

PROJECT : catchment 9 (after 5 years planting)
Tabung Haji, Pahang

A. CATCHMENT CHARACTERISTICS

From Topo Map sheets :
Area of catchment, A_c = 1.21 sq. km
Length of mainstream, L = 0.97 km
Percentage developed, = 10.00 % (Land use factor)

Weighted mean slope, s

l_i (km)	h_i (m)	$s_i = h_i / l_i$ (%)	$l_i \cdot \sqrt{s_i}$
0.97	160.00	16.49	3.94
0.97	160.00	16.49	3.94

$$s = \frac{\sum (l_i \cdot \sqrt{s_i})}{\sum l_i}$$

$$= \frac{3.94}{0.97}$$

$$= 16.49 \%$$

B. LOCATION OF BRIDGE

From Topo Sheet No :

Longitude 102° 18' 0" E
Latitude 4° 12' 0" N

From figure 1 of HP # 5
Region No 4

Note : Region 1 - Perlis, Kedah, Perak
Region 2 - Kuala Lumpur
Region 3 - Johor
Region 4 - Kelantan, Terengganu, Pahang

C. ESTIMATION OF THE DESIGN RAINSTORM

1. Adopt return period, T = 2 years (HP # 1)

$$T_c = \left\{ \frac{1.286 \times L}{1.21^{0.223} \times 16.49^{0.263}} \right\}$$

$$= 0.57 \text{ hours}$$

$$= 34.32 \text{ mins}$$

3. Values of $x(T, t)$
(N.B. values of t is to envelope the value of T_c)

From Fig. 1 to 8 of HP # 1 :

$x(2, 0.5) = 40 \text{ mm}$
 $x(20, 0.5) = 70 \text{ mm}$
 $x(2, 3) = 80 \text{ mm}$
 $x(20, 3) = 140 \text{ mm}$

4. Plot those values above on graph Figure 10 of HP # 1

5. Read off values, with $T = 2$ years.

$x(T, 0.5) = 75.00 \text{ mm}$
 $x(T, 3) = 120.00 \text{ mm}$

6. Plot values obtained in steps 3 and 5 on graph Fig. 9 of HP # 1.

7. Read off values :

With $T_c = 0.57 \text{ hours}$
and $T = 2 \text{ years}$.
 $x(2, 0.57) = 43.00 \text{ mm}$
 $x(20, 0.57) = 75.26 \text{ mm}$
 $x(T, 0.57) = 78.38 \text{ mm}$

8. Confidence limits

$$D = x(20) - x(2)$$

$$= 75.255184 - 43.002962$$

$$= 32.252222$$

$$0.43 D = 13.868455 \text{ mm}$$

$$\begin{aligned} \text{Max } x(T) &= x(T) + 0.43 D \\ [T = 2] &= 78.378333 + 13.868455 \\ &= 92.25 \text{ mm} \end{aligned}$$

D. FLOOD ESTIMATION

1. From step C,

$$\begin{aligned} \text{Max } x_i(2) &= 92.246788 \text{ mm} \\ \text{Therefore, } i(2) &= x_i(100) = 92.246788 \end{aligned}$$

$$\begin{aligned}
 &= T_c = 0.5719907 \\
 &= 161.27 \text{ mm/hr} \\
 2. \text{ From Figure 4 with,} & \text{Region} = 4 \\
 & T = 2 \text{ years.} \\
 & C_{10} = 0.38 \\
 & C_t / C_{10} = 0.712 \\
 \text{Therefore } C_t &= 0.27 \\
 3. \text{ Percentage developed} &= 10\% \\
 \text{Land use factor, } F &= 1 \\
 \text{THEREFORE} & \\
 Q_{\max} &= F \times 0.278 \times C_t \times i(T) \times A \\
 &= 14.68 \text{ cu. m/s}
 \end{aligned}$$

E. DETERMINATION OF THE FLOOD WATER LEVEL AND VELOCITY

1. Plot cross-section of the river.
2. consider the recorded flood level as our first trial
3. Divide into sub-section
4. Stream slope at bridge site,

From the river survey plan :

Number of Part	= 4 Section			
Part	BedL1	BedL2	Length	Slope
1	6.880	6.544	60.000	0.006
2	6.544	6.067	25.000	0.019
3	6.067	6.037	25.000	0.001
4	6.037	5.604	20.000	0.022
5				
6				
7				
Average Slope, S _o	0.0118825			

5. Calculation of V_m and Q_c

$$V_i = R_i^{(2/3)} \times S_o^{(1/2)} / n_i$$

$$\text{TRY Flood Level} = 7.700 \text{ m} \quad \text{OK}$$

Sc.	Level	Chng.	Roughness	Area, A	Wetted	Hydraulic	Velocity	Q=V _i A _i
	(m)	(m)	n _i	Sq. ft	perimeter (pi) (m)	Radius R _i =A _i /Pi (m)	v _i (m/s)	(cu. m)
0	9.200	0.000	0.045					
1	7.000	4.000	0.045	-1.600	4.565	-0.350	#NUM	
2	6.741	18.000	0.045	11.613	14.002	0.829	2.138	24.832
3	5.857	23.100	0.045	7.145	5.176	1.380	3.003	21.458
4	5.792	27.000	0.045	7.314	3.901	1.875	3.684	26.944
5	5.272	33.600	0.045	14.309	6.620	2.161	4.049	57.941
6	6.344	38.000	0.045	8.325	4.529	1.838	3.635	30.261
7	6.659	42.500	0.045	5.393	4.511	1.196	2.729	14.717
8	7.000	50.500	0.045	6.964	8.007	0.870	2.207	15.370
9	9.200	54.000	0.045					
10								
			TOTAL	59.4634			TOTAL	191.52328

Type of bed material (Code) = 7 Rock

Therefore,

$$\begin{aligned}
 \text{Mean velocity, } V_m &= E(V_i A_i) / E(A_i) \\
 &= 191.523277 / 59.4634 \\
 &= 3.220859839
 \end{aligned}$$

< 5.18 m/sec
Therefore OK

$$\begin{aligned}
 \text{Discharge capacity, } Q_c &= V_m \times E(A_i) \\
 &= 191.523277 > 14.6776 \text{ cu. m} \\
 &\text{Therefore OK}
 \end{aligned}$$

CODE	BED
1	Clay
2	Sandy Clay
3	Very fine sand
4	Fine sand
5	Fine Gravel
6	Rocky soil
7	Rock
8	Grass-lined

9.5 HP5 catchment 9 Tabung Haji (Q after 5 years planting)

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A. CATCHMENT CHARACTERISTICS

From Topo Map sheets :

Area of catchment, A_c = 1.21 sq. km
Length of main stream, L = 0.97 km
Percentage developed, = 10.00 % (Land use factor)

Weighted mean slope, s

l_i (km)	h_i (m)	$s_i = h_i / l_i$ (%)	$l_i * \text{SQRT } s_i$
0.97	160.00	16.49	3.94
0.97	160.00	16.49	3.94

$$s = \frac{\sum (l_i * \text{SQRT } s_i)}{\sum l_i}$$

$$= \frac{3.94}{0.97}$$

$$= 16.49 \%$$

B. LOCATION OF BRIDGE

From Topo Sheet No :

Longitude 102° 18' 0" E
Latitude 4° 12' 0" N

From figure 1 of HP # 5
Region No 4

Note : Region 1 - Perlis, Kedah, Perak
Region 2 - Kuala Lumpur
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C. ESTIMATION OF THE DESIGN RAINSTORM

1. Adopt return period, T = 5 years (HP # 1)

$$T_c = \frac{1.286 \times L}{1.21^{0.223} \times 16.49^{0.263}}$$

$$= \frac{1.286 \times 0.97}{1.21^{0.223} \times 16.49^{0.263}}$$

$$= 0.57 \text{ hours}$$

$$= 34.32 \text{ mins}$$

3. Values of $x(T, t)$
(N.B. values of t is to envelope the value of T_c)

From Fig. 1 to 8 of HP # 1 :

$x(2, 0.5) = 40 \text{ mm}$
 $x(20, 0.5) = 70 \text{ mm}$
 $x(2, 3) = 80 \text{ mm}$
 $x(20, 3) = 140 \text{ mm}$

4. Plot those values above on graph Figure 10 of HP # 1

5. Read off values, with $T = 5$ years.

$x(T, 0.5) = 98.94 \text{ mm}$
 $x(T, 3) = 176.59 \text{ mm}$

6. Plot values obtained in steps 3 and 5 on graph Fig. 9 of HP # 1.

7. Read off values :

9.5 HP5 catchment 9 Tabung Haji (Q after 5 years planting)

$$\begin{aligned}
 &\text{With } T_c = 0.5719907 \text{ hours} \\
 &\text{and } T = 5 \text{ years.} \\
 &x(2, 0.57) = 43.00 \text{ mm} \\
 &x(20, 0.57) = 75.26 \text{ mm} \\
 &x(T, 0.57) = 104.77 \text{ mm}
 \end{aligned}$$

8. Confidence limits

$$\begin{aligned}
 D &= x(20) - x(2) \\
 &= 75.255184 - 43.002962 \\
 &= 32.252222 \\
 0.43 D &= 13.87 \text{ mm}
 \end{aligned}$$

$$\begin{aligned}
 9. \text{ Max } x \left[T = 5 \right] &= x(T) + 0.43 D \\
 &= 104.77184 + 13.868455 \\
 &= 118.64 \text{ mm}
 \end{aligned}$$

D. FLOOD ESTIMATION

1. From step C,

$$\begin{aligned}
 \text{Max } x(5) &= 118.6403 \text{ mm} \\
 \text{Therefore, } i(10) &= x(100) = 118.6403 \\
 &\quad T_c = 0.5719907 \\
 &= 207.42 \text{ mm / hr}
 \end{aligned}$$

2. From Figure 4 with,

$$\begin{aligned}
 \text{Region} &= 4 \\
 T &= 5 \text{ years.} \\
 C_{10} &= 0.38 \\
 C_t / C_{10} &= 0.88 \\
 \text{Therefore } C_t &= 0.3344
 \end{aligned}$$

$$\begin{aligned}
 3. \text{ Percentage developed} &= 10 \% \\
 \text{Land use factor, } F &= 1
 \end{aligned}$$

THEREFORE

$$\begin{aligned}
 Q_{\max} &= F \times 0.278 \times C_t \times i(T) \times A \\
 &= 23.33 \text{ cu. m / s}
 \end{aligned}$$

9.5 HP5 catchment 9 Tabung Haji (Q after 5 years planting)

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PROJECT : catchment 9 (after 5 years planting)
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A. CATCHMENT CHARACTERISTICS

From Topo Map sheets :

Area of catchment, A_c = 1.21 sq. km
Length of main stream, L = 0.97 km
Percentage developed, = 10.00 % (Land use factor)

Weighted mean slope, s

l_i (km)	h_i (m)	$s_i = h_i / l_i$ (%)	$l_i * \text{SQRT } s_i$
0.97	160.00	16.49	3.94
0.97	160.00	16.49	3.94

$$s = \frac{\sum (l_i * \text{SQRT } s_i)}{\sum l_i}$$

$$= \frac{3.94}{0.97}$$

$$= 16.49 \%$$

B. LOCATION OF BRIDGE

From Topo Sheet No :

Longitude 102° 18' 0" E
Latitude 4° 12' 0" N

From figure 1 of HP # 5
Region No 4

Note : Region 1 - Perlis, Kedah, Perak
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C. ESTIMATION OF THE DESIGN RAINSTORM

1. Adopt return period, T = 10 years (HP # 1)

$$T_c = \frac{1.286 \times L}{1.21^{0.223} \times 16.49^{0.263}}$$

$$= \frac{1.286 \times 0.97}{1.21^{0.223} \times 16.49^{0.263}}$$

$$= 0.57 \text{ hours}$$

$$= 34.32 \text{ mins}$$

3. Values of $x(T, t)$
(N.B. values of t is to envelope the value of T_c)

From Fig. 1 to 8 of HP # 1 :

$x(2, 0.5) = 40 \text{ mm}$
 $x(20, 0.5) = 70 \text{ mm}$
 $x(2, 3) = 80 \text{ mm}$
 $x(20, 3) = 140 \text{ mm}$

4. Plot those values above on graph Figure 10 of HP # 1

5. Read off values, with $T = 10$ years.

$x(T, 0.5) = 114.79 \text{ mm}$
 $x(T, 3) = 214.06 \text{ mm}$

6. Plot values obtained in steps 3 and 5 on graph Fig. 9 of HP # 1.

7. Read off values :

9.5 HP5 catchment 9 Tabung Haji (Q after 5 years planting)

$$\begin{aligned}
 &\text{With } T_c = 0.5719907 \text{ hours} \\
 &\text{and } T = 10 \text{ years.} \\
 &x(2, 0.57) = 43.00 \text{ mm} \\
 &x(20, 0.57) = 75.26 \text{ mm} \\
 &x(T, 0.57) = 122.25 \text{ mm}
 \end{aligned}$$

8. Confidence limits

$$\begin{aligned}
 D &= x(20) - x(2) \\
 &= 75.255184 - 43.002962 \\
 &= 32.252222 \\
 0.43 D &= 13.87 \text{ mm}
 \end{aligned}$$

$$\begin{aligned}
 9. \text{ Max } x(10) &= x(T) + 0.43 D \\
 [T = 10] &= 122.24664 + 13.868455 \\
 &= 136.12 \text{ mm}
 \end{aligned}$$

D. FLOOD ESTIMATION

1. From step C,

$$\begin{aligned}
 \text{Max } x(10) &= 136.1151 \text{ mm} \\
 \text{Therefore, } i(10) &= \frac{x(100)}{T_c} = \frac{136.1151}{0.5719907} \\
 &= 237.97 \text{ mm/hr}
 \end{aligned}$$

2. From Figure 4 with,

$$\begin{aligned}
 \text{Region} &= 4 \\
 T &= 10 \text{ years.} \\
 C_{10} &= 0.38 \\
 C_t / C_{10} &= 1
 \end{aligned}$$

$$\text{Therefore } C_t = 0.38$$

$$\begin{aligned}
 3. \text{ Percentage developed} &= 10 \% \\
 \text{Land use factor, } F &= 1
 \end{aligned}$$

THEREFORE

$$\begin{aligned}
 Q_{\max} &= F \times 0.278 \times C_t \times i(T) \times A \\
 &= 30.42 \text{ cu. m/s}
 \end{aligned}$$

9.5 HP5 catchment 9 Tabung Haji (Q after 5 years planting)

HYDROLOGICAL CALCULATION RATIONAL METHOD (HP # 5 - 1989)

PROJECT : catchment 9 (after 5 years planting)
Tabung Haji, Pahang

A. CATCHMENT CHARACTERISTICS

From Topo Map sheets :

Area of catchment, A_c = 1.21 sq. km
Length of main stream, L = 0.97 km
Percentage developed, = 10.00 % (Land use factor)

Weighted mean slope, s

l_i (km)	h_i (m)	$s_i = h_i / l_i$ (%)	$l_i * \text{SQRT } s_i$
0.97	160.00	16.49	3.94
0.97	160.00	16.49	3.94

$$s = \frac{\sum (l_i * \text{SQRT } s_i)}{\sum l_i}$$

$$= \frac{3.94}{0.97}$$

$$= 16.49 \%$$

B. LOCATION OF BRIDGE

From Topo Sheet No :

Longitude 102° 18' 0" E
Latitude 4° 12' 0" N

From figure 1 of HP # 5
Region No 4

Note : Region 1 - Perlis, Kedah, Perak
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C. ESTIMATION OF THE DESIGN RAINSTORM

1. Adopt return period, T = 20 years (HP # 1)

$$T_c = \frac{1.286 \times L}{1.21^{0.223} \times 16.49^{0.263}}$$

$$= \frac{1.286 \times 0.97}{1.21^{0.223} \times 16.49^{0.263}}$$

$$= 0.57 \text{ hours}$$

$$= 34.32 \text{ mins}$$

3. Values of $x(T, t)$
(N.B. values of t is to envelope the value of T_c)

From Fig. 1 to 8 of HP # 1 :

$x(2, 0.5)$ = 40 mm
 $x(20, 0.5)$ = 70 mm
 $x(2, 3)$ = 80 mm
 $x(20, 3)$ = 140 mm

4. Plot those values above on graph Figure 10 of HP # 1

5. Read off values, with T = 20 years.

$x(T, 0.5)$ = 130.00 mm
 $x(T, 3)$ = 250.00 mm

6. Plot values obtained in steps 3 and 5 on graph Fig. 9 of HP # 1.

7. Read off values :

9.5 HP5 catchment 9 Tabung Haji (Q after 5 years planting)

$$\begin{aligned}
 &\text{With } T_c = 0.5719907 \text{ hours} \\
 &\text{and } T = 20 \text{ years.} \\
 x(2, 0.57) &= 43.00 \text{ mm} \\
 x(20, 0.57) &= 75.26 \text{ mm} \\
 x(T, 0.57) &= 139.01 \text{ mm}
 \end{aligned}$$

8. Confidence limits

$$\begin{aligned}
 D &= x(20) - x(2) \\
 &= 75.255184 - 43.002962 \\
 &= 32.252222 \\
 0.43 D &= 13.87 \text{ mm}
 \end{aligned}$$

$$\begin{aligned}
 9. \text{ Max } x(20) &= x(T) + 0.43 D \\
 [T = 20] &= 139.00889 + 13.868455 \\
 &= 152.88 \text{ mm}
 \end{aligned}$$

D. FLOOD ESTIMATION

1. From step C,

$$\begin{aligned}
 \text{Max } x(20) &= 152.87734 \text{ mm} \\
 \text{Therefore, } i(20) &= \frac{x(100)}{T_c} = \frac{152.87734}{0.5719907} \\
 &= 267.27 \text{ mm/hr}
 \end{aligned}$$

2. From Figure 4 with,

$$\begin{aligned}
 \text{Region} &= 4 \\
 T &= 20 \text{ years.} \\
 C_{10} &= 0.38 \\
 C_t / C_{10} &= 1.128 \\
 \text{Therefore } C_t &= 0.43
 \end{aligned}$$

$$\begin{aligned}
 3. \text{ Percentage developed} &= 10 \% \\
 \text{Land use factor, } F &= 1
 \end{aligned}$$

THEREFORE

$$\begin{aligned}
 Q_{\max} &= F \times 0.278 \times C_t \times i(T) \times A \\
 &= 38.54 \text{ cu. m/s}
 \end{aligned}$$

9.5 HP5 catchment 9 Tabung Haji (Q after 5 years planting)

HYDROLOGICAL CALCULATION RATIONAL METHOD (HP # 5 - 1989)

PROJECT : catchment 9 (after 5 years planting)
Tabung Haji, Pahang

A. CATCHMENT CHARACTERISTICS

From Topo Map sheets :

Area of catchment, A_c = 1.21 sq. km
Length of main stream, L = 0.97 km
Percentage developed, = 10 % (Land use factor)

Weighted mean slope, s

l_i (km)	h_i (m)	$s_i = h_i / l_i$ (%)	$l_i * \text{SQRT } s_i$
0.97	160.00	16.49	3.94
0.97	160.00	16.49	3.94

$$s = \frac{\sum (l_i * \text{SQRT } s_i)}{\sum l_i}$$

$$= \frac{3.94}{0.97}$$

$$= 16.49 \%$$

B. LOCATION OF BRIDGE

From Topo Sheet No :

Longitude 102° 18' 0" E
Latitude 4° 12' 0" N

From figure 1 of HP # 5
Region No 4

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C. ESTIMATION OF THE DESIGN RAINSTORM

1. Adopt return period, T = 50 years (HP # 1)

$$T_c = \frac{1.286 \times L}{\{1.21^{0.223} \times 16.49^{0.263}\}}$$

$$= \frac{1.286 \times 0.97}{1.21^{0.223} \times 16.49^{0.263}}$$

$$= 0.57 \text{ hours}$$

$$= 34.32 \text{ mins}$$

3. Values of $x(T, t)$
(N.B. values of t is to envelope the value of T_c)

From Fig. 1 to 8 of HP # 1 :

$x(2, 0.5) = 40 \text{ mm}$
 $x(20, 0.5) = 70 \text{ mm}$
 $x(2, 3) = 80 \text{ mm}$
 $x(20, 3) = 140 \text{ mm}$

4. Plot those values above on graph Figure 10 of HP # 1

5. Read off values, with $T = 50$ years.

$x(T, 0.5) = 149.68 \text{ mm}$
 $x(T, 3) = 296.52 \text{ mm}$

6. Plot values obtained in steps 3 and 5 on graph Fig. 9 of HP # 1.

7. Read off values :

9.5 HP5 catchment 9 Tabung Haji (Q after 5 years planting)

$$\begin{aligned}
 &\text{With } T_c = 0.5719907 \text{ hours} \\
 &\text{and } T = 50 \text{ years.} \\
 &x(2, 0.57) = 43.00 \text{ mm} \\
 &x(20, 0.57) = 75.26 \text{ mm} \\
 &x(T, 0.57) = 160.71 \text{ mm}
 \end{aligned}$$

8. Confidence limits

$$\begin{aligned}
 D &= x(20) - x(2) \\
 &= 75.255184 - 43.002962 \\
 &= 32.252222 \\
 0.43 D &= 13.868455 \text{ mm}
 \end{aligned}$$

$$\begin{aligned}
 9. \text{ Max } x \left[T = 50 \right] &= x(T) + 0.43 D \\
 &= 160.7059 + 13.868455 \\
 &= 174.57 \text{ mm}
 \end{aligned}$$

D. FLOOD ESTIMATION

1. From step C,

$$\begin{aligned}
 \text{Max } x(50) &= 174.57435 \text{ mm} \\
 \text{Therefore, } i(50) &= \frac{x(100)}{T_c} = \frac{174.57435}{0.5719907} \\
 &= 305.20 \text{ mm/hr}
 \end{aligned}$$

2. From Figure 4 with,

$$\begin{aligned}
 \text{Region} &= 4 \\
 T &= 50 \text{ years.} \\
 C_{10} &= 0.38 \\
 C_t / C_{10} &= 1.296 \\
 \text{Therefore } C_t &= 0.49
 \end{aligned}$$

$$\begin{aligned}
 3. \text{ Percentage developed} &= 10 \% \\
 \text{Land use factor, } F &= 1
 \end{aligned}$$

THEREFORE

$$\begin{aligned}
 Q_{\max} &= F \times 0.278 \times C_t \times i(T) \times A \\
 &= 50.56 \text{ cu. m/s}
 \end{aligned}$$

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PROJECT : catchment 9 (after 5 years planting)
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A. CATCHMENT CHARACTERISTICS

From Topo Map sheets :

Area of catchment, A_c = 1.21 sq. km
Length of mainstream, L = 0.97 km
Percentage developed, = 10 % (Land use factor)

Weighted mean slope, s

l_i (km)	h_i (m)	$s_i = h_i / l_i$ (%)	$l_i * \text{SQRT } s_i$
0.97	160.00	16.49	3.94
0.97	160.00	16.49	3.94

$$s = \frac{\sum (l_i * \text{SQRT } s_i)}{\sum l_i}$$

$$= \frac{3.94}{0.97}$$

$$= 16.49 \%$$

B. LOCATION OF SITE

From Topo Sheet No :

Longitude 102° 18' 0" E
Latitude 4° 12' 0" N

From figure 1 of HP # 5
Region No 4

Note : Region 1 - Perlis, Kedah, Perak
Region 2 - Kuala Lumpur
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C. ESTIMATION OF THE DESIGN RAINSTORM

1. Adopt return period, T = 100 years (HP # 1)

$$2. T_c = \{1.286 \times L\} / \{A^{0.223} \times S^{0.263}\}$$

$$= \frac{\{1.286 \times 0.97\}}{\{1.21^{0.223} \times 16.49^{0.263}\}}$$

$$= 0.57 \text{ hours}$$

$$= 34.32 \text{ mins}$$

3. Values of $x(T, t)$
(N.B. values of t is to envelope the value of T_c)

From Fig. 1 to 8 of HP # 1 :

$x(2, 0.5)$ = 40 mm
 $x(20, 0.5)$ = 70 mm
 $x(2, 3)$ = 80 mm
 $x(20, 3)$ = 140 mm

4. Plot those values above on graph Figure 10 of HP # 1

5. Read off values, with T = 100 years.

$x(T, 0.5)$ = 164.43 mm
 $x(T, 3)$ = 331.38 mm

6. Plot values obtained in steps 3 and 5 on graph Fig. 9 of HP # 1.

7. Read off values :

9.5 HP5 catchment 9 Tabung Haji (Q after 5 years planting)

$$\begin{aligned}
 &\text{With } T_c = 0.57 \text{ hours} \\
 &\text{and } T = 100 \text{ years.} \\
 &x(2, 0.57) = 43.00 \text{ mm} \\
 &x(20, 0.57) = 75.26 \text{ mm} \\
 &x(T, 0.57) = 176.96 \text{ mm}
 \end{aligned}$$

8. Confidence limits

$$\begin{aligned}
 D &= x(20) - x(2) \\
 &= 75.255184 - 43.002962 \\
 &= 32.252222 \\
 0.43 D &= 13.87 \text{ mm}
 \end{aligned}$$

$$\begin{aligned}
 9. \text{ Max } x &= 100 \\
 [T = 100] &= x(T) + 0.43 D \\
 &= 176.96475 + 13.868455 \\
 &= 190.83 \text{ mm}
 \end{aligned}$$

D. FLOOD ESTIMATION

1. From step C,

$$\begin{aligned}
 \text{Max } x &= 100 \\
 \text{Therefore, } i(100) &= \frac{x(100)}{T_c} = \frac{190.83321}{0.5719907} \\
 &= 333.63 \text{ mm/hr}
 \end{aligned}$$

2. From Figure 4 with,

$$\begin{aligned}
 \text{Region} &= 4 \\
 T &= 100 \text{ years.} \\
 C_{10} &= 0.38 \\
 Q / C_{10} &= 1.46 \\
 \text{Therefore } Q &= 0.5548
 \end{aligned}$$

$$\begin{aligned}
 3. \text{ Percentage developed} &= 10 \% \\
 \text{Land use factor, } F &= 1
 \end{aligned}$$

THEREFORE

$$\begin{aligned}
 Q_{\text{max}} &= F \times 0.278 \times Q \times i(T) \times A \\
 &= 62.26 \text{ cu. m/s}
 \end{aligned}$$