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APPENDIX A



Derivation of Wardrop's formula⁽²⁷⁾

If all of the vehicles has equal speeds, it is apparent from dimensional analysis of the variables that

$$q = ku \quad \text{----- (A-1)}$$

where q = mean rate of flow
 u = mean speed
 k = mean density

If any two of these three variables are known, the third is uniquely determined. There is actually no single dependent variable; however, density is often considered the dependent variable because flow and speed are easier to measure and, therefore, serve as the independent variables.

In practice, vehicle speed has a distribution within some range, and we will define two kinds of mean speeds, space mean speed and time mean speed. For this purpose, we introduce two probability density functions of the speed u ; 1) a space density function of speed $f_s(u)$, defined as the density function of vehicle speed for vehicles occupying a given length of roadway at a given instant. 2) a time density function of speed $f_t(u)$, defined as the density function of vehicle speed for vehicles passing a given point of roadway during a given time. Space mean speed \bar{u}_s and time mean speed \bar{u}_t are then defined by

$$\bar{u}_s = \int_0^{\infty} u f_s(u) du \quad \text{--- (A-2)}$$

$$\bar{u}_t = \int_0^{\infty} u f_t(u) du \quad \text{--- (A-3)}$$

the integrals starting at 0 because we assume no cars are in reverse gear. Harmonic means speeds \hat{u}_s and \hat{u}_t based on the two density functions above are defined as

$$\hat{u}_s = \frac{1}{\int_0^{\infty} \frac{1}{u} f_s(u) du} \quad \text{--- (A-4)}$$

$$\hat{u}_t = \frac{1}{\int_0^{\infty} \frac{1}{u} f_t(u) du} \quad \text{--- (A-5)}$$

We implicitly assume above that the traffic flow is steady and that the speed of each vehicle is constant for a time that defines the time mean speed, or along the road length that defines space mean speed. Let $k_u du$ and $q_u du$ be the differential volume and density of vehicles whose speed lies in the range between u and $u + du$. Then the following expressions for the density functions $f_s(u)$ and $f_t(u)$ are immediate:

$$f_s(u) du = k_u du / k \quad \text{--- (A-6)}$$

$$f_t(u) du = q_u du / q \quad \text{--- (A-7)}$$

where k and q are respectively the volume and density of the traffic.

From Eq. A-1

$$q_u = u k_u \quad \text{--- (A-8)}$$

Using this relation, we obtain from Eq.A-6 through A-8

$$qf_t(u) = ukf_s(u) \text{ --- (A-9)}$$

Then
$$\bar{u}_s = \int_0^{\infty} uf_s(u)du = q/k$$

since
$$\int_0^{\infty} f_u(u)du = 1$$

We have shown that

$$q = k \cdot \bar{u}_s \text{ --- (A-10)}$$

Thus Eq.A-1 is valid for the space mean speed \bar{u}_s , even if the vehicle speeds are not constant but instead have a probability distribution.

(27)

Derivation of relationship between time-mean speed and space-mean speed

On the other hand, by substituting Eq.A-10 into Eq.A-9, we find

$$f_t(u) = f_s(u) u/\bar{u}_s \text{ --- (A-11)}$$

Eq. A-11 describes the relationship between the space and time densities of the speed. By dividing by u and integrating both sides of Eq.A-11,

$$\int_0^{\infty} \frac{1}{u} f_t(u) du = \frac{1}{\bar{u}_s} \int_0^{\infty} f_s(u) du = \frac{1}{\bar{u}_s}$$

Then, recalling Eq.A-5, we observe that

$$\hat{u}_t = \bar{u}_s \text{ --- (A-12)}$$

Thus, the space mean speed is equal to the harmonic time mean speed.

Next, we will consider the relationship between \bar{u}_t and \bar{u}_s .

Substituting Eq. A-11 into Eq. A-3

$$\bar{u}_t = \int_0^{\infty} u^2 f_s(u) du / \bar{u}_s$$

If we define the variance σ_s^2 of the space speed by

$$\begin{aligned} \sigma_s^2 &= \int_0^{\infty} (u - \bar{u}_s)^2 f_s(u) du \\ &= \int_0^{\infty} u^2 f_s(u) du - \frac{1}{\bar{u}_s^2} \end{aligned}$$

then we obtain

$$\bar{u}_t = \bar{u}_s \left[1 + (\sigma_s / \bar{u}_s)^2 \right] \quad \text{--- (A-13)}$$

Thus, for large values of σ_s , the difference between the space mean speed \bar{u}_s and the time mean speed \bar{u}_t becomes larger. The space mean speed, unfortunately, is difficult to measure automatically, whereas the time mean speed can easily be measured by traffic detectors. Thus, in order to estimate the space mean speed automatically, one instead estimates the harmonic time mean speed \bar{u}_t and uses Eq. A-12.

APPENDIX B

Table B-1 Flow-density-speed measurements, Rama I Road

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
3480	242.9	14.3	2640	255.2	10.4
1440	357.2	4.0	2160	77.3	27.9
1380	283.7	4.9	3240	128.9	25.1
3600	171.6	21.0	2040	94.7	21.5
2100	146.3	14.4	1620	77.2	21.0
1500	111.7	13.4	1740	129.0	13.5
1680	371.0	4.5	1740	122.7	14.2
2700	265.1	10.2	1800	84.8	21.2
1740	329.2	5.3	900	14.8	60.8
2100	116.0	18.1	2520	66.3	38.0
2220	297.9	7.5	2160	57.4	37.6
2520	260.5	9.7	2100	103.0	20.4
2940	176.4	16.7	600	11.9	50.4
3360	175.8	19.1	2280	70.4	32.4
3780	153.2	24.7	1380	38.0	36.3
2400	143.9	16.7	1380	34.3	40.2
2820	307.5	9.2	2640	69.5	38.0
3300	240.6	13.7	2400	75.1	32.0
1560	376.4	4.1	1800	70.2	25.6
2520	277.1	9.1	1560	61.7	25.3
2400	111.8	21.5	2340	218.4	10.7
2760	74.6	37.0	2940	135.8	21.7
2520	102.4	24.6	2580	68.8	37.5
2580	152.5	16.9	2340	72.1	32.5
1380	404.0	3.4	2940	121.3	24.2
3120	213.0	14.6	900	8.5	105.9
2520	147.7	17.1	2280	65.5	34.8
2100	144.7	14.5	1620	71.5	22.7
2940	225.6	13.0	720	15.9	45.3
2760	136.0	20.3	3420	125.9	27.2
3300	89.4	36.9	960	20.9	45.9
2520	133.2	18.9	3060	104.8	29.2
3440	235.5	14.6	1800	132.9	13.5
2160	194.1	11.1	1800	59.6	30.2
1680	454.1	3.7	1020	16.7	61.1
1200	393.8	3.1	2820	93.5	30.2

Table B-1 (continued)

Flow, vph q	Density, vpk k	Speed, kph $u = q/k$	Flow, vph q	Density, vpk k	Speed, kph $u = q/k$
1860	64.3	28.9	2460	73.1	33.7
1860	44.4	41.9	3060	91.7	33.4
2220	56.5	39.3	2400	85.3	28.1
3180	82.3	38.6	2820	81.1	34.8
2400	71.0	33.8	660	11.5	57.4
2040	64.2	31.8	3000	85.6	35.1
2520	65.2	38.7	2580	80.5	32.1
1200	23.0	52.5	1500	59.6	25.2
2100	62.0	33.9	2520	238.4	10.6
2460	109.4	22.5	1740	238.9	7.3
840	12.8	65.6	2220	59.5	37.3
2880	140.4	20.5	1560	36.9	42.3
1500	37.2	40.3	2220	74.4	29.8
1740	59.9	29.1	1920	379.2	5.1
2100	275.2	7.6	2760	150.9	18.3
2220	160.3	13.9	2520	98.1	25.7
2340	132.9	17.6	1740	37.0	47.0
1740	148.3	11.7	2100	230.5	9.1
1680	61.2	27.5	2400	250.5	9.6
2640	85.9	30.7	2460	321.4	7.7
1440	27.9	51.6	2340	191.4	12.2
1320	40.7	32.4	1080	520.3	2.1
2160	67.3	32.1	2700	272.2	9.9
1380	25.2	54.8	3420	294.4	11.6
1860	45.9	40.5	1980	185.5	10.7
2340	72.5	32.3	960	239.8	4.0
1020	27.0	37.8	1140	447.1	2.6
3240	93.7	34.6	2880	257.1	11.2
2640	124.7	21.2	2940	144.9	20.3
1800	54.4	33.1	1560	479.8	3.3
2340	75.6	31.0	3000	170.2	17.6
1320	49.2	26.8	2160	376.1	5.7
1920	50.1	38.3	1800	352.1	5.1
3180	81.2	39.2	2700	79.4	34.0
2580	74.6	34.6	2400	77.7	30.9
1860	58.2	32.0	2940	93.9	31.3
900	17.7	50.9	2220	60.2	36.9
1740	68.2	25.5			

Table B-2 Flow-density-speed measurements, Rama IV road

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
1440	30.3	47.5	1920	35.5	54.1
3060	60.3	50.8	2520	50.5	49.9
4440	117.2	37.9	1740	35.7	48.7
2880	69.1	41.7	2940	58.6	50.2
5760	167.1	34.5	1560	29.2	53.4
1680	39.3	42.8	1740	30.8	56.5
1620	30.4	53.3	2880	73.2	39.3
4140	97.5	42.5	3000	60.5	49.6
4500	136.6	32.9	2100	39.7	52.9
1200	23.0	52.2	3180	80.6	39.5
1320	25.1	52.6	2760	56.0	49.3
3360	62.7	53.6	840	15.5	54.2
3720	87.0	42.8	3780	74.2	50.9
1860	42.8	43.5	1380	27.2	50.7
1500	31.6	47.5	1980	35.2	56.3
1140	20.2	56.4	3360	71.3	47.1
3600	84.3	42.7	2100	37.1	56.6
1500	22.9	65.5	1260	19.0	66.3
960	18.2	52.8	4560	88.2	51.7
3900	84.6	46.1	3980	93.7	42.5
4440	110.4	40.2	1260	28.8	43.8
1080	23.6	45.8	4020	83.4	48.2
1560	31.8	49.1	2040	47.2	43.2
2100	37.5	56.0	1920	37.5	51.2
1560	30.3	51.5	3000	64.5	46.5
1140	15.2	75.0	3660	85.2	43.0
3840	72.4	53.0	1860	31.6	58.9
4500	122.2	36.8	3480	67.3	51.7
1260	16.5	76.4	3840	110.0	34.9
3360	69.9	48.1	2820	48.2	58.5
780	13.4	58.2	4320	114.1	37.9
1080	21.1	51.2	1380	30.5	45.3
3120	58.2	53.6	2520	42.0	60.0
2280	53.1	42.9	1620	30.1	53.8
1560	31.3	49.8	1980	33.7	58.8
4920	122.5	40.2	4620	114.4	40.4
1620	37.2	43.6	1680	38.9	43.2
960	17.5	54.9	2100	41.9	50.1
4140	87.8	47.2	2640	58.1	45.4
2340	51.4	45.5	3120	65.0	48.0
1260	21.6	58.3	1440	27.3	52.8
4140	89.8	46.1	3660	79.8	45.9

Table B-2 (continued)

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
1680	29.9	56.2	4740	104.3	45.5
3900	68.8	56.7	4320	106.5	40.6
2280	42.0	54.3	1680	37.1	45.3
3540	83.1	42.6	3240	70.4	46.0
1920	37.4	51.3	4960	105.7	46.9
2460	60.8	40.5	1560	27.3	57.1
1500	27.3	55.0	2220	53.2	41.7
3900	95.2	41.0	4140	85.8	48.3
1560	34.0	45.9	4680	120.5	38.8
1800	34.9	51.6	1440	32.3	44.6
5040	132.0	38.2	1260	25.6	49.2
1620	32.8	49.4	900	17.1	52.6
3540	71.4	49.6	2700	60.1	44.9
2460	48.5	50.7	1680	33.5	50.1
1260	21.5	58.6	4620	90.6	51.0
1920	37.2	51.6	5720	125.6	45.9
1320	25.1	52.6	2640	58.0	45.5
3000	77.6	38.7	2220	44.0	50.5
1140	24.2	47.1	2520	47.9	52.6
1920	37.2	51.6	2700	54.7	49.4
1200	28.0	42.9	4620	116.9	39.5
2220	47.1	47.1	3780	90.9	41.6
2400	44.9	53.5	2520	61.1	41.2
4440	100.4	44.2	3300	70.7	46.7
1200	22.9	52.4	4480	101.7	44.1
1980	42.2	46.9	2340	57.3	40.8
5040	123.6	40.8	3180	58.2	54.6
2280	55.7	40.9	4680	104.7	44.7
2640	59.9	44.1	5220	144.5	30.1
5520	117.1	47.1	4500	180.0	25.0
1200	16.0	75.0	4980	148.5	33.5
5220	135.0	38.7	4200	271.5	15.5
2700	66.7	40.5	4560	228.5	20.0
2100	42.8	49.1	4200	300.0	14.0
1560	35.0	44.6	4860	162.5	29.9
2460	58.4	42.1	4650	168.5	27.6
2940	60.4	48.7	5130	189.5	27.1
3240	71.6	45.3	4710	192.5	24.5
4200	95.8	43.8	3900	100.0	39.0
1680	38.3	43.9	3990	106.5	37.5
2100	51.1	41.1	5370	210.1	25.6
2700	56.7	47.6	4950	260.0	19.0
4290	268.5	16.0	4830	220.0	22.0
4860	248.5	19.6			

Table B-3 Flow-density-speed measurements, Yaowaraj Road

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
2340	181.9	12.9	3660	324.7	11.3
2280	254.2	9.0	2400	402.2	6.0
2220	324.4	6.8	2520	382.9	6.6
2640	348.8	7.6	3060	348.7	8.8
3060	380.0	8.1	2760	382.4	7.2
2220	314.3	7.1	2580	389.5	6.6
1800	202.5	8.9	2580	277.4	9.3
3120	388.0	8.0	3540	382.7	9.3
2760	335.2	8.2	3480	530.4	6.6
2100	296.1	7.1	2700	366.1	7.4
2880	297.5	9.7	1440	238.9	6.0
2040	298.9	6.8	3240	227.4	9.9
2160	383.4	5.6	2400	447.0	5.4
3000	392.3	7.6	2520	525.0	4.8
2340	257.6	9.1	2580	432.2	6.0
2940	290.5	10.1	3180	564.2	5.6
2580	324.8	7.9	2940	303.1	9.7
2280	229.1	9.9	2460	559.7	4.4
3360	386.3	8.7	2880	430.4	6.7
2520	392.9	6.4	3300	602.3	5.5
2280	234.2	9.7	2940	457.2	6.4
3060	500.3	6.1	2220	453.1	4.9
2040	304.6	6.7	2760	618.5	4.5
2520	490.3	8.3	2220	366.0	6.1
1320	376.4	3.5	2580	514.6	5.0
2340	489.6	4.8	2700	232.9	11.6
2760	504.7	5.5	3420	458.0	7.5
1740	323.6	5.4	3420	425.1	8.0
1860	265.2	7.0	3060	468.7	6.5
1680	423.2	4.0	3240	346.4	9.4
2820	492.8	5.7	2760	435.1	6.3
1920	355.6	5.4	2580	425.5	6.1
2880	572.0	5.0	2940	592.2	5.0
2580	618.2	4.2	3720	629.0	5.9
2280	623.8	3.7	3000	559.9	5.4
2940	252.1	11.7	3300	339.7	9.7
2700	535.7	5.0	2820	298.2	9.5
2460	342.5	7.2	3600	622.8	5.8
3240	596.9	5.4	3120	578.6	5.4
2400	477.8	5.0	2280	308.8	7.4
2340	289.2	8.1	3000	462.0	6.5
2640	442.1	6.0	3480	385.2	9.0

Table B-3 (continued)

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
3600	297.3	12.1	1200	30.0	40.0
3720	356.2	10.4	1950	105.5	18.5
2460	398.8	6.2	1950	68.5	28.5
2040	456.5	4.5	1500	42.5	35.3
2640	435.0	6.1	1950	64.5	30.2
2940	609.6	4.8	2130	85.5	24.9
2580	574.6	4.5	840	18.5	45.4
3480	573.1	6.1	1230	42.5	28.9
3300	552.1	6.0	1980	180.0	11.0
2520	459.1	5.5	1080	32.5	33.2
2460	562.2	4.4	2160	154.5	14.0
2460	440.6	5.6	1740	120.0	14.5
2340	507.0	4.6	2460	159.5	15.4
2640	487.4	5.4	2310	140.0	16.5
3480	508.5	6.8	1620	64.5	25.1
2520	344.8	7.3	2400	200.0	12.0
2460	364.0	6.8	2250	78.9	28.5
3720	613.6	6.1	1980	98.5	20.1
2580	409.9	6.3	1140	25.3	45.0
3240	433.6	7.5	1860	76.5	24.3
2820	501.3	5.6	1800	72.5	24.8
2460	326.4	7.5	1830	70.0	26.1
2250	150.5	15.0	1920	85.5	22.5
1890	145.5	13.0	1290	34.5	37.4
1860	132.5	14.0	2220	120.0	18.5
1710	85.5	20.0	1740	60.0	29.0
1560	51.5	30.3	1620	51.5	31.8

Table B-4 Flow-density-speed measurements, Ratchadamnoen Khang Road

Flow, vph q	Density, vpk k	Speed, kph $u = q/k$	Flow, vph q	Density, vpk k	Speed, kph $u = q/k$
2280	62.8	36.3	2760	60.1	45.9
3060	48.1	63.6	2460	71.5	34.4
3120	80.1	39.0	2820	69.6	40.5
2640	67.3	39.2	3120	69.5	44.9
2160	55.7	38.8	2280	49.1	46.4
2340	59.2	39.5	3060	67.3	45.5
2240	54.2	41.3	2160	43.7	49.4
2280	53.9	42.3	1500	36.8	40.8
3300	50.3	65.6	2640	69.2	38.2
2820	71.0	39.7	2400	51.5	46.6
1680	45.0	37.3	1920	42.9	44.8
2100	58.1	36.2	2820	71.7	39.3
3240	93.4	34.7	1740	39.9	43.6
2940	70.7	41.6	1800	46.9	38.4
1860	41.8	44.5	2580	33.8	76.3
2700	80.3	33.6	2580	68.1	37.9
3840	97.4	39.4	1920	50.3	38.2
2340	57.6	40.6	3000	75.8	39.6
1800	41.4	43.5	2640	65.6	40.2
2820	72.7	38.8	2520	55.3	45.6
2100	52.5	40.0	2400	53.1	45.2
2880	75.8	38.0	1260	28.5	44.2
2760	65.5	42.1	2400	50.8	47.2
3320	73.9	44.9	2700	63.9	42.3
1860	50.0	37.2	1980	49.6	39.9
2880	74.8	38.5	2400	60.3	39.8
3120	64.8	48.2	3060	67.1	45.6
1860	43.2	43.1	2220	58.6	37.9
2400	44.3	54.2	2700	68.1	39.7
2820	68.7	41.1	1680	41.7	40.3
1920	49.7	38.6	2340	64.4	36.3
2940	78.7	37.4	1680	47.1	35.7
3060	74.8	40.9	2040	50.6	40.3
1980	48.5	40.8	3000	68.9	43.5
2520	58.0	43.5	2340	47.9	48.9
2700	49.6	54.4	3120	83.1	37.6
2400	63.1	38.0	3300	70.8	46.6
2160	50.8	42.5	2880	82.7	34.8
1620	36.3	44.6	3300	74.6	44.2
2460	60.3	40.8	1860	45.7	40.7
2460	53.9	45.6	2760	59.5	46.4
2940	77.5	37.9	1200	27.8	43.2
1980	46.1	43.0	2460	50.5	48.7

Table B-4 (continued)

Flow, vph q	Density, vpk k	Speed, kph $u = q/k$	Flow, vph q	Density, vpk k	Speed, kph $u = q/k$
3420	89.1	38.4	2040	52.2	39.1
3000	71.8	41.8	2220	47.5	46.7
1740	41.8	41.6	1800	42.3	42.6
3000	60.1	49.9	2580	72.3	35.7
1500	37.5	40.4	2400	61.6	39.0
1440	32.9	43.8	3120	71.0	43.9
2640	57.8	45.7	1860	49.1	37.9
1860	44.8	41.5	1860	45.9	40.5
3180	75.1	42.3	3060	64.2	47.7
1680	41.9	40.1	1860	44.8	41.5
2820	66.7	42.3	1860	43.5	42.8
3240	72.4	44.8	1420	52.9	26.8
2280	57.5	39.7	2460	56.5	43.5
2820	69.6	40.5	2040	51.9	39.3
2340	55.7	42.0	1740	36.6	47.5
2520	65.1	38.7	2720	50.7	53.7
2100	49.3	42.6	2520	58.8	42.9
2580	65.8	39.2	3600	105.5	34.0
1920	49.9	38.5	4140	229.5	18.0
2700	59.6	46.1	3240	260.0	12.5
2160	58.9	38.0	3240	100.0	32.4
3000	79.1	37.9	3660	116.5	31.4
1920	52.3	36.7	3960	158.5	25.0
3240	80.8	40.1	3890	129.5	30.0
1800	44.2	40.7	3270	109.0	30.0
3060	75.6	40.5	3570	142.5	25.1
2700	70.5	38.3	3390	271.5	12.5
2880	76.5	37.7	3750	186.5	20.1
1800	43.0	41.9	3540	128.5	27.6
2640	64.0	41.3	4320	162.5	26.6
2460	61.3	40.1	2400	58.6	41.0
2100	54.0	38.9	3690	125.0	29.5
2220	53.6	41.4	3600	120.0	30.0
1800	46.4	38.8	3660	210.0	17.4
1620	38.3	42.3	4020	200.0	20.1
2760	63.3	43.6	1980	44.1	44.9
2460	60.8	40.5	3780	140.0	27.0
2700	67.9	39.8	3810	231.5	16.5
3000	74.5	40.3	3750	162.5	23.1
2400	58.3	41.2	3360	134.5	25.0
2100	54.3	38.7	3720	255.5	14.6
2820	67.5	41.8			

Table B-5 Flow-density-speed measurements, Phaholyothin Road

Flow, vph q	Density, vpk k	Speed, kph $u = q/k$	Flow, vph q	Density, vpk k	Speed, kph $u = q/k$
1980	270.0	7.3	2280	55.4	41.2
2280	142.7	16.0	2040	165.0	12.4
2100	138.2	15.2	1680	56.3	29.9
1920	72.5	26.5	1920	89.5	21.5
1830	174.1	10.5	2280	70.4	32.4
1800	77.8	23.1	2220	80.0	27.8
2040	74.8	27.3	2040	74.0	27.6
1620	190.5	8.5	1800	44.9	40.1
1920	88.4	21.7	1920	39.8	48.2
1920	50.6	37.9	2400	51.5	46.6
1320	29.1	45.4	1740	41.6	41.8
1620	33.4	48.5	1920	96.9	19.9
1920	43.1	44.6	2400	63.4	37.8
1380	27.5	50.2	2220	55.6	39.9
2220	53.4	41.6	1560	34.4	35.3
1200	28.5	42.2	2220	72.4	30.7
1860	46.8	39.8	2340	117.7	19.9
2640	72.7	36.3	2280	271.5	8.4
2220	53.6	41.4	1860	77.5	24.0
1680	38.7	43.4	1860	126.7	14.7
1320	28.7	46.0	2400	97.9	24.5
1800	39.6	45.5	2220	84.0	26.4
1560	30.6	51.0	1860	122.4	15.2
1620	38.0	42.7	1620	121.4	13.3
1560	34.7	45.0	1680	47.9	35.1
2100	46.8	44.9	1620	58.0	27.9
1920	40.8	47.1	1380	75.7	18.2
1440	32.2	44.7	1260	24.9	50.6
2040	42.7	47.8	1560	37.0	42.2
2220	53.4	41.6	2280	61.6	37.0
1200	31.3	38.3	1680	48.6	34.6
2340	88.6	26.4	2580	73.5	35.1
1320	40.5	32.6	1500	71.0	21.1
1800	42.1	42.8	2100	84.1	25.0
2580	67.5	38.2	1560	37.5	41.6
1800	49.7	36.2	1740	41.4	42.0
2220	55.8	40.2	2040	46.9	43.5
1440	32.5	44.3	1860	49.7	37.4
1440	30.2	47.7	1440	33.3	43.2
1080	22.2	48.7	1920	49.9	38.5
2700	58.2	46.4	2520	70.3	35.9
2100	50.1	41.9	2280	55.4	41.2
1620	34.5	46.9	1200	26.4	45.5
1200	33.5	35.8	1560	32.0	48.8

Table B-5 (continued)

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
1560	34.1	45.8	2100	40.4	52.0
1500	34.8	43.1	2340	63.1	37.1
1740	49.6	35.1	1440	29.7	48.5
1980	58.5	33.8	1740	42.1	41.3
2280	50.9	44.8	2220	58.8	37.8
1620	49.5	32.7	2460	55.3	44.5
2220	65.3	34.0	1920	44.5	43.2
1800	39.9	45.1	2880	54.3	53.0
2340	57.3	40.8	1440	26.6	54.1
1560	100.2	15.6	1320	23.9	55.2
1980	62.2	31.8	2460	57.2	43.0
1620	205.0	7.9	1860	47.1	39.5
1440	54.8	26.3	1560	24.2	64.5
1800	205.6	8.8	1980	45.0	44.0
1500	56.1	26.7	2340	54.1	43.3
1980	62.6	31.6	1980	50.8	39.0
1680	54.8	30.7	2520	59.8	42.1
1920	50.0	38.4	1260	29.8	42.3
1560	34.4	45.4	1980	47.7	41.5
2280	80.1	28.5	1800	42.4	42.5
2340	136.4	17.2	20-0	105.0	19.4
2340	65.1	35.9	1740	36.7	47.5
1500	74.7	20.1	2040	63.2	32.3
2160	220.6	9.8	2280	58.9	38.7
2340	191.1	12.2	1380	29.0	47.6
1740	38.0	45.8	1320	33.8	39.1
2820	168.1	16.8	1860	38.0	49.0
1680	120.5	14.0	2280	54.0	42.2
1620	44.9	36.1	1920	44.0	43.6
2760	243.5	11.3	2280	51.1	44.6
1860	217.5	8.6	1380	28.5	48.4
1740	211.7	8.2	2820	90.2	31.3
1860	214.2	8.7	2520	105.5	23.9
2520	151.7	16.6	2280	88.6	25.7
1680	79.7	21.1	1920	62.4	30.8
1800	46.1	39.1	1800	48.4	37.2
1800	50.9	35.4	660	11.7	56.4
1440	45.7	31.5	1800	303.5	5.9
2100	50.5	41.6	2580	131.5	19.6
1020	26.2	38.9	1680	41.8	40.2
1980	53.8	36.8	1440	31.5	45.7

Table B-6 Flow-density-speed measurements, Sukhumvit Road

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
2100	46.1	45.6	1680	35.7	47.1
1920	60.0	32.0	1080	23.6	45.8
1620	45.1	35.9	2640	86.4	30.6
1620	32.6	49.7	2280	48.0	47.5
2700	78.2	34.5	1860	44.2	42.1
1740	41.4	42.0	2040	47.9	42.6
1920	56.6	33.9	2700	76.2	35.4
1740	34.0	51.2	1860	48.5	38.4
1860	42.3	44.0	2280	56.5	40.4
1680	42.2	39.8	2340	75.8	30.9
1920	44.8	42.9	2280	53.2	42.9
960	20.6	46.6	1560	34.6	45.1
2760	72.0	38.3	2640	64.1	41.2
2340	58.3	40.1	1740	45.0	38.7
2340	52.1	44.9	1980	44.9	44.1
2040	63.7	32.0	2100	46.9	44.8
1500	43.5	34.5	900	16.2	55.6
2700	71.5	37.8	1560	35.1	44.4
1620	32.6	49.7	2220	51.0	43.5
2520	59.9	42.1	2220	58.7	37.8
2400	77.4	31.0	1560	45.1	34.6
2580	89.3	28.9	1800	47.3	38.1
1680	48.5	34.5	2400	101.7	23.6
2220	54.5	40.7	2820	99.2	28.4
2400	49.2	48.8	2400	68.4	35.1
1920	44.2	43.4	840	15.0	56.0
1740	43.3	40.2	2100	54.5	39.6
3060	81.1	37.7	1800	47.4	38.0
1380	37.3	37.0	2280	57.7	39.5
1800	47.9	37.6	1560	36.9	42.3
1560	36.0	43.3	2100	38.7	54.3
2400	60.5	39.7	1980	48.7	40.7
1500	38.2	39.3	1260	27.3	46.2
1200	28.2	42.6	2700	60.8	44.4
2160	47.0	46.0	2520	52.7	47.8
1320	35.5	37.2	2880	148.9	19.3
1740	47.0	37.0	2040	60.2	33.9
420	8.1	51.9	1560	39.0	40.0
1260	24.4	51.6	2400	50.1	47.9
1680	36.6	45.9	2220	55.6	39.9
2740	46.8	58.6	1980	52.9	37.4
1920	46.1	41.7	2580	58.9	43.8

Table B-6 (continued)

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
2280	52.3	43.6	2340	55.6	42.1
1320	25.0	52.8	2280	53.2	42.9
1920	44.5	43.2	2100	56.2	37.4
2100	50.8	41.3	2760	76.7	36.0
1740	35.2	49.4	2040	40.7	50.1
1860	43.2	43.1	2340	50.1	46.7
1860	41.2	45.2	2400	55.3	43.4
1620	44.0	36.8	1860	37.1	50.1
2460	59.3	41.5	2040	46.4	44.0
1080	9.9	109.1	1800	37.3	48.3
2520	54.5	46.2	2100	51.6	40.7
2340	59.1	39.6	2520	148.5	17.0
1680	38.5	43.6	2520	61.5	41.0
2460	54.8	44.9	2160	51.7	41.8
2640	123.1	21.5	1920	50.6	38.0
2280	108.7	21.0	2220	48.2	46.1
2400	60.3	39.8	1680	37.5	44.8
2640	107.4	24.6	2760	64.6	42.7
2580	62.9	41.0	2100	48.9	43.0
2340	60.7	38.6	2700	82.6	32.7
2100	172.3	12.2	2760	95.4	28.9
2700	66.3	40.7	1440	35.3	40.8
1560	35.7	43.7	2760	71.7	38.5
1740	41.5	41.9	2400	94.2	25.5
2280	51.5	44.3	2820	119.3	23.6
2160	50.7	42.6	2460	71.0	34.7
2160	50.6	42.7	3060	83.5	36.7
2220	52.6	42.2	1980	50.3	39.4
2220	48.5	45.8	2880	75.3	38.3
720	16.5	43.6	2940	175.1	16.8
2640	63.0	41.9	1860	58.1	32.0
1980	41.1	48.2	2880	68.9	41.8
2280	57.7	39.5	2160	47.5	45.5
1980	50.0	39.6	3240	96.1	33.7
2100	70.2	29.9	1200	25.5	47.1
2160	55.2	39.1	2520	63.7	39.6
1320	28.0	47.1	2580	71.9	35.9
2400	49.6	48.4	2160	50.9	42.4
2160	64.7	33.4	2070	206.5	10.0
2040	47.1	43.3	2850	113.5	25.1
2520	54.4	46.3	2370	188.5	12.6
1920	45.8	41.9	2970	102.5	29.0

Table B-6 (continued)

Flow, vph q	Density, vpk k	Speed, kph $u = q/k$	Flow, vph q	Density, vpk k	Speed, kph $u = q/k$
3180	108.1	29.4	2730	155.5	17.6
2880	130.0	22.2	3000	120.0	25.0
2640	165.1	16.0	2790	116.5	24.0
2880	96.5	29.8	2850	142.5	20.0
2880	86.5	33.3	2760	85.1	32.4

Table B-7 Flow-density-speed measurements, New Petchbury Road

Flow, vph q	Density, vpk k	Speed, kph $u = q/k$	Flow, vph q	Density, vpk k	Speed, kph $u = q/k$
1920	29.6	64.8	3240	77.0	42.0
1920	40.7	47.2	2460	49.2	50.0
2060	38.2	54.0	2280	56.2	40.6
2880	80.9	35.6	2520	55.2	45.6
2760	68.0	40.6	2280	50.7	45.0
1680	36.1	46.5	2700	62.0	43.6
3420	73.2	46.8	2580	62.5	41.3
1260	23.8	53.1	3120	70.1	44.5
2760	60.8	45.4	2460	52.6	46.7
2500	58.4	48.8	2640	64.1	41.2
3180	69.8	45.6	2220	48.7	45.6
1860	41.9	44.4	1260	20.5	61.4
2340	66.5	35.2	2400	25.3	94.7
2460	62.3	35.5	2880	90.9	31.7
2220	46.3	48.0	2820	90.6	31.1
1920	36.1	53.2	2280	67.4	33.8
1500	29.3	51.2	480	97.2	35.8
2340	44.1	53.0	2820	70.8	39.9
2160	46.4	46.6	3300	94.0	35.7
2400	55.8	43.0	2040	45.6	44.7
1500	28.9	51.9	3240	69.1	46.9
2760	55.8	49.7	2340	49.5	47.3
1920	40.5	47.4	3120	60.5	51.6
3060	68.7	44.6	3000	69.9	48.9
1440	32.4	44.4	2460	52.8	46.6
1820	28.1	64.8	1980	36.3	54.6
1020	19.3	53.0	3520	73.2	48.1
3420	79.7	42.9	2520	67.9	57.1
2040	40.6	50.2	3300	81.6	40.5
2880	56.0	51.5	2040	40.4	50.4
1980	37.6	52.7	3180	65.6	48.4
3060	68.2	44.9	2100	46.3	45.4
2880	65.6	43.9	2940	59.3	49.6
3060	68.4	44.7	1560	26.1	59.7
1800	36.2	49.8	1980	37.7	52.5
3720	89.3	41.7	1920	42.0	45.8
2340	44.8	52.3	1500	28.0	53.6
2400	58.4	41.1	3300	76.5	43.1
1740	35.1	49.6	2760	57.9	47.7
3480	76.0	45.8	2280	48.7	47.4
3780	103.9	36.4	2760	58.1	47.5
2880	50.7	45.0	2100	34.8	60.3

Table B-7 (continued)

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
2580	54.7	47.1	1860	47.7	39.0
2760	79.2	47.1	3000	67.6	44.4
1760	79.2	34.8	3540	89.2	39.7
3120	63.3	49.3	3420	136.9	25.0
2760	65.6	42.1	3300	168.7	19.6
1320	18.2	72.4	3540	181.7	19.5
3480	78.9	44.1	3360	198.5	16.9
2200	69.1	31.8	3240	260.3	12.4
3420	66.4	51.5	2520	197.7	12.7
2820	63.0	44.8	2820	199.6	14.1
3300	81.6	40.4	3840	249.0	15.9
2800	80.2	34.9	3060	240.4	12.5
2280	63.8	35.7	2220	246.0	9.0
2760	63.4	43.5	1740	294.5	5.9
2400	26.4	90.9	4020	240.7	16.7
1800	37.2	48.4	4020	160.0	25.0
3540	71.5	46.3	3600	160.0	22.5
2820	62.6	45.0	3840	190.0	20.2
1500	26.6	56.4	3300	195.0	16.9
1980	38.3	51.7	2760	210.0	13.1
3840	90.8	42.3	3300	150.0	22.0
3540	86.0	41.2	3600	110.5	32.6
2040	45.1	45.2	3600	130.5	27.6
2760	53.2	51.9	3060	220.0	13.9
2880	65.1	44.3	2910	242.5	12.0
2760	66.9	41.3	3120	130.5	23.9
2940	61.5	47.8	3540	115.0	30.8
2760	57.9	47.7	3240	180.5	18.0
2940	61.5	47.8	3240	190.0	17.1
2760	57.9	47.7	3060	188.5	16.2
3060	71.4	42.9	3540	130.0	27.2
2940	166.4	17.7	3480	175.0	19.9
4080	136.3	29.9	3540	200.0	17.7
3240	179.3	18.1	2580	270.0	9.6
1680	57.5	29.2	3810	130.0	29.3
3060	90.3	33.9	2640	48.5	54.4
2400	63.5	37.8	3180	119.0	26.7
2760	177.2	15.6			

Table B-8 Flow-density-speed measurements, Raj Prarop Road

Flow,vph q	Density,vpk k	Speed,kph $u = q/k$	Flow,vph q	Density,vpk k	Speed,kph $u = q/k$
1680	177.3	9.5	1740	166.6	10.4
900	172.6	5.2	1500	284.4	5.3
1020	29.8	34.2	2040	200.9	10.2
480	17.5	27.4	1500	96.3	15.6
2160	128.3	16.8	1200	145.6	8.2
1140	160.0	7.1	1860	157.0	11.9
2220	173.0	12.8	2160	139.9	15.4
1080	38.9	27.8	1680	122.8	13.7
1860	88.4	21.0	1740	120.3	14.5
1440	133.9	10.8	1620	99.2	16.3
300	7.6	39.5	660	22.6	29.2
1260	36.7	34.3	1860	71.3	26.1
2400	134.8	17.8	1020	305.3	3.3
2040	132.7	15.4	1620	81.9	19.8
1460	93.9	15.6	1380	214.8	6.4
1500	245.6	6.1	1920	144.8	13.3
2040	91.8	22.2	1860	71.8	25.9
2160	122.3	17.7	1320	70.9	18.6
1980	146.8	13.5	1560	46.5	33.6
1200	24.5	49.0	1680	130.2	12.9
2160	128.1	16.9	2460	198.2	12.4
1200	38.5	31.2	1920	88.1	21.8
2220	100.3	22.1	1260	47.5	26.5
1080	67.5	16.0	2100	77.5	27.1
1860	71.2	26.1	3040	301.4	10.1
1800	240.8	7.5	300	8.5	35.3
1260	47.4	26.6	1500	47.6	31.5
1500	75.4	19.9	1800	72.7	24.8
1920	61.8	31.1	2100	78.3	26.8
2460	155.0	15.9	1920	160.2	12.0
600	33.4	18.0	1920	64.8	29.6
900	31.4	28.7	1980	115.2	17.2
2580	92.1	28.0	1980	69.2	28.6
1580	135.5	11.7	1740	101.3	17.2
1380	43.6	31.7	1080	40.8	26.5
1740	60.1	29.0	1680	52.6	31.9
720	22.4	32.1	1860	206.6	9.9
1500	49.8	30.1	1020	55.3	18.4
2040	70.1	29.1	1920	59.9	32.1
1800	141.5	12.7	1380	45.0	30.7
1260	177.7	7.1	840	22.9	36.7
2040	218.6	9.3	1440	45.6	31.6

Table B-8 (continued)

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
2100	76.3	27.5	420	172.4	2.4
1680	79.3	21.2	2280	165.0	13.8
2160	65.9	32.8	1500	126.9	11.8
2160	118.9	18.2	660	43.9	15.0
1800	234.2	7.7	1620	189.1	8.6
2700	90.3	29.9	1740	264.7	6.6
1980	95.0	20.8	1920	102.4	18.8
1040	31.6	32.9	1920	82.6	23.2
2400	107.4	22.4	960	42.8	22.4
1920	57.8	33.2	1380	78.0	17.7
960	30.0	32.0	1620	148.8	10.9
2040	59.0	34.6	1140	70.4	16.2
1860	81.7	22.8	1340	155.7	8.6
720	21.4	33.6	1800	117.0	15.4
1080	40.4	26.7	1140	228.5	5.0
2220	84.9	26.2	1140	308.1	3.7
1380	57.5	24.0	960	225.0	4.3
2340	93.8	25.0	1620	105.3	15.4
2280	66.4	34.3	2460	147.3	16.7
1860	97.2	19.1	1500	104.0	14.4
780	18.0	43.3	1800	146.1	12.3
2460	110.6	22.2	1620	192.3	8.4
1040	42.1	24.7	1440	191.2	7.5
1560	67.7	23.0	2160	126.9	17.0
1500	35.3	42.5	660	20.3	32.5
1380	76.3	18.1	610	39.9	38.0
1860	62.4	29.8	1870	125.0	15.0
1260	38.9	32.4	760	20.0	38.0
1560	42.5	36.7	1400	280.0	5.0
120	400.0	3.3	1560	60.0	26.0
1020	62.0	16.5	960	30.0	32.0
1620	223.1	7.3	1680	140.0	12.0

Table B-9 Flow-density-speed measurements, Charoen Krung Road

Flow,vph q	Density,vpk k	Speed,kph u = q/k	Flow,vph q	Density,vpk k	Speed,kph u = q/k
3660	38.1	96.1	1740	81.6	21.3
1920	63.7	30.1	2100	86.1	24.4
1680	55.5	30.3	2040	73.6	27.7
1200	42.3	28.4	2280	102.8	22.2
2040	103.4	19.7	1620	56.3	28.8
1740	78.6	22.1	1560	52.1	29.9
1680	70.1	24.0	1440	45.8	31.4
2280	96.6	23.6	1860	55.1	33.8
2400	95.8	25.1	1440	46.3	31.1
1980	70.4	28.1	1440	56.6	25.4
1860	72.1	25.8	1740	53.0	32.8
1860	62.3	29.9	1860	74.8	24.9
1620	77.7	20.8	1800	63.7	28.3
1620	52.9	30.6	1800	57.9	31.1
1860	57.4	32.4	2220	101.5	21.9
1680	60.2	27.9	2400	87.4	27.5
1980	73.2	27.0	1740	61.0	28.5
1980	64.5	30.7	2340	88.9	26.3
1680	55.1	30.5	2040	59.6	34.2
1920	63.8	30.1	1560	44.6	35.0
2280	69.1	33.0	1680	55.5	30.3
1680	71.4	23.5	1740	49.4	35.2
2040	64.4	31.7	1920	66.5	28.9
1320	44.3	29.8	1440	45.9	31.4
1740	58.5	29.7	1680	65.3	25.7
1440	55.7	25.9	1920	66.5	28.9
1680	66.4	25.3	1140	31.0	36.8
1620	54.8	29.6	1620	47.3	34.2
1620	66.4	24.4	1680	47.8	35.1
1740	59.1	29.4	1980	53.8	36.8
1680	109.7	15.3	1500	42.6	35.2
2220	82.1	27.0	1440	38.8	37.1
1740	56.2	31.0	1200	39.5	30.4
1620	55.9	29.0	1440	40.5	35.5
1980	66.9	29.6	1440	41.1	35.0
1320	40.6	32.5	1200	32.9	36.5
1740	76.7	22.7	1320	37.2	35.5
1620	53.4	30.3	1620	46.7	34.7
1500	67.7	22.2	1680	52.5	32.0
2220	139.4	15.9	1740	52.1	33.4
1620	91.2	17.8	1800	57.6	31.3
2220	113.3	19.6	1980	73.7	26.9

Table B-9 (continued)

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
1800	65.1	27.6	1260	35.9	35.1
2040	90.3	22.6	2160	82.2	26.3
1620	77.8	20.8	2340	85.8	27.3
1920	55.3	34.7	2220	88.2	25.2
1860	59.1	31.5	1740	65.1	26.7
1380	47.8	28.9	2280	114.0	20.6
1500	47.1	31.8	2160	66.3	32.6
1920	62.3	30.8	2400	77.8	30.8
2040	73.4	27.8	2280	87.0	26.2
1680	62.0	27.1	1680	80.4	20.9
1800	76.2	23.6	1800	67.9	26.5
1860	53.0	35.1	1800	226.1	8.0
1500	57.3	26.2	1860	70.6	26.3
1920	66.1	29.0	1980	83.6	23.7
1440	55.4	26.0	2100	82.5	25.5
1860	64.9	28.7	1680	59.6	28.2
1500	37.2	40.3	1680	64.0	26.3
1980	61.6	32.1	1620	57.0	28.4
1320	39.3	33.6	1320	49.8	26.5
1860	57.4	32.4	2400	200.0	12.0
2220	69.7	31.9	2330	155.5	15.0
1860	70.9	26.2	2100	200.0	10.5
2280	117.8	19.4	1710	200.0	8.6
2100	99.5	21.1	2460	130.0	18.9
1440	56.7	25.4	2130	176.5	12.1
1740	58.9	29.5	2100	155.6	13.5
2520	81.1	31.1	2580	120.0	21.5
2340	81.0	28.9	2460	110.0	22.4
1680	54.6	30.8	2220	220.0	10.1
2220	81.7	27.2	2280	190.0	12.0
2340	79.4	29.5			

Table B-10 Flow-density-speed measurements, Raj Vithee Road

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
780	10.9	71.6	1620	42.2	38.4
1080	23.6	45.8	240	3.5	68.6
1620	37.1	43.7	1860	53.3	34.9
1660	15.3	43.1	1440	50.0	28.8
1860	38.5	48.3	1140	25.2	45.2
1620	38.0	42.6	900	21.1	42.7
840	16.3	51.5	1200	25.5	47.1
1800	36.4	49.5	1680	37.6	44.7
900	22.8	39.5	300	3.3	90.9
1080	21.3	50.7	1800	39.6	45.5
1800	48.5	37.1	1380	32.4	42.6
900	20.7	43.5	1020	28.3	36.0
1080	23.9	45.2	2280	52.2	43.7
2040	49.8	41.0	720	15.3	47.1
1080	24.5	44.1	2580	73.6	35.1
840	16.8	50.0	960	19.1	50.3
2160	39.8	54.3	1500	33.1	45.4
1500	41.1	36.5	1920	80.4	23.9
960	20.1	47.8	780	9.8	79.6
480	5.4	88.9	1380	29.8	46.3
1020	18.8	54.3	2580	73.0	35.3
2220	55.6	39.9	1440	50.5	28.5
480	5.3	90.6	1260	24.7	51.0
1860	37.0	50.3	1200	26.7	44.9
1260	27.7	45.5	1740	46.9	37.1
1460	80.0	18.3	1680	46.6	36.1
1200	24.7	48.6	1500	41.0	36.6
720	10.8	66.7	1200	24.8	48.4
1920	43.1	44.6	1440	47.0	30.6
1340	34.1	39.3	1500	27.0	55.6
1200	25.3	47.4	1500	33.3	45.1
1680	39.7	42.3	2160	108.7	19.9
1260	24.1	52.3	1500	52.8	28.4
1620	58.9	27.5	1680	58.2	28.9
900	17.0	52.9	1440	38.0	37.9
1560	32.8	47.6	1860	46.7	39.9
1740	63.2	27.5	1380	29.4	46.9
2280	50.6	45.1	660	17.1	38.6
1020	24.1	42.3	2100	71.5	29.4
1560	32.1	48.6	2160	87.4	24.7
840	14.7	57.1	1800	51.7	34.8
1740	26.8	64.9	1980	56.9	34.8

Table B-10 (continued)

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
1380	58.9	23.4	1260	28.7	43.9
1560	57.0	27.4	1920	88.9	21.6
1080	27.8	38.8	1620	120.9	13.4
2040	50.3	40.6	1020	293.5	3.5
2340	94.1	24.9	1200	37.3	32.2
1500	37.2	40.3	900	156.1	5.8
1280	47.8	26.8	180	180.0	1.0
900	24.0	37.5	1710	142.5	12.0
960	26.5	36.2	1470	185.5	7.9
1560	40.4	38.6	1800	185.0	14.9
1980	71.7	27.6	1680	112.5	14.9
2040	54.6	37.4	1770	118.5	14.9
1140	28.1	40.6	1920	100.0	19.2
960	23.4	41.0	2100	142.5	14.7
1800	44.5	40.4	1830	160.0	11.4
1800	45.3	39.7	1140	191.5	6.0
1320	28.6	46.2	1860	142.5	13.1
1020	22.1	46.2	1080	214.0	5.1
1560	43.1	36.2	1560	77.5	20.1
1980	60.4	32.8	2070	121.5	17.0
1800	59.1	30.3	1470	97.5	15.1
1020	24.0	42.5	2070	172.5	12.0
1860	46.7	39.8	1680	140.0	12.0
2220	54.1	41.0	1560	129.5	12.1
2100	94.2	22.3	2310	128.5	18.0
720	16.0	45.0	1440	180.0	8.0
660	12.5	52.8	1590	158.5	10.0
660	10.6	62.3	2-20	100.0	25.2

Table B-11 Flow-density-speed measurements, Lat Phrao Road

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
840	14.2	59.4	1500	28.7	52.3
1500	29.5	50.8	2160	44.3	48.8
1680	31.7	53.0	1860	37.4	49.8
1200	23.7	50.6	1260	23.1	54.6
960	19.5	49.1	1380	22.8	60.5
960	18.3	52.4	1860	37.6	49.5
1080	18.2	59.5	1260	23.7	53.2
2040	43.8	46.6	1380	26.5	52.0
2040	42.8	47.6	1320	21.5	61.3
1500	30.4	49.4	1500	25.8	58.1
960	16.9	56.7	1380	30.1	45.8
1920	37.9	50.7	900	14.8	60.8
1440	26.5	54.3	1320	25.3	52.3
1620	31.9	50.8	780	13.6	57.6
1560	27.8	52.4	1380	27.0	51.2
900	15.1	59.6	1500	30.5	49.2
1140	19.5	58.4	1920	37.0	51.9
2040	56.1	36.4	1740	35.2	49.5
1020	18.6	54.9	1080	23.3	46.3
1320	25.5	51.7	1860	37.6	49.5
1440	28.3	50.9	1380	28.8	47.9
1080	19.2	56.3	720	16.8	42.9
1140	23.9	47.7	1320	24.3	54.3
1020	19.2	53.2	2280	44.5	51.2
1920	48.4	39.7	1500	26.5	56.6
1440	25.6	56.2	1740	37.5	46.4
2100	47.2	44.5	1320	22.5	58.8
1560	29.4	53.0	1860	36.2	51.4
1020	21.4	47.6	1080	22.5	58.8
2700	68.2	39.6	1980	35.6	55.6
1140	18.8	60.6	1320	34.7	38.0
1140	18.6	61.2	660	13.0	50.7
1140	22.2	51.3	1740	36.5	47.7
1740	32.9	53.0	2400	48.0	50.0
1440	24.6	58.5	660	12.2	54.1
1200	22.6	53.1	720	12.7	56.7
660	9.8	67.3	1860	36.1	51.6
2160	46.4	46.6	1620	32.8	49.3
1920	43.1	44.5	1560	32.4	48.1
1020	20.6	49.5	1680	30.5	55.1
2040	44.4	46.0	1320	24.4	54.2
1080	20.8	52.0	780	15.5	50.5

Table B-11 (continued)

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
2460	59.8	41.1	2100	51.6	40.7
1800	40.4	44.5	1800	37.8	47.6
1200	29.3	41.0	2040	43.7	46.7
1740	32.5	53.5	2580	59.2	43.6
1620	35.1	46.2	1860	36.9	50.4
1560	30.1	51.8	2340	50.3	46.5
1560	28.1	55.5	3000	82.8	36.2
1920	42.8	44.9	1620	31.8	51.0
1800	34.3	52.5	1320	23.9	55.2
1140	24.3	46.9	1320	23.3	56.7
1920	39.6	48.5	1260	25.4	49.7
1920	38.6	49.8	2280	49.6	46.0
2460	52.5	46.8	1680	28.2	59.5
1140	24.0	47.6	2460	44.9	54.8
1800	38.5	46.7	1560	30.9	50.5
1380	25.3	54.5	2100	51.9	40.5
1200	20.3	59.3	1860	33.5	55.6
2100	48.7	43.1	1260	24.1	52.4
2040	47.8	42.7	2460	46.8	52.6
1860	39.6	47.0	2040	38.1	53.5
1800	40.6	44.4	1800	35.1	51.3
1320	26.0	50.7	1380	25.5	54.2
2220	53.5	41.5	2520	48.2	52.3
1920	44.9	42.8	1980	40.1	49.4
1740	36.0	48.3	2220	44.8	49.6
1500	29.3	51.1	2700	74.5	36.2
2400	49.4	48.6	2400	60.0	40.0
1860	36.6	50.8	2880	131.5	21.9
2280	45.1	50.6	3150	150.0	21.0
1860	41.4	44.9	2520	65.0	38.8
1500	30.3	49.5	3240	110.0	29.5
1680	33.7	49.9	2910	100.0	29.1
1440	28.3	50.9	2850	77.5	36.8
2160	42.0	51.4	3210	118.5	27.1
2460	52.5	46.9	3000	120.0	25.0
1620	31.9	50.8	3330	138.5	24.0
1680	37.4	44.9	3600	150.0	24.0
1680	33.6	50.1	3660	158.5	23.1
2040	46.6	43.8	2760	171.5	16.1
2160	66.2	32.7	2700	208.5	13.0
1860	35.3	52.8	2790	90.0	31.0
1980	45.0	44.0	3270	171.5	19.1

Table B-11(continued)

Flow, vph q	Density, vpk k	Speed, kph $u = q/k$	Flow, vph q	Density, vpk k	Speed, kph $u = q/k$
2940	162.5	18.1	2610	70.0	37.3
3210	140.0	22.9	3720	128.5	29.0
3060	132.5	23.1	2760	77.5	35.6
2730	80.0	34.1	2970	78.5	37.8
2520	70.0	36.0	3060	75.0	40.8
2790	85.5	32.6	3120	125.0	25.0
3170	88.5	35.8			

TableB-12 Flow-density-speed measurements, Phrachao Taksin Road

Flow,vph q	Density,vpk k	Speed,kph u = q/k	Flow,vph q	Density,vpk k	Speed,kph u = q/k
2160	50.8	42.5	1680	36.3	46.3
2400	70.7	33.9	2100	51.1	41.1
1920	43.2	44.5	2100	38.4	54.7
2640	71.0	37.2	2460	60.5	40.7
2160	67.5	32.0	2280	51.6	44.2
2040	54.6	37.4	2280	140.4	16.2
2340	64.7	36.1	2640	65.6	40.3
2460	62.1	39.7	1560	36.3	42.9
2940	65.1	45.2	2220	62.2	35.7
1800	44.8	40.1	1980	49.2	40.2
2400	58.4	41.1	2280	45.2	50.5
2760	75.7	36.5	1680	37.4	44.9
2880	75.9	38.0	2100	37.0	56.8
2340	61.9	37.8	1680	39.3	42.7
2340	58.8	39.8	2520	67.8	37.2
2880	99.5	29.0	1980	44.0	45.0
2640	64.9	40.7	2520	54.0	46.7
2100	56.8	37.0	1920	45.2	42.5
2520	62.2	40.6	1920	39.0	49.2
2100	56.1	37.5	1860	45.3	41.1
1620	40.8	39.7	2100	44.6	47.1
1620	40.4	40.1	2400	54.1	44.4
1620	37.5	43.2	1440	37.8	38.1
2100	56.1	37.4	1620	38.9	41.7
1620	34.3	47.3	2280	49.7	45.9
2400	60.3	39.8	2400	54.0	44.4
2700	67.7	39.9	2760	69.6	39.7
2340	62.3	37.6	2040	49.6	41.1
2160	53.1	40.7	1320	26.2	50.3
2040	46.3	44.0	2040	40.8	50.0
1860	48.6	38.3	1860	46.8	39.7
2880	69.1	41.7	2100	49.9	42.1
2220	47.9	46.4	1980	48.5	40.8
1980	50.2	39.4	1920	35.6	54.0
2220	48.3	45.9	2160	43.9	49.2
2820	68.4	41.3	2220	55.4	40.0
1500	43.7	34.4	2280	52.6	43.3
2700	75.7	35.7	1980	45.4	43.6
2280	52.9	43.1	2520	59.0	42.7
2640	58.6	45.1	2340	56.0	41.8
1620	36.0	45.0	1800	47.3	38.0
1680	32.3	52.1	2580	55.7	46.3

Table B-12(continued)

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
2340	49.5	47.3	2400	66.7	36.0
2100	47.8	44.0	1440	31.1	46.3
2340	55.9	41.9	2400	64.5	37.2
2400	56.6	42.4	2700	60.5	44.6
2580	53.1	48.6	1560	39.3	39.7
2220	62.5	35.5	1860	42.1	44.2
1980	53.2	37.2	2040	43.5	46.9
2400	52.6	45.6	1980	48.4	40.9
2460	54.8	44.9	1920	52.7	36.5
2640	54.8	44.9	2400	75.8	31.6
2640	61.9	42.6	2760	83.4	33.1
1800	37.4	48.1	2940	66.2	44.4
1680	38.5	43.6	2580	51.4	50.2
1920	46.9	40.9	1620	41.1	39.5
2400	36.2	42.7	2760	64.4	42.9
2340	48.5	48.2	2280	51.7	44.1
2340	48.5	48.2	2640	56.2	47.0
1800	37.8	47.6	2140	50.3	42.5
1680	33.7	49.9	2760	62.2	44.4
1560	35.4	47.4	2820	65.1	43.3
3000	73.3	40.9	1200	27.5	43.7
1680	43.6	38.5	2340	43.3	54.0
1680	34.8	48.3	2220	50.3	44.1
2160	50.7	42.6	1740	39.0	44.6
3180	84.2	37.8	1560	31.6	49.4
2520	62.8	40.1	2580	63.3	40.8
1800	44.9	40.1	2220	68.0	32.6
1800	44.9	40.1	3060	71.1	43.0
2520	62.0	40.6	2760	71.9	38.4
2760	69.8	39.5	3000	72.7	41.2
1860	49.1	37.9	2700	71.1	38.0
2340	53.2	44.0	1920	46.0	41.7
1440	36.5	39.5	2490	85.5	29.1
2760	66.7	41.4	3180	115.5	27.6
2160	47.4	45.6	2790	105.5	26.5
1140	29.6	38.6	2520	100.1	25.0
2280	54.4	41.9	2820	115.6	24.4
2160	68.3	31.6	3000	125.2	24.0
2280	55.1	41.4	2580	120.1	21.5
1980	56.0	35.4	2730	140.0	19.5
1800	43.3	41.6	2340	146.5	16.0
3060	82.9	36.9	2130	152.5	14.0

Table B-12 (continued)

Flow, vph q	Density, vpk k	Speed, kph $u = q/k$	Flow, vph q	Density, vpk k	Speed, kph $u = q/k$
2400	150.5	16.0	1980	65.5	30.2
2700	150.0	18.0	3210	128.5	25.0
3090	92.0	33.6	2460	92.5	26.6
3450	115.5	29.9	2850	142.5	20.0
2430	98.5	24.7	2160	172.5	12.5
2730	108.5	25.2			

Table B-13 Flow-density-speed measurements, Phran Nok Road

Flow, vph q	Density, vpk k	Speed, kph $u = q/k$	Flow, vph q	Density, vpk k	Speed, kph $u = q/k$
1020	18.6	54.8	1140	35.0	32.6
900	20.8	43.3	1500	39.9	37.6
1080	28.8	37.5	1380	37.1	37.2
1140	28.1	40.5	720	17.4	41.3
1320	36.9	35.8	1980	65.1	30.4
1020	28.1	36.3	780	17.8	43.8
1080	24.5	44.0	1260	33.1	38.0
1020	35.6	28.7	1440	38.5	37.4
1860	55.2	33.7	1500	33.5	44.8
720	19.8	36.4	1200	29.8	40.3
1500	41.6	36.1	1140	31.9	35.8
660	18.5	35.7	960	30.9	31.0
1620	43.3	37.4	900	23.0	39.1
1566	46.1	34.0	480	9.9	48.4
900	27.0	33.3	1440	39.8	36.2
1380	36.0	38.4	1620	40.5	40.0
840	14.4	58.3	960	22.1	43.4
840	26.3	31.9	1260	31.9	39.5
960	27.7	34.7	660	19.0	34.7
1440	38.9	37.0	1920	58.0	33.1
900	27.3	33.0	1140	28.7	39.8
900	26.6	33.8	1800	50.3	35.8
900	24.4	36.9	1320	37.1	35.6
1260	33.9	37.2	1440	33.9	42.5
1380	36.4	37.9	1560	39.4	39.6
900	23.8	37.9	1020	26.2	38.9
1440	36.9	59.0	1440	41.8	34.5
1320	35.1	37.6	1140	26.3	43.3
600	17.6	34.1	1320	30.8	42.9
1080	32.2	33.5	1620	46.5	34.8
1020	28.8	35.5	840	22.7	37.1
1560	64.3	24.3	2040	50.0	40.8
1080	34.9	30.9	1560	46.8	33.3
1020	26.5	38.5	1500	43.4	34.5
1320	37.5	35.2	1080	26.4	40.8
2040	52.2	39.1	1320	35.8	36.8
540	13.2	41.0	1440	35.8	40.2
1620	51.9	31.2	1740	43.1	40.3
660	17.9	36.9	1440	47.3	30.4
1620	45.5	35.6	1860	44.4	41.9
780	18.4	42.5	2100	59.3	35.4
1680	50.9	33.0	1500	35.7	42.0

Table B-13(continued)

Flow,vph q	Density,vpk k	Speed,kph u = q/k	Flow,vph q	Density,vpk k	Speed,kph u = q/k
1560	29.3	53.3	1500	40.0	37.5
1020	25.0	40.0	1320	29.3	45.1
1960	41.7	47.0	1500	37.2	40.4
1800	39.8	45.3	1260	37.2	40.4
660	17.2	38.4	1260	37.2	33.9
1380	35.9	38.5	1440	44.8	32.1
1260	38.2	33.0	1320	36.5	36.2
1740	51.8	33.6	1380	36.6	37.7
1260	34.9	36.2	900	24.0	37.5
1440	37.4	38.5	1080	29.2	37.0
1680	45.3	37.1	720	20.3	35.4
600	14.7	40.7	1980	51.1	38.7
720	18.5	39.0	1680	57.9	29.0
2020	61.7	32.7	1920	59.8	32.1
960	26.1	36.8	1080	30.3	35.6
1140	29.4	38.8	1560	45.1	34.6
780	19.5	40.0	1080	32.2	33.6
1620	41.7	38.9	1680	49.4	34.0
1080	30.6	35.3	1620	42.7	37.9
2100	70.6	29.8	1620	202.5	8.0
2220	74.6	29.8	2370	159.0	14.9
1020	30.8	33.1	2340	116.5	20.1
1500	39.9	37.6	1380	33.3	41.9
1440	39.2	36.8	2160	105.0	20.6
1980	54.0	36.7	2040	100.0	20.4
1980	51.1	38.7	2280	86.1	26.5
1800	52.6	34.2	2010	80.0	25.1
1500	39.4	38.1	1710	74.2	23.1
2160	53.2	40.6	1800	92.5	19.5
1320	36.5	36.1	1710	171.1	10.0
780	18.4	42.4	2130	142.5	15.0
1320	36.1	36.5	1620	46.6	34.8
1440	40.3	35.8	2070	125.5	16.5
1680	51.6	32.6	1920	71.1	27.0
1260	31.2	40.3	1710	162.5	10.5
1260	34.4	36.6	2460	100.0	24.6
1440	41.6	34.6	2070	165.5	12.5

Table B-14 Flow-density-speed measurements, Ramkhamhaeng Road

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
1980	51.8	38.2	1980	47.1	42.0
1920	43.9	43.7	1020	21.2	18.0
1800	37.4	48.1	1980	41.3	47.9
1860	42.2	44.1	1440	26.3	54.8
1500	30.3	49.5	1560	22.5	69.3
1620	36.2	44.8	2010	45.2	45.1
2220	48.2	46.0	2160	42.2	51.2
1680	38.0	44.2	1680	33.0	50.9
1440	32.1	44.8	1740	34.9	49.9
1200	18.0	66.7	1680	34.7	48.4
2460	69.2	35.5	2700	61.7	44.2
1860	33.4	55.7	1800	47.7	37.8
1740	43.4	40.1	2340	48.8	48.0
1860	35.4	52.6	1740	33.7	51.7
1500	30.3	49.6	1260	27.0	46.7
1740	39.5	41.1	1680	26.0	60.6
2280	50.7	45.0	1200	27.1	44.3
1380	36.2	38.1	2220	54.3	40.9
1800	39.6	45.5	2160	54.3	39.7
1860	43.9	42.4	1740	37.4	46.5
1680	33.6	50.1	1860	40.2	46.3
1500	18.7	80.0	1620	37.3	43.4
2580	53.6	48.1	1560	26.7	58.4
1140	12.5	91.2	2220	50.3	44.1
1260	80.6	61.1	2100	52.5	40.0
1020	15.8	64.6	1920	19.2	39.0
1080	23.1	46.8	1500	39.0	38.5
1320	23.4	56.4	1920	52.9	36.3
2520	50.1	50.3	1800	41.1	43.8
2640	61.7	42.8	1440	34.4	41.9
1740	40.7	42.7	1620	39.6	40.9
1260	18.1	69.6	2520	65.8	38.3
2160	55.7	38.8	1260	38.4	44.3
1800	32.7	55.0	2460	55.4	44.4
1980	41.3	47.9	2220	54.2	41.0
2760	68.4	40.3	1860	36.2	51.4
1980	57.2	34.6	1500	35.0	42.9
2940	97.5	30.1	2940	87.9	33.4
1680	41.4	40.6	2400	72.3	33.2
2100	54.6	38.5	1500	31.8	47.2
1620	39.8	40.7	1200	29.4	40.8
2280	56.5	40.4	2160	53.8	40.1



Table B-14(continued)

Flow,vph q	Density,vpk k	Speed,kph u = q/k	Flow,vph q	Density,vpk k	Speed,kph u = q/k
2040	20.7	98.6	1680	36.7	45.7
2220	59.6	37.2	2280	55.3	41.2
2100	57.3	36.7	1680	42.4	39.6
1680	39.3	42.8	2160	55.3	39.0
1800	43.7	41.2	1620	42.1	38.5
1560	25.6	61.0	2100	42.6	49.4
2640	61.5	42.9	1740	50.5	34.4
1800	29.2	61.6	2100	55.4	37.9
1800	37.4	48.2	1200	29.5	40.7
1920	43.6	44.0	2100	63.5	33.1
1740	38.6	45.0	2880	70.6	40.8
1620	40.8	39.7	2820	112.5	25.1
1680	32.1	52.3	2640	105.0	25.1
1380	28.4	48.6	2460	100.0	24.6
1440	26.8	53.7	2250	71.3	31.5
1140	27.2	41.9	2760	100.0	27.6
1860	40.0	46.5	2590	78.5	33.0
1680	37.8	44.4	2100	41.9	50.1
2100	48.3	43.5	2400	171.5	14.0
1800	33.5	53.7	2970	131.5	22.6
1740	45.4	38.4	2640	122.1	21.6
2040	49.1	41.9	2490	90.0	27.7
2280	50.6	45.1	2250	74.5	30.2
1860	40.2	46.3	2760	138.5	19.9
1680	41.6	40.4	2490	150.0	16.6
1980	48.2	41.1	2520	70.0	36.0
1980	49.6	39.9	2310	200.0	11.6
2340	64.6	36.2	2640	85.5	30.9
1740	30.3	57.4	2580	89.5	28.8
2280	68.6	42.0	2700	110.0	24.6
2280	49.8	45.8	2940	139.5	21.1
1980	45.7	43.3	2700	169.5	15.9
1560	32.3	48.4	2880	165.5	17.4
1500	34.6	43.3	2700	145.5	18.6
1560	32.2	48.5	2460	214.5	11.5

Table B-15 Flow-density-speed measurements, Soi Sena Nikhom

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
300	6.7	45.0	360	9.1	39.7
360	7.4	48.9	840	25.2	33.3
600	15.8	38.0	480	12.4	38.6
240	4.4	54.6	900	25.0	36.0
540	11.4	47.4	600	13.2	45.6
780	14.4	54.0	420	8.1	51.9
300	5.3	56.3	300	6.0	50.0
180	4.0	45.0	720	15.8	45.6
540	10.8	50.0	480	10.1	47.4
480	10.7	45.0	540	10.5	51.4
600	18.2	32.9	240	5.5	43.9
240	4.1	58.1	540	12.8	42.2
420	9.6	43.6	600	18.4	32.6
720	19.8	36.4	420	8.4	50.0
360	7.2	50.0	660	20.3	32.5
300	5.2	58.1	600	15.8	37.9
300	5.9	50.7	540	13.8	39.1
120	2.8	42.9	240	4.8	50.0
480	10.7	45.0	540	13.2	40.9
420	9.3	45.0	120	9.3	12.9
300	6.7	45.0	540	15.2	35.5
420	10.0	41.9	420	12.0	35.1
420	9.6	43.5	480	11.9	40.3
540	11.2	48.2	540	15.3	35.3
480	10.7	45.0	780	19.7	39.6
480	11.0	43.6	480	12.0	40.0
600	13.3	45.0	480	12.8	37.5
540	13.6	39.7	660	17.2	38.3
420	7.7	54.6	540	12.6	42.9
480	12.3	39.1	720	21.9	32.9
660	15.4	42.9	720	20.0	36.0
840	18.7	45.0	900	21.7	41.5
240	4.8	50.0	660	14.7	45.0
480	10.0	47.8	180	4.6	39.1
660	15.4	42.9	720	18.2	39.6
420	8.9	47.4	420	8.9	47.4
240	5.5	43.4	540	13.7	39.6
300	5.1	59.0	600	13.3	45.0
360	7.5	48.2	720	22.4	32.1
660	15.2	43.5	600	16.8	35.6
480	11.7	40.9	900	32.4	27.8
300	7.2	41.5	600	14.8	40.4

TableB-15 (continued)

Flow,vph q	Density,vpk k	Speed,kph u = q/k	Flow,vph q	Density,vpk k	Speed,kph u = q/k
660	16.4	40.3	780	26.0	30.0
960	23.5	40.9	1020	23.5	43.4
420	9.3	45.0	1200	34.3	35.0
420	10.6	39.7	1080	31.4	30.4
1080	26.1	41.4	900	22.7	39.7
360	8.4	42.9	720	18.8	38.3
480	12.8	37.5	900	18.9	47.7
780	21.8	35.7	300	6.3	47.4
840	24.3	34.6	600	13.3	45.0
780	17.3	45.0	1200	30.7	39.1
840	20.8	40.3	780	17.9	43.5
480	12.8	37.5	900	27.4	32.8
540	12.8	41.9	720	16.0	45.0
960	27.2	35.3	1200	31.5	38.1
480	12.8	37.5	1020	26.6	38.3
540	12.2	44.3	3220	44.0	30.0
540	13.0	41.5	1140	26.4	43.3
780	22.5	34.6	540	12.8	42.4
1020	28.9	35.3	1140	26.9	42.5
480	8.2	58.7	900	18.3	19.3
660	20.5	32.1	900	19.8	45.6
600	11.7	51.4	1140	26.6	42.9
660	14.2	46.6	720	15.2	47.4
720	17.4	41.4	540	12.6	42.9
1020	29.0	35.2	960	29.3	33.7
720	17.6	40.9	900	23.3	38.7
600	17.7	34.0	1080	40.2	26.9
960	24.5	39.1	960	24.5	39.1
660	19.8	33.7	1500	39.0	38.5
480	11.6	41.5	1440	56.0	25.7
900	25.7	35.1	540	10.8	50.0
1200	31.3	38.3	1080	28.0	38.6
960	26.7	36.0	840	19.6	42.9
1440	34.6	41.7	720	20.5	35.1
780	20.8	37.5	1320	50.0	26.4
780	17.3	45.0	1380	85.1	16.2
1560	56.2	27.8	1140	95.5	11.9
720	18.7	38.6	1350	63.5	21.3
720	17.6	40.9	1140	35.0	32.6
720	16.8	42.9	1410	65.1	21.7
360	8.0	45.0	1200	85.0	14.1
1080	26.1	41.4	1350	54.5	24.8

Table B-15 (continued)

Flow,vph q	Density,vpk k	Speed,kph u = q/k	Flow,vph q	Density,vpk k	Speed,kph u = q/k
1380	56.5	24.4	1260	48.5	26.0
1380	44.5	31.0	1320	78.5	16.8
1200	38.5	31.2	1290	38.5	35.5
1290	46.5	27.7	1380	60.0	23.0
1560	77.5	20.1	1230	54.5	22.6
1200	77.5	15.5			

Table B-16 Flow-density-speed measurements, Soi Aree

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
180	5.8	31.0	300	10.5	28.7
120	5.5	21.7	240	8.0	30.0
240	8.0	29.9	120	4.4	27.0
300	10.5	28.6	360	10.1	35.5
60	1.4	43.9	300	16.7	18.0
120	3.1	39.1	180	5.2	34.6
180	5.9	30.5	180	4.8	37.5
120	2.7	45.0	120	4.3	28.1
60	1.5	39.1	60	1.5	40.9
240	6.7	36.0	180	5.5	32.7
180	4.4	40.9	240	7.3	32.7
240	7.7	31.0	240	5.9	40.9
120	2.1	56.3	60	2.0	30.0
420	18.7	22.5	120	3.8	31.4
300	9.7	31.0	60	1.9	32.1
120	6.0	20.0	300	9.7	31.0
120	2.9	40.9	180	7.0	25.7
240	10.7	22.5	180	6.0	30.0
180	12.2	14.8	240	81.1	29.7
120	4.2	28.6	300	13.0	23.1
120	4.7	25.7	360	14.0	25.7
300	11.0	27.3	180	5.6	32.1
60	1.8	33.3	360	12.0	30.0
60	3.5	17.3	180	7.4	24.3
240	9.8	24.3	360	9.2	39.3
120	5.3	22.5	180	6.0	30.0
180	7.4	24.5	240	11.6	20.8
120	5.3	22.5	120	3.7	32.1
120	3.7	32.4	240	9.1	26.5
120	5.1	23.7	240	11.4	21.1
180	5.6	32.1	180	6.0	30.0
120	4.0	30.0	180	7.0	25.7
360	25.8	14.0	180	7.8	23.1
180	6.7	27.0	360	12.0	30.0
120	5.7	21.2	180	5.4	33.3
360	10.9	33.1	540	25.6	21.1
420	16.8	25.0	120	8.0	15.0
120	3.4	35.3	180	8.0	22.5
120	7.9	22.8	180	9.6	18.6
120	3.3	36.0	60	2.0	30.0
60	1.7	35.3	240	9.5	25.2
60	2.8	21.4	300	10.7	28.1

Table B-16 (continued)

Flow,vph q	Density,vpk k	Speed,kph u = q/k	Flow,vph q	Density,vpk k	Speed,kph u = q/k
120	5.3	22.5	180	6.8	26.5
180	6.3	28.6	360	18.0	20.0
240	8.8	27.3	180	6.0	30.0
360	13.5	26.6	120	4.0	30.0
180	5.2	34.6	180	6.4	28.1
300	12.1	24.8	180	8.7	20.7
240	12.7	19.0	360	13.8	26.1
240	8.2	29.4	300	12.3	24.3
300	12.7	23.7	180	6.6	27.3
240	6.5	37.0	60	2.1	28.1
240	11.1	21.6	300	10.8	27.7
180	4.0	45.0	300	11.6	26.0
240	12.0	20.0	240	14.7	16.4
240	6.4	37.5	360	15.0	22.5
300	15.0	20.0	330	16.5	20.0
180	7.1	25.5	600	30.0	20.0
240	8.0	30.0	640	65.0	9.9
360	12.6	28.6	480	30.0	16.0
120	4.7	25.7	480	31.5	15.2
240	11.7	20.5	420	26.5	15.9
180	6.0	30.0	420	26.8	15.7
240	7.7	31.4	360	25.1	14.3
240	8.8	27.3	420	28.5	14.7
300	10.7	28.1	420	24.5	17.1
180	6.2	29.0	300	8.5	35.3
360	15.7	22.9	510	71.5	7.5
240	9.1	26.5	480	45.0	10.7
120	4.0	30.0	180	5.5	32.5
120	3.3	36.0	450	61.5	7.3
180	6.0	30.0	390	20.0	19.5
240	6.4	37.5	420	36.5	11.5
300	13.3	22.5	490	50.0	9.8
120	3.3	36.0	540	57.5	9.4
120	4.0	30.0	660	42.5	15.5
180	6.0	30.0	540	28.5	19.0
120	3.7	32.1	300	10.5	28.7
240	8.4	28.7	510	20.0	25.5
360	20.0	18.0			

Table B-17 Flow-density-speed measurements, Chula Soi 12

Flow,vph q	Density,vpk k	Speed,kph u = q/k	Flow,vph q	Density,vpk k	Speed,kph u = q/k
420	9.3	45.0	780	51.7	15.1
780	32.6	23.9	840	36.6	23.0
360	10.6	34.0	1020	41.7	24.5
480	12.4	38.6	660	23.3	28.3
540	21.8	24.8	360	8.8	40.9
660	38.9	17.0	720	37.6	19.1
840	31.5	26.7	780	38.1	20.5
780	28.6	27.3	480	18.0	26.7
960	27.3	35.2	360	15.6	23.1
540	18.6	29.0	1020	38.9	26.2
420	15.6	26.9	480	17.1	28.1
720	18.0	40.0	600	16.4	36.5
840	41.7	20.1	600	18.0	33.3
600	28.7	20.9	660	17.4	38.0
540	22.2	24.3	900	26.5	34.0
600	17.3	34.6	360	10.4	34.6
660	33.0	20.0	600	20.9	28.7
540	17.0	31.8	240	7.1	34.0
960	31.5	30.5	660	19.6	33.8
420	9.8	42.9	240	7.1	33.8
540	23.4	23.1	360	15.6	23.1
780	26.1	29.8	900	29.6	30.4
420	16.5	25.5	780	32.1	24.3
660	26.2	25.2	600	22.0	27.3
600	24.7	24.3	300	7.7	39.1
420	13.4	31.4	720	20.8	34.6
960	44.6	21.5	780	26.6	29.3
180	5.4	33.3	420	16.7	25.2
420	14.0	30.0	600	23.3	25.7
660	26.2	25.2	480	12.9	37.2
240	8.3	29.0	600	23.3	25.7
540	33.4	16.2	540	15.8	34.2
900	36.4	24.7	420	13.4	31.4
480	15.1	31.8	480	18.4	26.1
540	15.2	35.5	660	19.7	33.6
360	11.5	31.4	600	19.1	31.5
840	36.4	23.1	960	31.6	30.4
240	6.9	34.6	600	21.7	27.7
600	22.9	26.2	600	22.9	26.2
600	27.3	22.0	480	24.0	20.0
840	42.7	19.7	480	16.0	30.0
780	45.1	17.3	600	15.3	39.1

Table B-17 (continued)

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
540	18.0	30.0	900	26.8	33.6
480	14.7	32.7	600	15.8	37.9
480	14.0	34.2	480	19.6	24.5
540	14.6	37.0	360	11.3	31.8
300	10.3	29.0	540	15.4	35.1
600	17.3	34.6	660	23.0	28.7
600	16.9	35.5	360	8.6	41.9
660	17.6	37.5	600	16.7	36.0
120	2.9	40.9	660	20.4	32.4
660	24.8	26.7	540	16.2	33.3
660	28.2	23.4	660	18.1	36.5
720	50.4	14.3	540	14.8	36.5
600	29.3	20.5	360	10.0	36.0
480	15.3	31.4	540	13.2	40.9
780	30.0	26.0	540	13.3	40.5
780	29.8	26.2	600	17.8	33.8
780	29.7	26.3	660	19.3	34.2
120	3.3	36.0	240	6.3	37.9
660	17.1	38.6	960	24.5	39.1
720	27.7	26.0	300	8.8	34.2
300	11.2	26.7	900	27.2	33.1
720	19.5	37.0	600	18.0	33.3
480	21.9	22.0	360	9.8	36.7
300	10.0	30.0	240	5.9	40.4
900	25.0	36.0	300	8.8	34.0
840	24.6	34.2	840	35.9	23.4
660	21.0	31.4	300	8.9	33.6
480	16.5	29.0	540	20.3	26.7
540	18.0	30.0	420	14.6	28.8
960	27.9	34.4	600	16.9	35.4
300	7.3	40.9	300	9.3	32.1
360	10.0	36.0	840	22.6	37.1
480	14.7	32.7	540	17.6	30.8
420	13.1	32.1	660	20.0	33.0
900	26.5	34.0	420	12.4	34.0
420	14.2	29.5	300	9.0	33.3
480	14.6	32.9	600	16.7	36.0
360	9.1	39.6	600	18.8	31.9
900	25.7	35.1	780	24.9	31.3
600	18.5	32.4	660	21.8	30.3
780	18.8	41.5	480	14.3	33.6
900	24.0	37.5	840	60.0	14.0

Table B-17 (continued)

Flow, vph q	Density, vpk k	Speed, kph u = q/k	Flow, vph q	Density, vpk k	Speed, kph u = q/k
780	78.0	10.0	540	77.1	7.0
480	19.7	24.3	600	50.0	12.0
660	77.7	8.5	420	76.4	5.5
480	21.9	22.0	540	72.0	7.5
540	60.0	9.0	720	62.6	11.5
660	44.0	15.0			

APPENDIX C

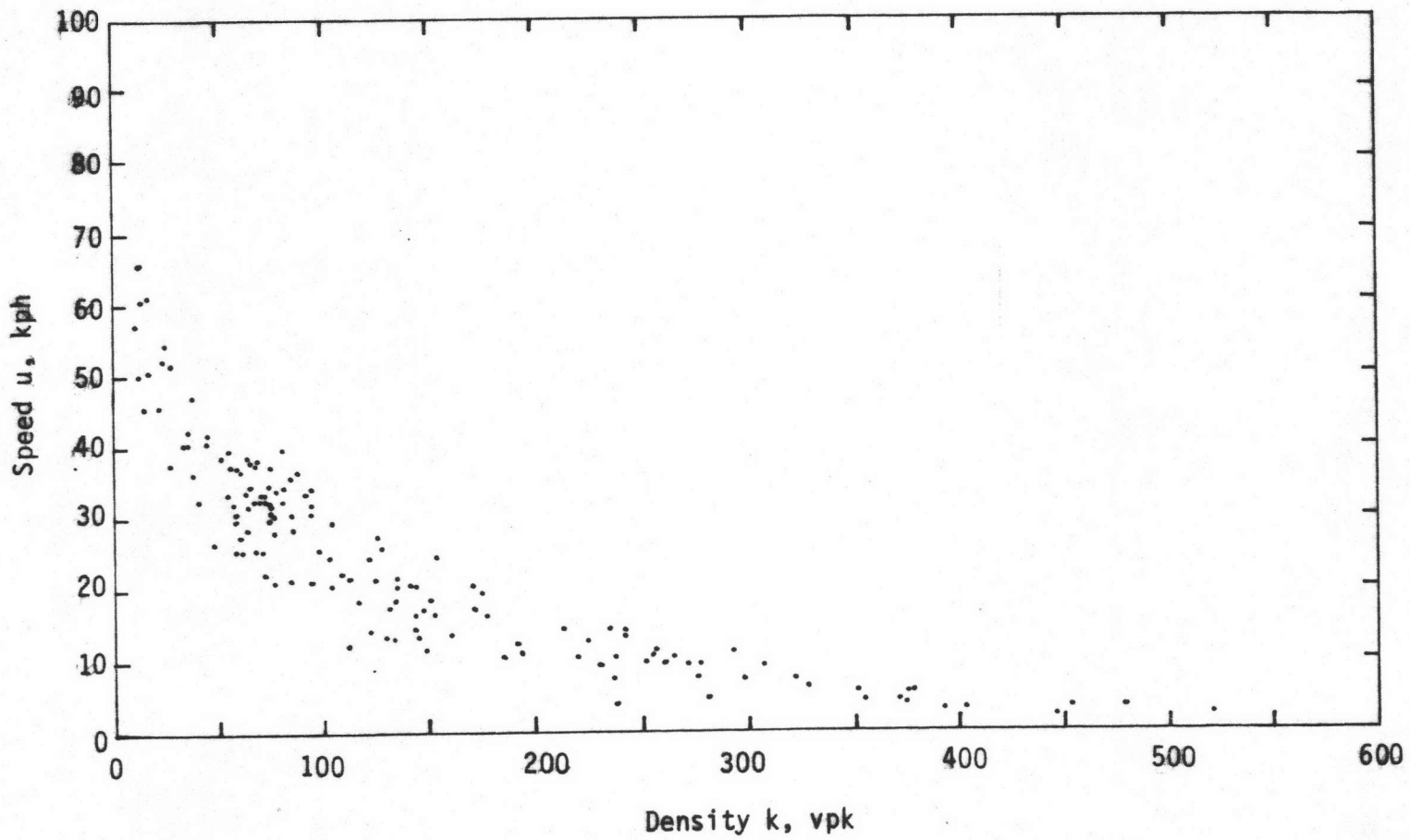


Fig.C-1 Observed relationship between speed and density,
Rama I Road

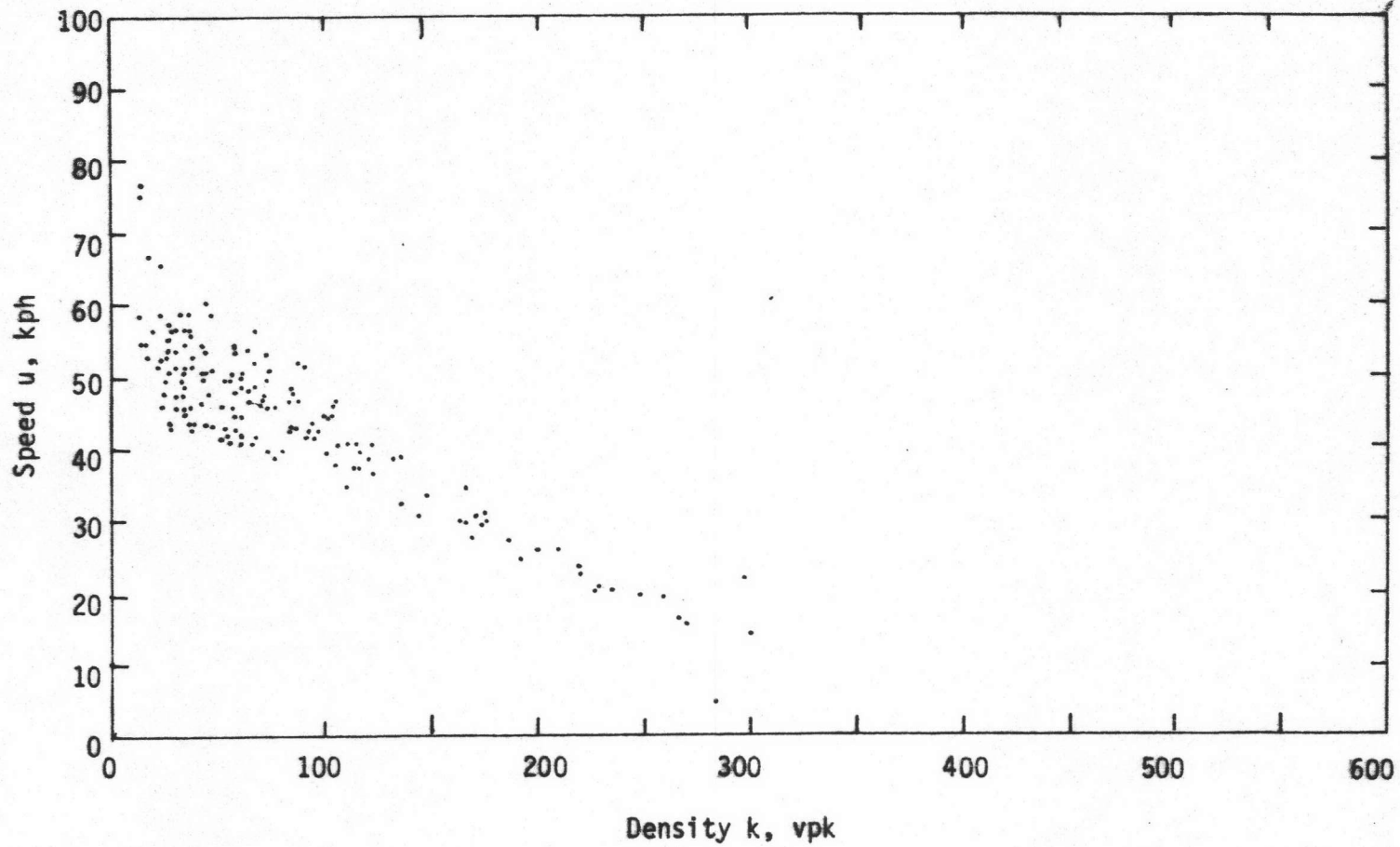


Fig.C-2 Observed relationship between speed and density,

Rama IV Road

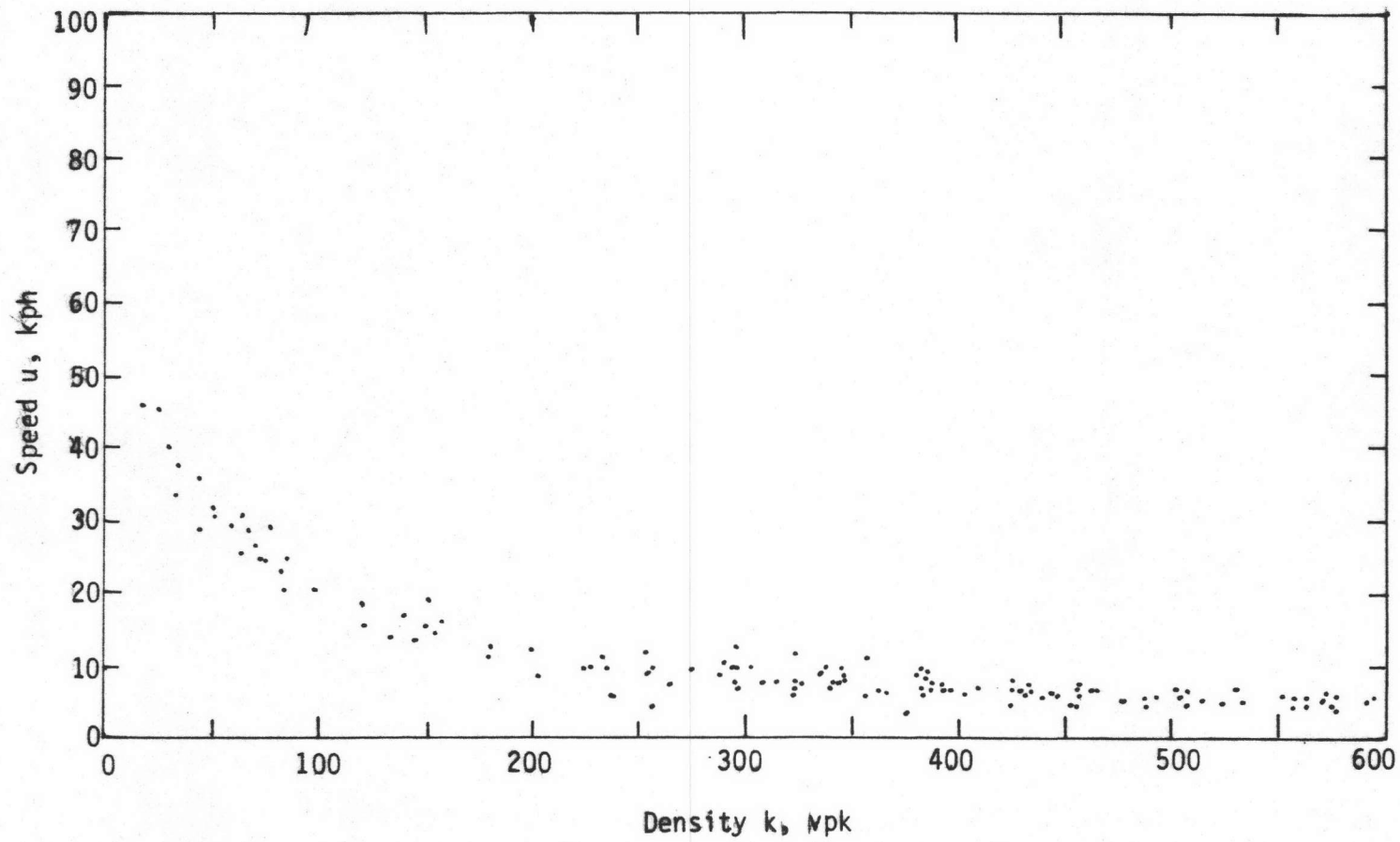


Fig. C-3 Observed relationship between speed and density,
Yaowaraj Road

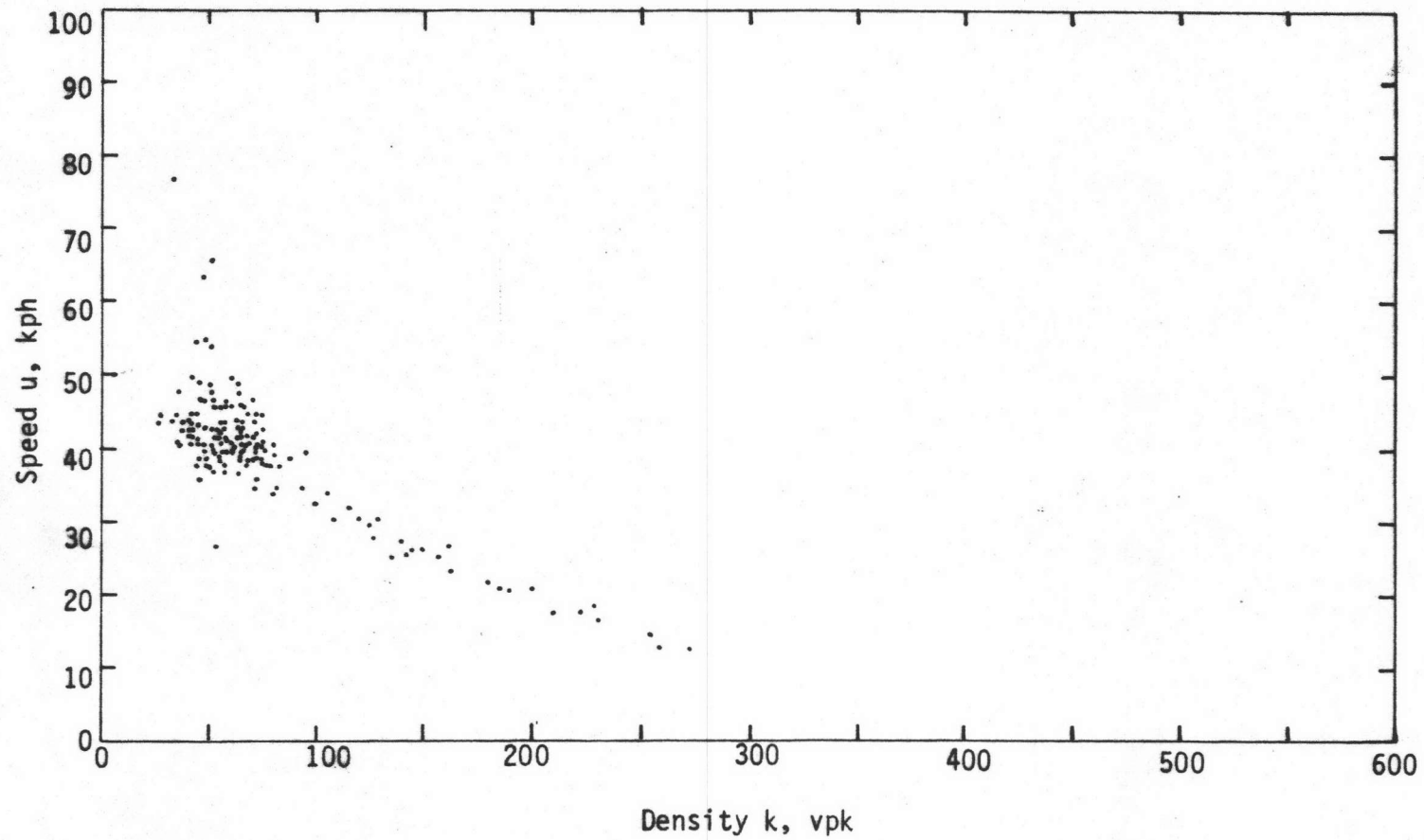


Fig. C-4 Observed relationship between speed and density,
Ratchadamnoen Khang Road

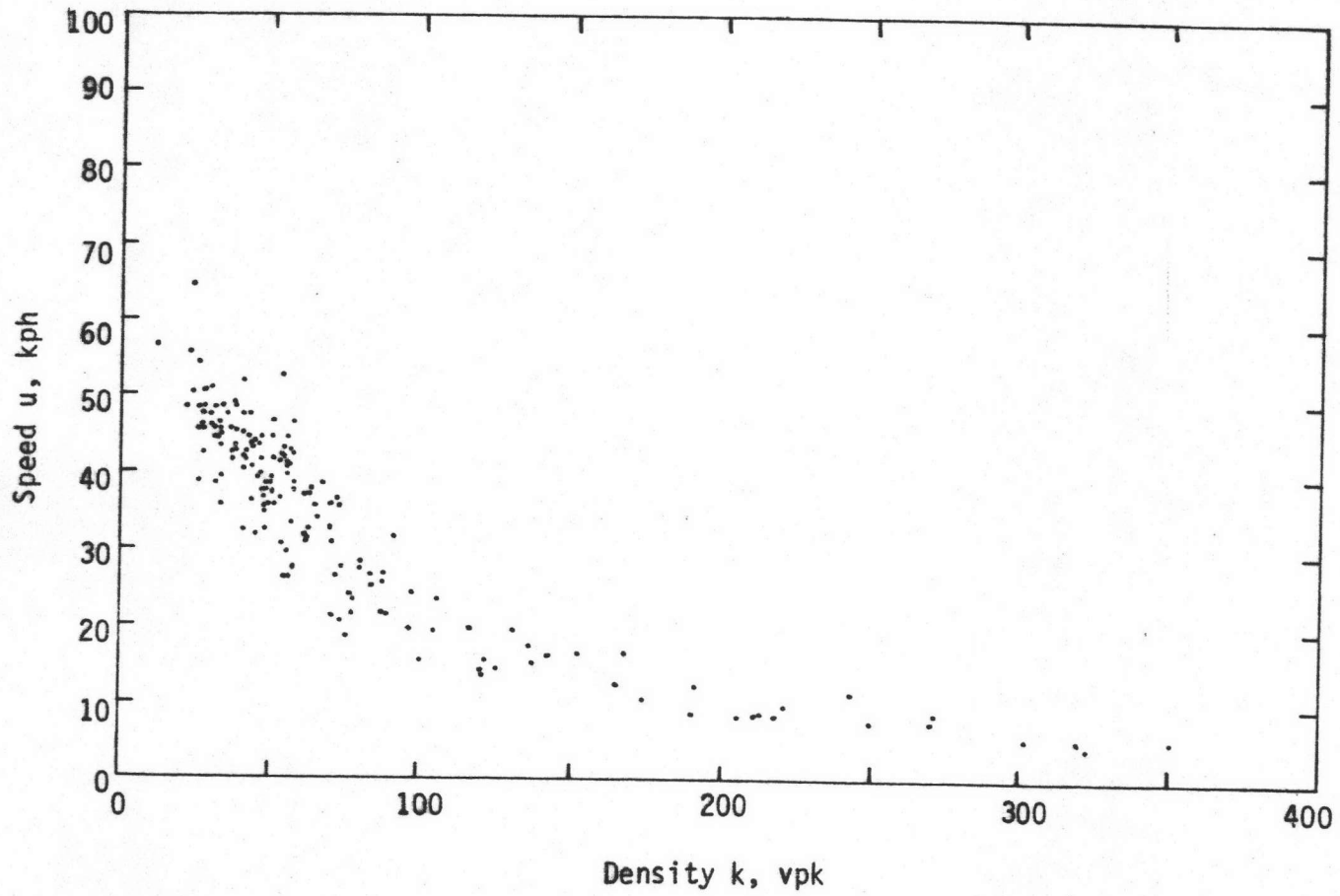


Fig.C-5 Observed relationship between speed and density,
Phaholyothin Road

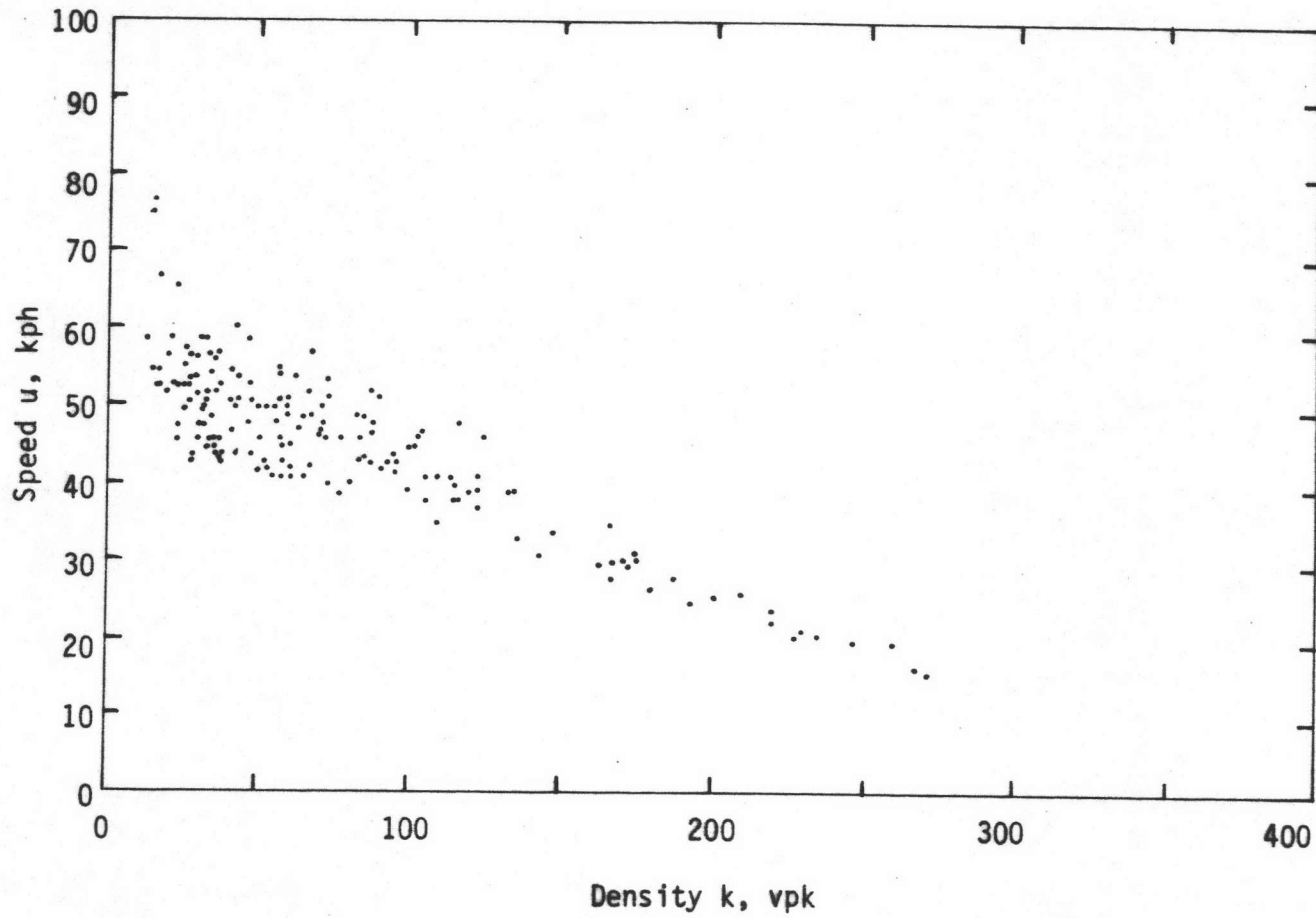


Fig.C-6 Observed relationship between speed and density,
Sukhumvit Road

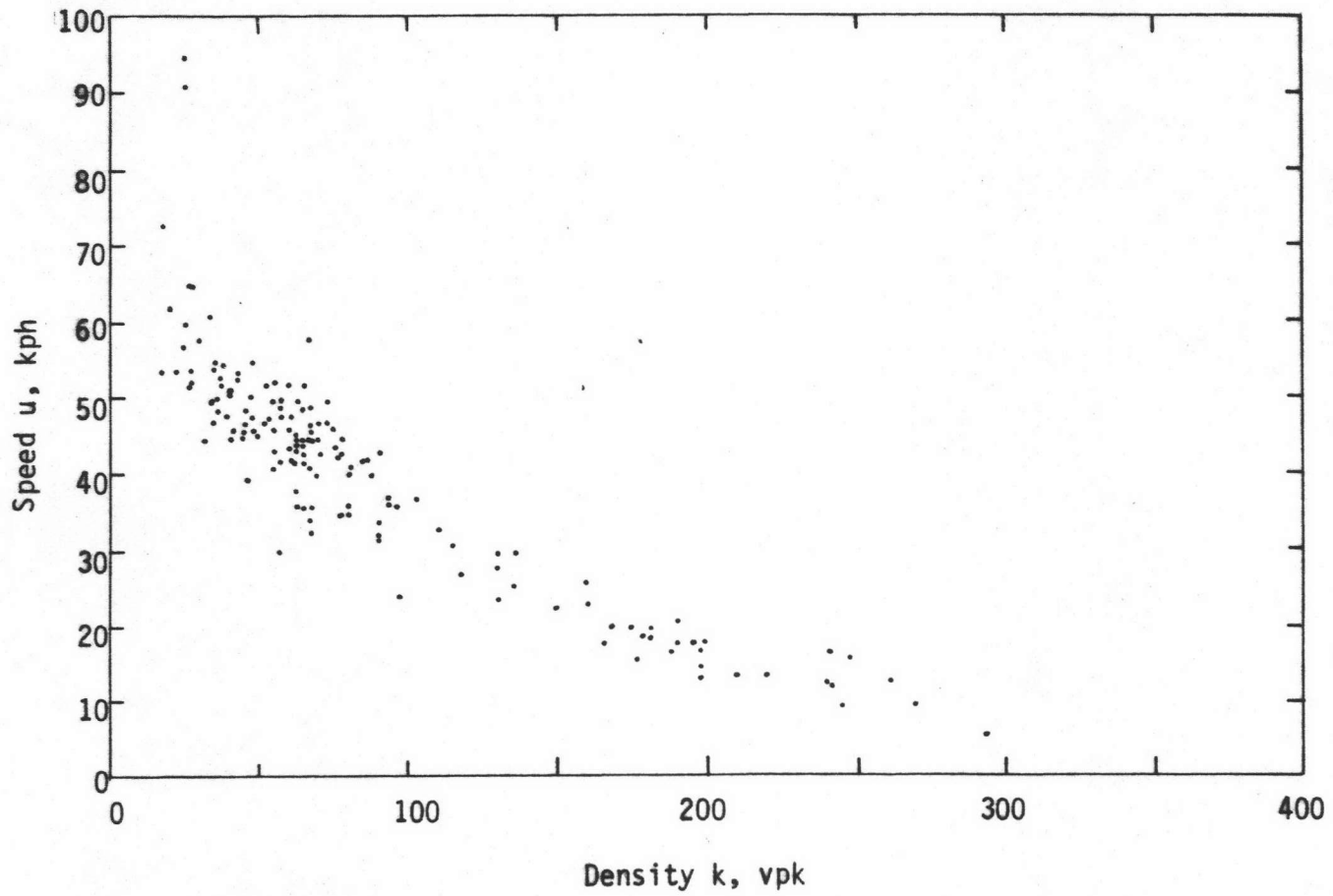


Fig. C-7 Observed relationship between speed and density,
New Petchbury Road

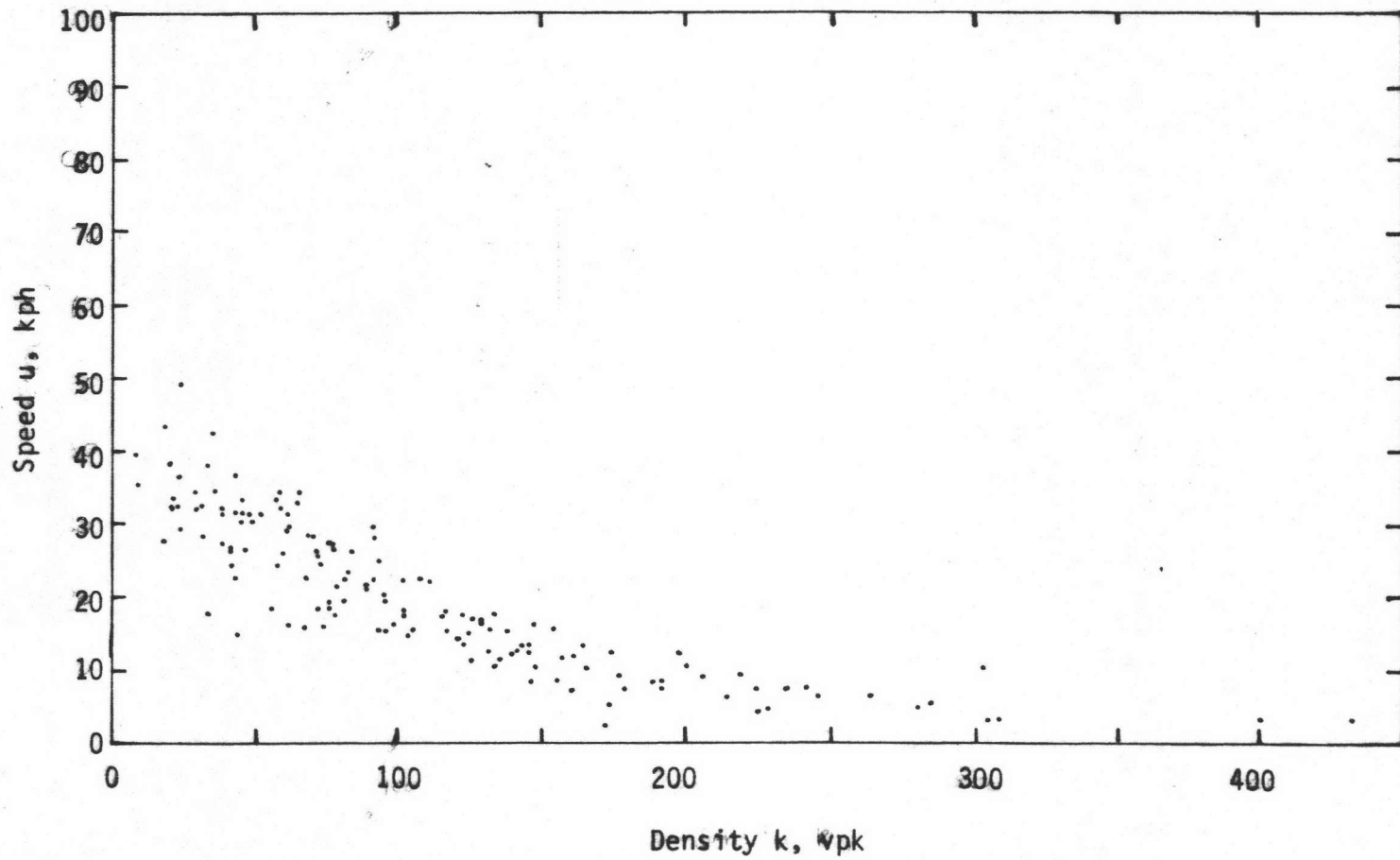


Fig.C-8 Observed relationship between speed and density,

Raj Prarop Road

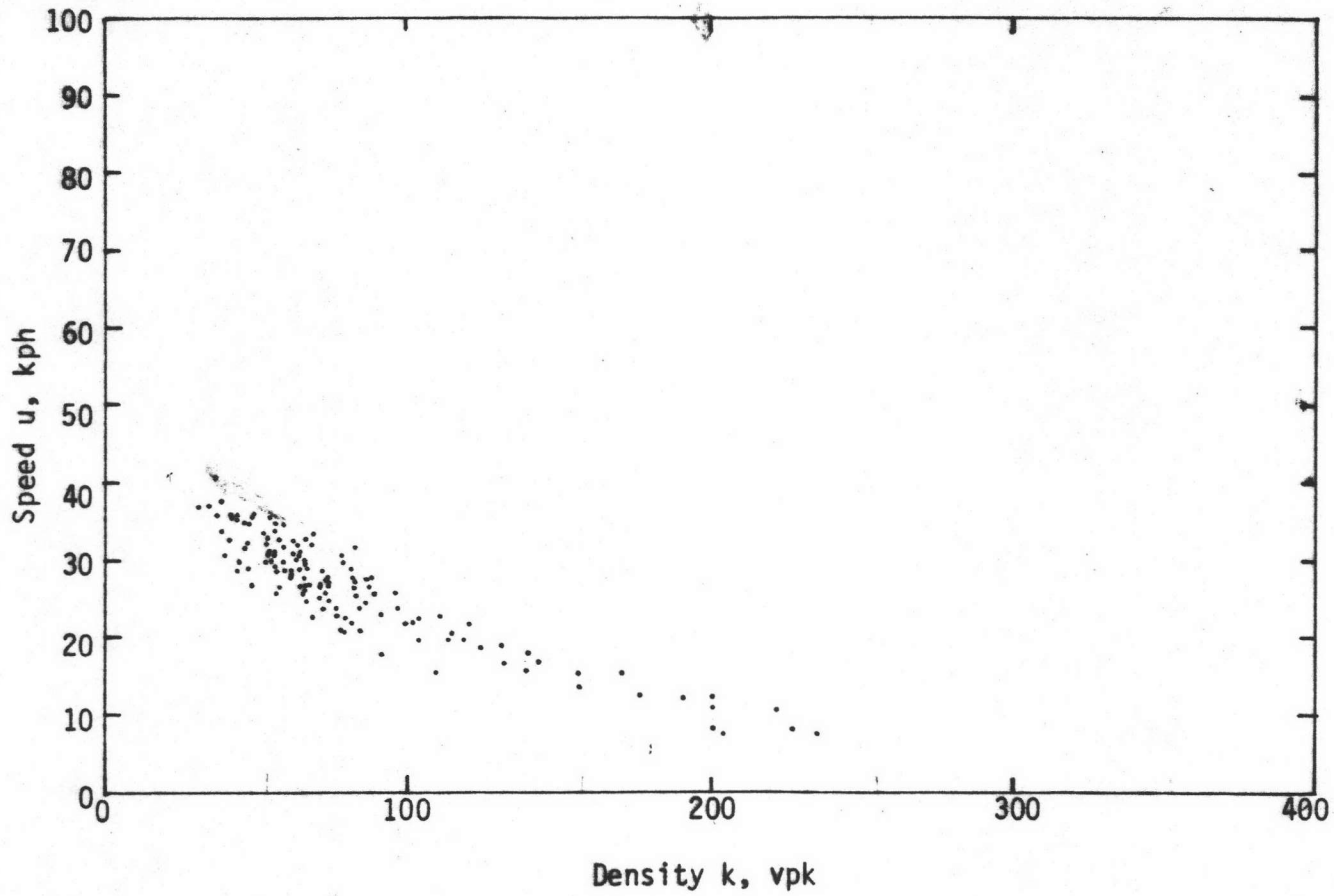


Fig.C-9 Observed relationship between speed and density,
Charoen Krung Road

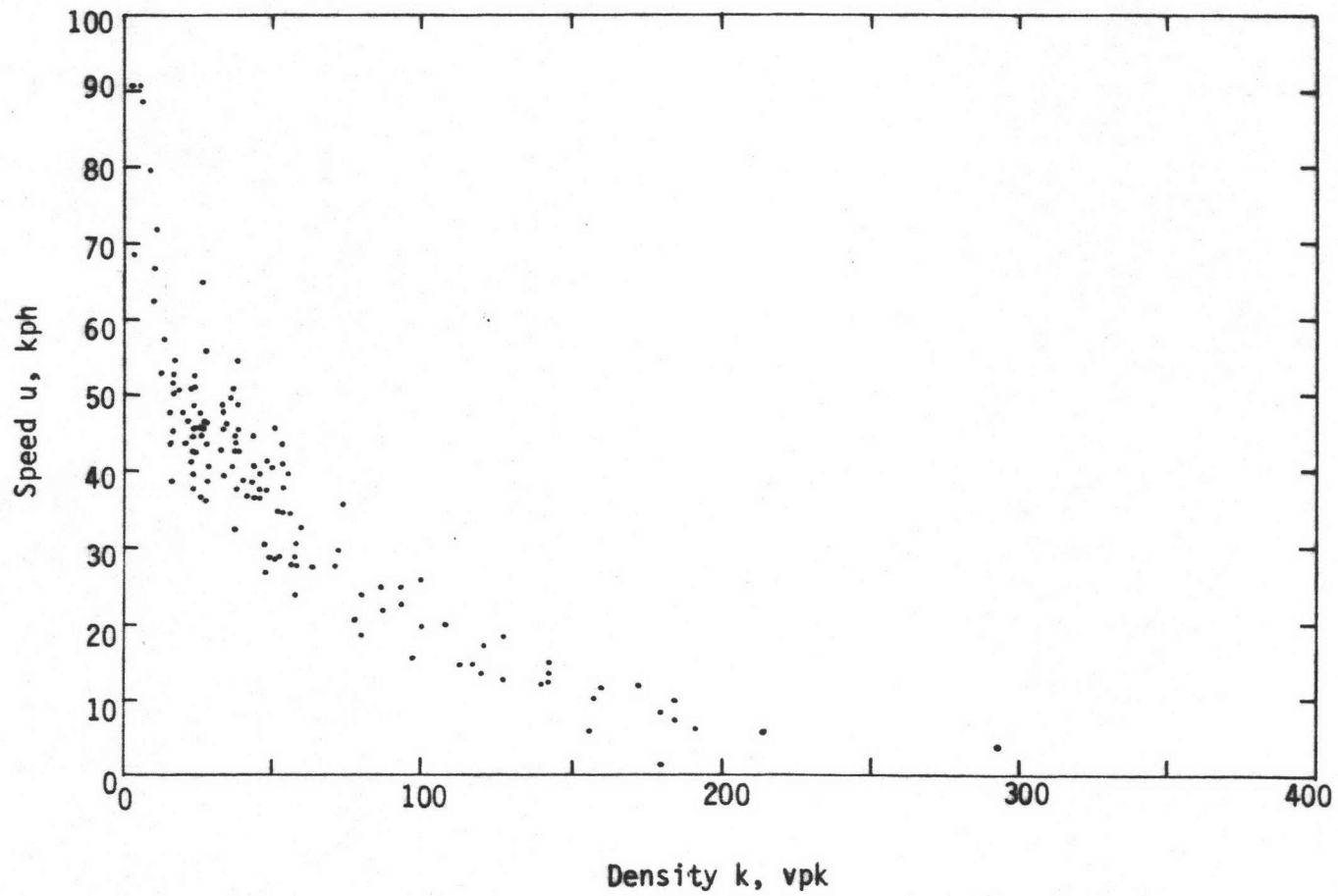


Fig. C-10 Observed relationship between speed and density,

Raj Vithee Road

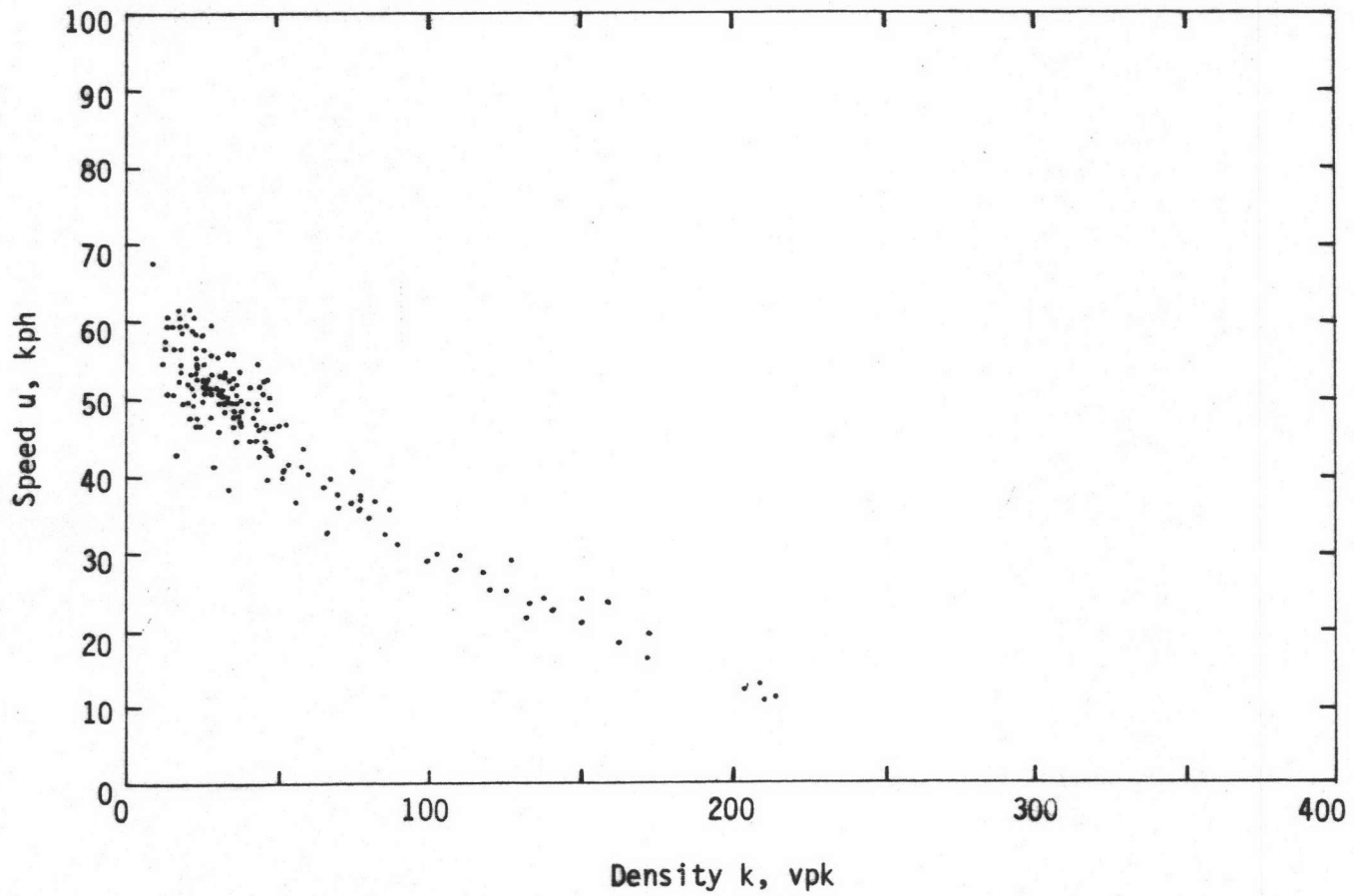


Fig.C-11 Observed relationship between speed and density,
Lat Phrao Road

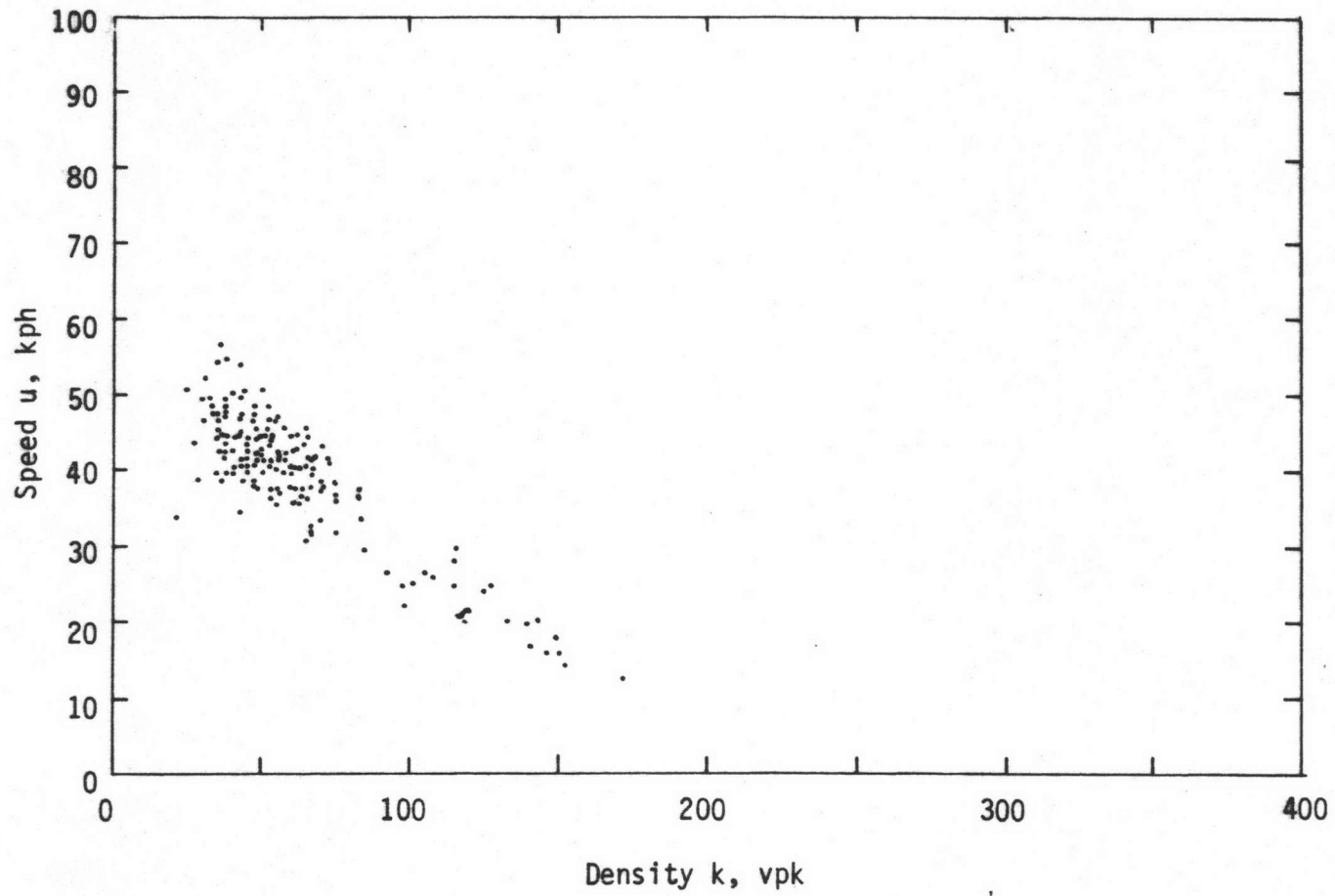


Fig.C-12 Observed relationship between speed and density,
Phrachao Taksin Road

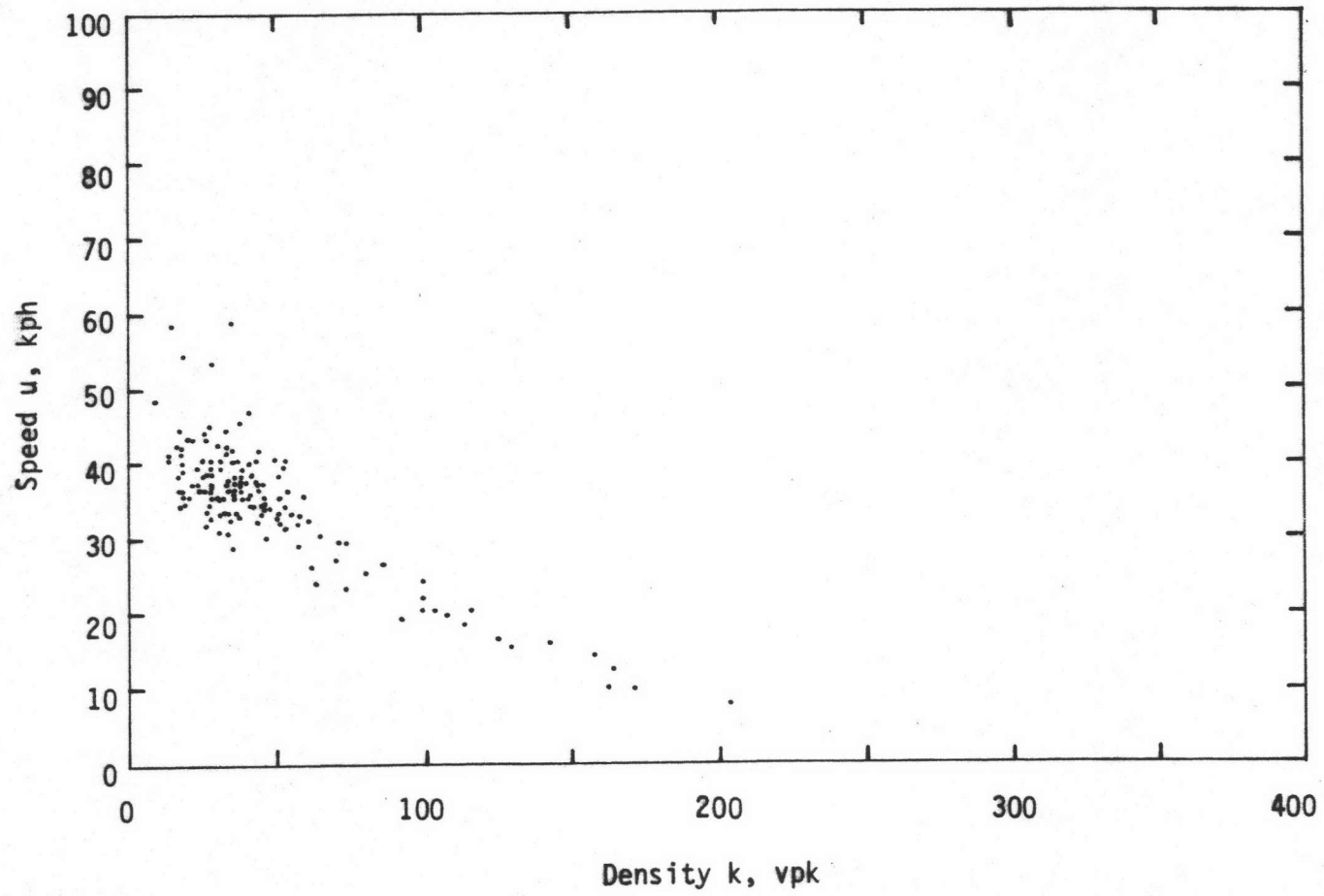


Fig.C-13 Observed relationship between speed and density,
Phran Nok Road

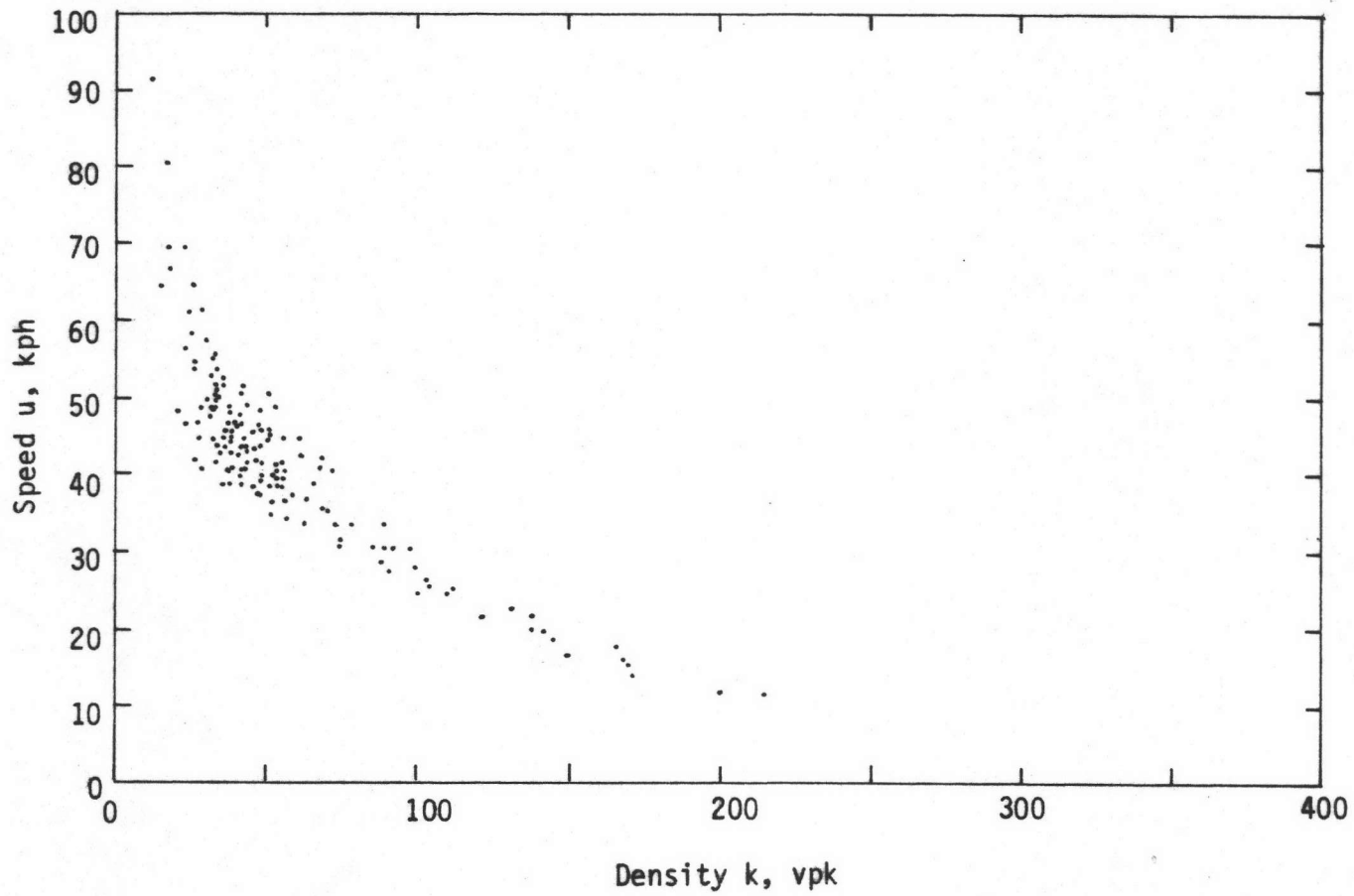


Fig. C-14 Observed relationship between speed and density,
Ramkhamhaeng Road

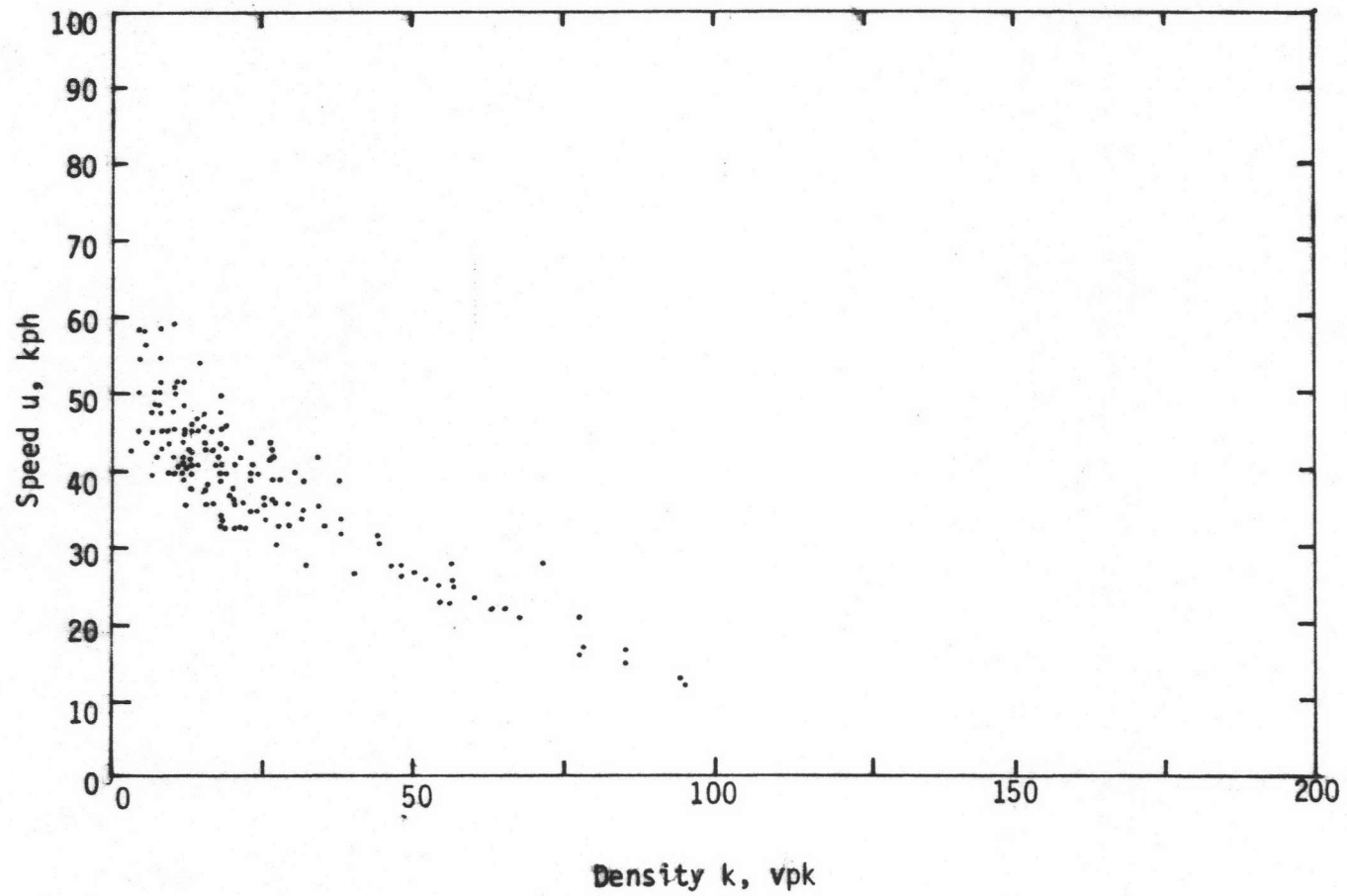


Fig.C-15 Observed relationship between speed and density,
Soi Sena Nikhom

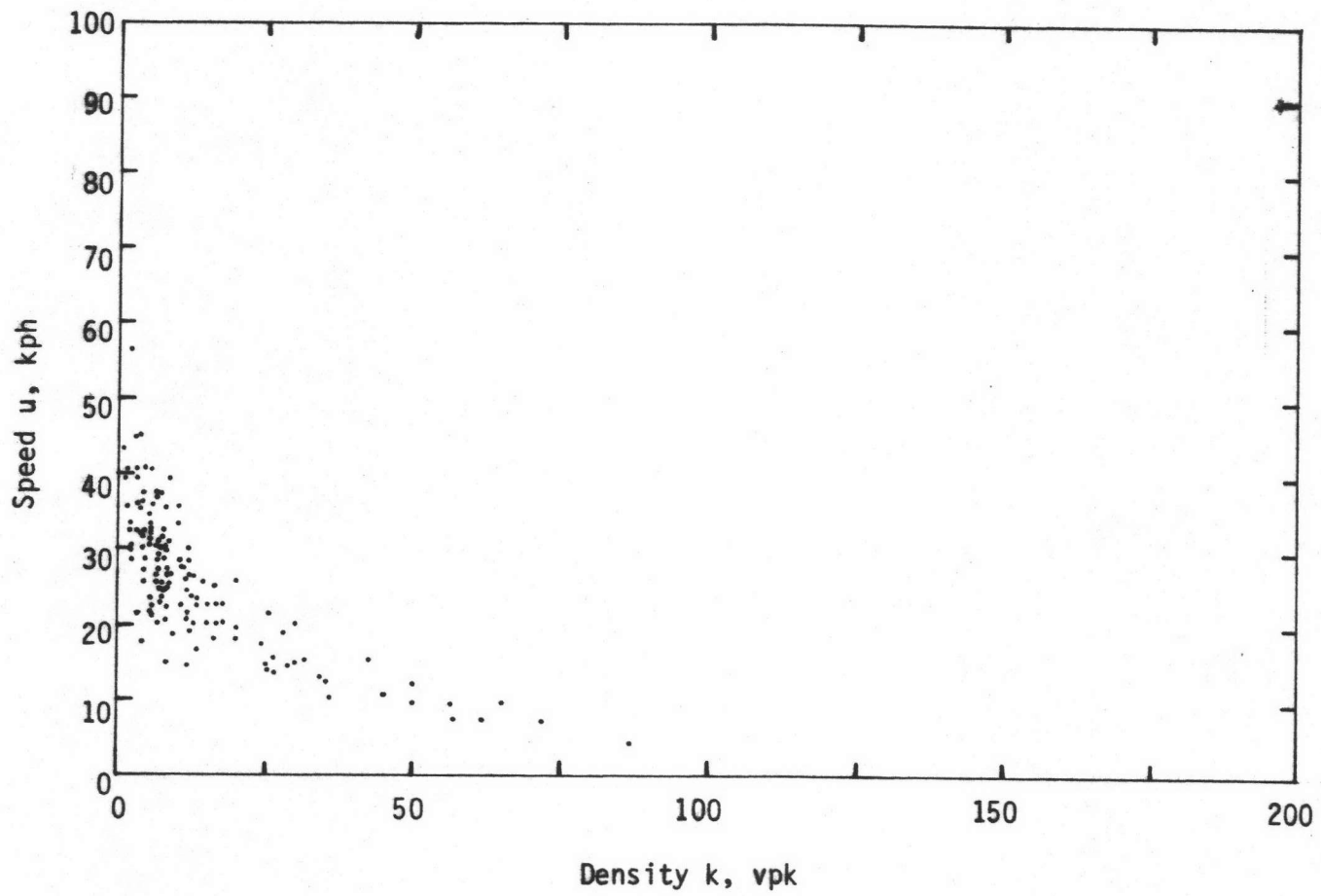


Fig. C-16 Observed relationship between speed and density,
Soi Area

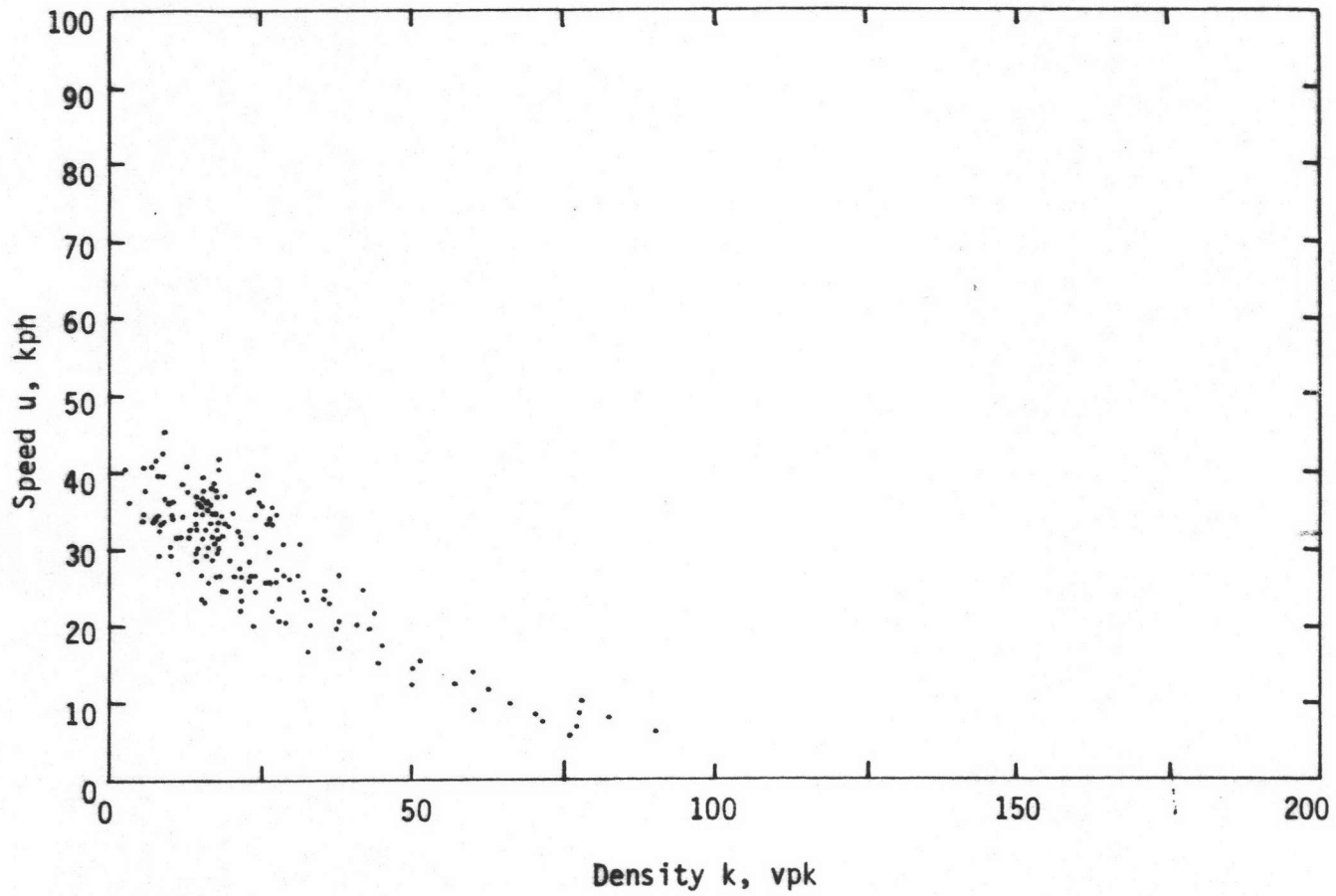


Fig.C-17 Observed relationship between speed and density,

Chula Soi 12

APPENDIX D

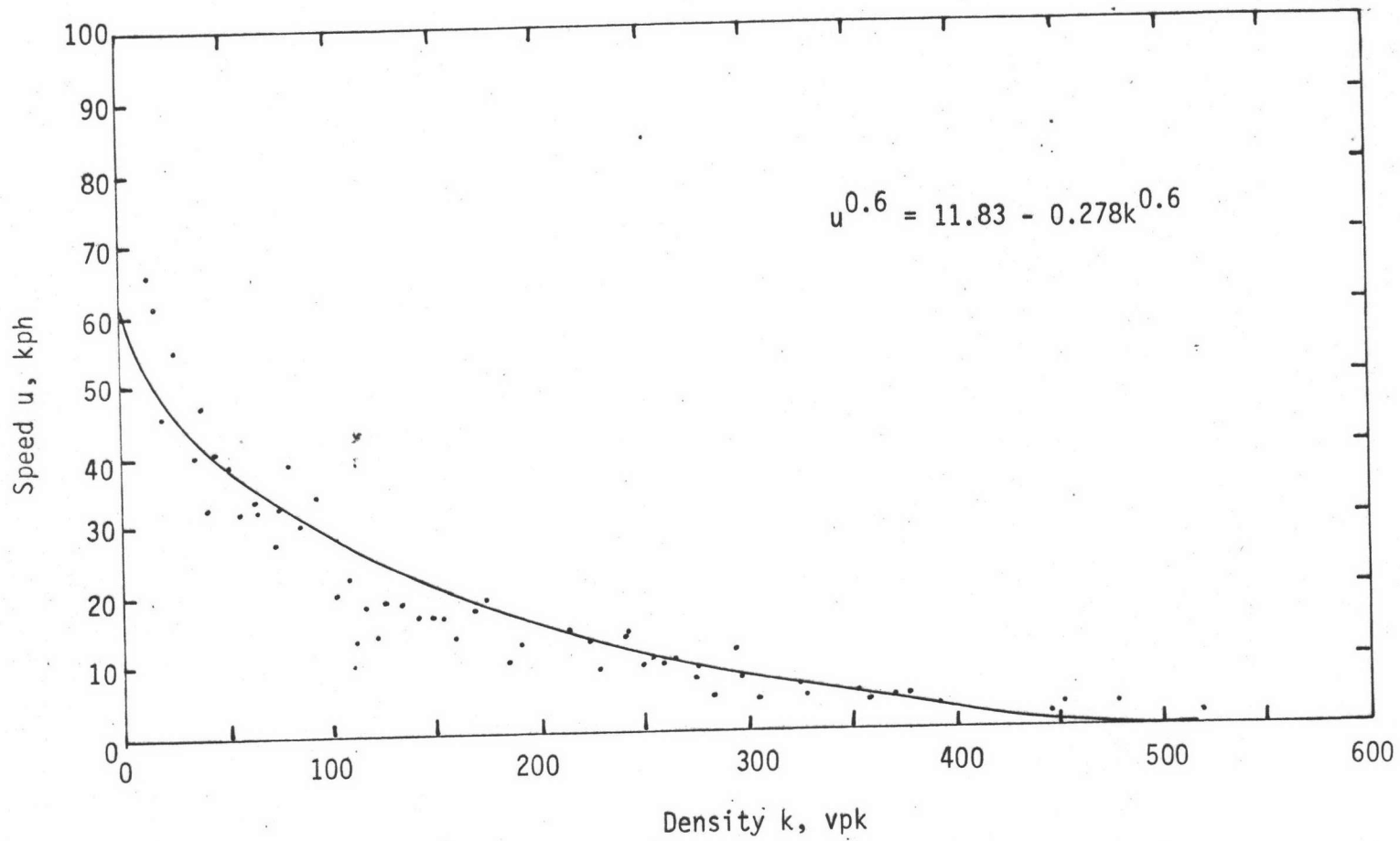


Fig.D-1 Speed-density model for Rama I Road

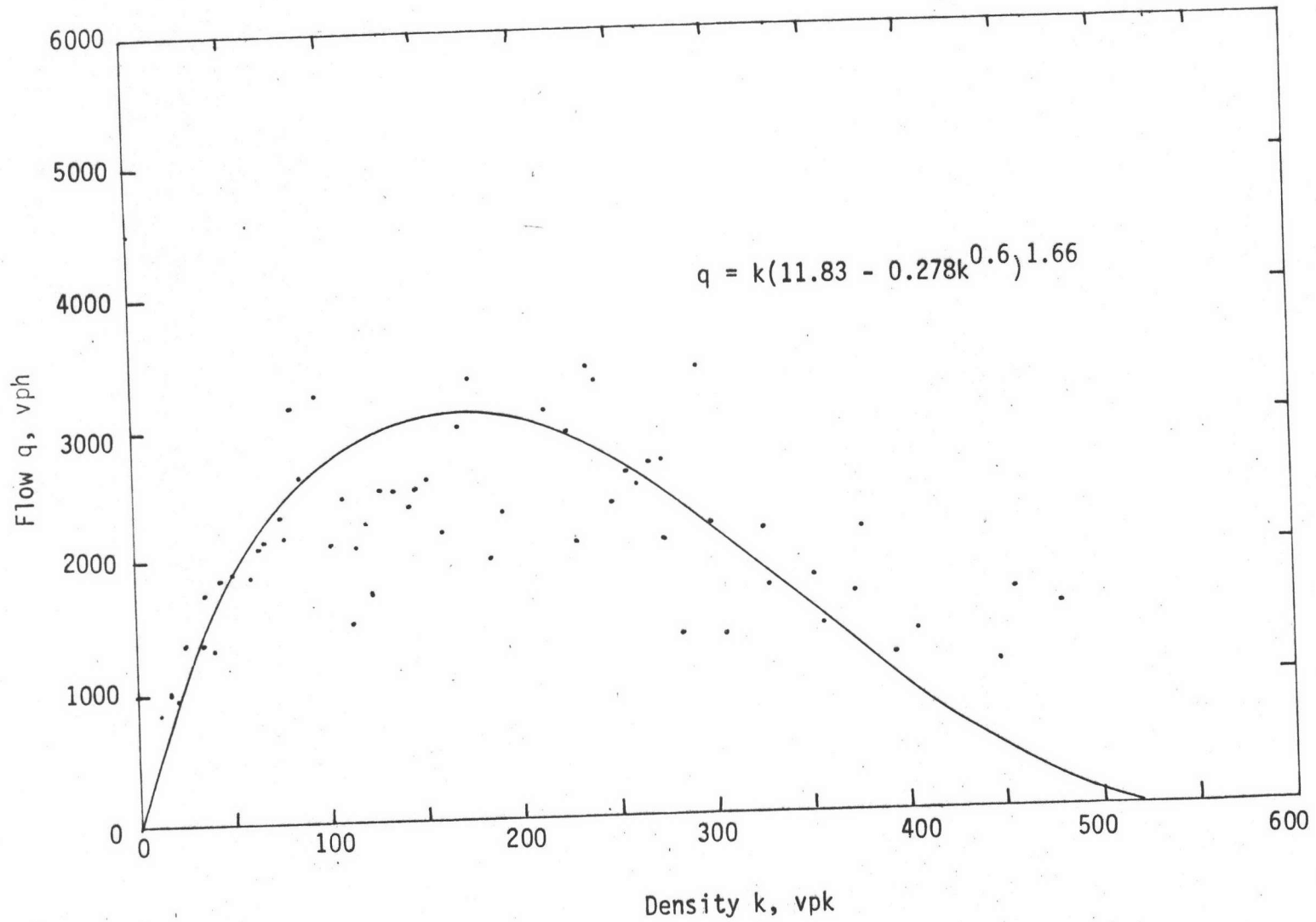


Fig.D-2 Flow-density model for Rama I Road

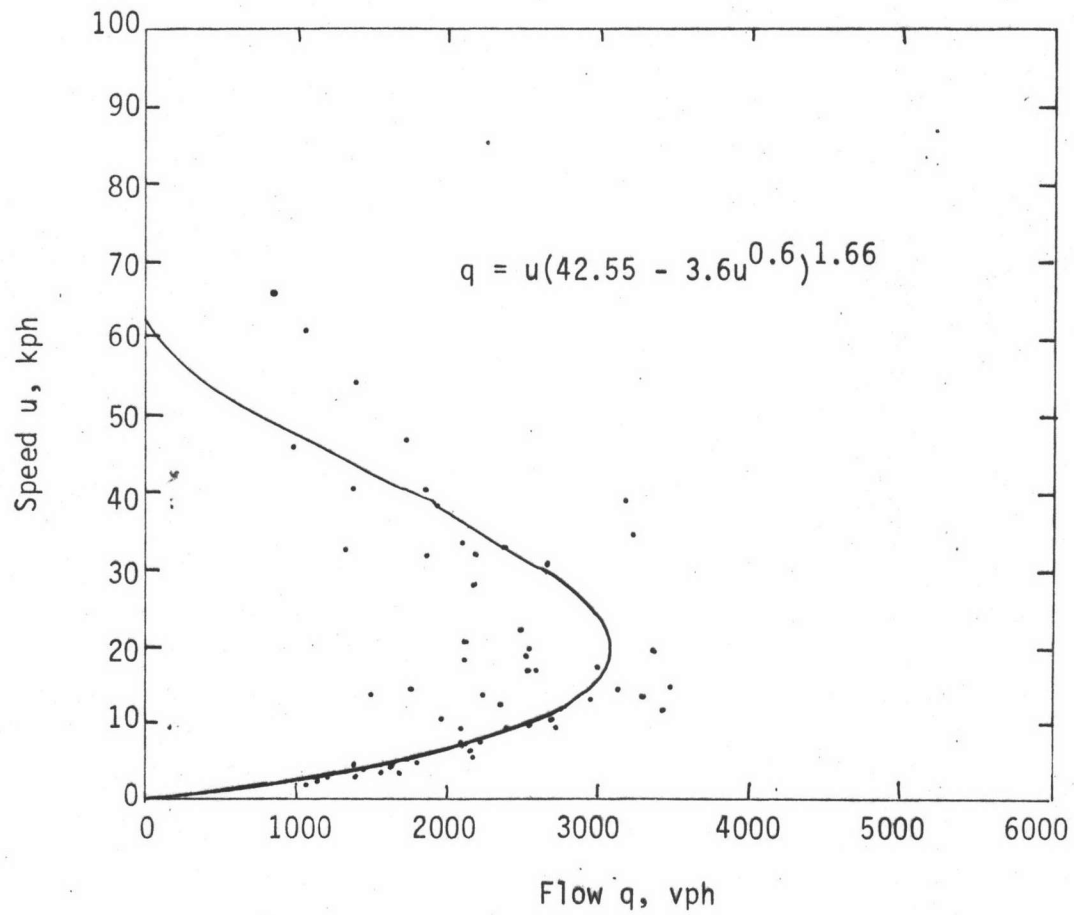


Fig.D-3 Speed-flow model for Rama I Road

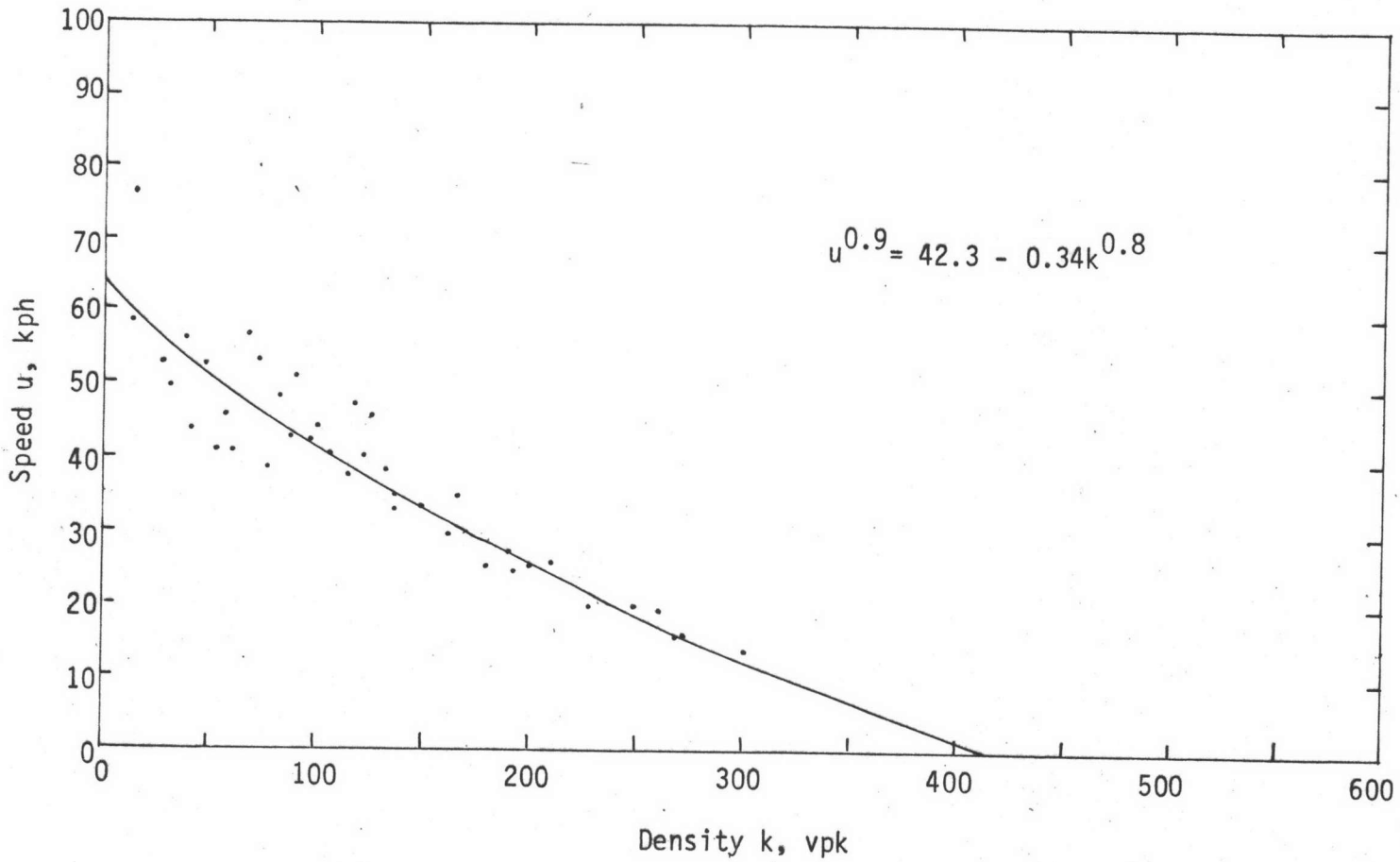


Fig.D-4 Speed-density model for Rama IV Road

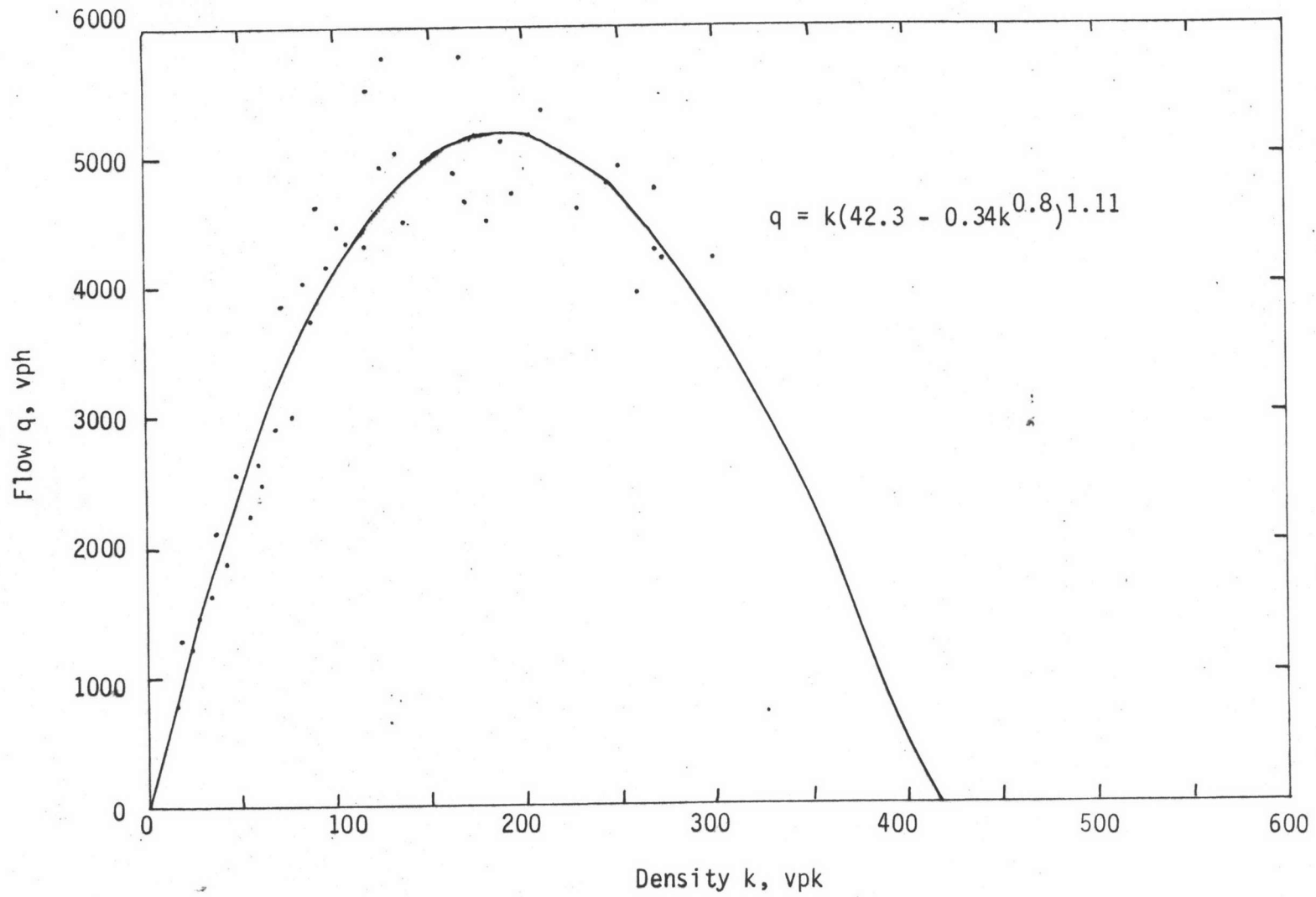


Fig.D-5 Flow-density model for Rama IV Road

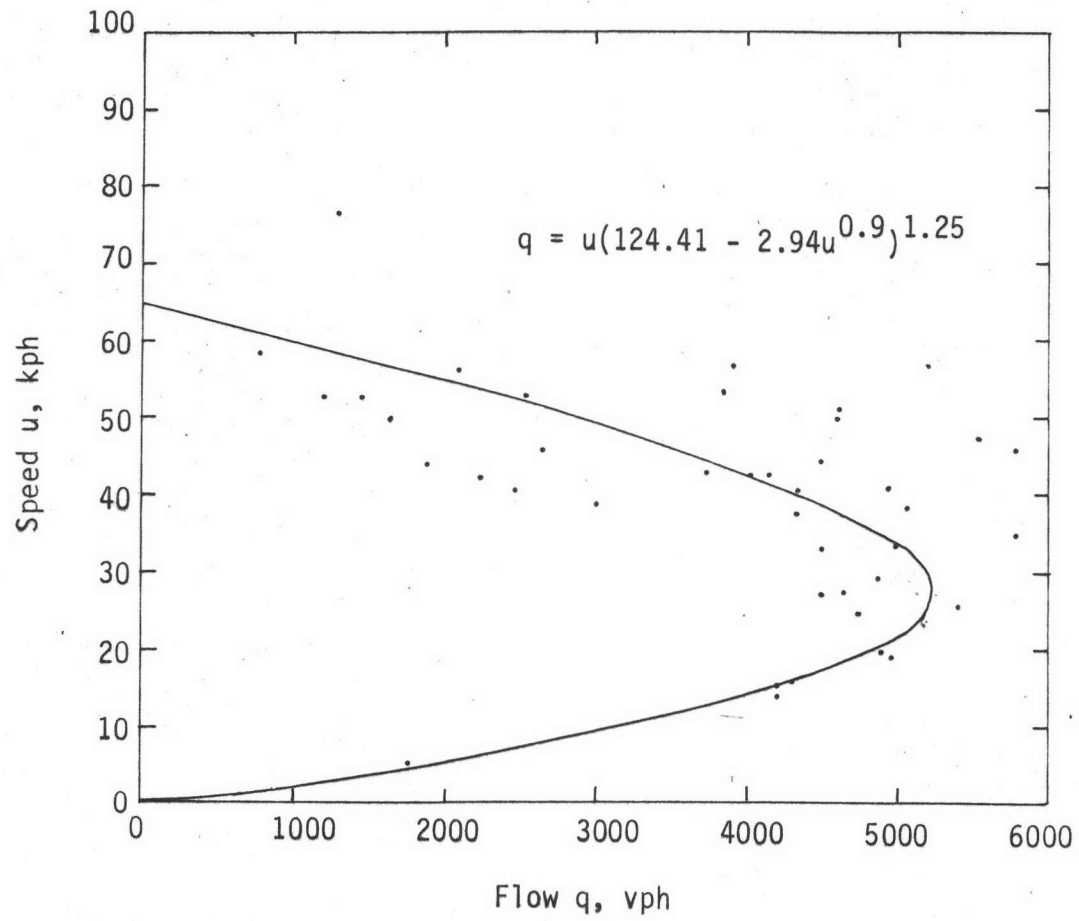


Fig.D-6 Speed-flow model for Rama IV Road

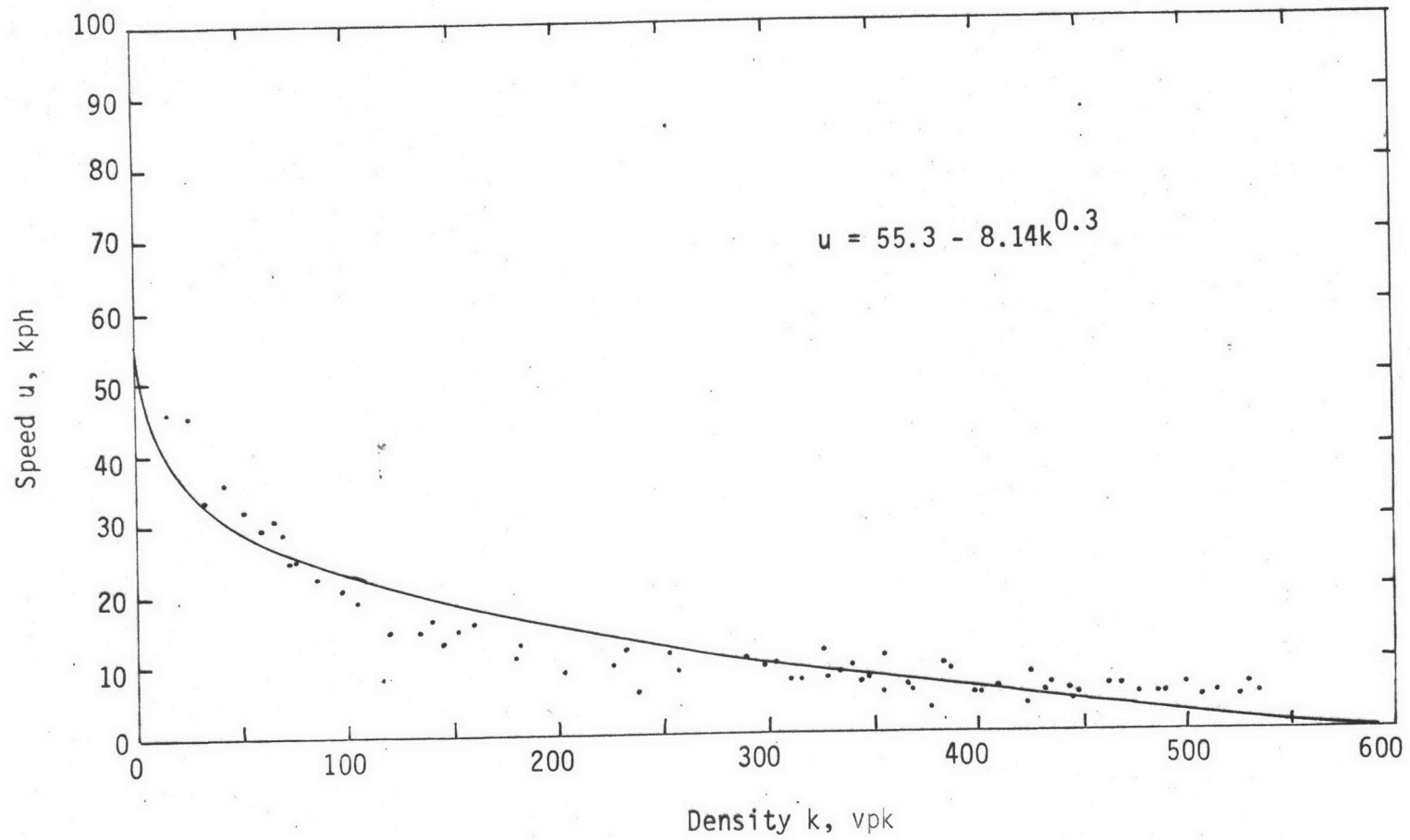


Fig.D-7 Speed-density model for Yaowaraj Road

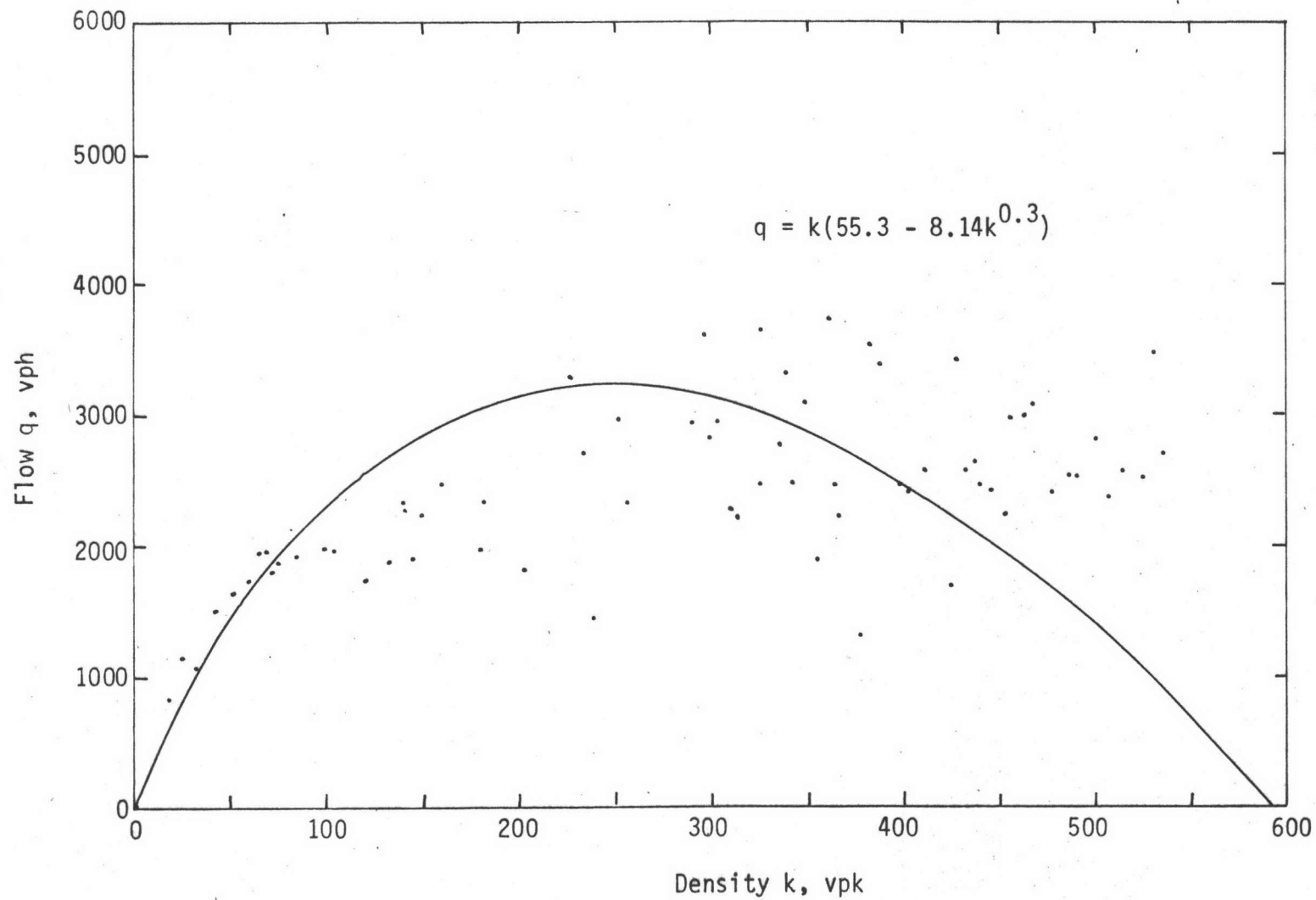


Fig.D-8 Flow-density model for Yaowaraj Road

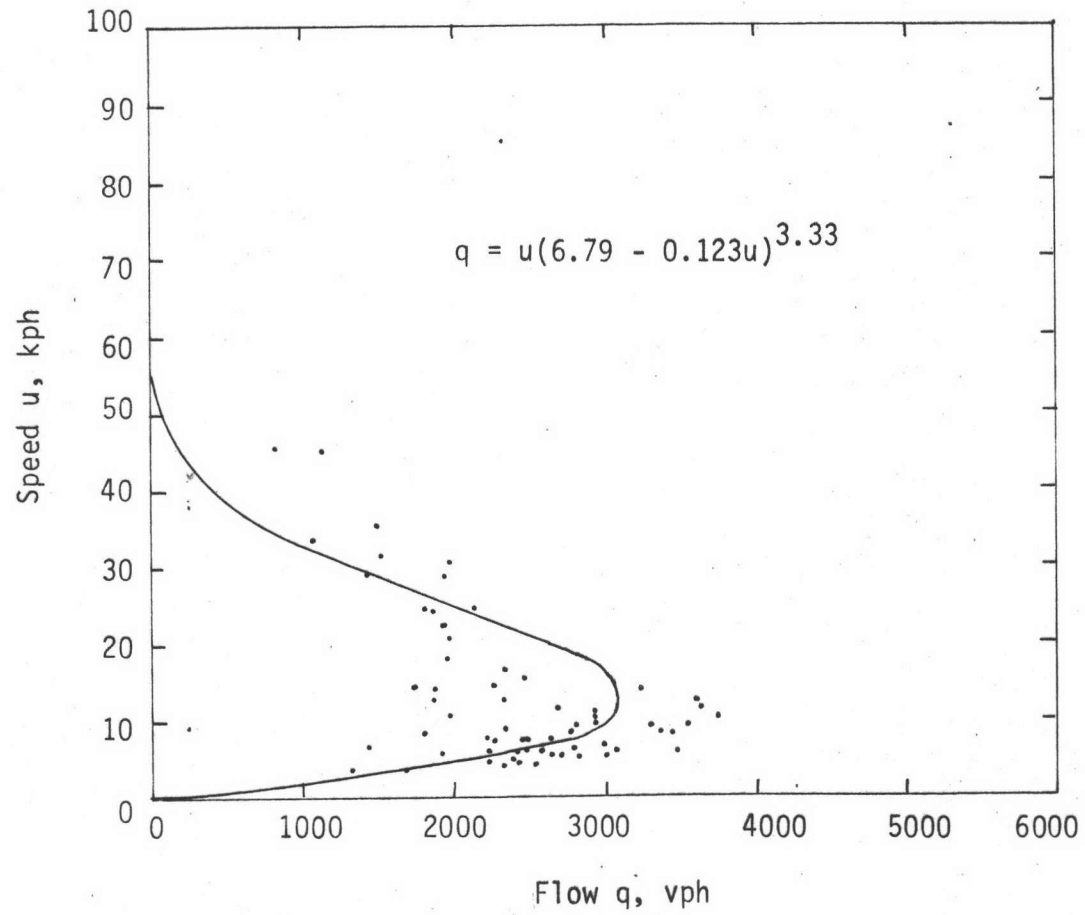


Fig.D-9 Speed-flow model for Yaowaraj Road

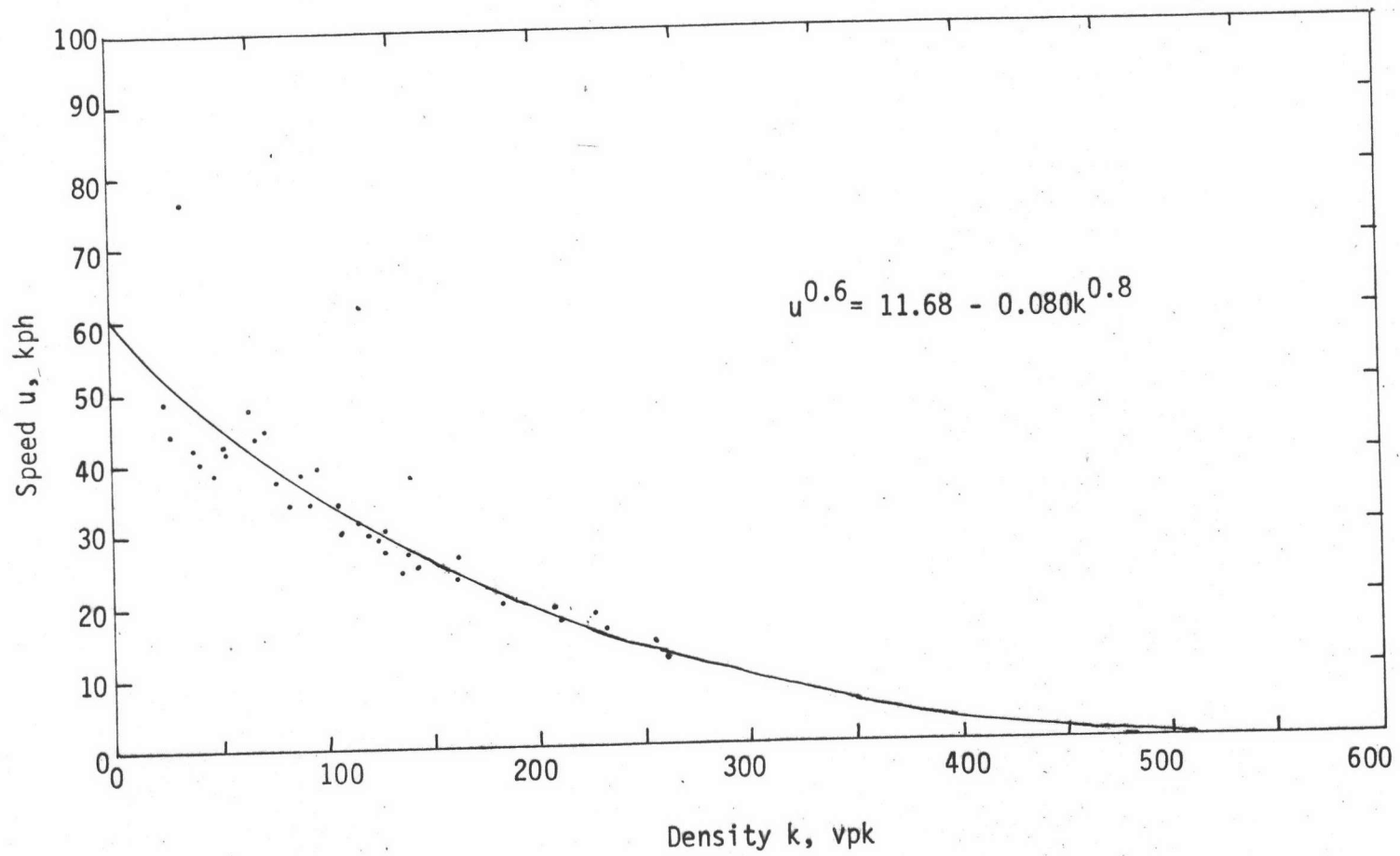


Fig.D-10 Speed-density model for Ratchadamnoen Khang Road

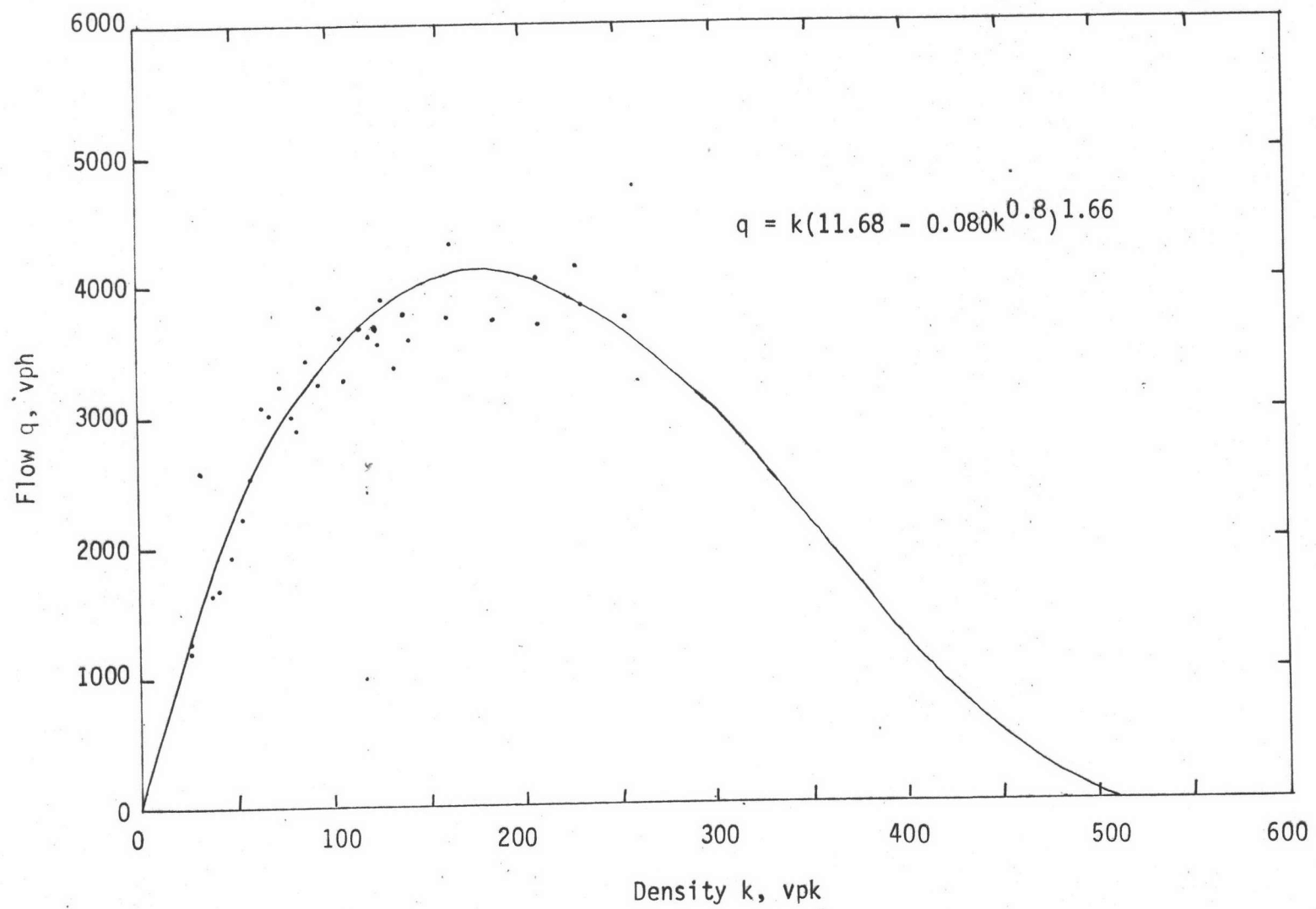


Fig.D-11 Flow-density model for Ratchadamnoen Khang Road

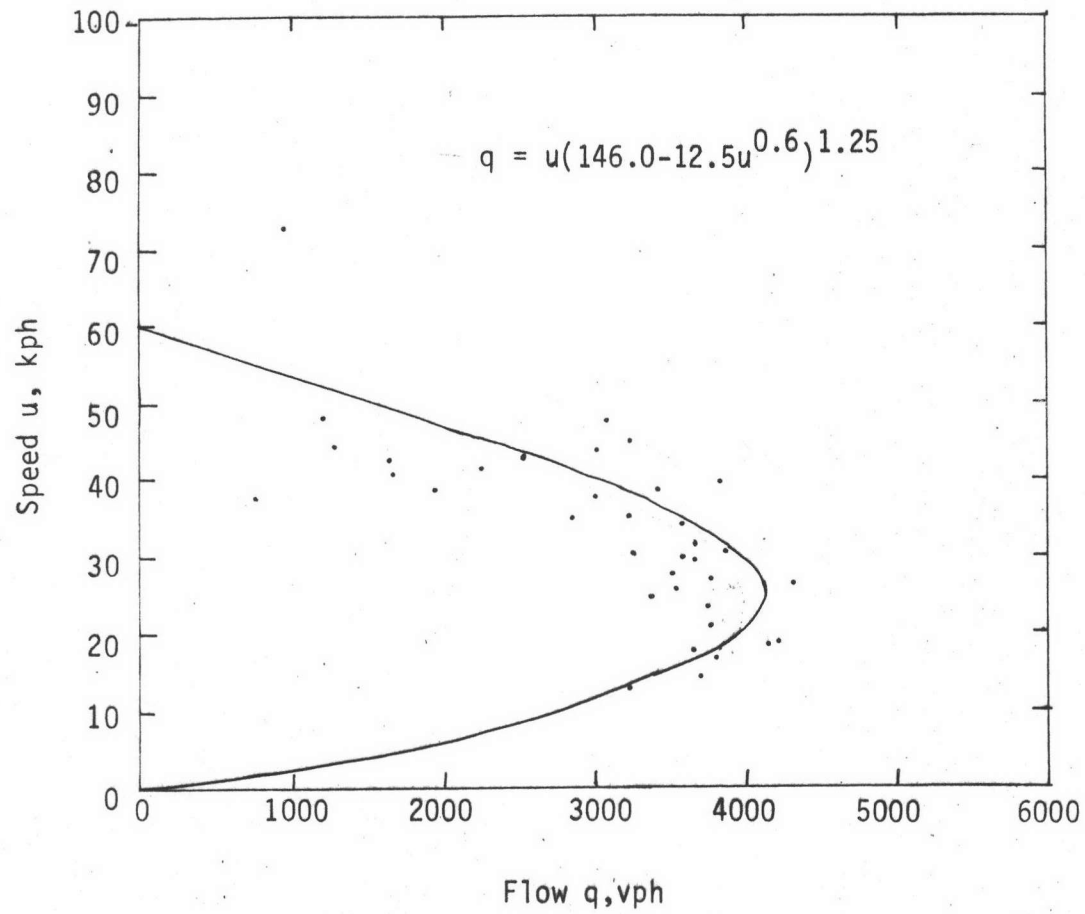


Fig.D-12 Speed-flow model for Ratchadamnoen Khang Road

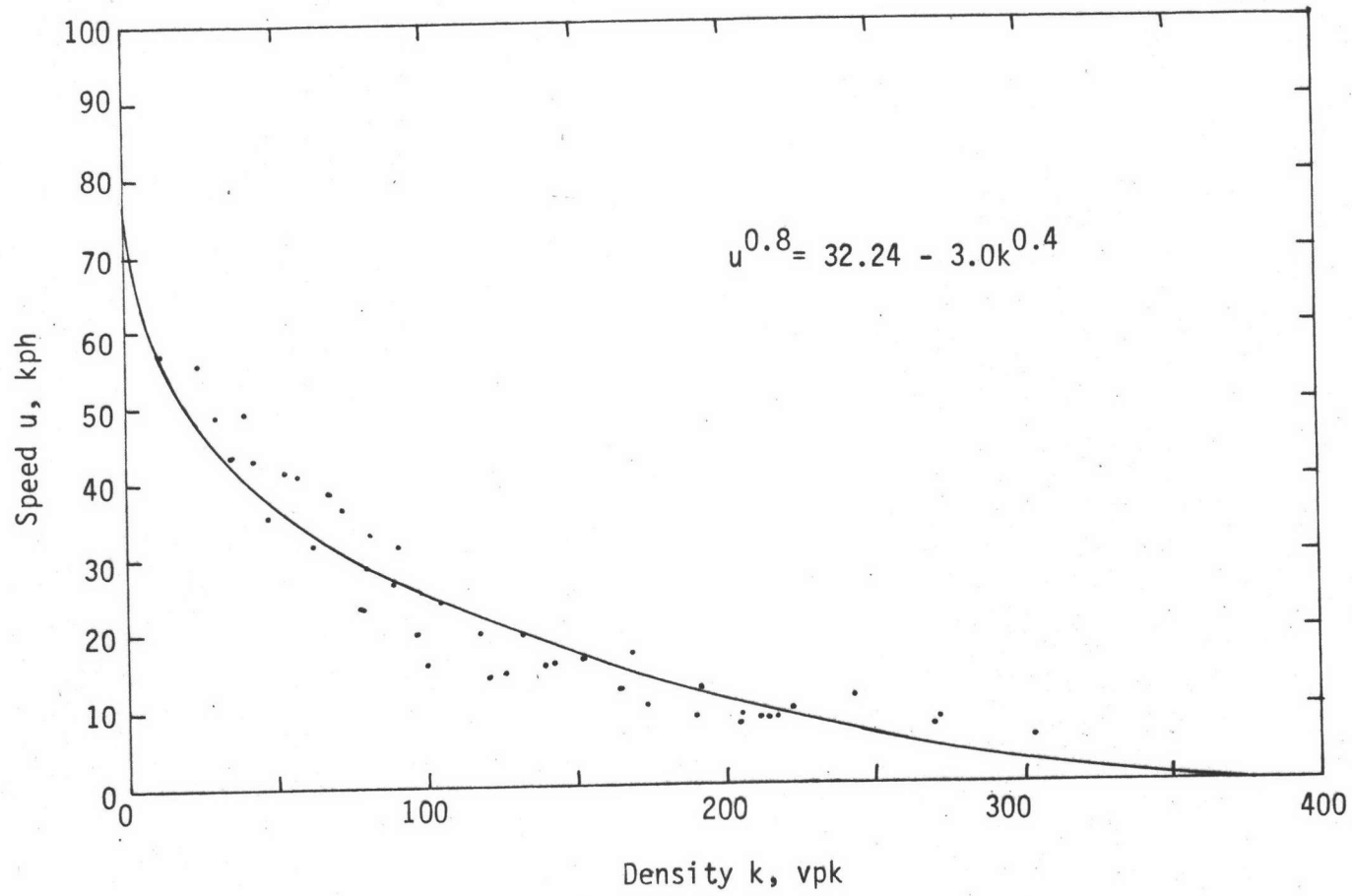


Fig.D-13 Speed-density model for Phaholyothin Road

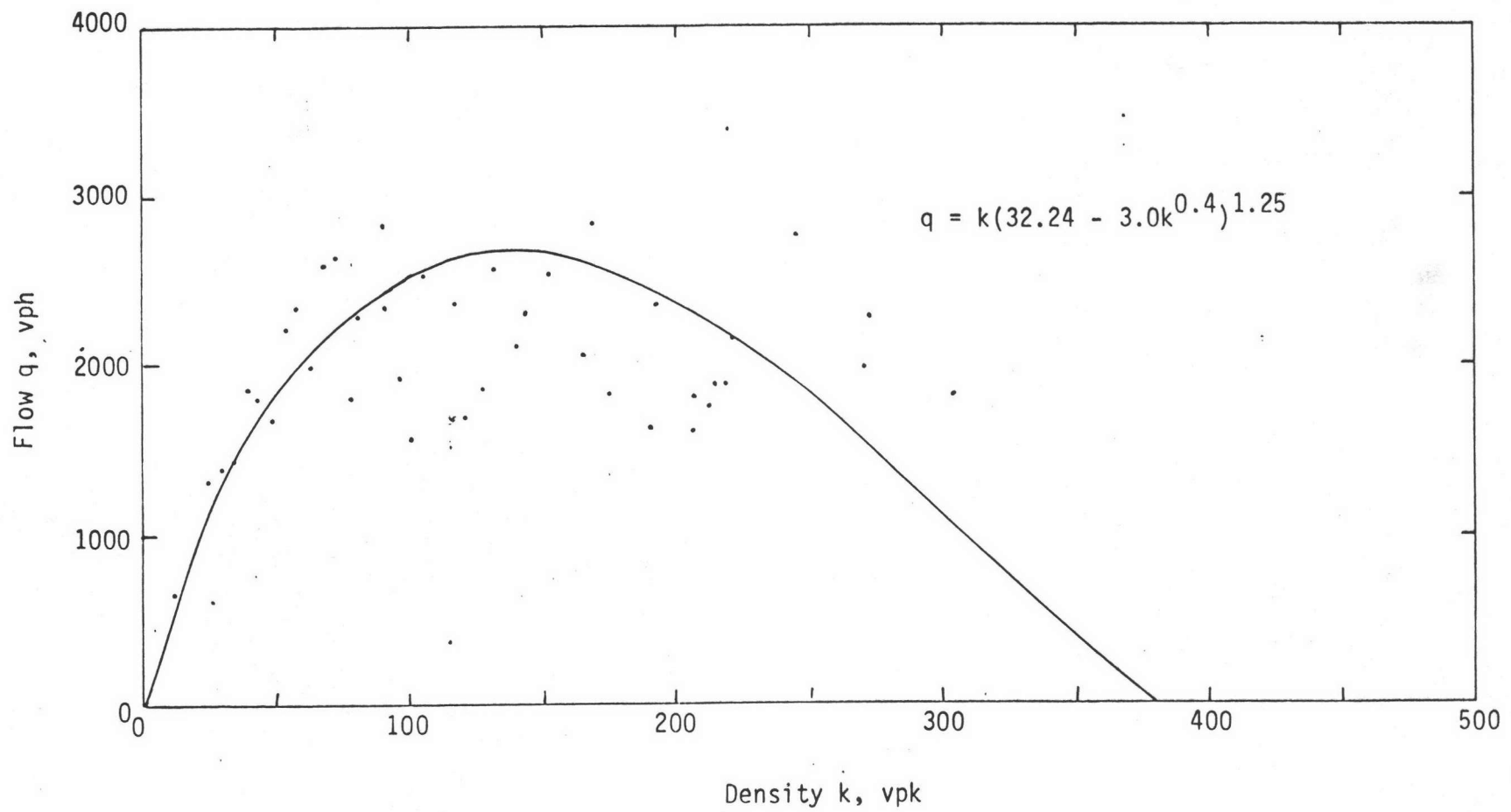


Fig.D-14 Flow-density model for Phaholyothin Road

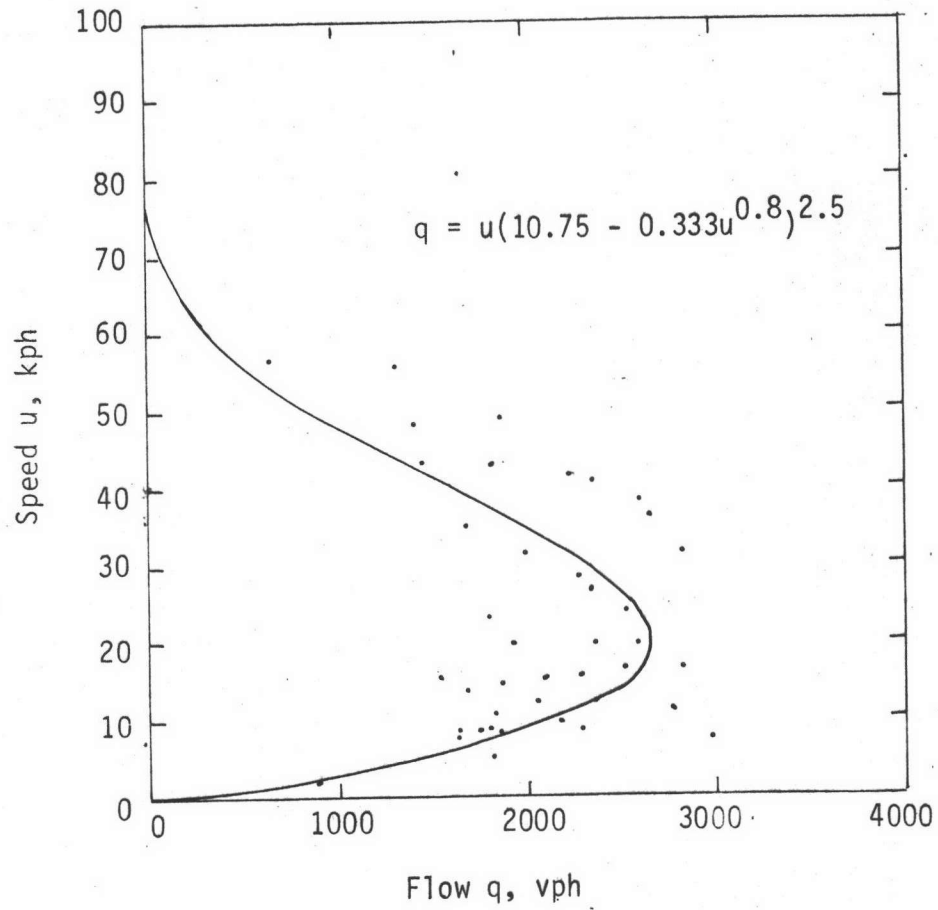


Fig.D-15 Speed-flow model for Phaholyothin Road

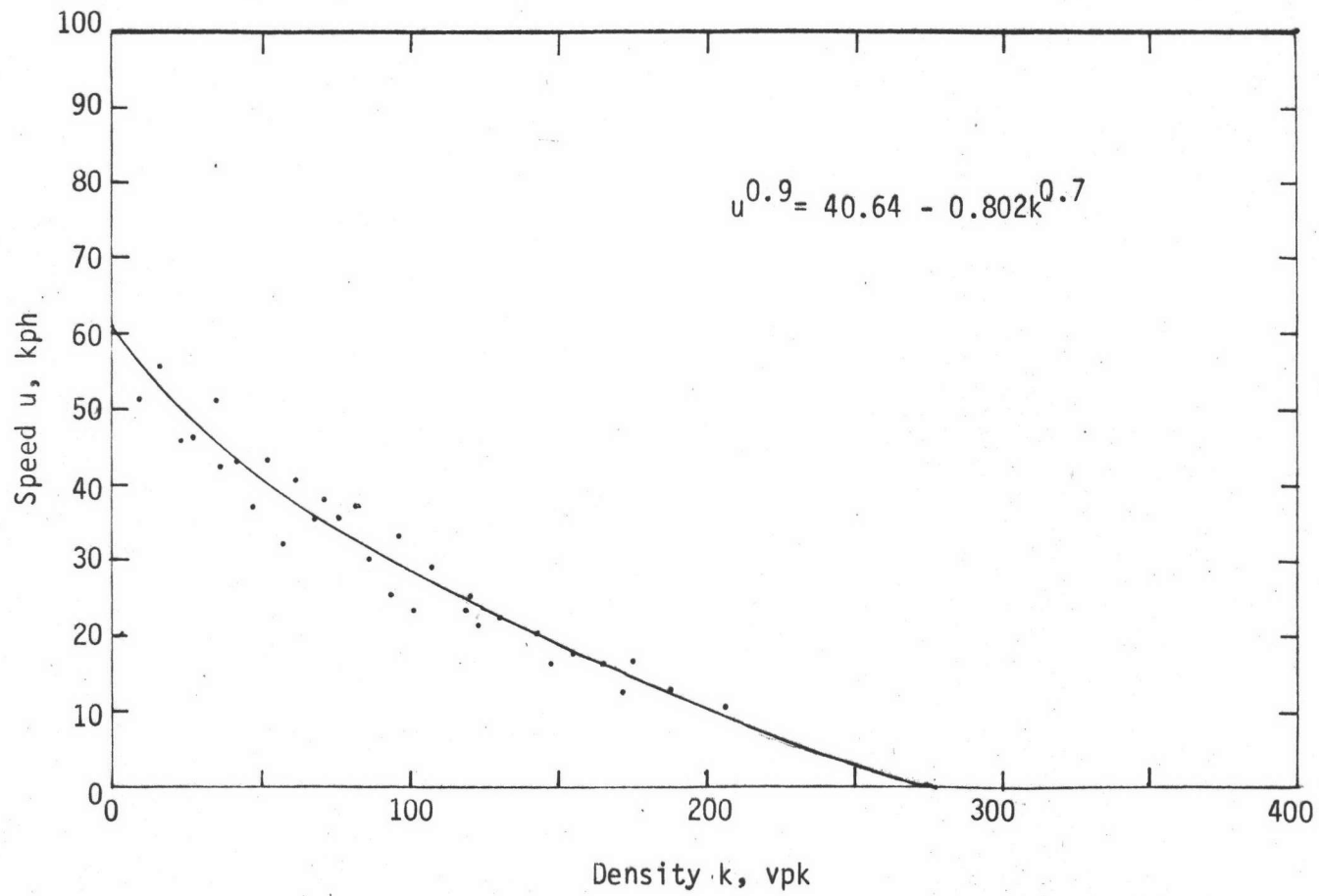


Fig.D-16 Speed-density model for Sukhumvit Road

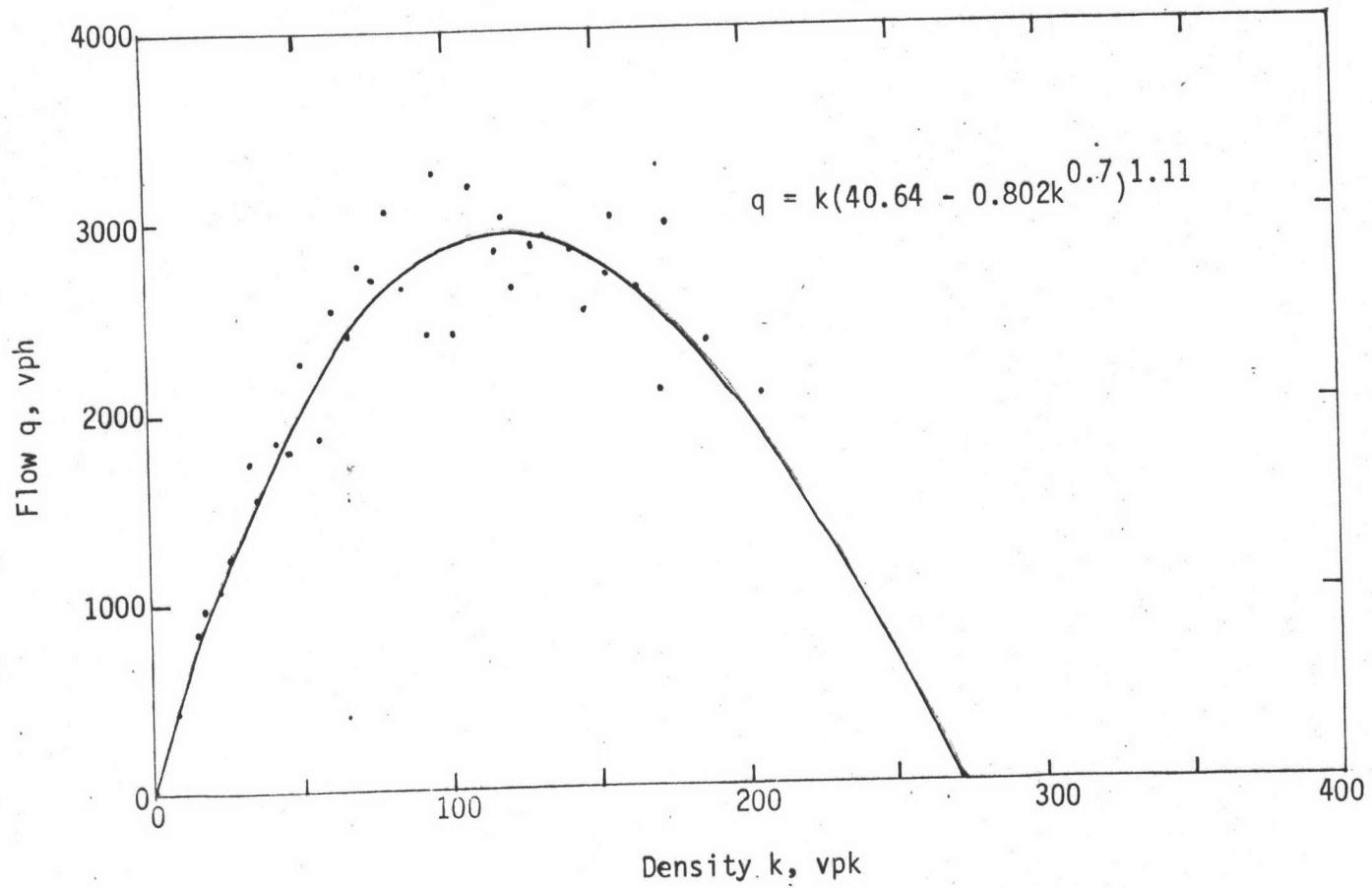


Fig.D-17 Speed-density model for Sukhumvit Road

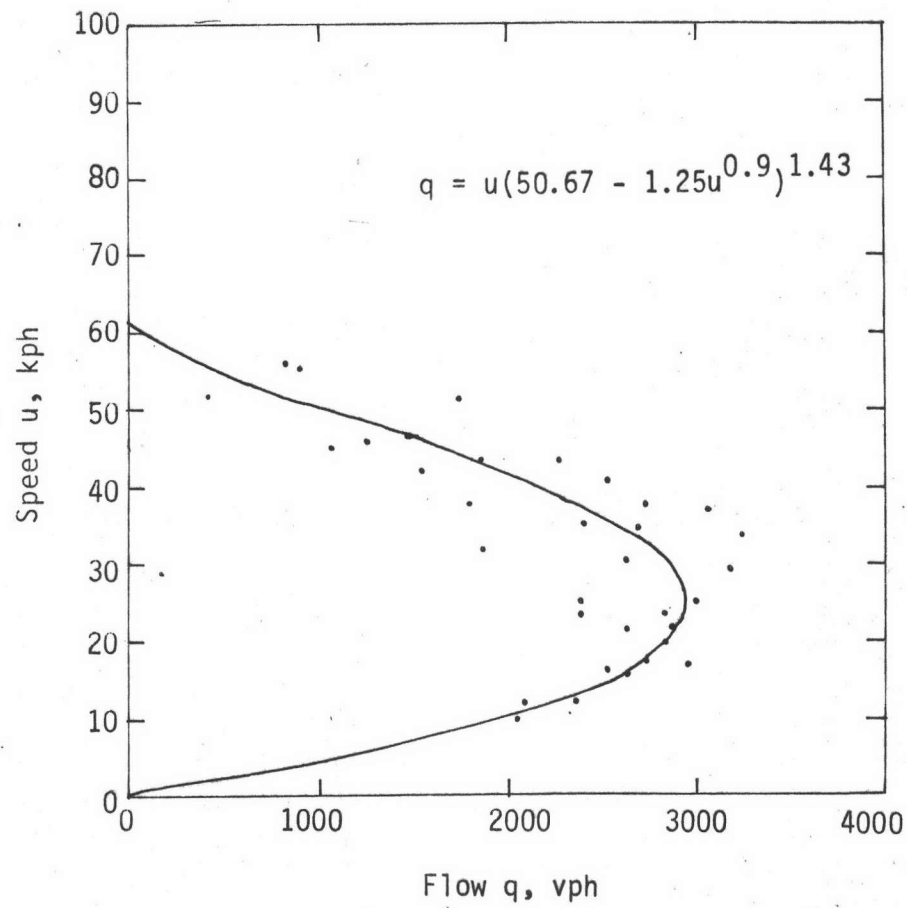


Fig.D-18 Speed-flow model for Sukhumvit Road

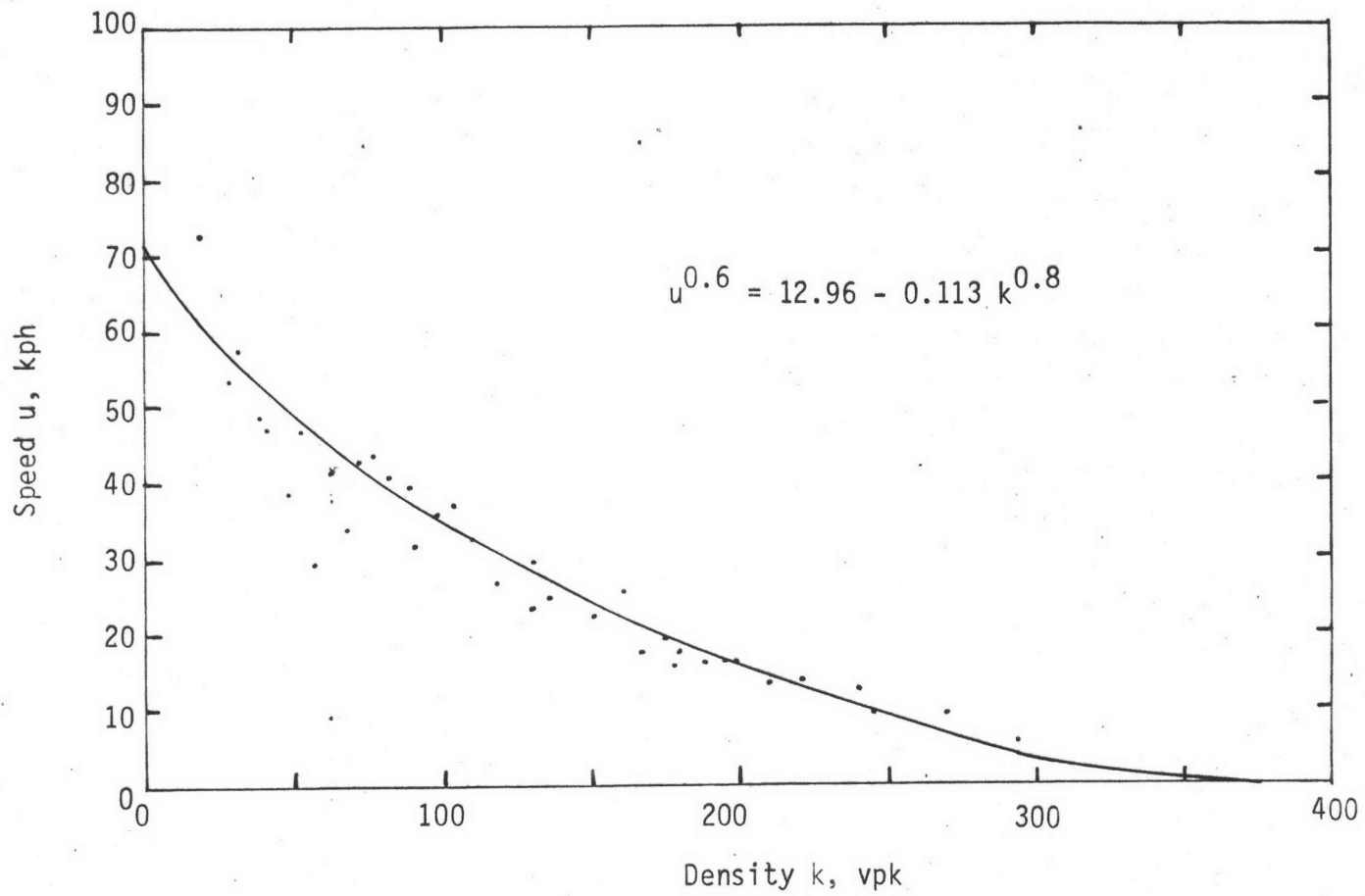


Fig.D-19 Speed-density model for New Petchabury Road

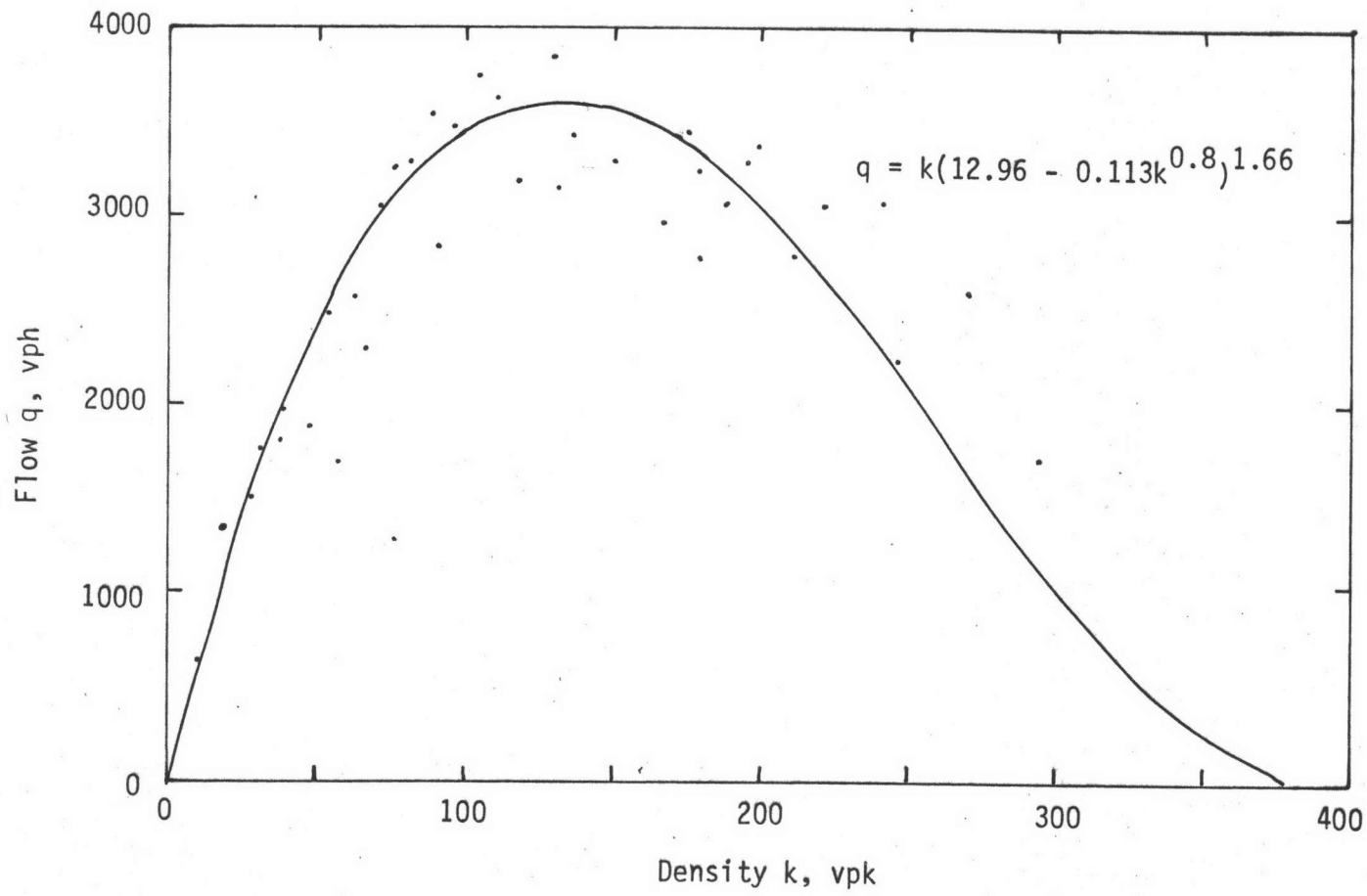


Fig.D-20 Flow-density model for New Petchbury Road

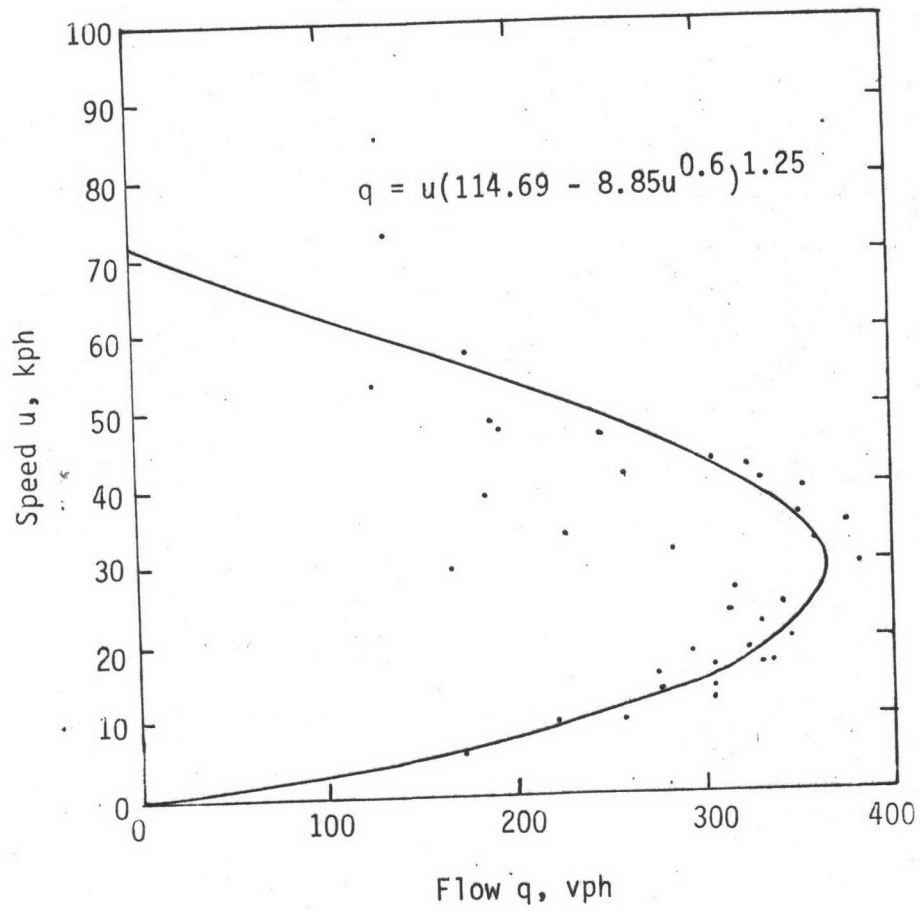


Fig.D-20 Speed-flow model for New Petchbury Road

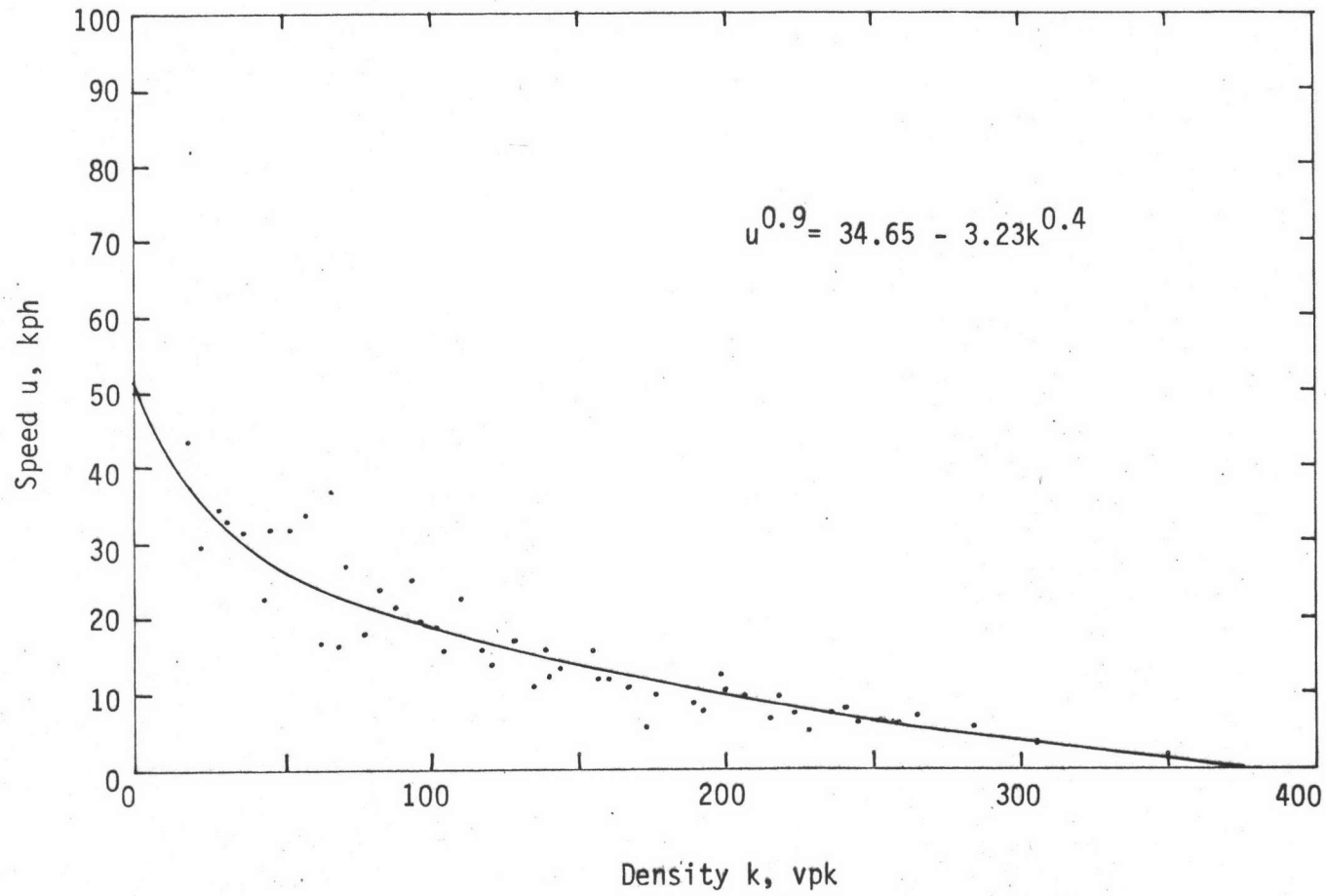


Fig.D-22 Speed-density model for Raj Prarop Road

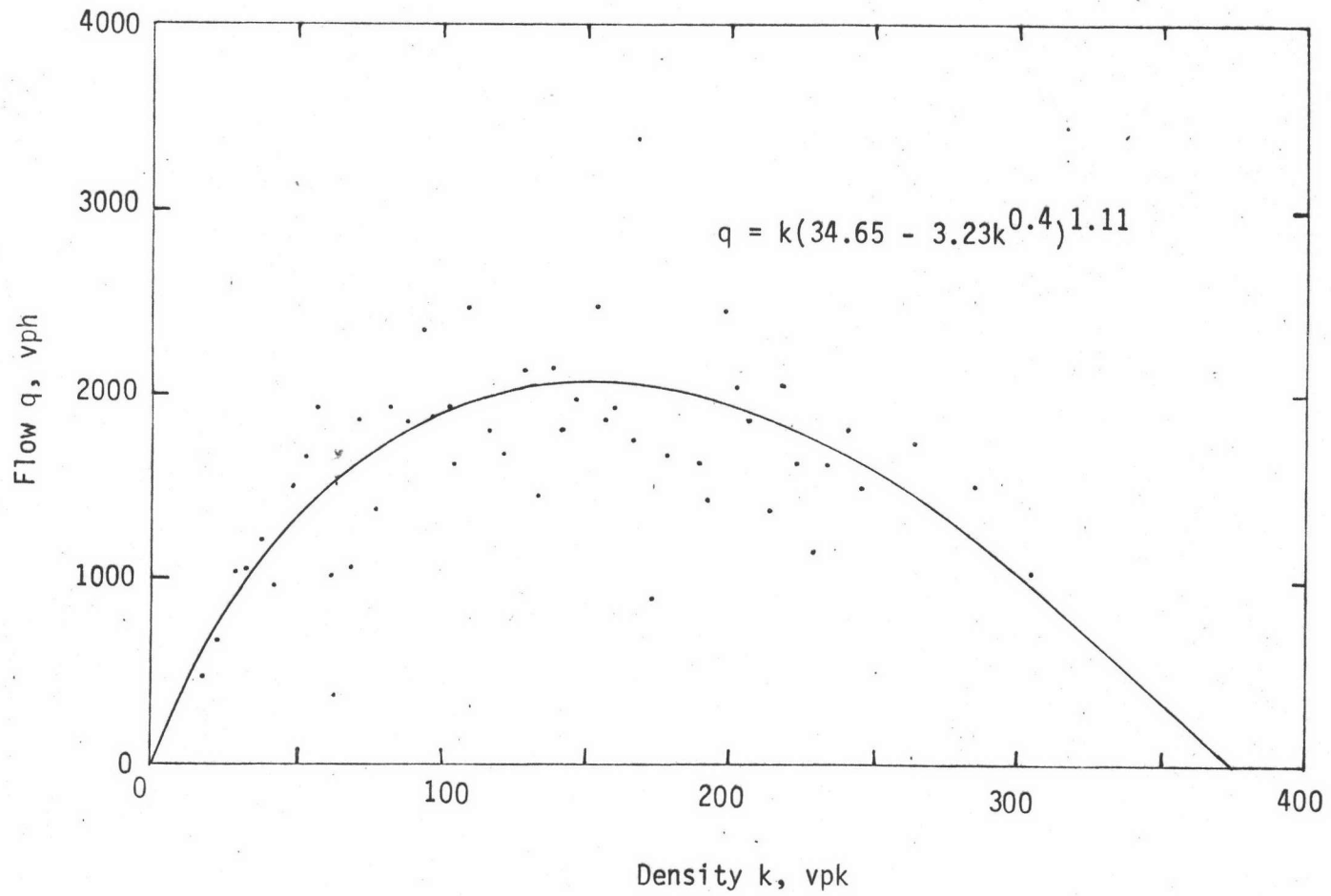


Fig.D-23 Flow-density model for Raj Prarop Road

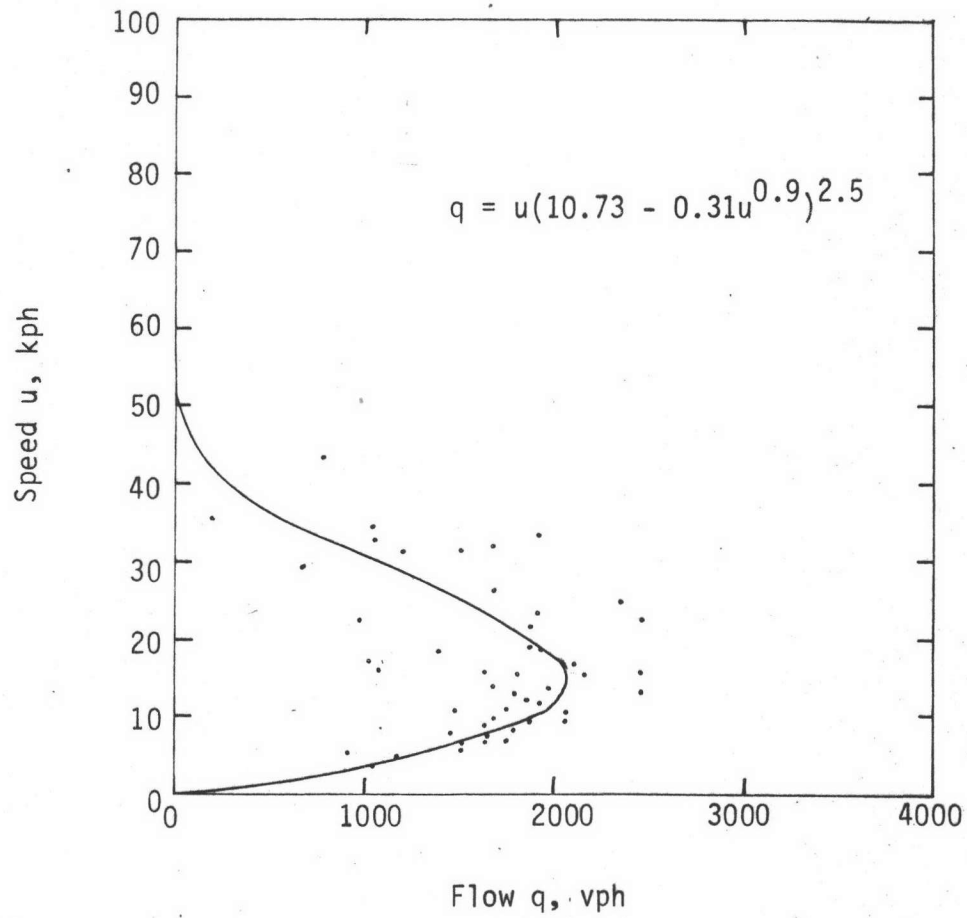


Fig.D-24 Speed-flow model for Raj Prarop Road

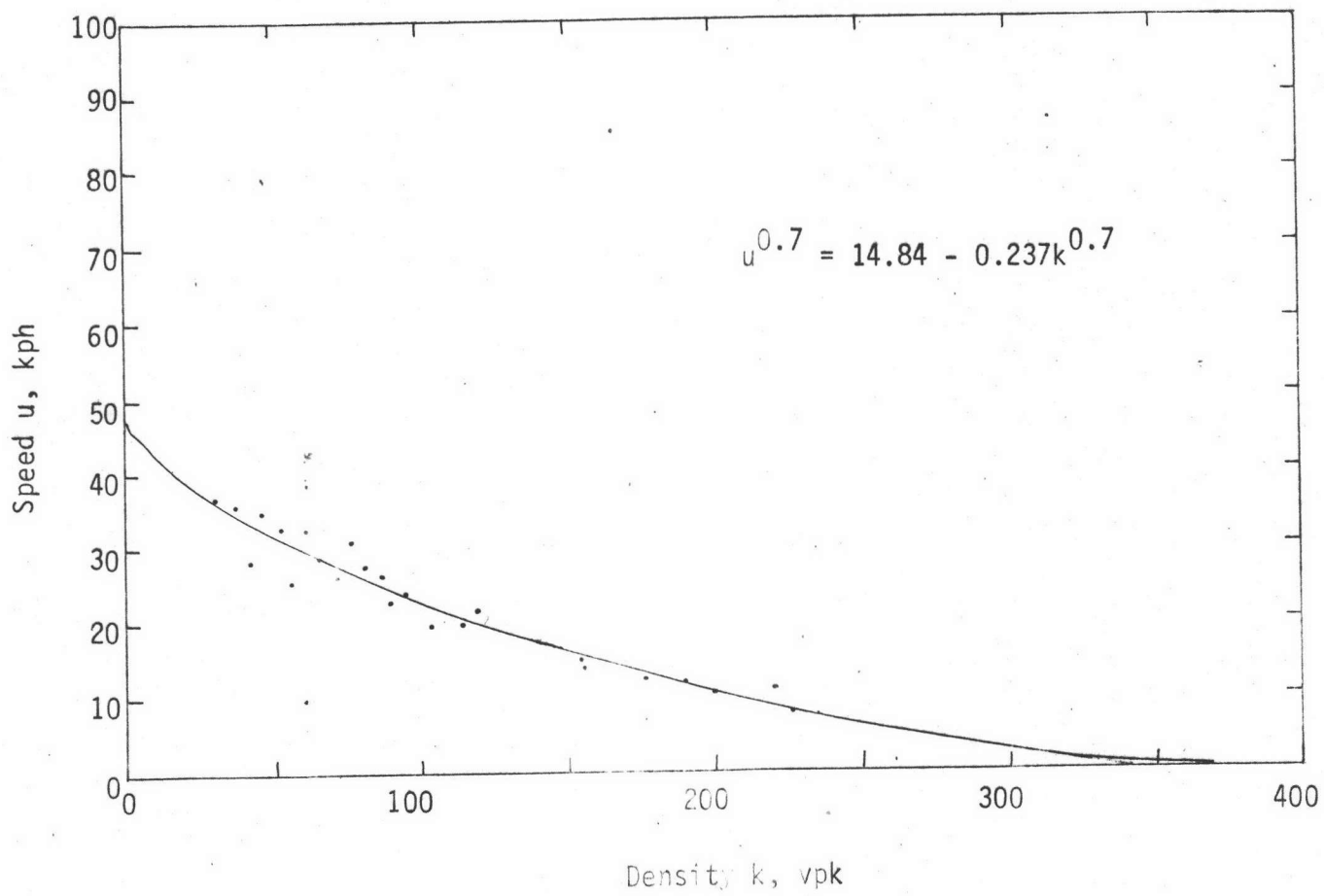


Fig.D-25 Speed-density model for Charoen Krung Road

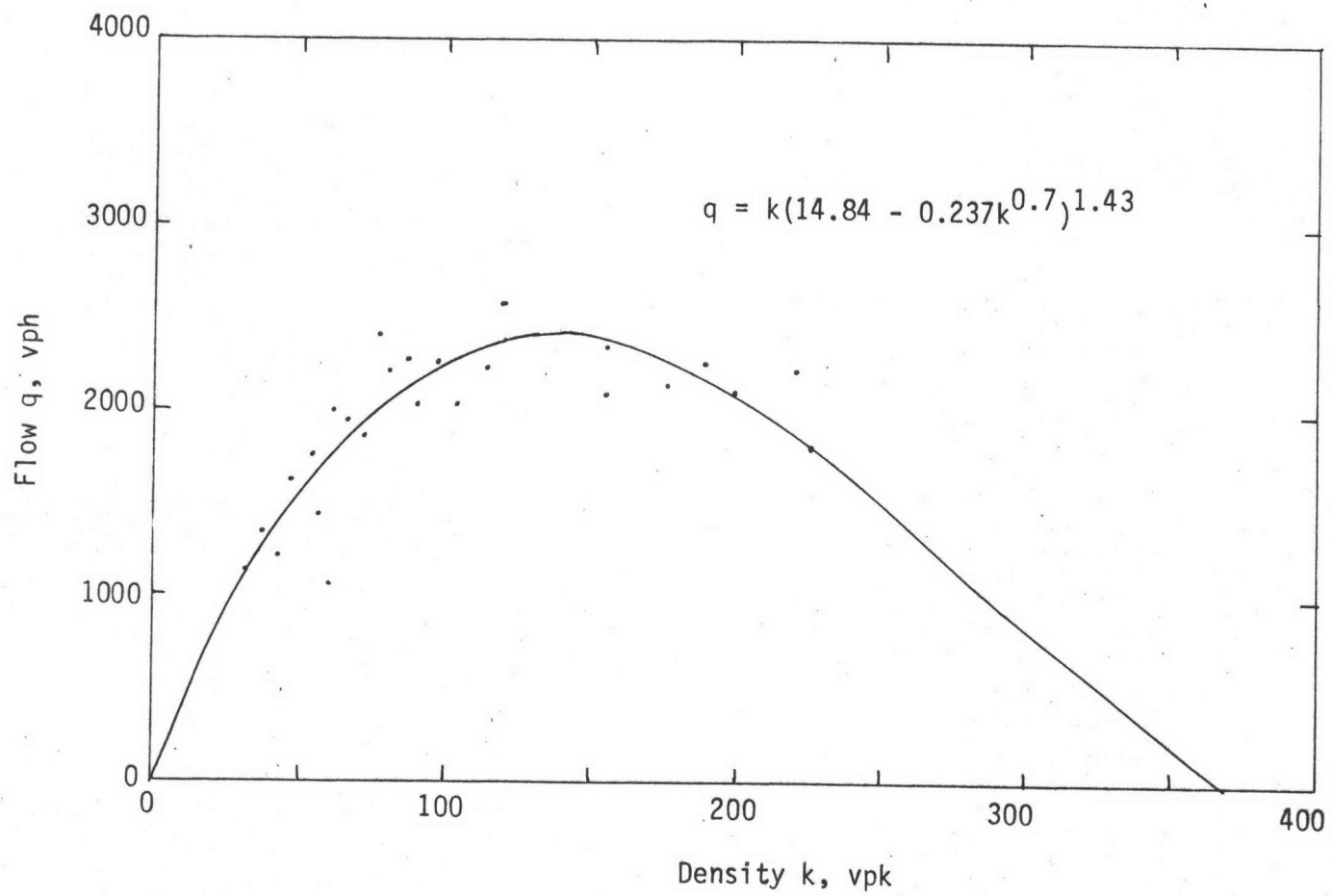


Fig.D-26 Flow-density model for Charoen Krung Road

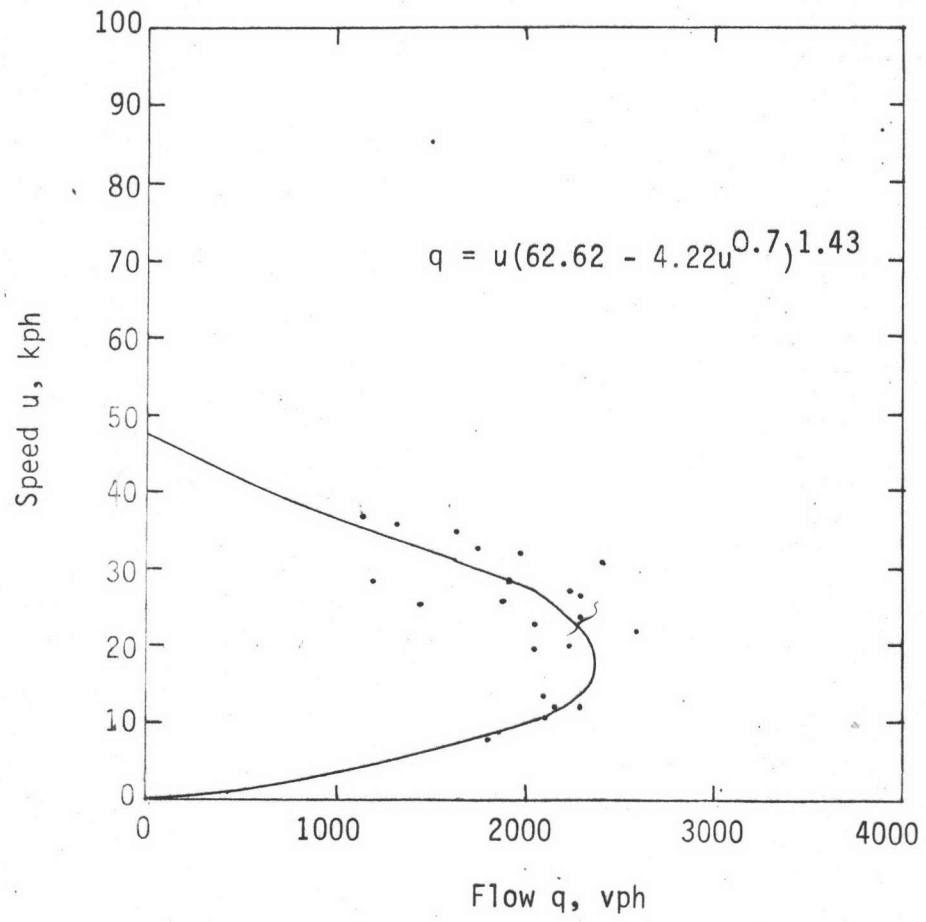


Fig.D-27 Speed-flow model for Charoen Krung Road

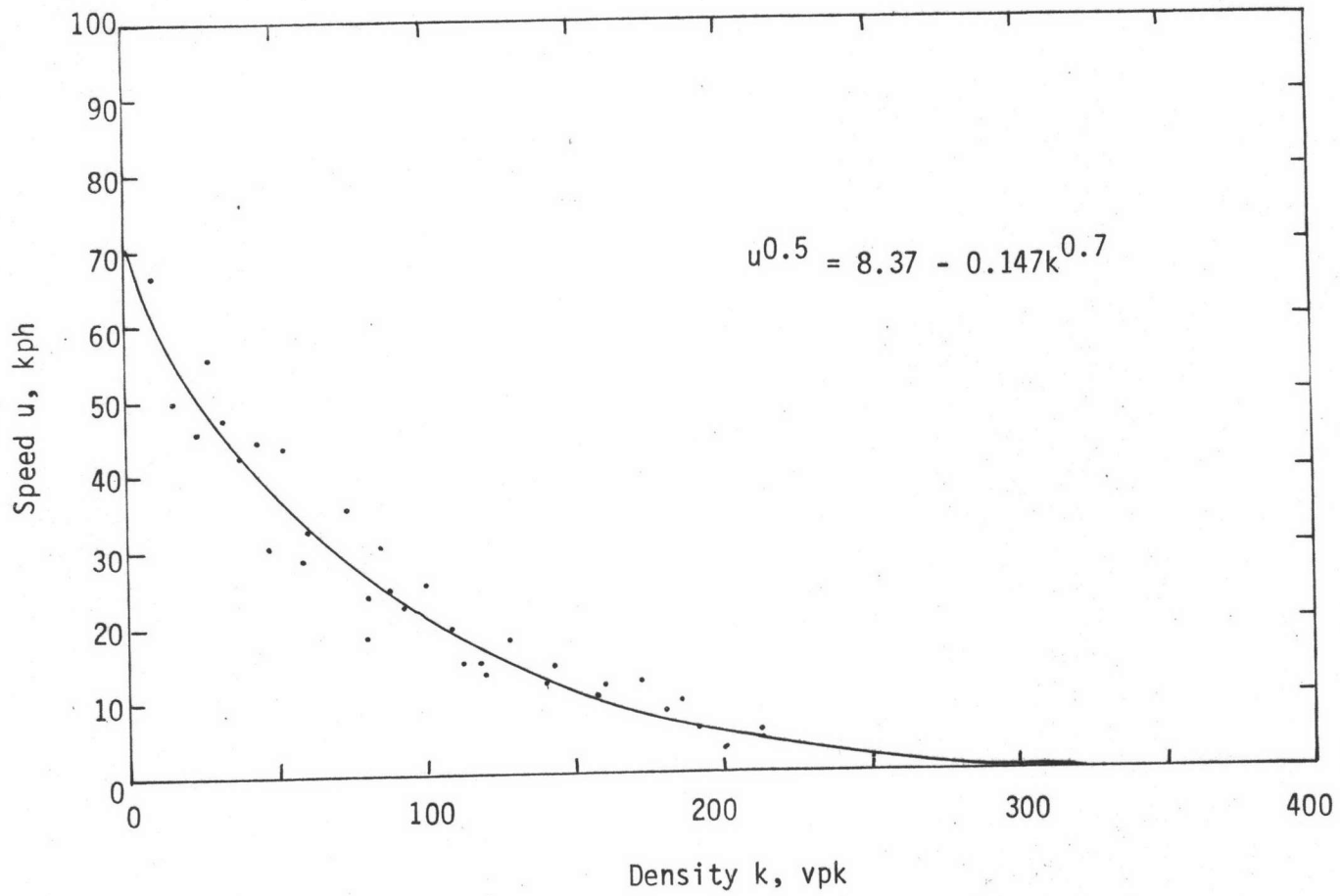


Fig. D-28 Speed-density model for Raj Vithee Road

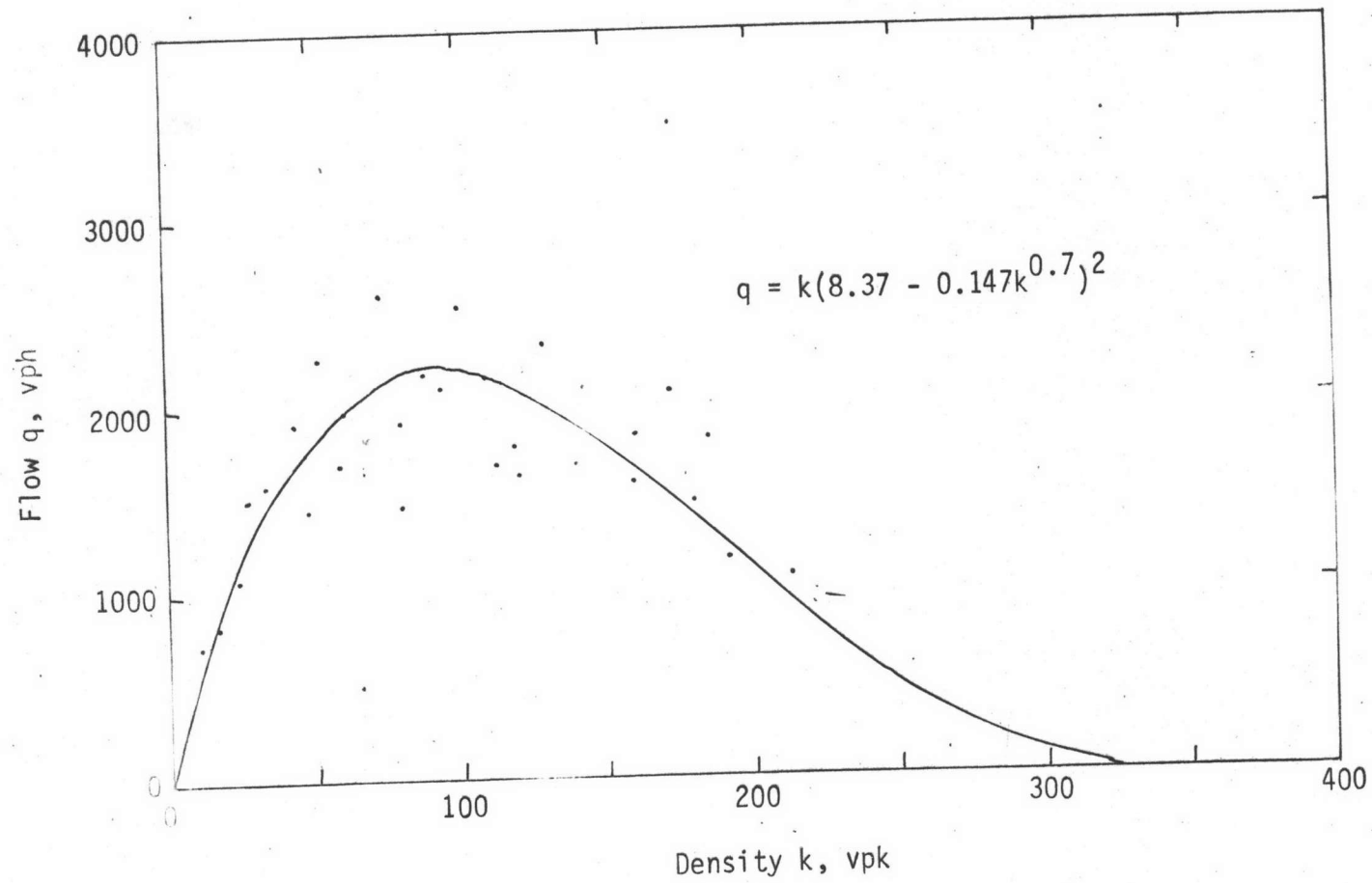


Fig.D-29 Flow-density model for Raj Vithee Road

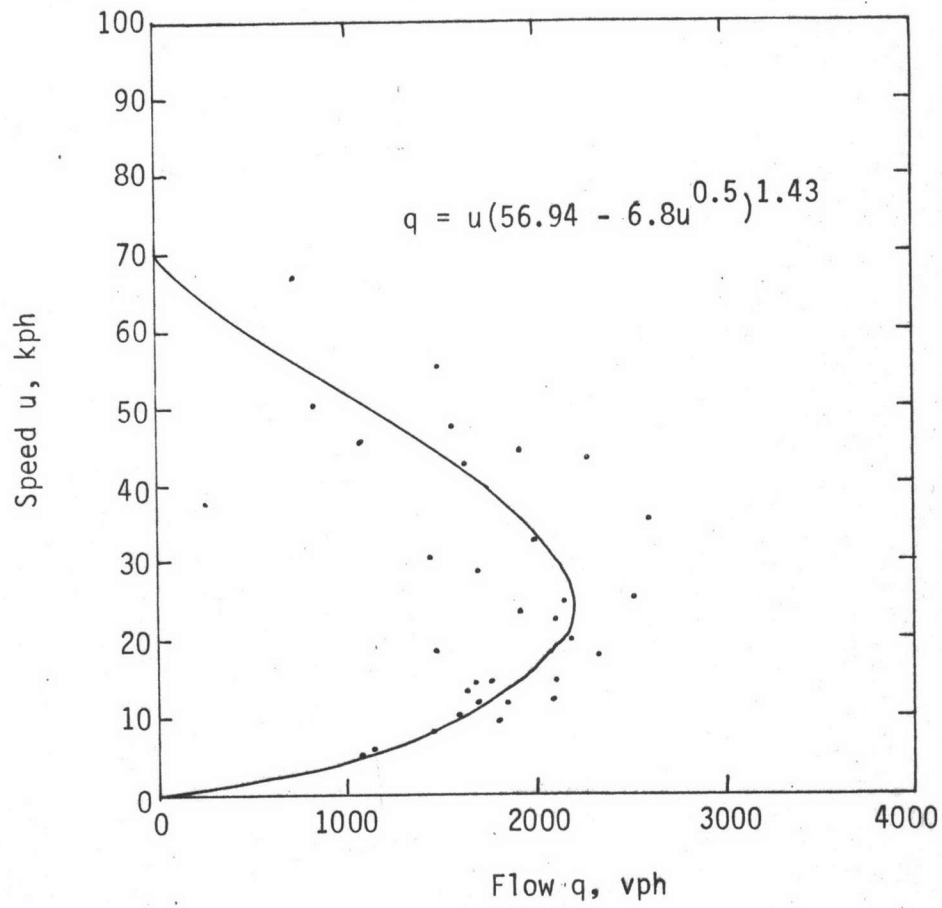


Fig. D-30 Speed-flow model for Raj Vithee Road

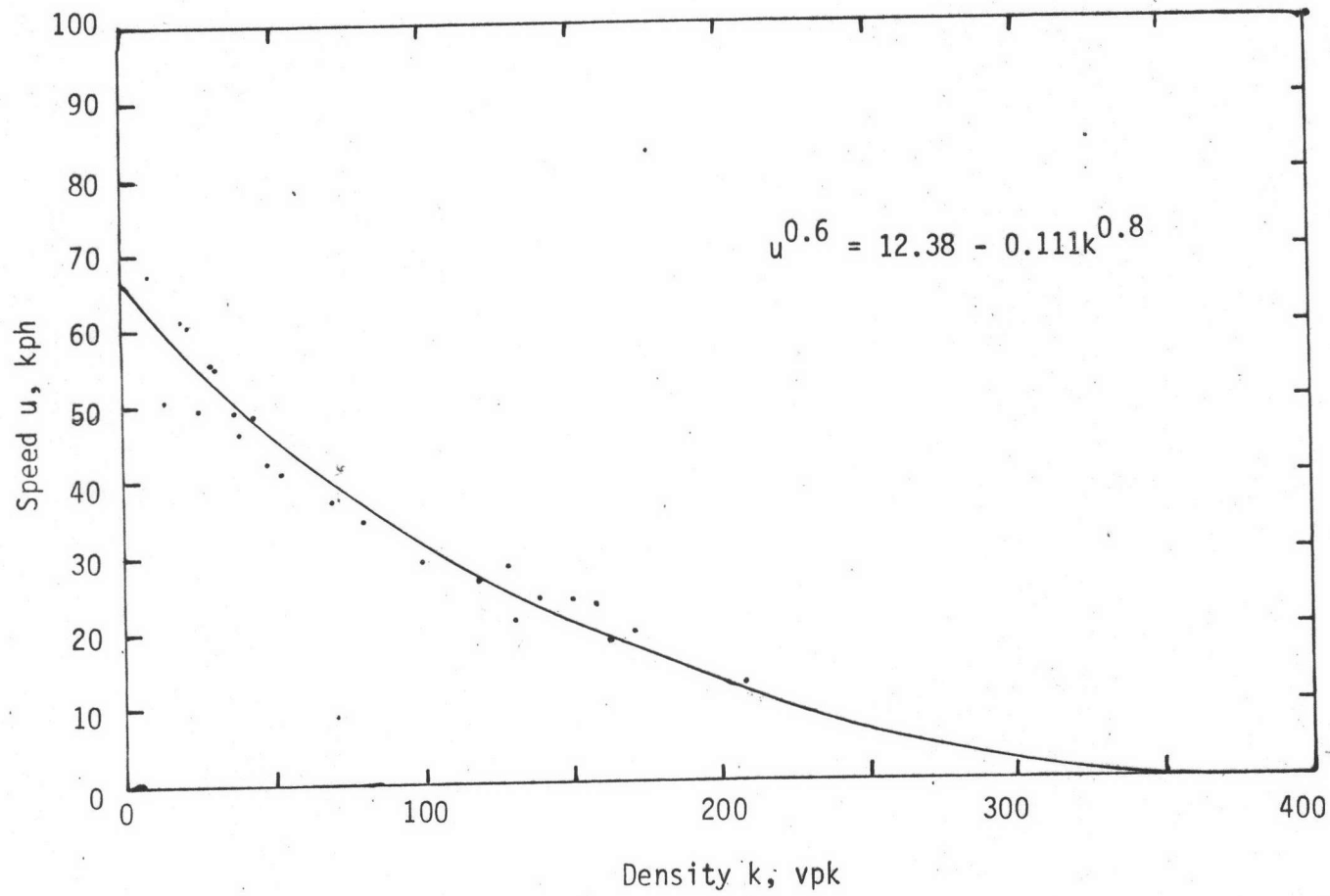


Fig.D-31 Speed-density model for Lat Phrao Road

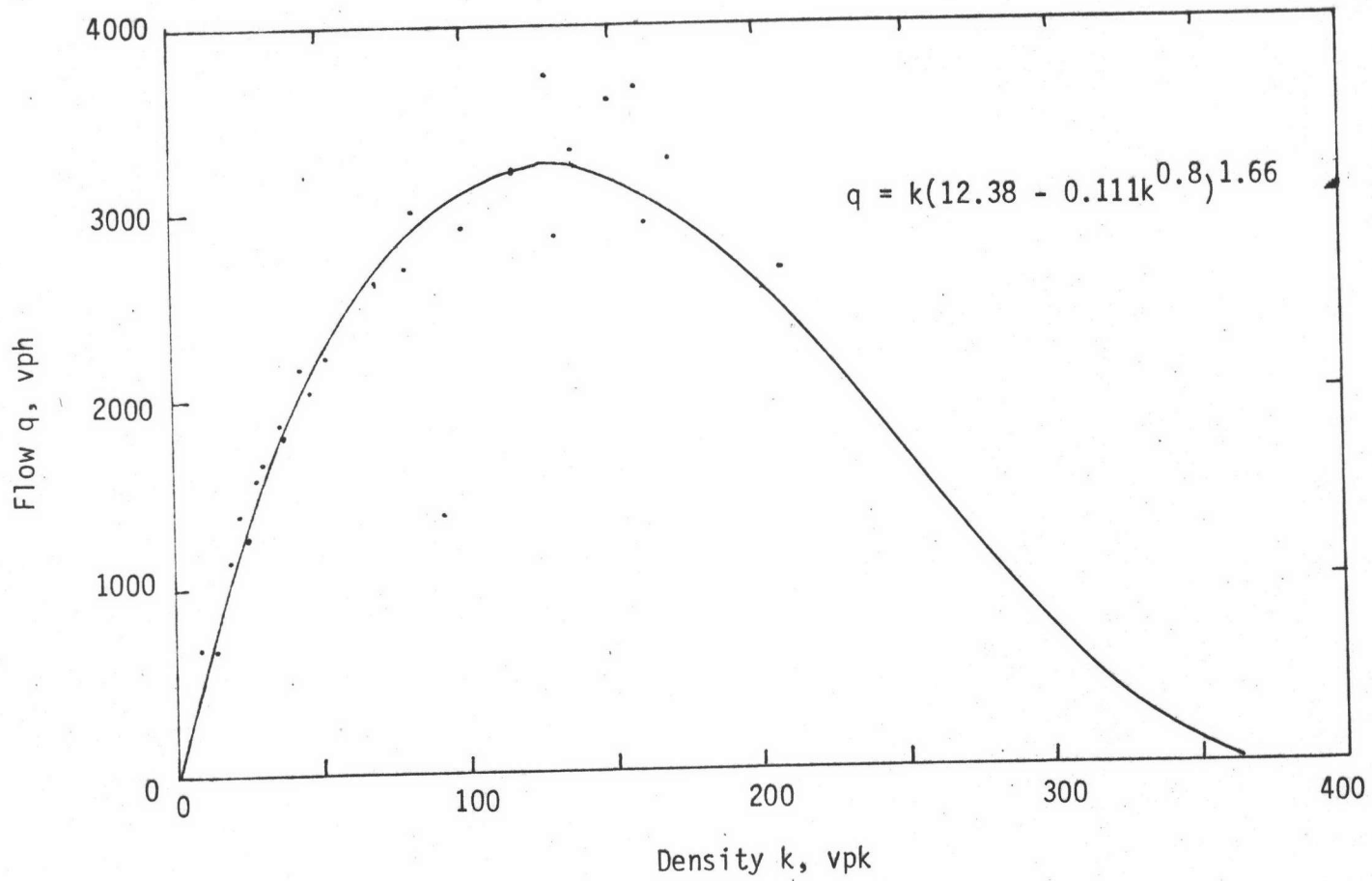


Fig.D-32 Flow-density model for Lat Phrao Road

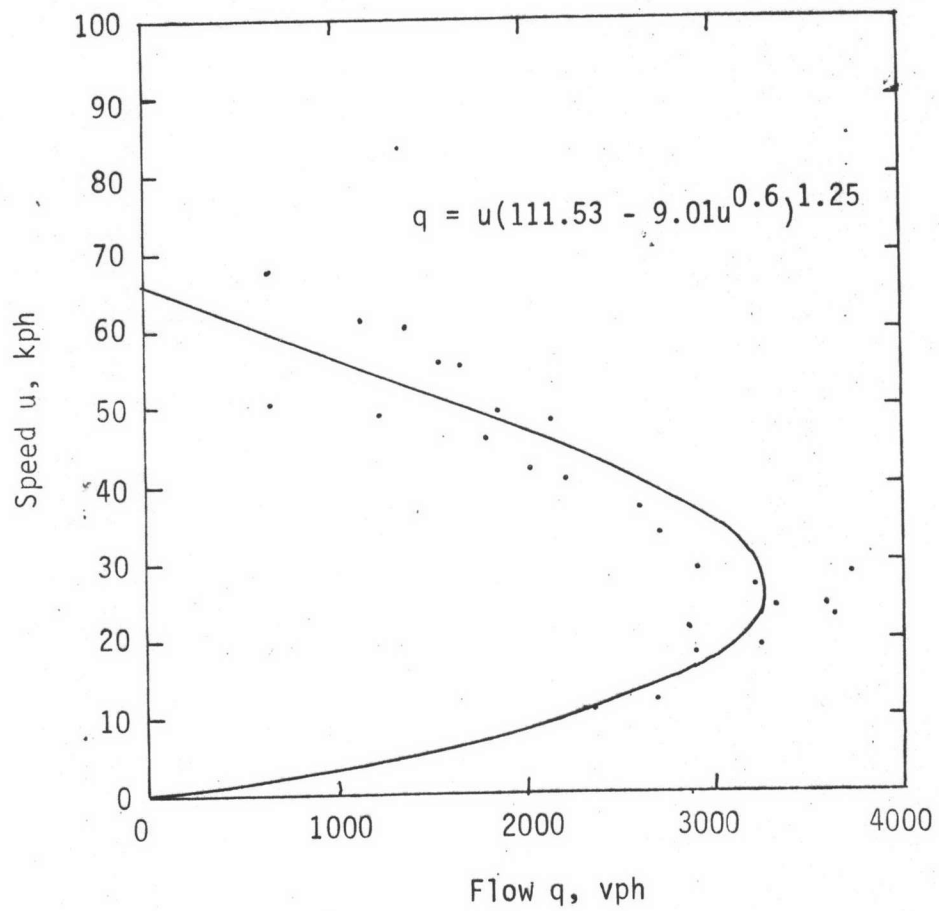


Fig.D-33 Speed-flow model for Lat Phrao Road

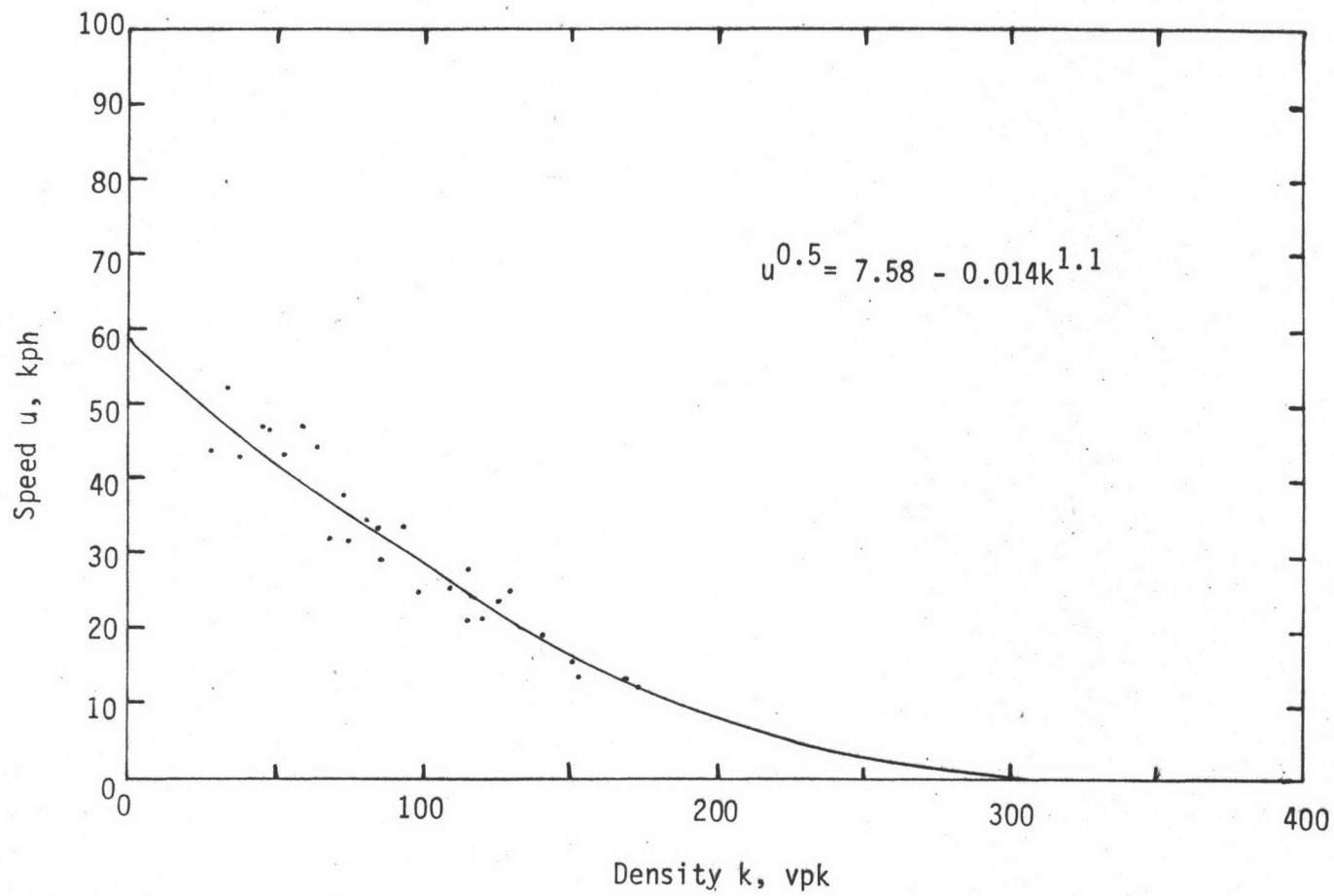


Fig.D-34 Speed-density model for Phrachao Taksin Road

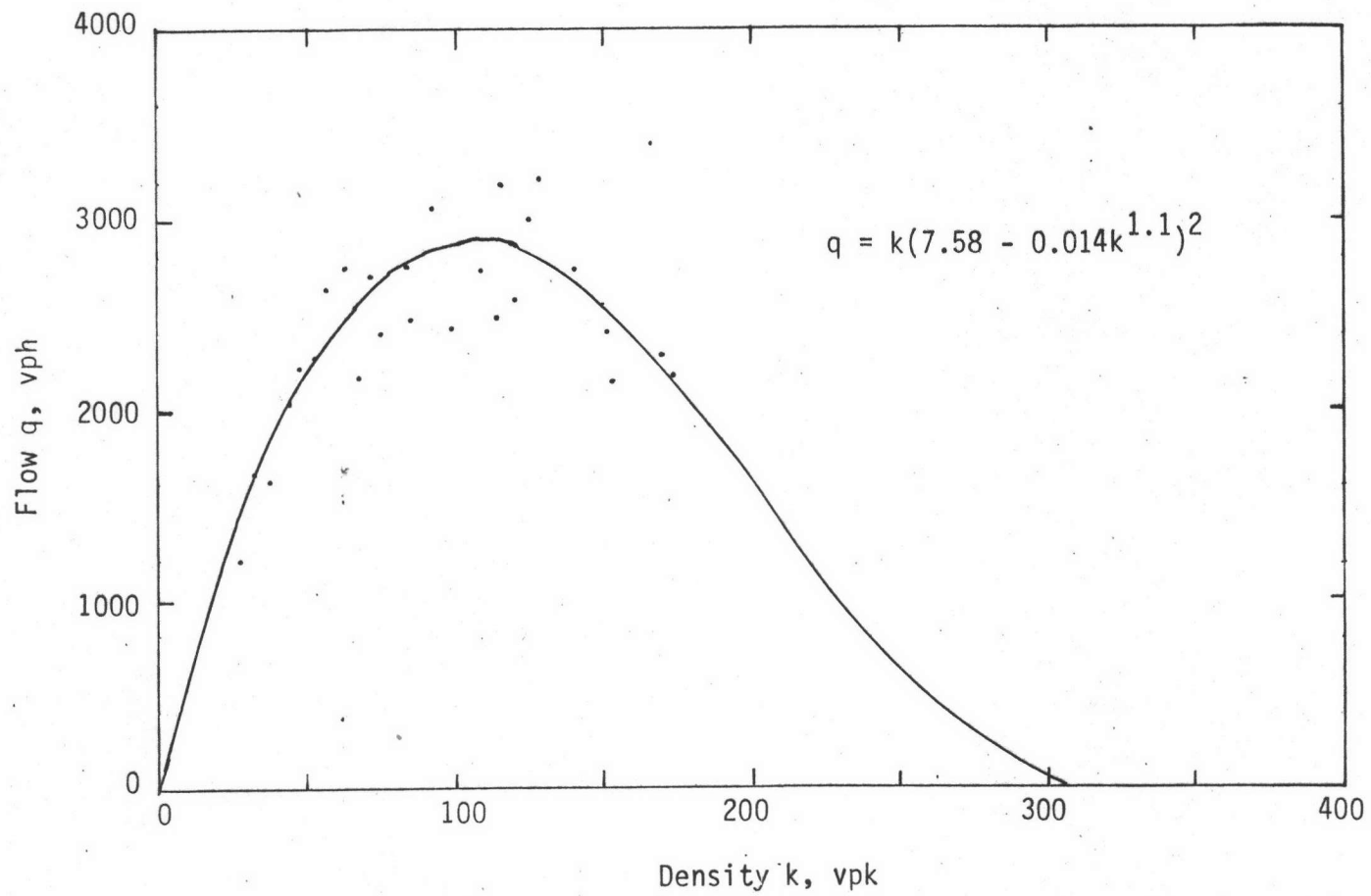


Fig.D-35 Flow-density model for Phrachao Taksin Road

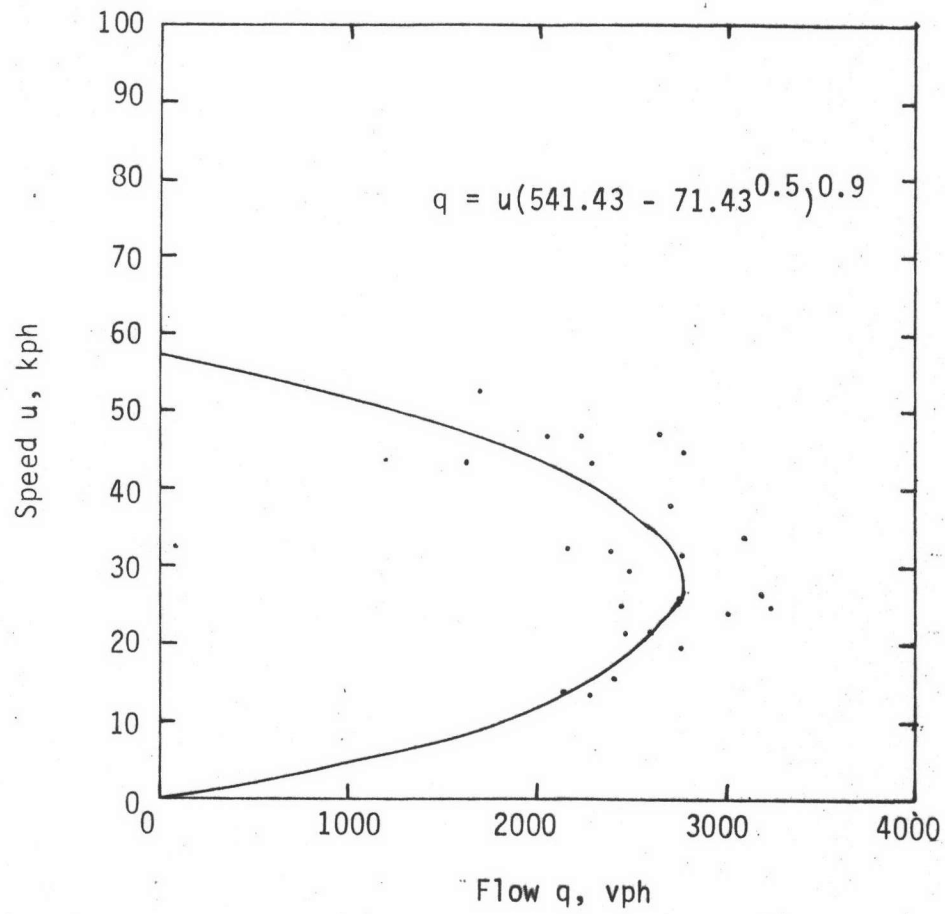


Fig.D-36 Speed-flow model for Phrachao Taksin Road

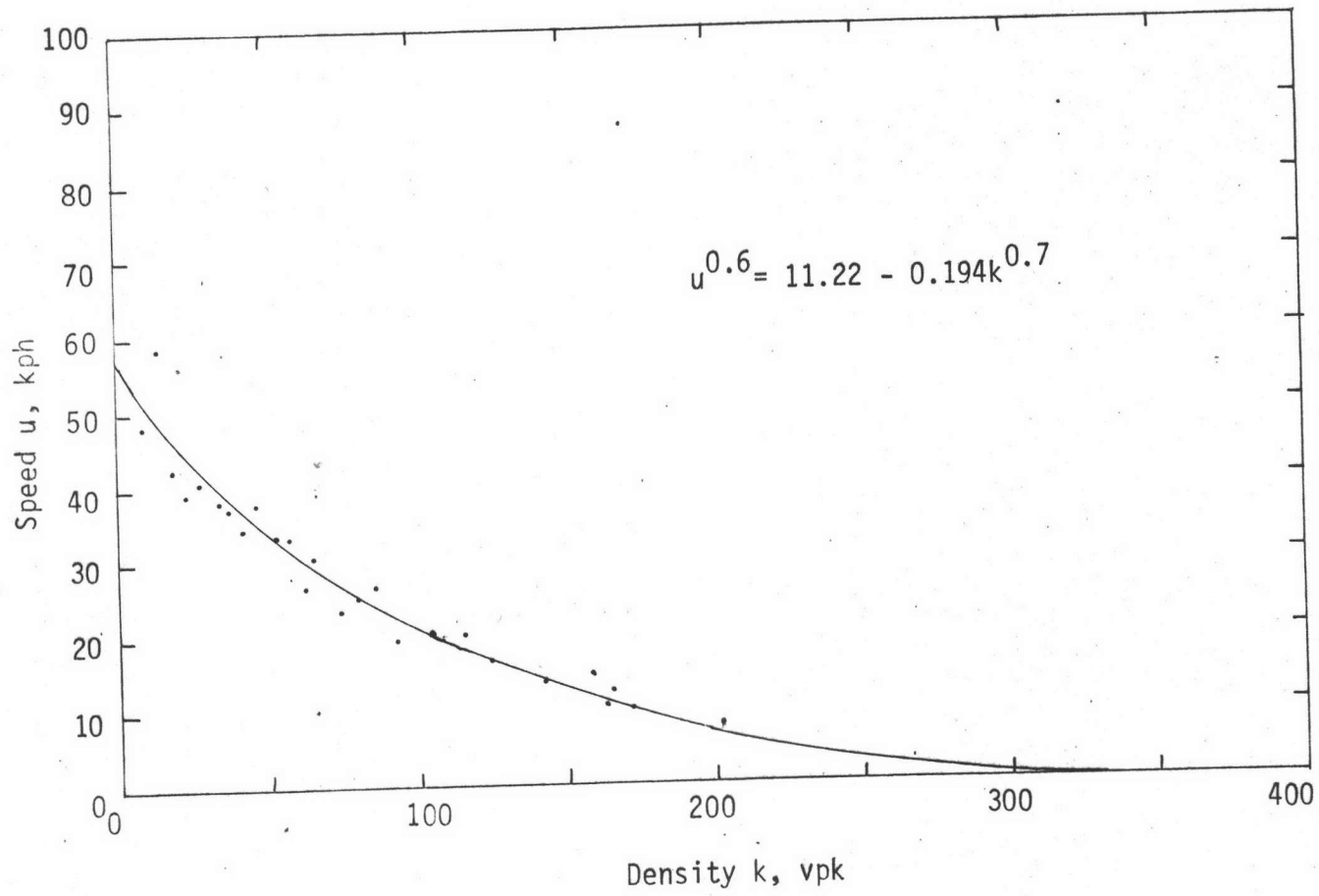


Fig.D-37 Speed-density model for Phran Nok Road

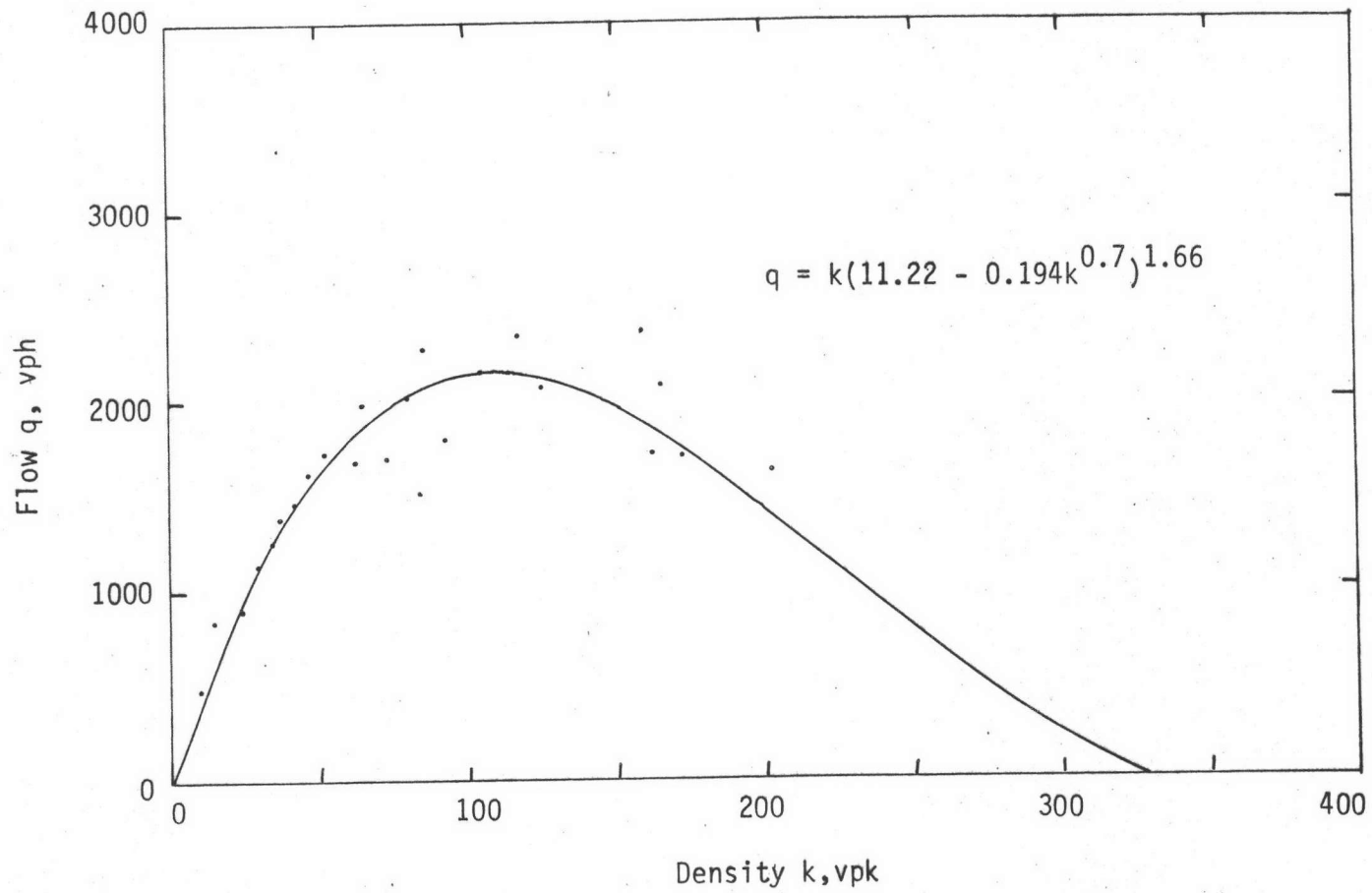


Fig.D-38 Flow-density model for Phran Nok Road

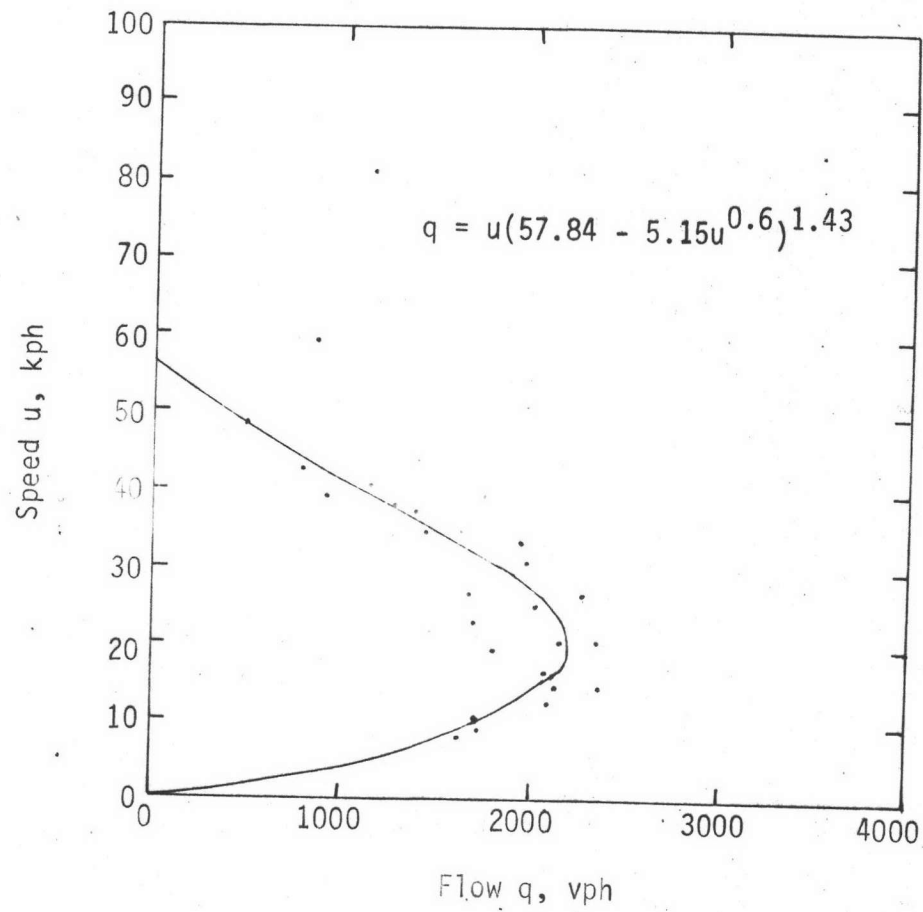


Fig.D-39 Speed-flow model for Phran Nok Road

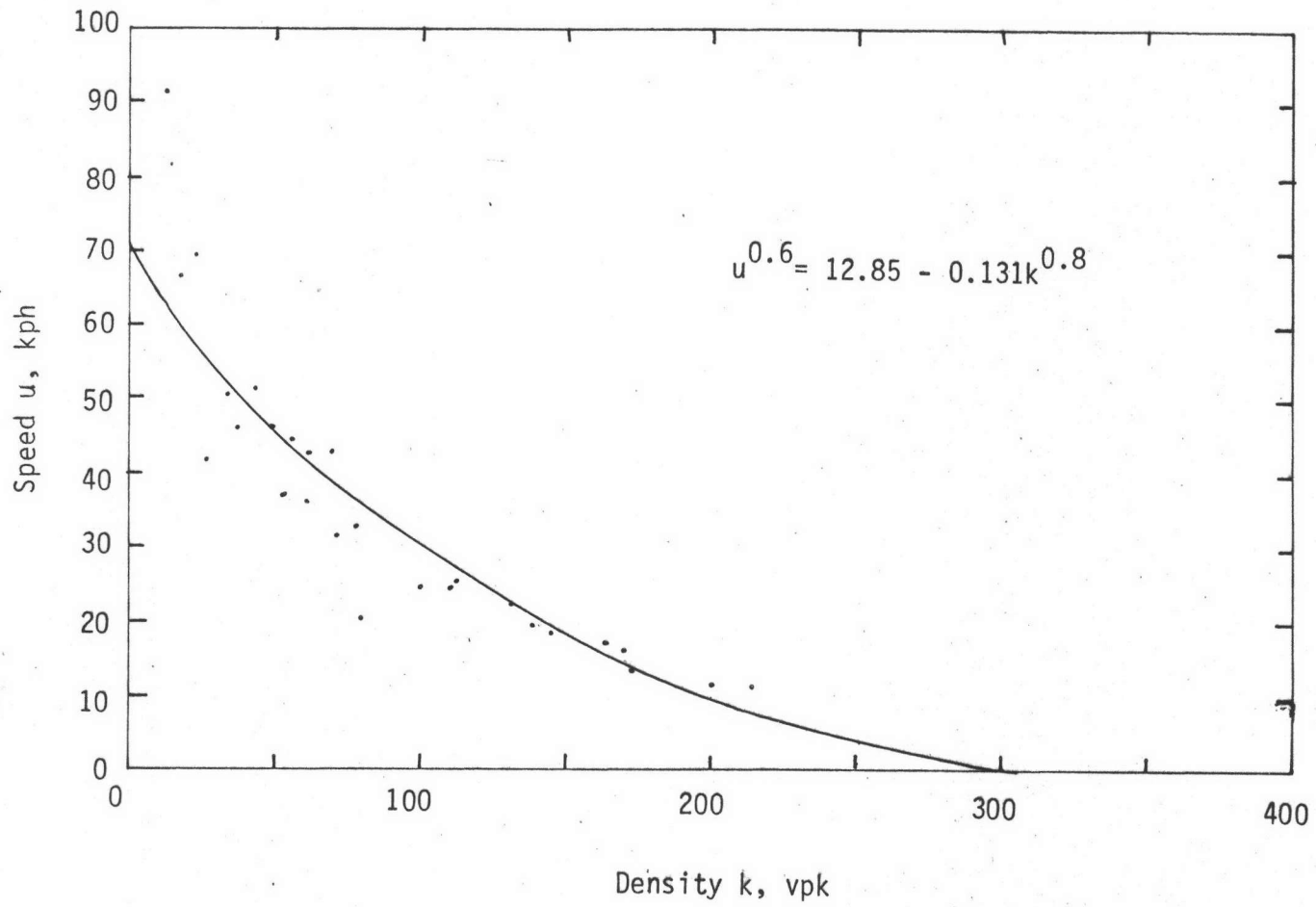


Fig.D-40 Speed-density model for Ramkhamhaeng Road

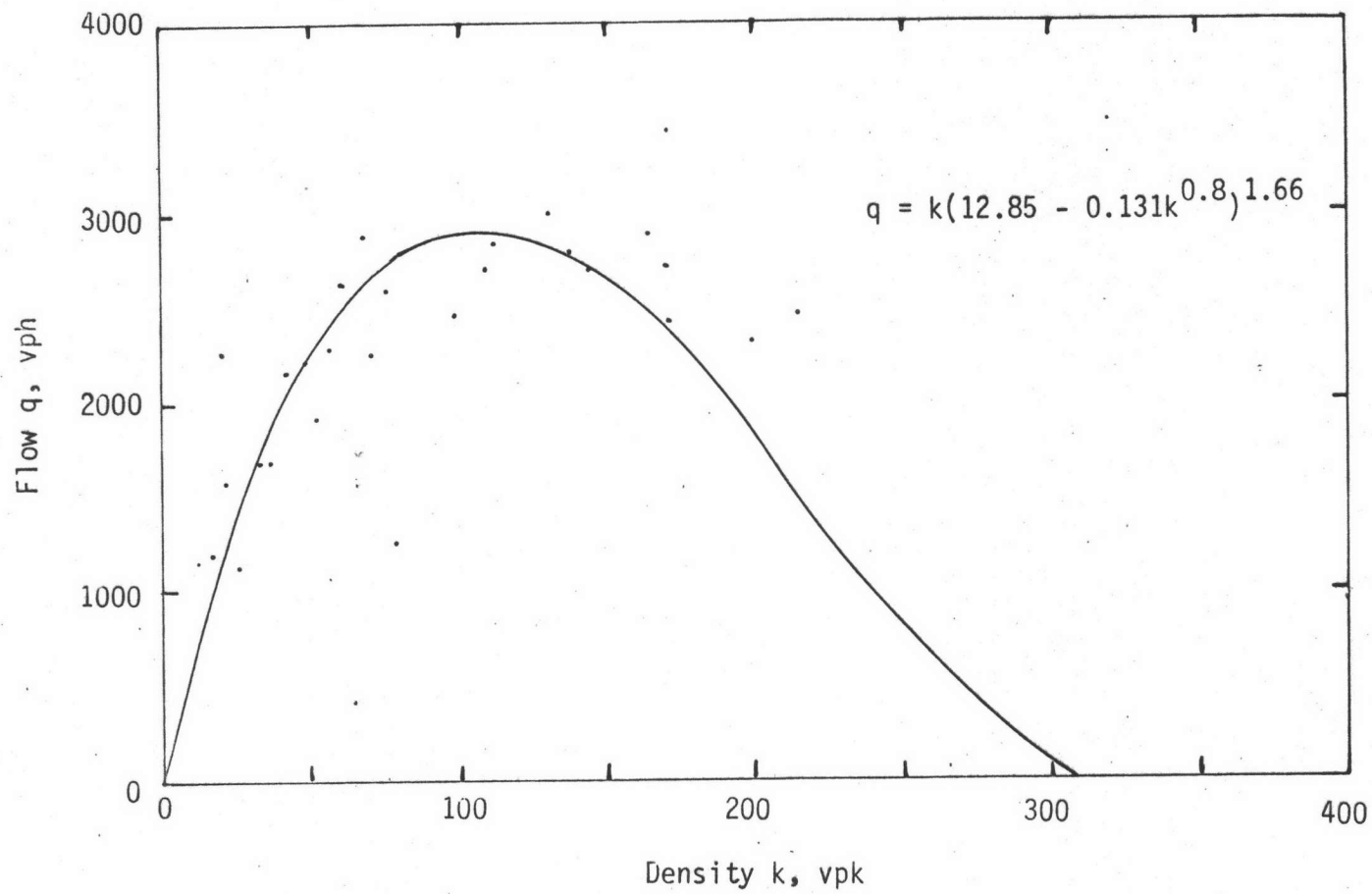


Fig.D-41 Flow density model for Ramkhamhaeng Road

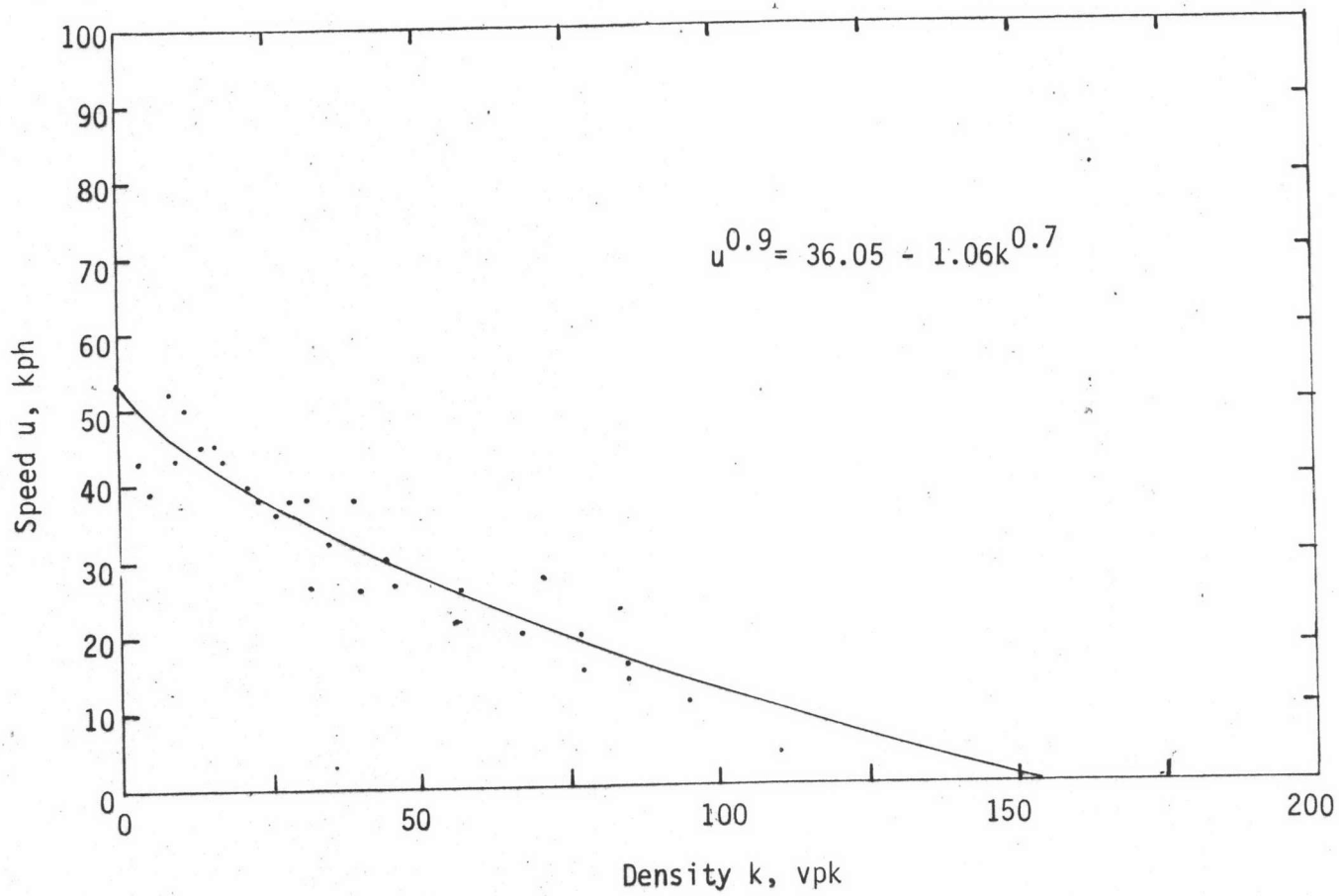


Fig.D-43 Speed-density model for Soi Sena Nikhom 1

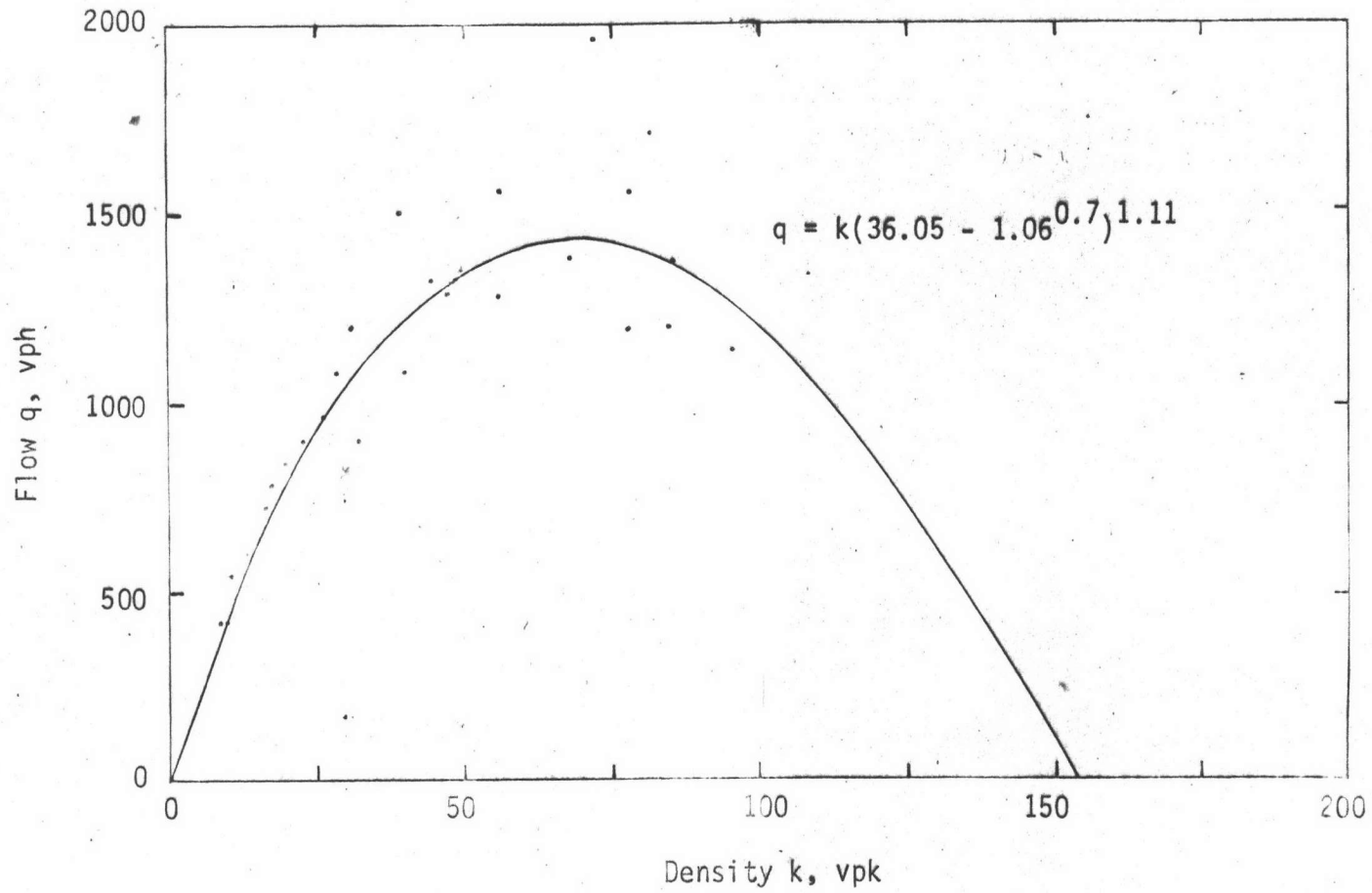


Fig.D-44 Flow-density model for Sqi Sena Nikhom 1

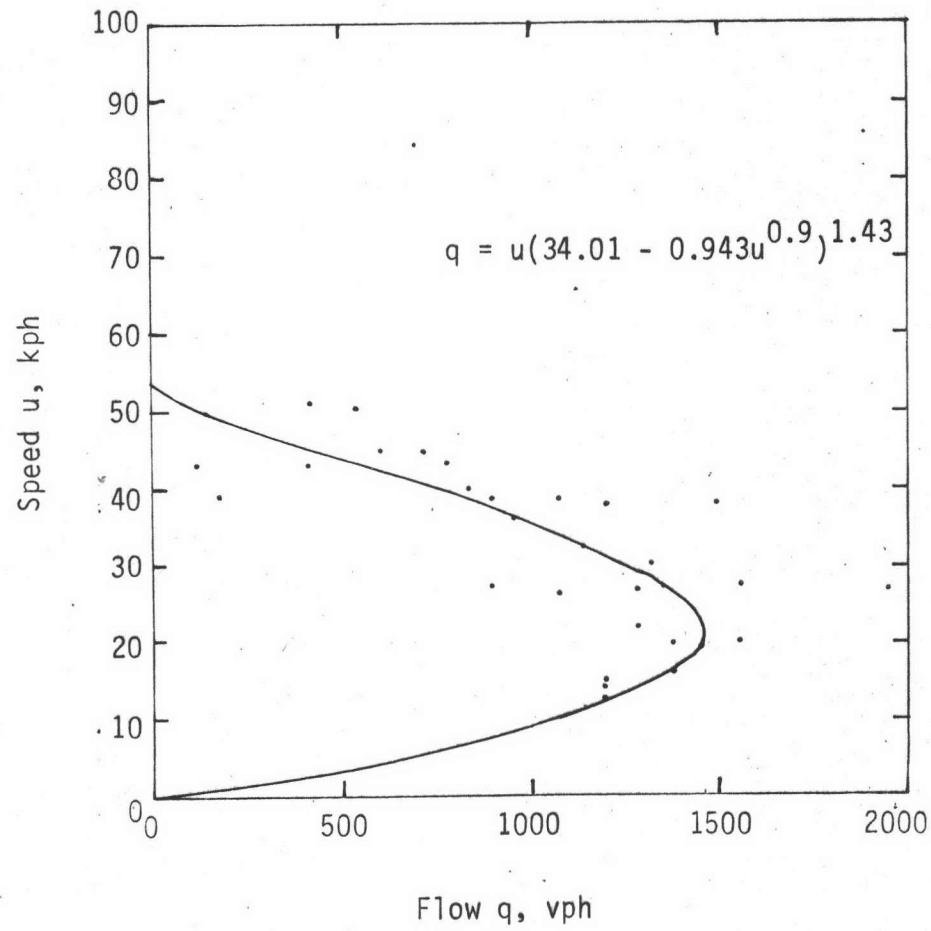


Fig. D-45 Speed-flow model for Soi Sena Nikhom 1

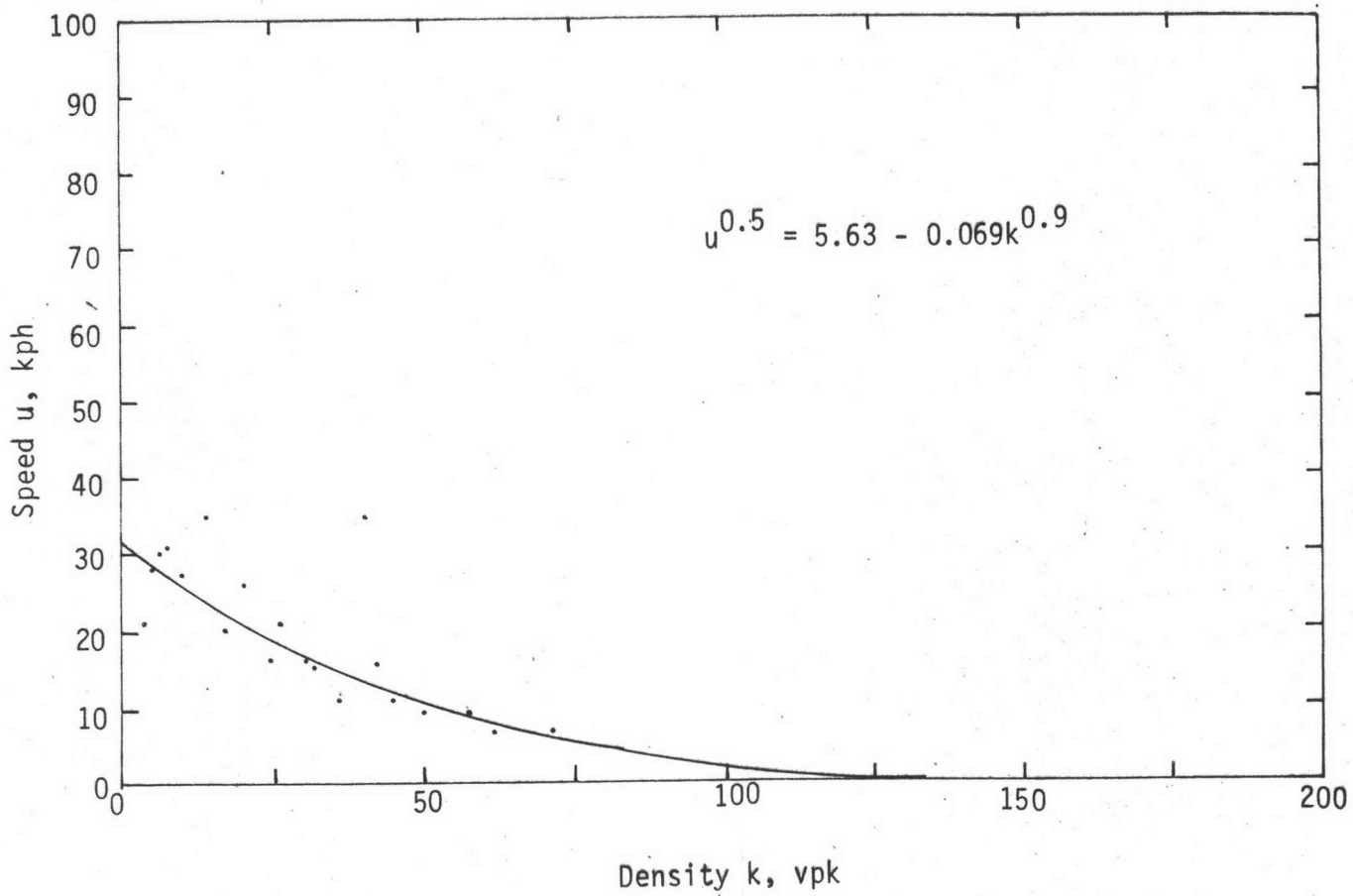


Fig.D-46 Speed-density model for Soi Area

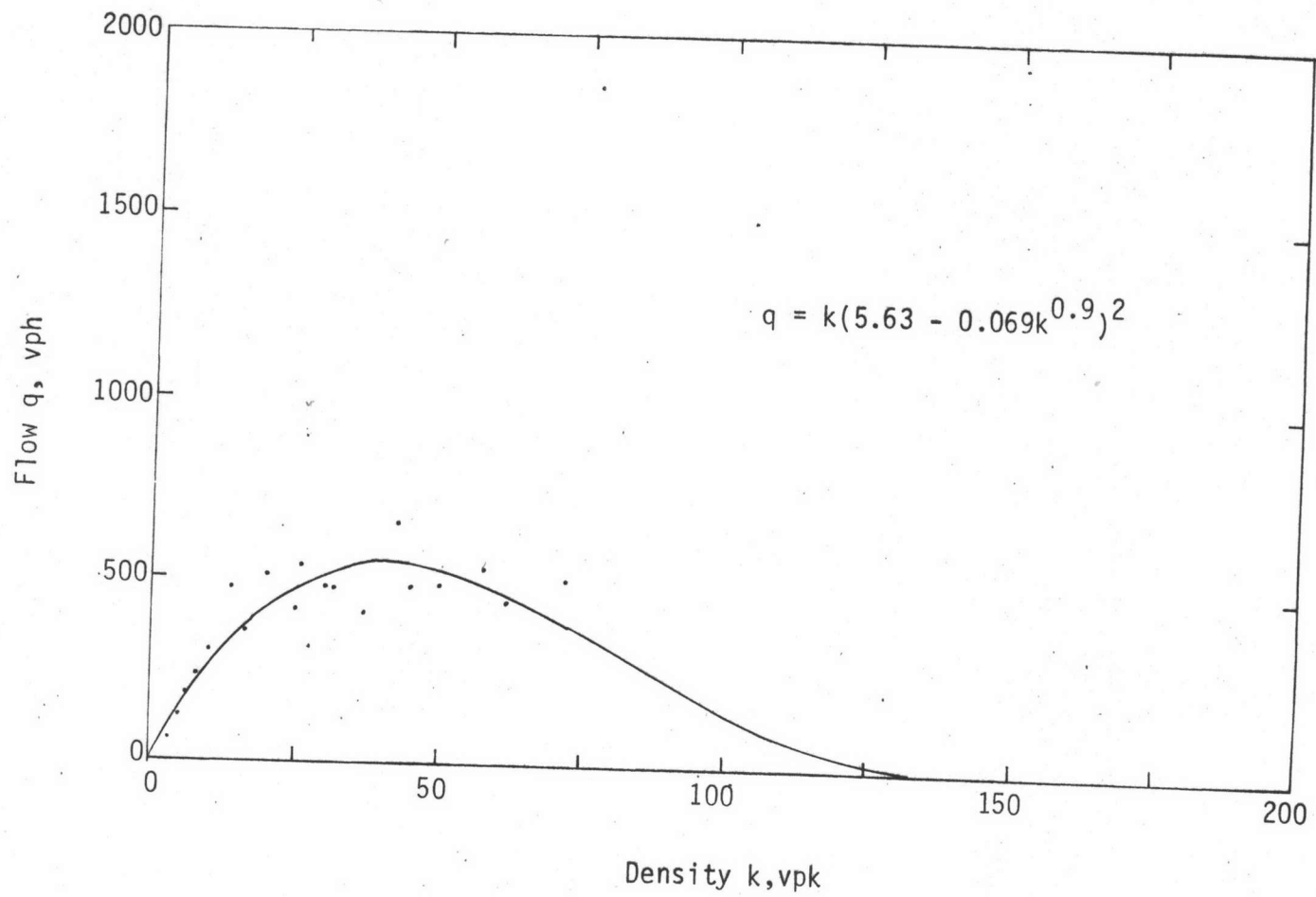


Fig.D-47 Flow-density model for Soi Aree

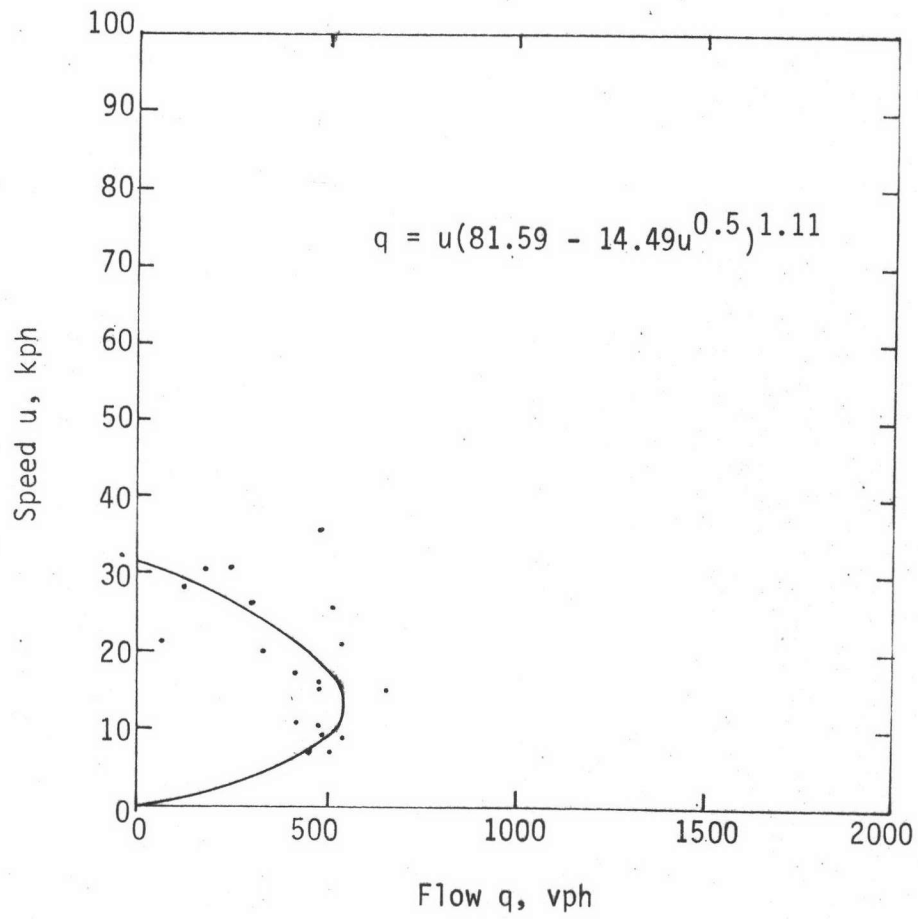


Fig.D-48 Speed-flow model for Soi Aree

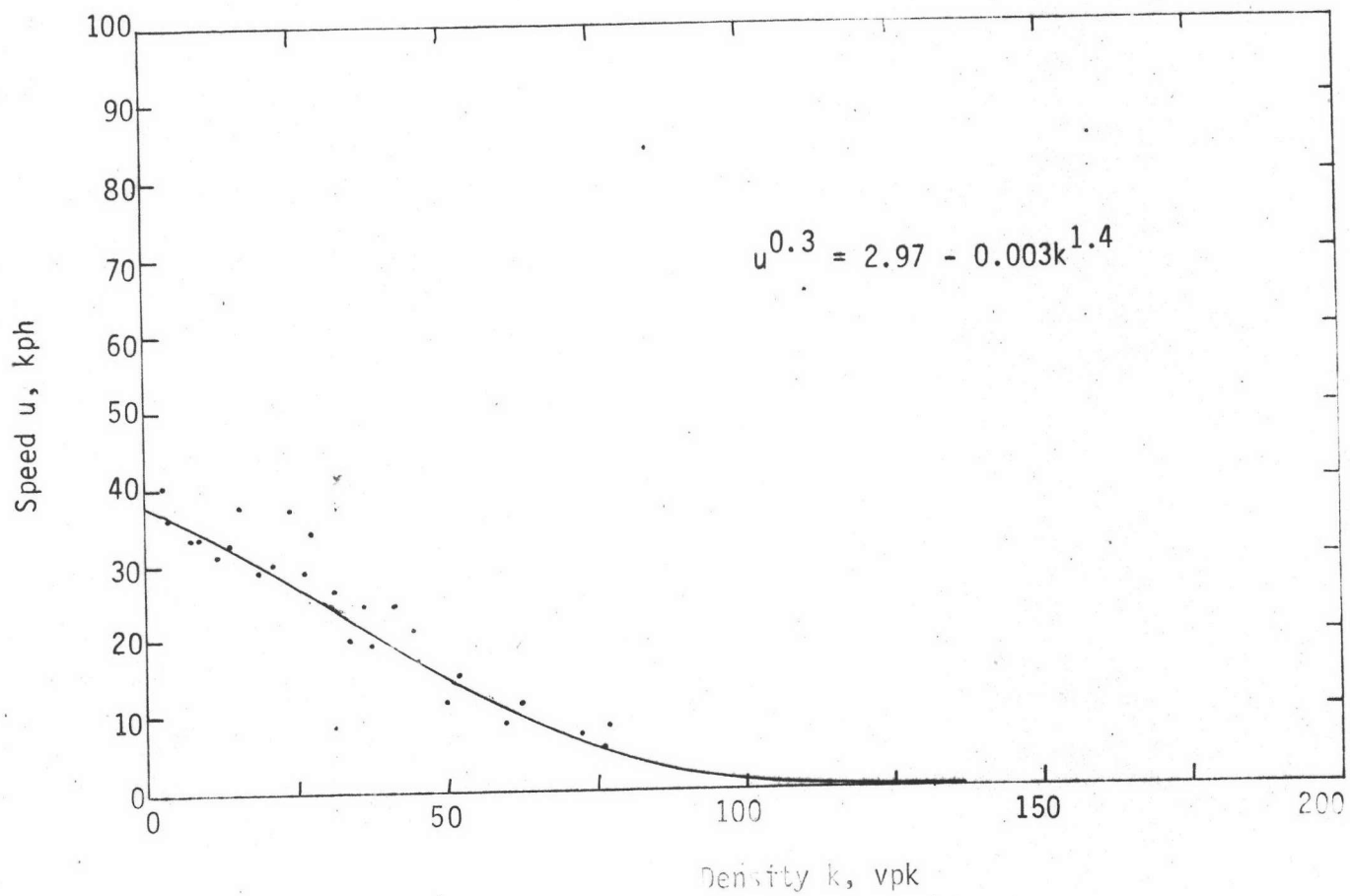


Fig.D-49 Speed-density model for Chula Soi 12

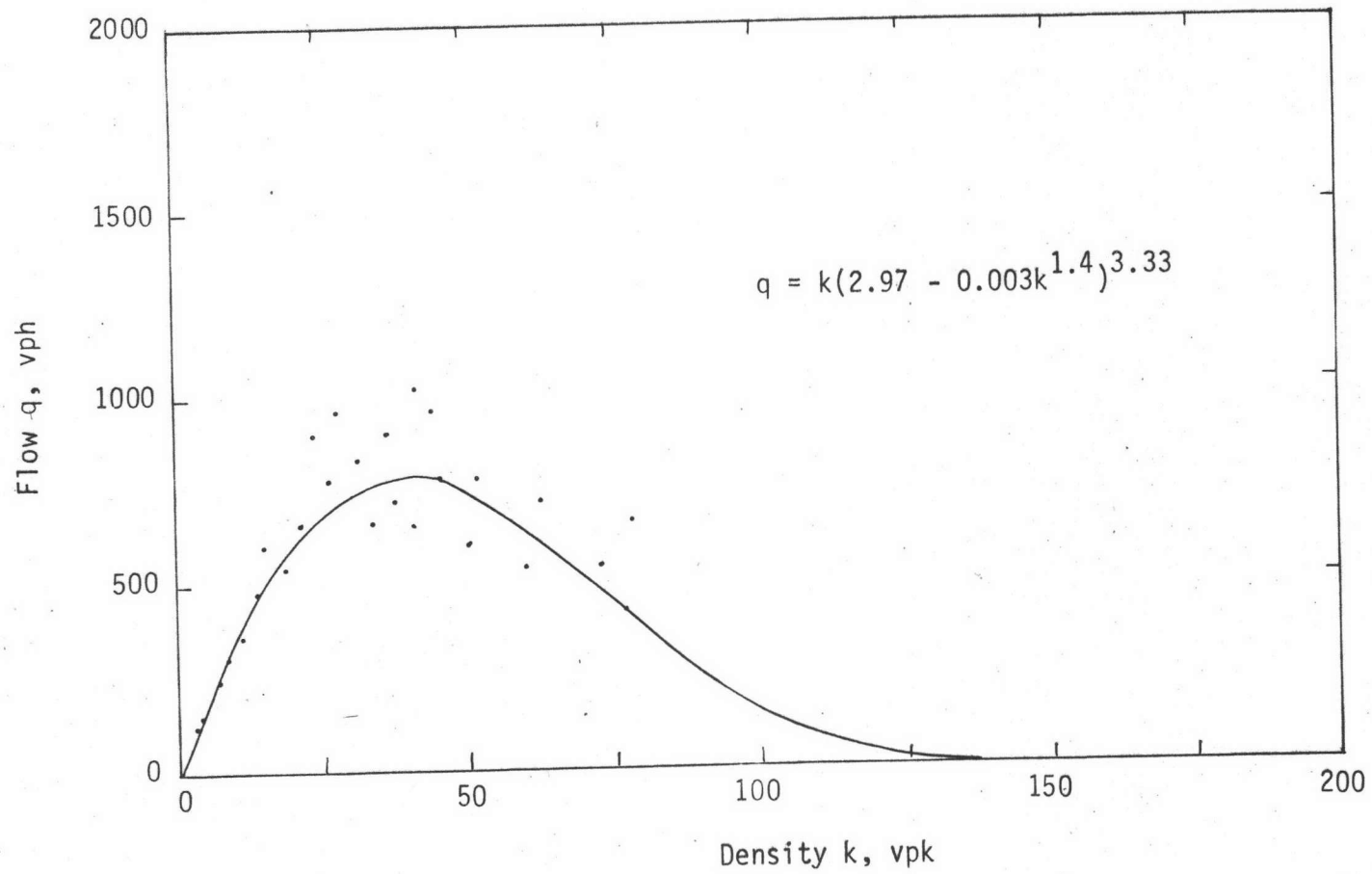


Fig.D-50 Flow-density model for Chula Soi 12

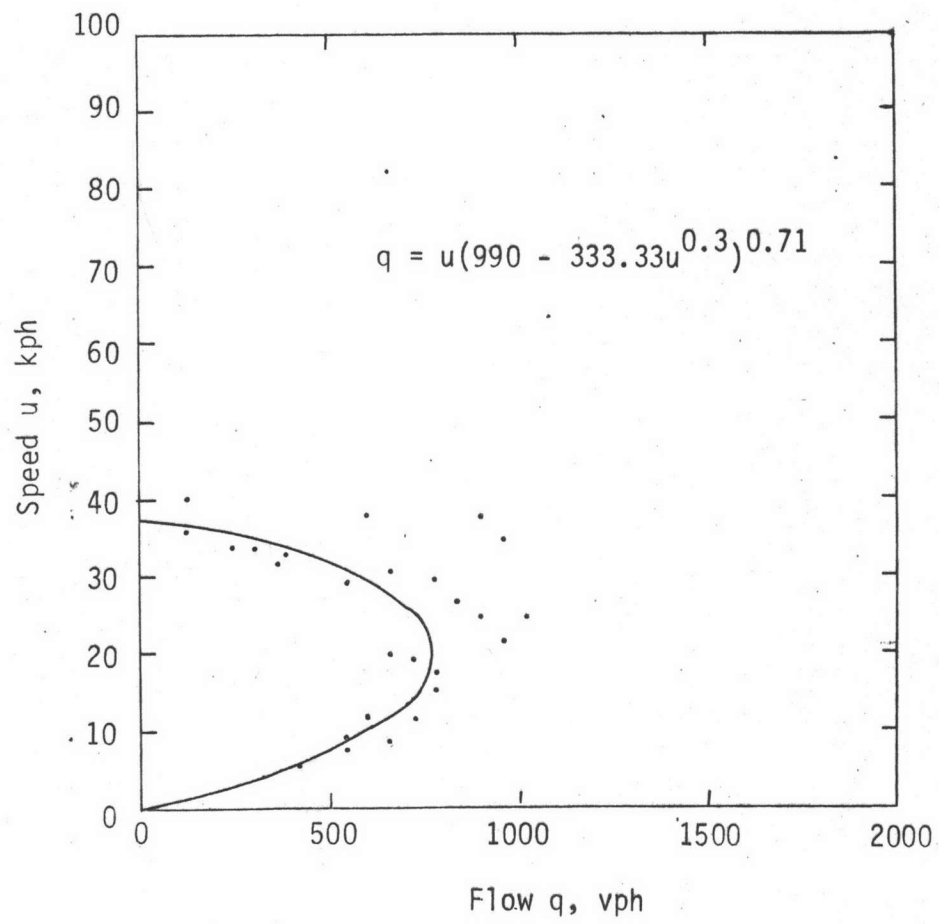
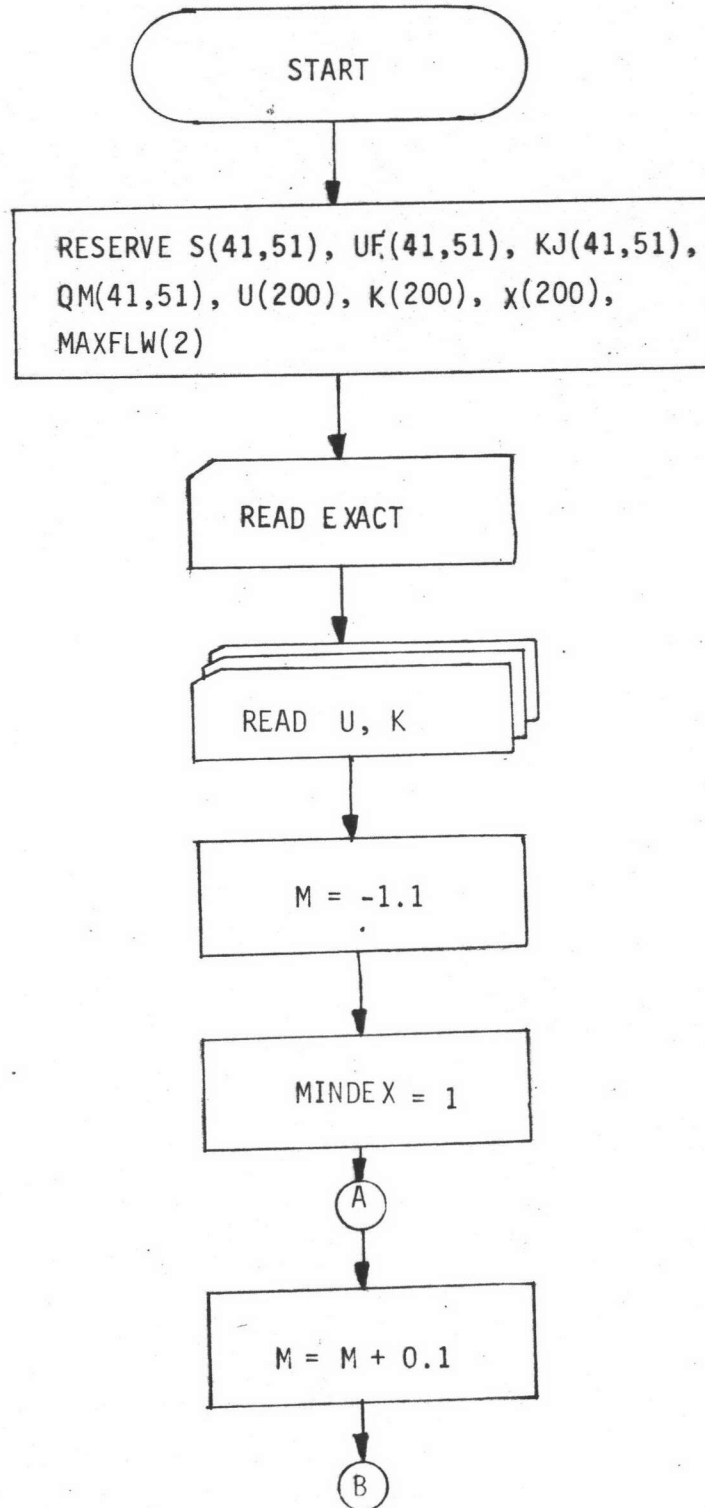
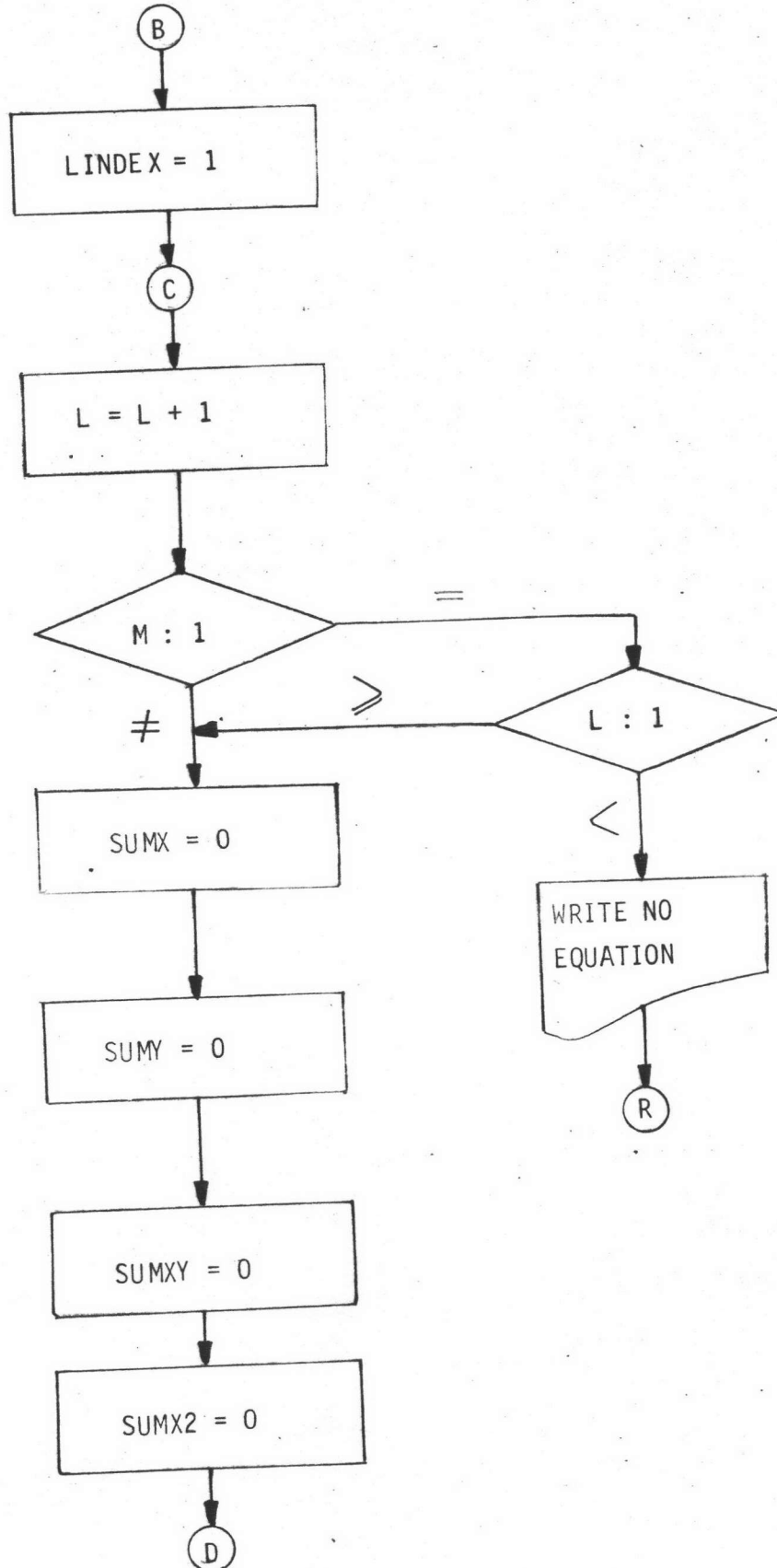


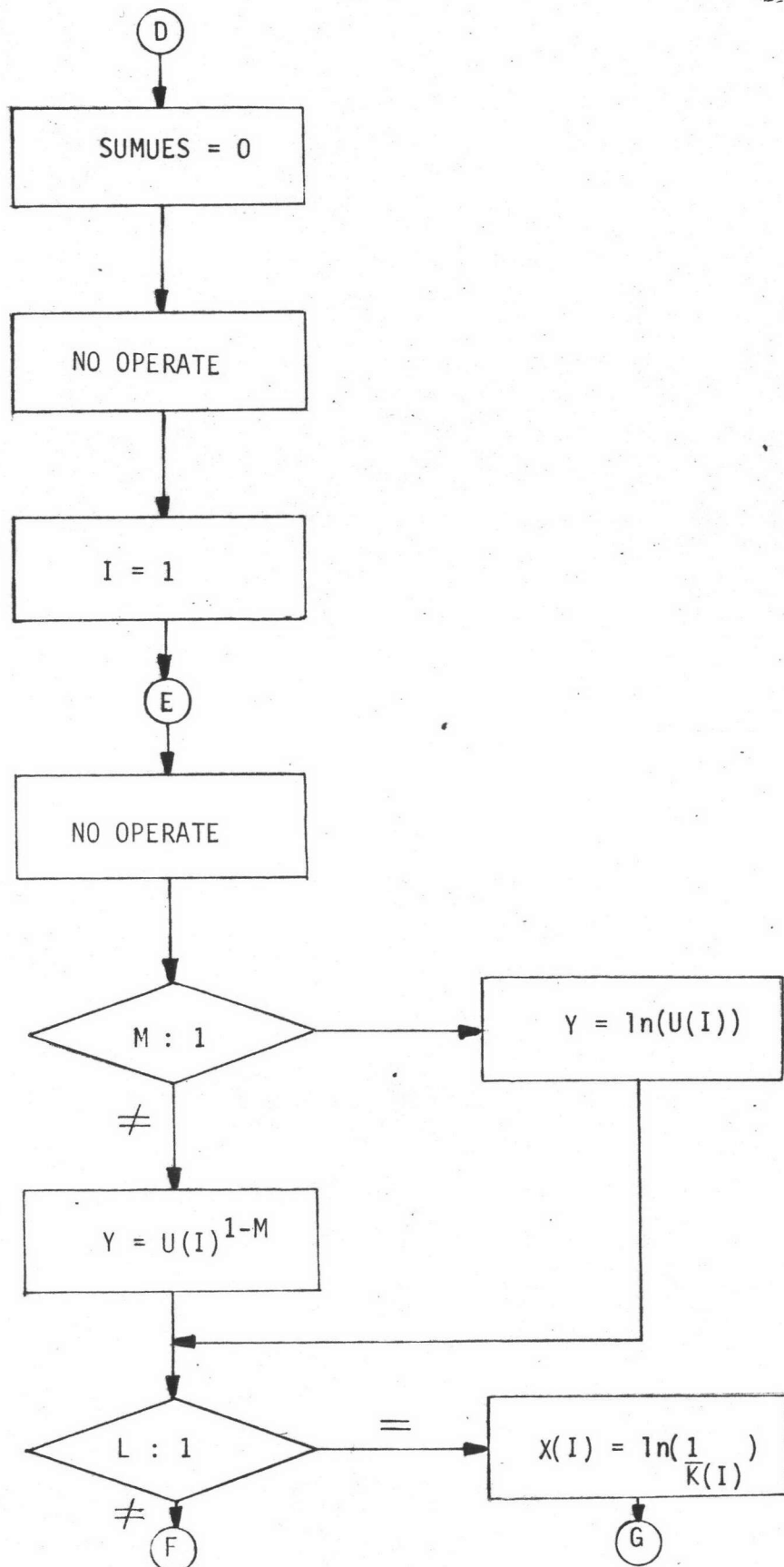
Fig. D-51 Speed-flow model for Chula Soi 12

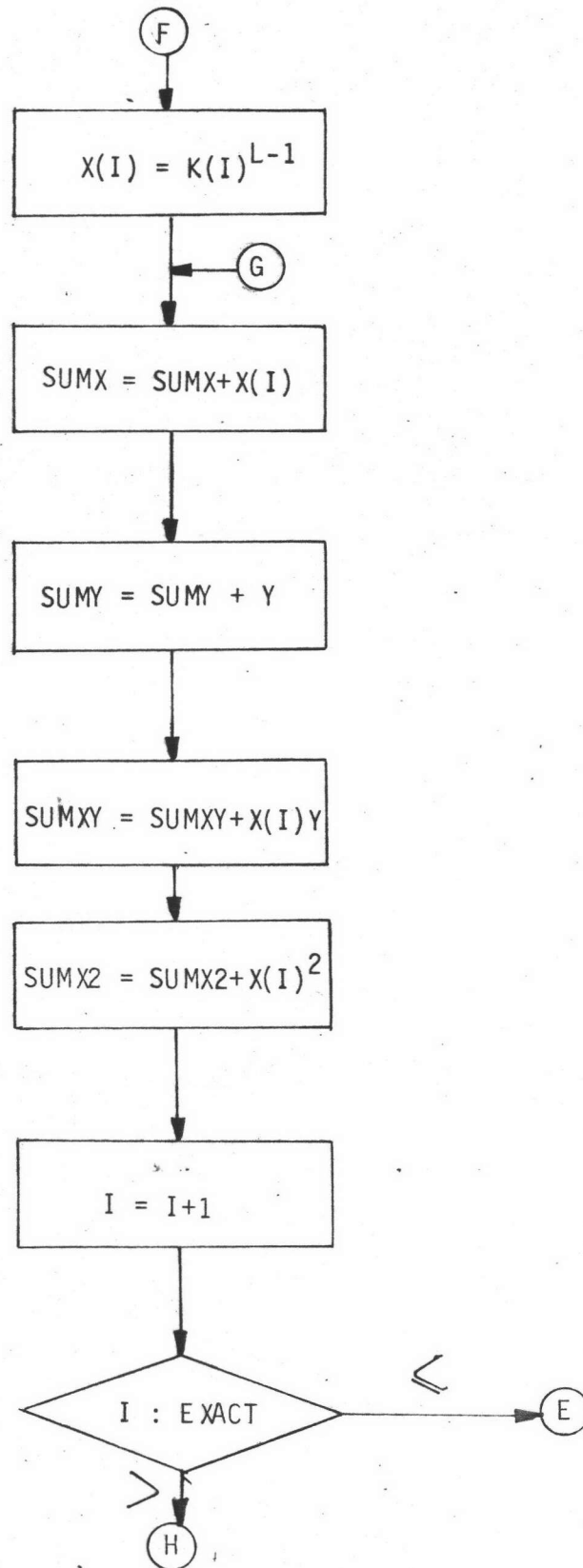
APPENDIX E

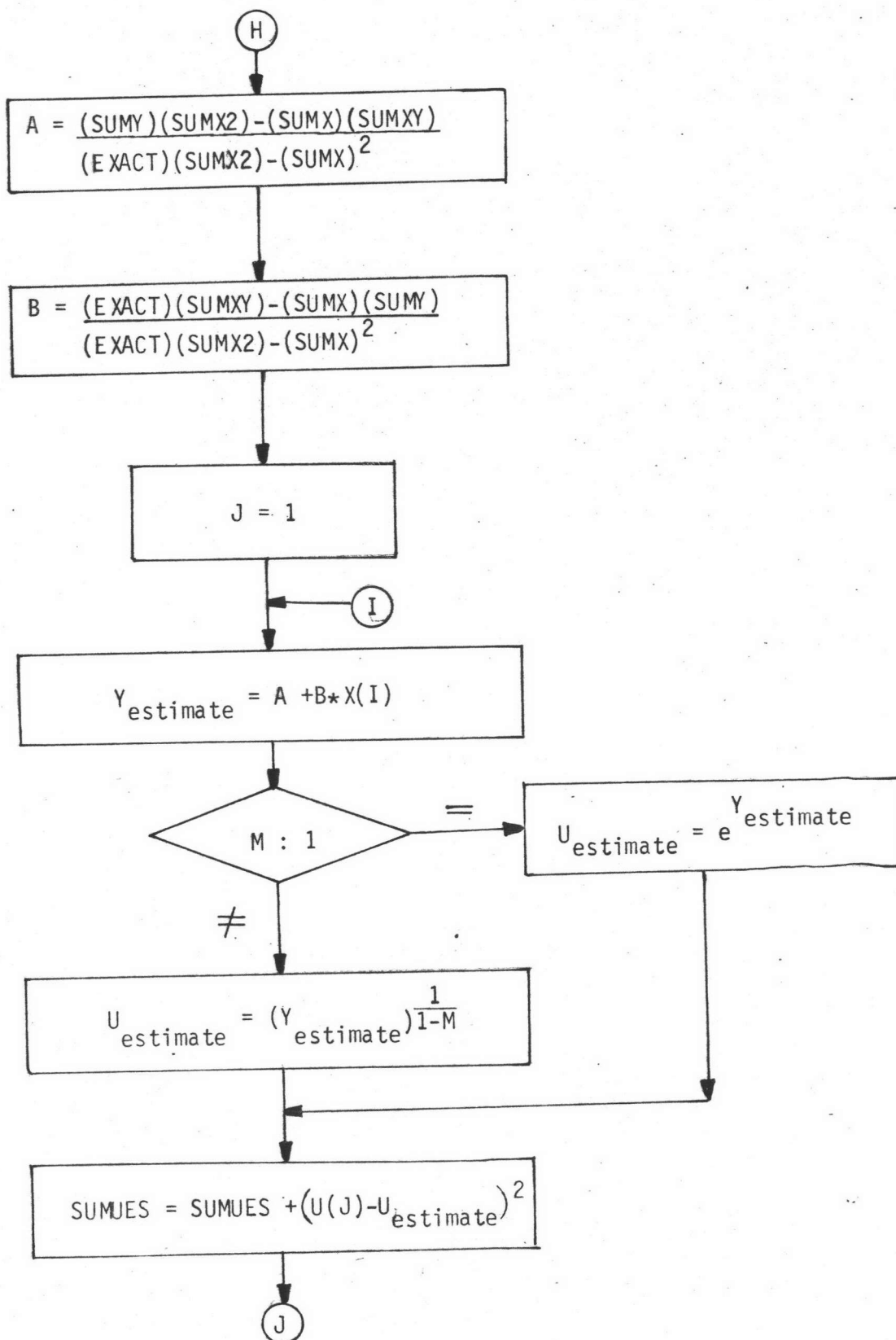
Flow Chart and Computer Program for Evaluation of Traffic Flow Models.

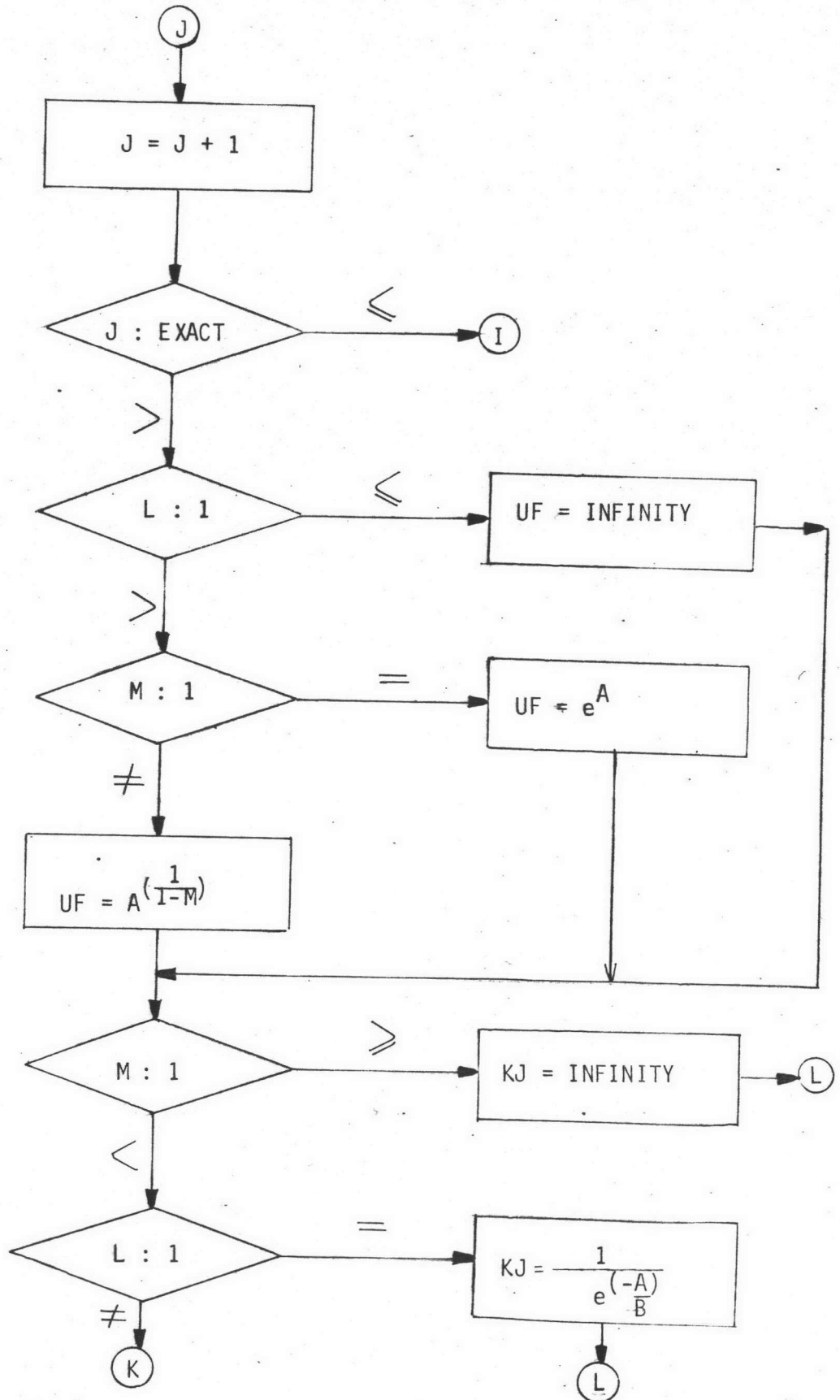


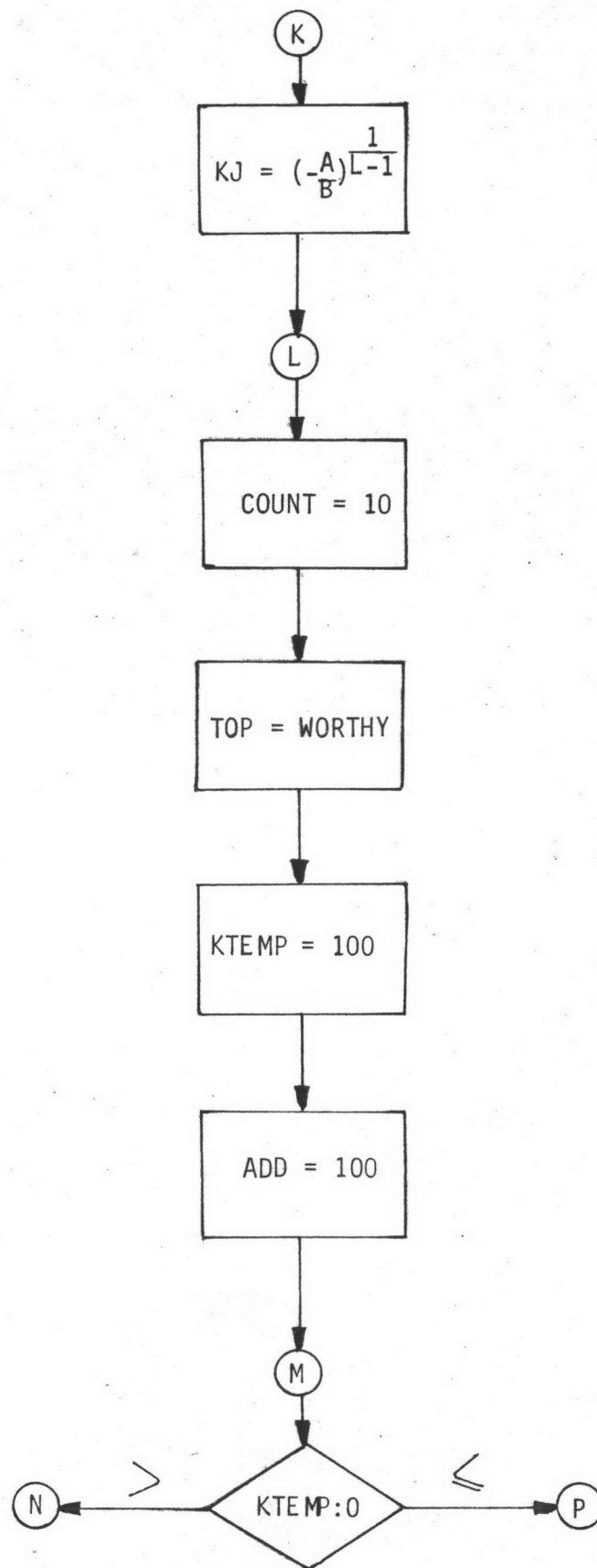


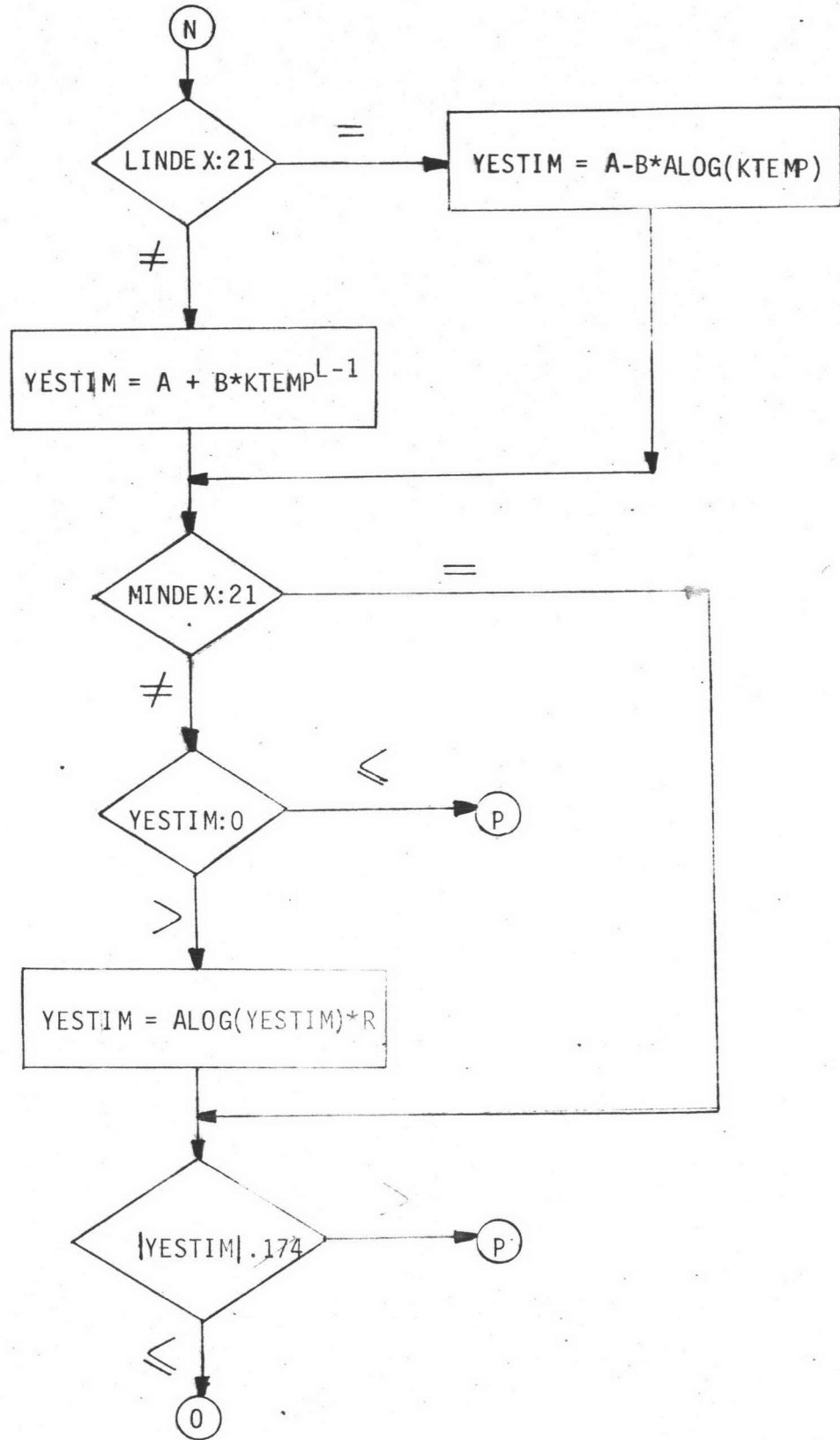


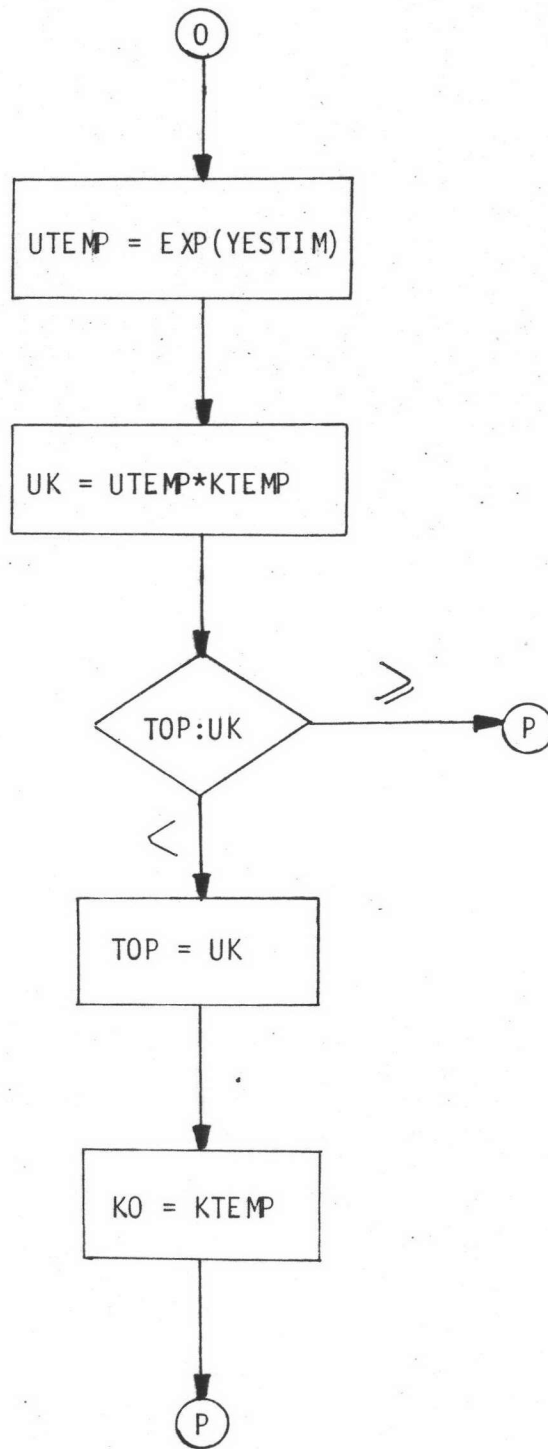


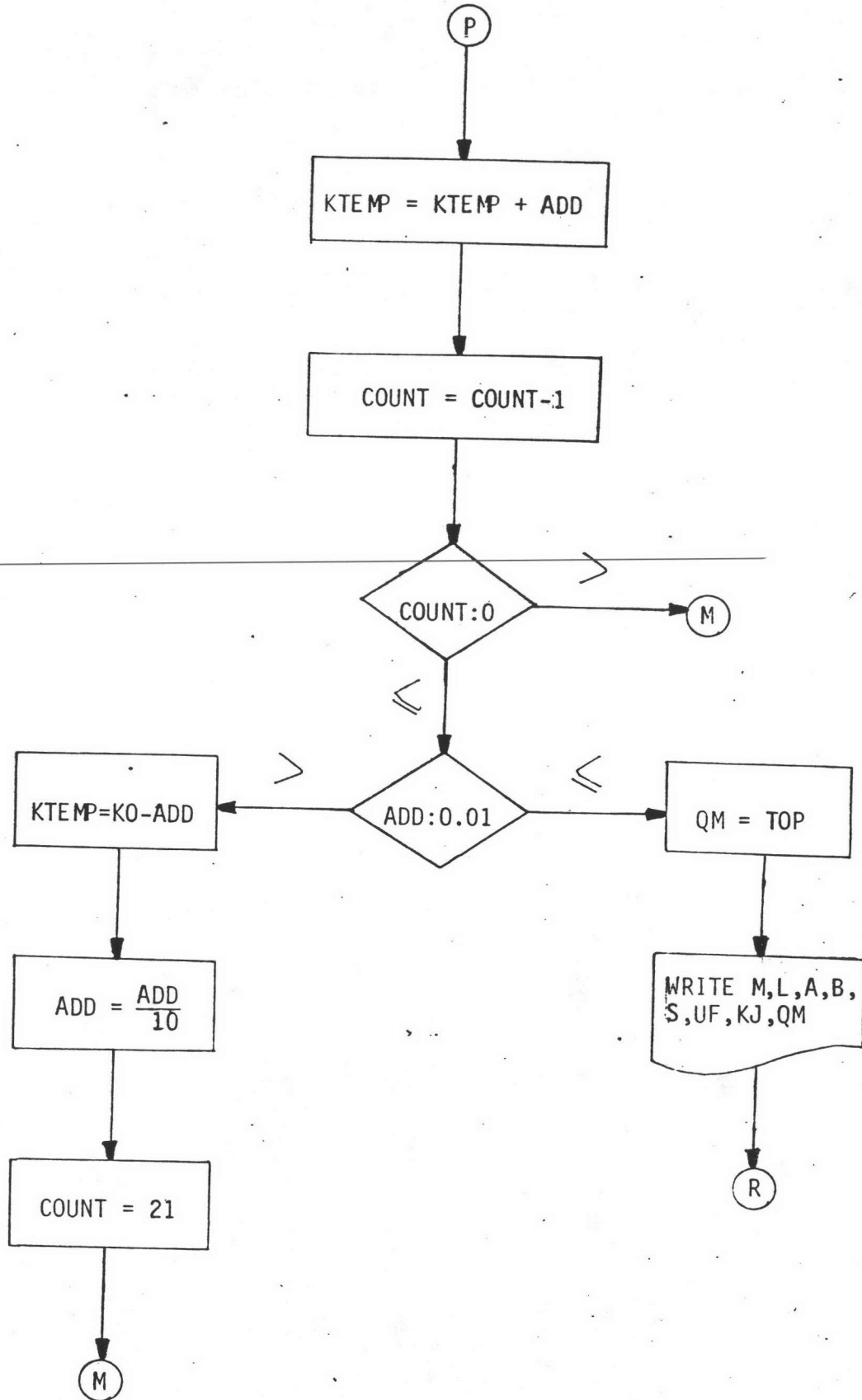


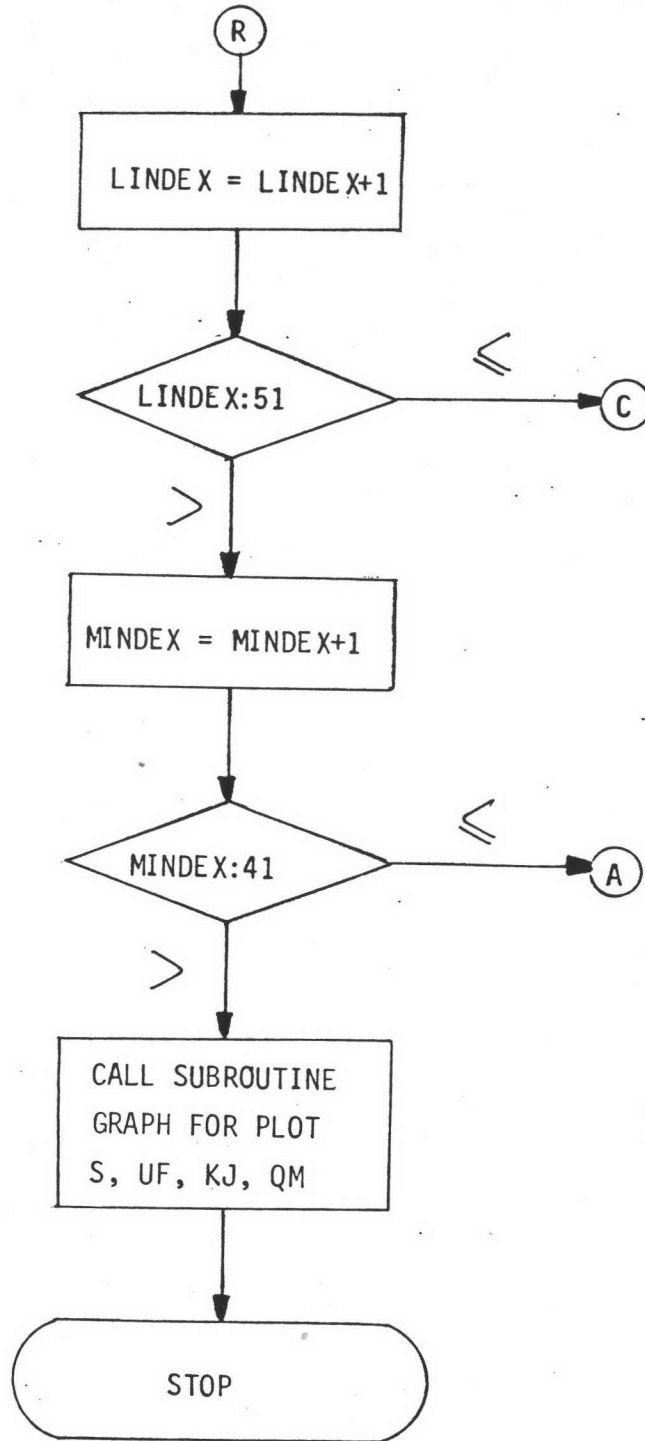


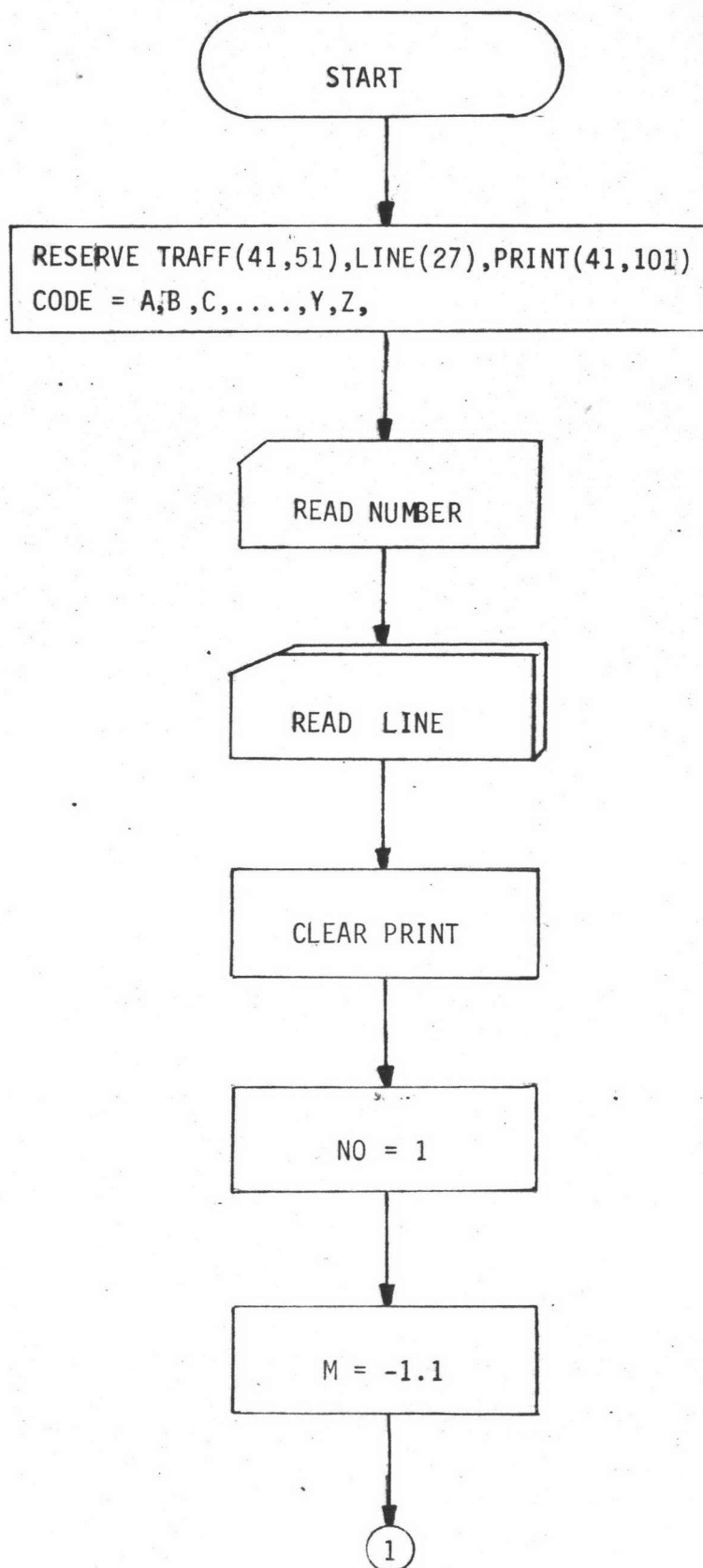


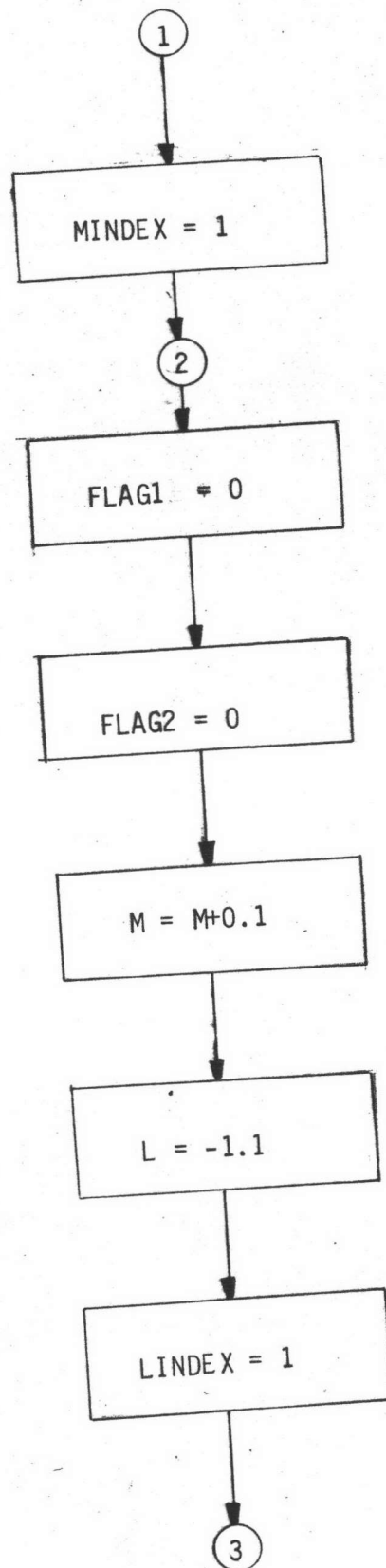


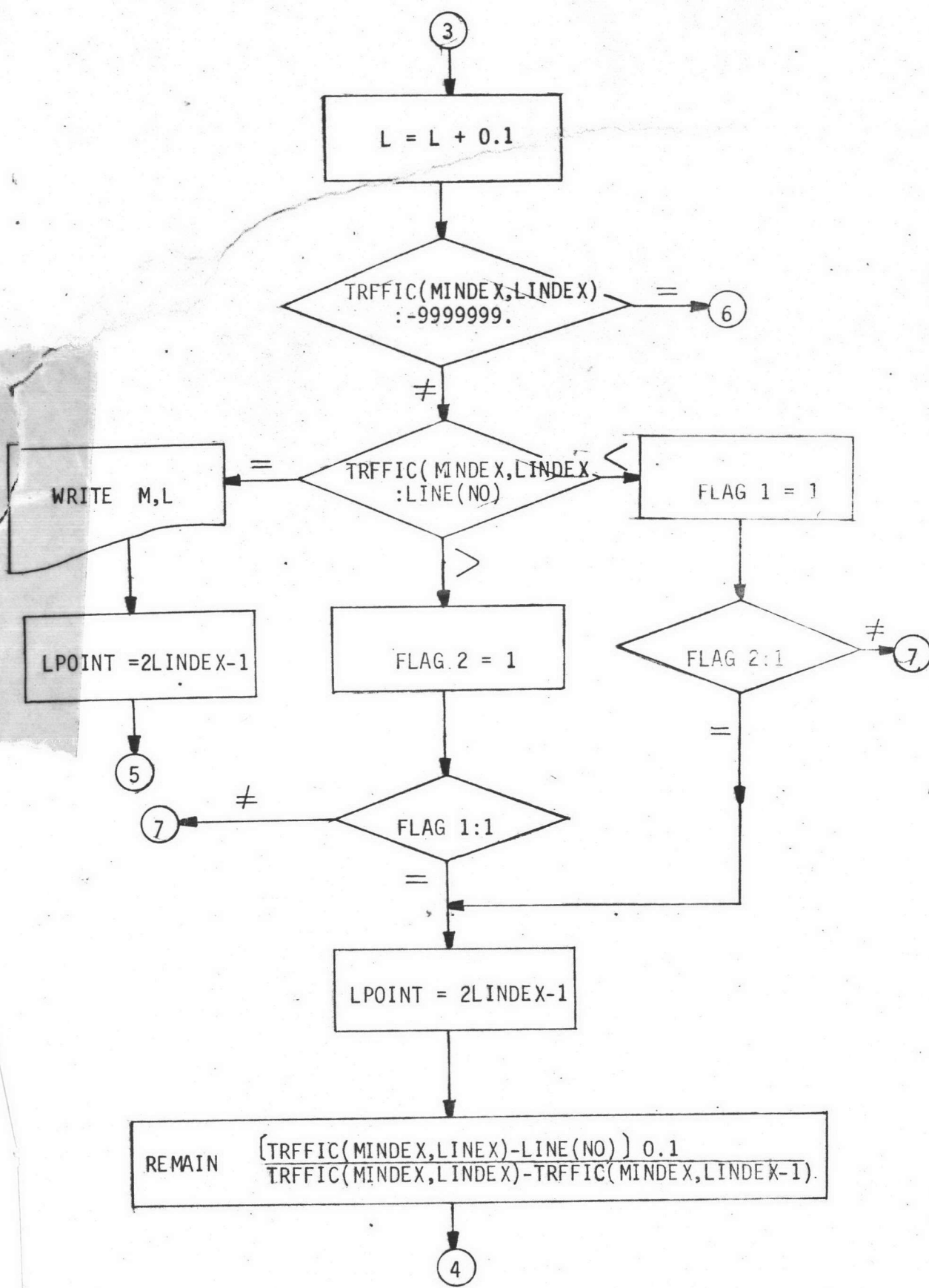


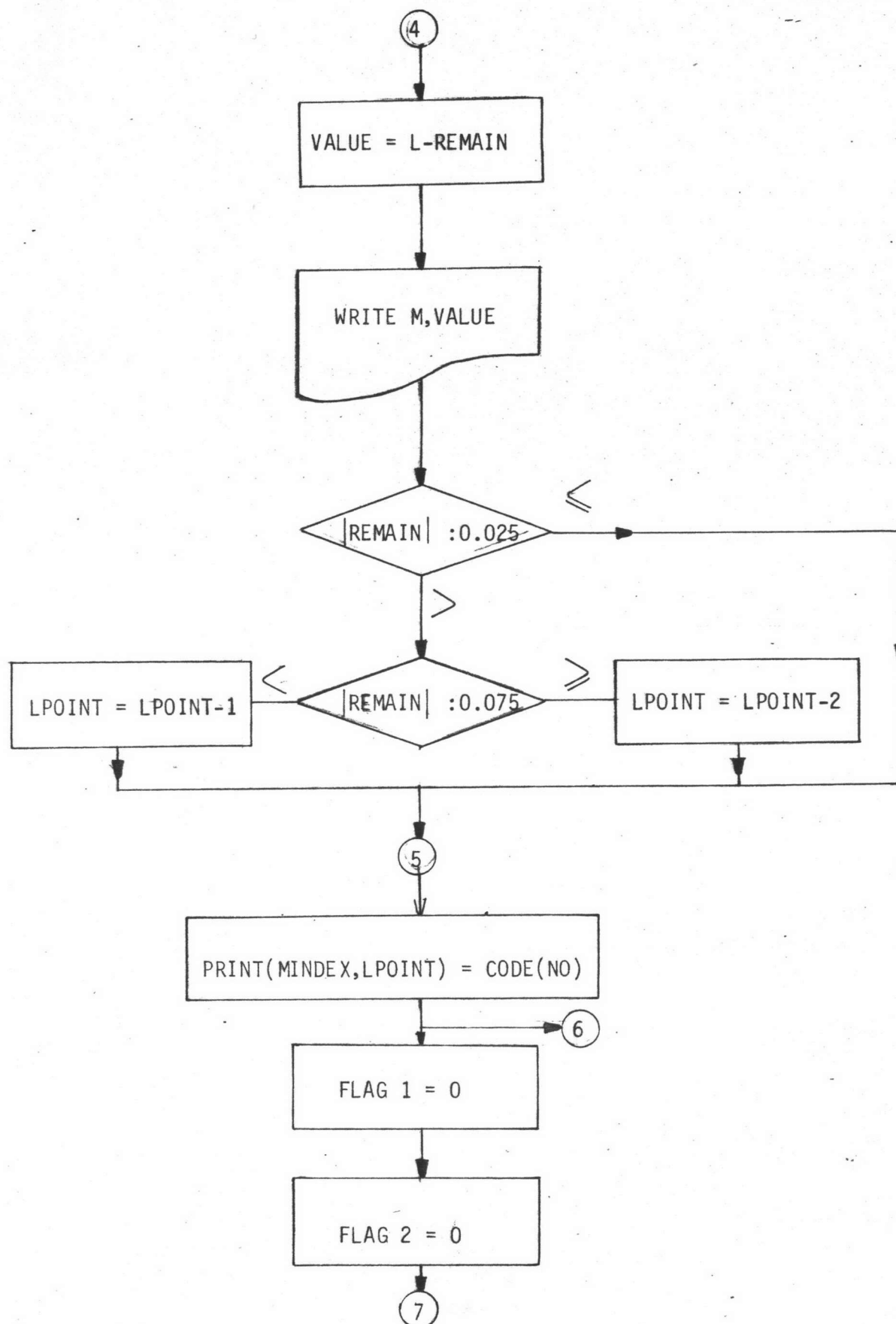


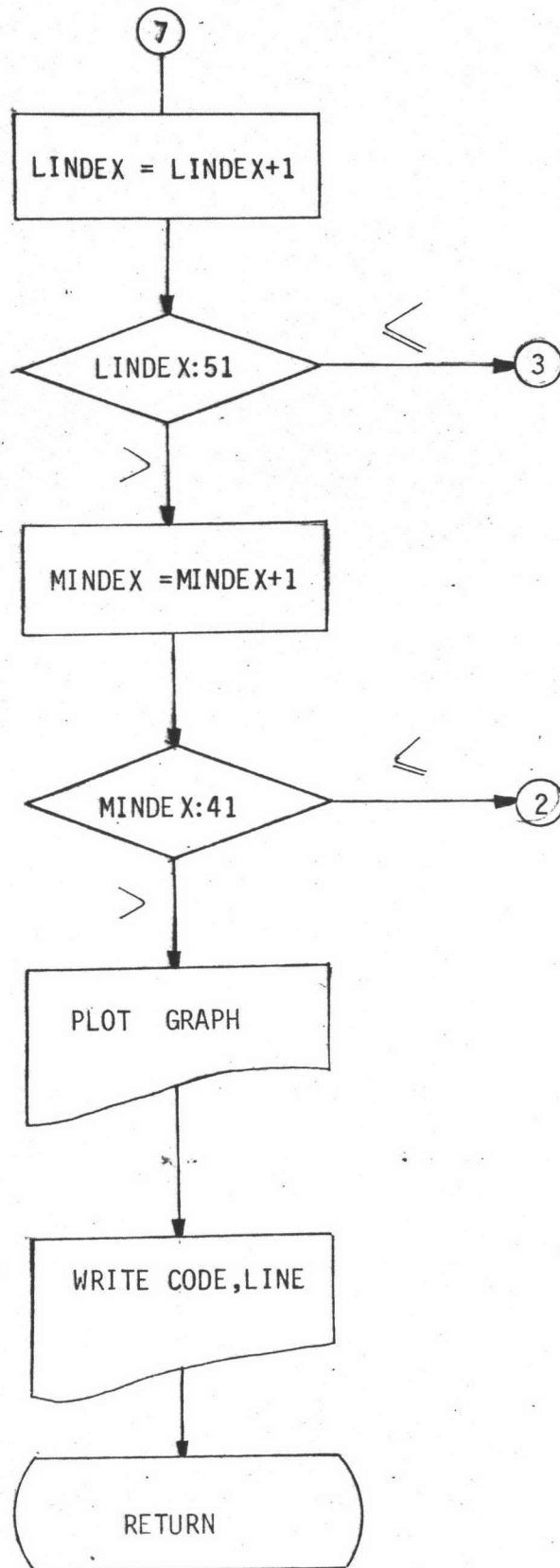












```

C-----
C
CB115046 MR. CHAISIT KURUKAT
C EVALUATION OF SINGLE & TWO-REGIME TRAFFIC FLOW MODEL
C 1. MEAN DIVIATION (SI)
C 2. FREE FLOW VELOCITY (U)
C 3. JAM DENSITY (KJ)
C 4. MAXIMUM FLOW (QM)
C DEFINED CONSTANTS & VARIABLES
C
0001 DIMENSION S(41,51) ,UF(41,51) ,QM(41,51) ,U(200) ,X(200)
0002 REAL KJ(41,51) ,K(200) ,M ,L ,KTEMP ,KO
0003 INTEGER APPROX ,LXACT
0004 WORTHY = -9999999.
0005 START = -1.1
0006 C100 = 100.
0007 C21 = 21.
0008 C10 = 10.
C IF VARIABLE-NAME = WORTHY MEANS THAT IT IS INFINITY
C
C-----
C FIRST READ DATA FROM CARD-FILE
C CARD-FILE
C 1. AMOUNT CARD COL 1-3 AMOUNT OF DATA(U OR K)
C IN MULTIPLE OF 13
C COL 4-6 EXACTLY AMOUNT OF U OR K
C 2. U-CARD EACH CARD CONTAIN 13 DATA
C ( 6 COLUMN / 1 DATA )
C 3. K-CARD LIKE U-CARD
C NOTE- U-DATA MUST EQUAL K-DATA AND NOT OVER 200
C
0009 READ(1,300) APPROX,EXACT
0010 READ(1,310) ( U(I),I=1,APPROX ),( K(I),I=1,APPROX )
0011 WRITE(3,420)
0012 WRITE(3,390)
0013 WRITE(3,400)( U(I),I=1,EXACT )
0014 WRITE(3,410)
0015 WRITE(3,400)( K(I),I=1,EXACT )
0016 M = START
0017 WRITE(3,380)
0018 DO 290 MINDEX = 1,41
0019 L = START
0020 M = M + 0.1
0021 DO 290 LINDEX = 1,51
0022 L = L + 0.1
C
C-----
C GENERAL FORM Y = A*B*X
C CONDITION OF EQUATION
C M # 1 Y = U**(1.-M)
C M = 1 Y = ALOG(U)
C L # 1 X = K**(L-1.)
C L = 1 X = ALOG(1./K)
C M = 1 L < 1 NO EQUATION
    
```



```

C=====
C   FIND CONSTANTS A & B
C   A   = (SUMY*SUMX2 - SUMX*SUMXY) / DIVIDE
C   B   = (AMOUNT*SUMXY - SUMX*SUMY) / DIVIDE
C   DIVIDE = AMOUNT*SUMX2 - SUMX*SUMX
C
0023   IF ( IINDEX.NE.21) .OR. (LINDEX.GE.21) ) GO TO 20
0024   10  S(MINDEX,LINDEX) = WORTHY
0025   UF(MINDEX,LINDEX) = WORTHY
0026   KJ(MINDEX,LINDEX) = WORTHY
0027   QM(MINDEX,LINDEX) = WORTHY
0028   WRITE(J,360)M,L
0029   GO TO 290
0030   20  SUMX = 0.
0031   SUMY = 0.
0032   SUMXY = 0.
0033   SUMX2 = 0.
0034   SUMUES = 0.
0035   30  CON1 = 1.-1.
0036   CONM = 1.-4
C
0037   AMOUNT = EXACT
0038   DO 40 LOOP1 = 1,EXACT
0039   Y = U(LOOP1)**CONM
0040   IF (MINDEX.EQ.21) Y = ALOG(U(LOOP1))
0041   X(LOOP1) = K(LOOP1)**CONL
0042   IF (LINDEX.EQ.21) X(LOOP1) = ALOG(1/K(LOOP1))
0043   SUMX = SUMX + X(LOOP1)
0044   SUMY = SUMY + Y
0045   SUMXY = SUMXY + X(LOOP1)*Y
0046   40  SUMX2 = SUMX2 + X(LOOP1)**2
0047   DIVIDE = AMOUNT*SUMX2 - SUMX*SUMX
0048   IF (DIVIDE.EQ.0.) GO TO 10
0049   A = ( SUMY*SUMX2 - SUMX*SUMXY ) / DIVIDE
0050   B = ( AMOUNT*SUMXY - SUMX*SUMY ) / DIVIDE
C=====
C   FIND MEAN DIVIATION
C   BY FIND SQUARE ROOT OF SIGMA (U-UESTIMATE)**2
C   EXPONENTIAL FUNCTION -174. < ARGUMENT < 174.
C
0051   R = 1./CONM
0052   DO 100 LOOP2 = 1,EXACT
0053   YESTIM = A + B*X(LOOP2)
0054   IF (MINDEX.NE.21) GO TO 60
0055   IF (YESTIM.GT.174.) GO TO 70
0056   IF (YESTIM.LT.-174.) GO TO 50
0057   UESTIM = EXP(YESTIM)
0058   GO TO 90
0059   50  DELTA = U(LOOP2)
0060   GO TO 100
0061   60  IF (YESTIM.GT.0.) GO TO 80
0062   70  AMOUNT = AMOUNT - 1.
0063   DELTA = C.

```

```

0064      GO TO 100
0065      80  BUFFER = ALOG(IYESTIM)*R
0066      IF (BUFFER.GT.174.)      GO TO 70
0067      IF (BUFFER.LT.-174.)     GC TC 50
0068      UESTIM = EXP(BUFFER)
0069      90  DELTA = U(LDOP2) - UESTIM
0070      100 SUMMES = SUMMES + DELTA**2
0071      S(MINDEX,LINDEX) = SQRT(SUMMES/AMOUNT)

```

C

C=====

C FIND FREE FLOW VELOCITY BY SETTING K = 0

C EQUATION EXIST WHEN L > 1

C

```

0072      IF (LINDEX.GT.21)      GO TO 120
0073      110 U(MINDEX,LINDEX) = WORTHY
0074      GO TO 150
0075      120 IF (MINDEX.NE.21)  GO TC 140
0076      IF (A.GT.174.)        GO TO 110
0077      IF (A.GT.-174.)       GO TO 130
0078      125 U(MINDEX,LINDEX) = 0.
0079      GO TO 150
0080      130 U(MINDEX,LINDEX) = EXP(A)
0081      GO TO 150
0082      140 IF (A.LE.0.)      GO TO 110
0083      BUFFER = ALOG(A)*R
0084      IF (BUFFER.GT.174.)   GC TO 110
0085      IF (BUFFER.LT.-174.) GC TO 125
0086      U(MINDEX,LINDEX) = EXP(BUFFER)

```

C

C=====

C FIND JAM DENSITY BY SETTING U = 0

C EQUATION EXIST WHEN B ≠ 0 AND M < 1

C

```

0087      150 IF ( (B.NE.0.) .AND. (MINDEX.LT.21) ) GO TO 165
0088      160 KJ(MINDEX,LINDEX) = WORTHY
0089      GO TO 190
0090      165 BUFFER = (-A)/B
0091      IF (LINDEX.NE.21)      GO TO 180
0092      IF (BUFFER.GT.174.)    GO TO 170
0093      IF (BUFFER.LT.-174.)  GO TO 160
0094      KJ(MINDEX,LINDEX) = 1./EXP(BUFFER)
0095      GO TO 190
0096      170 KJ(MINDEX,LINDEX) = 0.
0097      GO TO 190
0098      180 R1 = 1./CONL
0099      IF (BUFFER.LE.0.)      GO TO 160
0100      BUFFER = ALGG(BUFFER)*R1
0101      IF (BUFFER.GT.174.)    GO TO 160
0102      IF (BUFFER.LT.-174.)  GO TO 170
0103      KJ(MINDEX,LINDEX) = EXP(BUFFER)

```

C

C=====

C FIND MAXIMUM FLOW (MAXIMUM OF U*W)

C 1. FIND K1 FROM 0 TO 100 INCREMENT BY 100 --> MAX U*K


```

C      2. FIND K2 FROM K1-100 TO K1+100 INCREMENT BY 10 --> MAX U*K
C      3. FIND K3 FROM K2-10 TO K2+10 INCREMENT BY 1 --> MAX U*K
C      4. FIND K... UNTIL INCREMENT EQUAL 0.01 THAT IS THE POINT QMAX
0104      190  COUNT = C10
0105      TOP  = WORTHY
0106      KTEMP = C100
0107      ADD  = C100
0108      200  IF (KTEMP.LE.0.) GO TO 240
0109      IF (LINDEX.EQ.21) GO TO 210
0110      YESTIM = A + B*KTEMP**CONL
0111      GO TO 220
0112      210  YESTIM = A - 3*ALOG(KTEMP)
0113      220  IF (MINDEX.EQ.21) GO TO 230
0114      IF (YESTIM.LE.0.) GO TO 240
0115      YESTIM = ALOG(YESTIM)*R
0116      230  IF (ABS(YESTIM).GT.174.) GO TO 240
0117      UTEMP = EXP(YESTIM)
0118      UK    = UTEMP*KTEMP
0119      IF (TOP.GE.UK) GO TO 240
0120      TOP  = UK
0121      K0   = KTEMP
0122      240  KTEMP = KTEMP + ADD
0123      COUNT = COUNT - 1.
0124      IF (COUNT.GT.0.) GO TO 230
0125      IF (ADD.LE.0.01) GO TO 250
0126      KTEMP = K0 - ADD
0127      ADD   = ADD / C10
0128      COUNT = C21
0129      GO TO 200
0130      250  QM(MINDEX,LINDEX) = TOP
0131      WRITE(3,370)M,L,A,B,S(MINDEX,LINDEX),UF(MINDEX,LINDEX),
      *LINDEX,QM(MINDEX,LINDEX)
0132      290  CONTINUE
0133      WRITE(3,320)
0134      CALL GRAPHIS)
0135      WRITE(3,330)
0136      CALL GRAPH(UF)
0137      WRITE(3,340)
0138      CALL GRAPH(KJ)
0139      WRITE(3,350)
0140      CALL GRAPH(QM)
C
C=====
C      FORMAT AREAS
0141      300  FORMAT(2I3)
0142      310  FORMAT(13F6.2)
0143      320  FORMAT(1H1,52X,'ISOLINES FOR MEAN DEVIATION'///)
0144      330  FORMAT(1H1,50X,'ISOLINES FOR FREE FLOW VELOCITY'///)
0145      340  FORMAT(1H1,52X,'ISOLINES FOR JAM DENSITY'///)
0146      350  FORMAT(1H1,52X,'ISOLINES FOR MAXIMUM FLOW'///)
0147      360  FORMAT(1H ,2(F5.1,5X),T50,'NO EQUATION')
0148      370  FORMAT(1H ,2(F5.1,5X),6(F13.4,5X))
0149      380  FORMAT(1H1,15,'M',T15,'L',T29,'A',T47,'B',T45,'S',T82,'UF',T100,'K
      *J',T110,'QM')

```

```
0150      390  FORMAT(//T10,'U-DATA')
0151      400  FORMAT(1H ,13(F8.2,2X))
0152      410  FORMAT(//T10,'K-DATA')
0153      420  FORMAT(1H1,/'EVALUATION OF SINGLE & TWO-REGIME TRAFFIC FLOW MODEL
              *//)
0154          STOP
0155          END
```

```

C
C*****
C SUBROUTINE FOR PLOT ISOLINLS
C PARAMETER FROM MAIN PROGRAM IS TRAFFIC-VALUE ( S,UF,KJ,QM )
0001 C SUBROUTINE GRAPH(TRAFFIC)
C DEFINED CONSTANTS & VARIABLES
C
0002 C DIMENSION COMP(27)
0003 C DIMENSION PRINT(41,101) ,CODE(27) ,TRFFIC(41,51)
0004 C REAL M ,L ,LINE(27)
0005 C INTEGER FLAG1 ,FLAG2
0006 C EQUIVALENCE (NUM1,NUMBER), (LINE,COMP)
0007 C NAMELIST /NAME/NUM1,COMP
0008 C DATA CODE/'A','B','C','D','E','F','G','H','I','J','K','L','M',
C *,'N','O','P','Q','R','S','T','U','V','W','X','Y','Z',' '/
0009 C WORTHY = -999999.
0010 C START = -1.1
C
C READ NUMBER OF LINES & VALUES OF EACH LINES TO PLOT GRAPH
C AND CLEAR PRINT
0011 C READ(1,NAME)
0012 C DO 10 MINDEX = 1,41
0013 C DO 10 LINDEX = 1,101
0014 C PRINT(MINDEX,LINDEX) = CODE(27)
C
C-----
C FIND RANGE OF M & L THAT HAS VALUS OF LINE(NO)
C WHEN FLAG1 = 1 AND FLAG2 = 1 MEAN THAT LINE(NO) IS IN RANGE
C
0015 C DO 50 NO= 1,NUMBER
0016 C WRITE(3,8)LINE(NO)
0017 C M = START
0018 C DO 50 MINDEX = 1,41
0019 C FLAG1 = 0
0020 C FLAG2 = 0
0021 C M = M + 0.1
0022 C L = START
0023 C DO 50 LINDEX = 1,51
0024 C L = L + 0.1
0025 C IF (TRFFIC(MINDEX,LINDEX).EQ.WORTHY) 60 TO 40
0026 C IF (TRFFIC(MINDEX,LINDEX).EQ.LINE(NO)) 60 TO 20
0027 C IF (TRFFIC(MINDEX,LINDEX).LT.LINE(NO)) FLAG1 = 1
0028 C IF (TRFFIC(MINDEX,LINDEX).GT.LINE(NO)) FLAG2 = 1
0029 C IF ( (FLAG1.NE.1) .OR. (FLAG2.NE.1) ) 60 TO 50
C
C INTERPOLATE TO FIND EXACTLY VALUE OF M & L
C
0030 C LPOINT = 2*LINDEX - 1
0031 C BUFFER = TRFFIC(MINDEX,LINDEX)
0032 C REMAIN = (BUFFER-LINE(NO))*0.1C/(BUFFER-TRFFIC(MINDEX,LINDEX-1))
0033 C VALUE = L - REMAIN
0034 C IF (ABS(REMAIN).GE.0.025) LPOINT = LPOINT - 1
0035 C IF (ABS(REMAIN).GT.0.075) LPOINT = LPOINT - 1
0036 C WRITE(3,90)M,VALUE

```

```
0037      GO TO 30
0038      20  WRITE(3,9C)M,L
0039          LPOINT = 2*LINDEX - 1
0040      30  PRINT(MINDEX,LPOINT) = CODE(NO)
0041      40  FLAG1 = 0
0042          FLAG2 = 0
0043      50  CONTINUE
          C  WRITE HEAD
0044          WRITE(3,100)
0045          WRITE(3,110)
0046          L = -1.05
0047      DO 60 LPOINT = 1,101
0048          L = L + 0.05
0049      60  WRITE(3,120)L,(PRINT(MPOINT,LPOINT),MPOINT = 1,41)
0050      DO 70 NO= 1,NUMBER
0051      70  WRITE(3,130)CODE(NO),LINE(NO)
          C  FORMAT AREAS
0052      80  FORMAT(1H ,F9.2,T13,'M',I23,'L')
0053      90  FORMAT(1H ,I1),F6.2,I20,F6.2)
0054      100  FORMAT(1H1,T6,'M',T9,'-1',T24,'-.5',T40,'0',T54,'0.5',T70,'1',T84,
          *'1.5',T100,'2',T114,'2.5',T130,'3')
0055      110  FORMAT(1H ,T6,'L',I10,41('I '))
0056      120  FORMAT(1H ,F6.2,I10,41(A2))
0057      130  FORMAT(1H ,I20,A1,' = ',F10.2)
0058      RETURN
0059      END
```

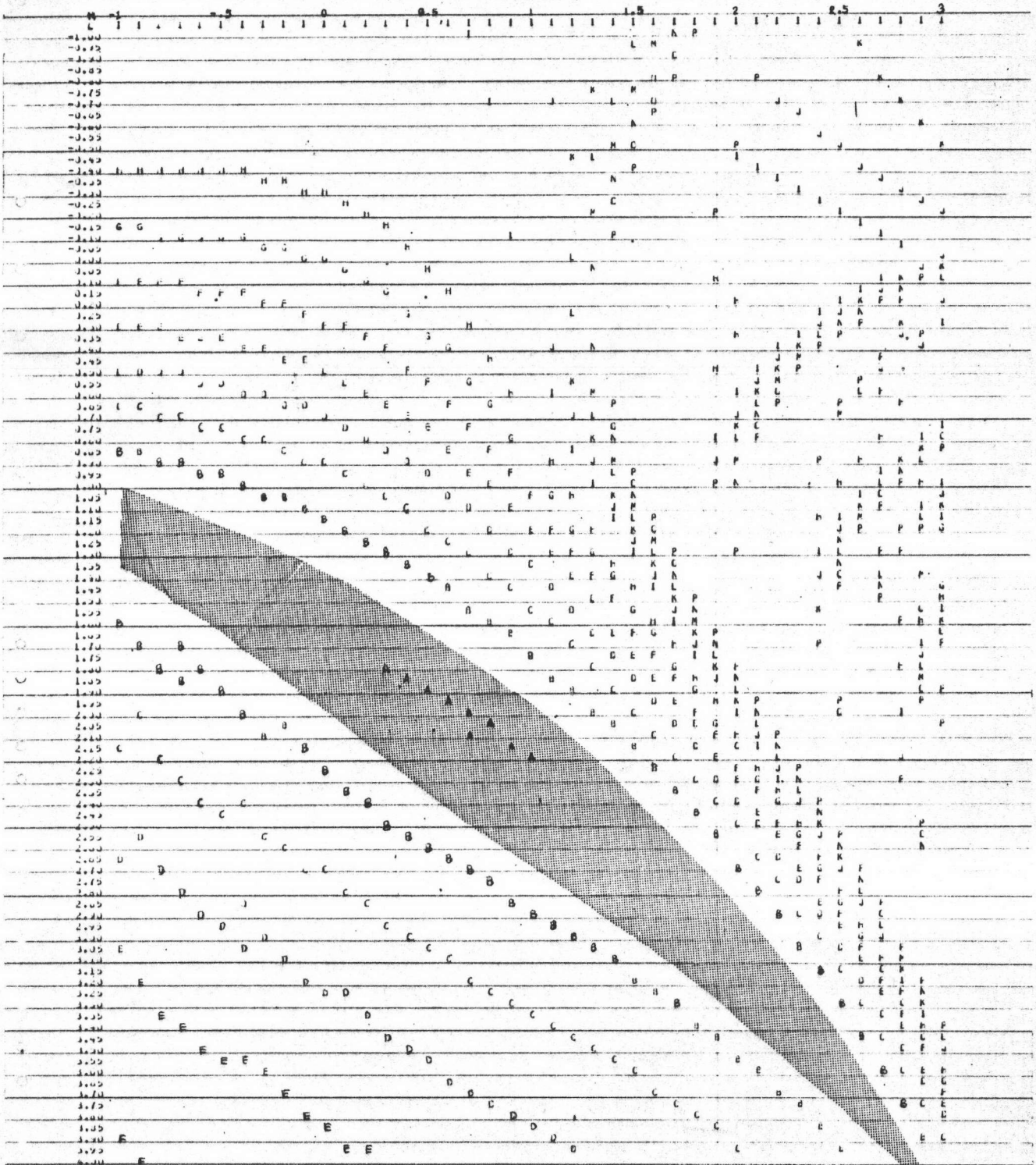
APPENDIX F

SAMPLE OF RESULTS OF ANALYTICAL PROCEDURE

Table F-1 Input data, u and k, selected sample of observations, for Sukhumvit Road.

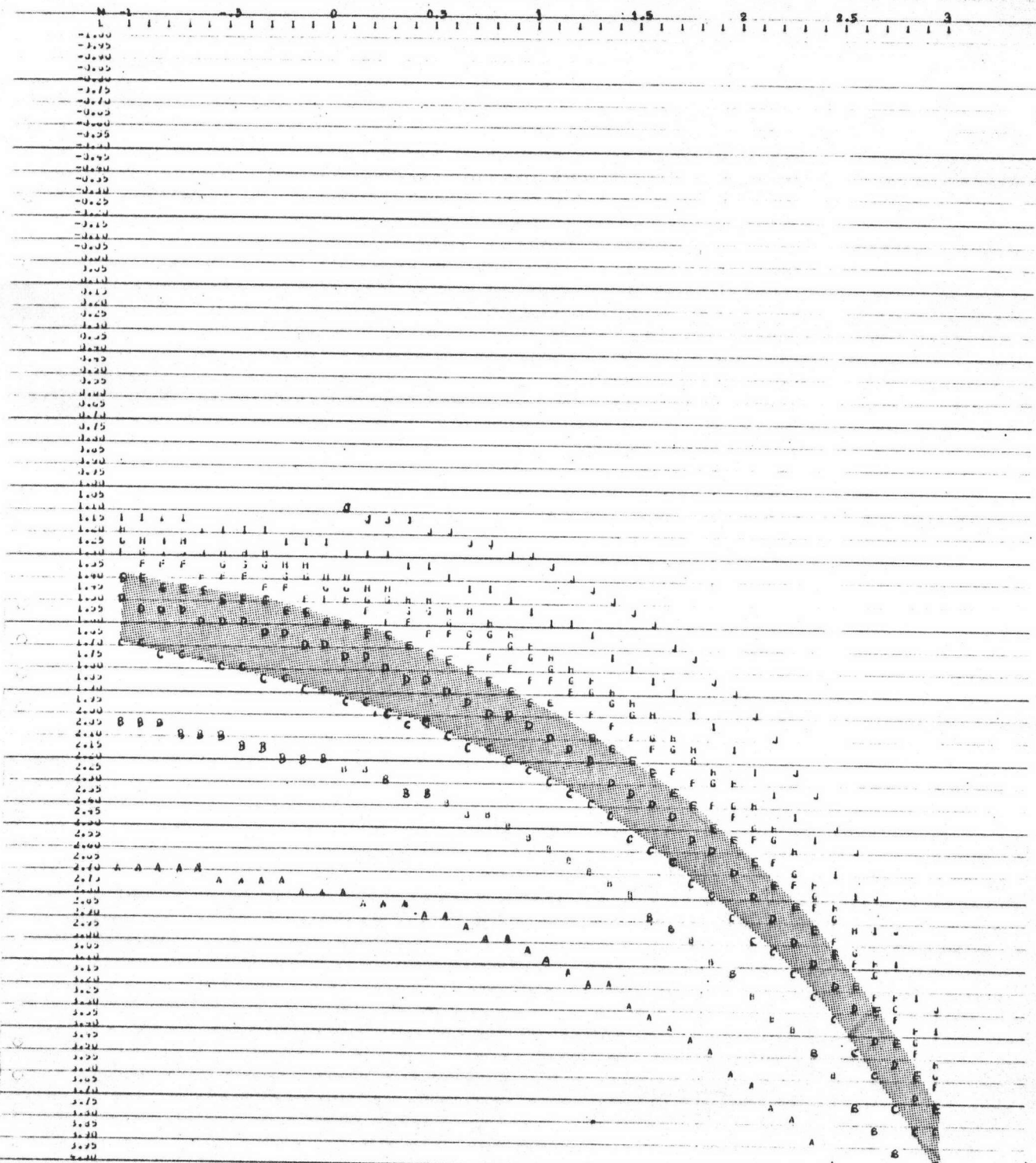
u	k	u	k
51.9	8.1	30.6	86.4
56.0	15.0	25.5	94.2
55.6	16.2	33.7	96.1
45.8	23.6	23.6	101.7
46.2	27.3	29.4	108.1
51.2	34.0	23.6	119.3
42.3	36.9	25.0	120.0
44.0	42.3	21.5	123.1
38.0	47.4	17.0	148.5
43.6	52.3	12.2	172.3
32.0	58.1	16.8	175.1
41.0	61.5	22.2	130.0
35.1	68.4	10.0	206.5
38.5	71.7	12.6	188.5
35.4	76.2	16.0	165.1
37.7	81.1	17.6	155.5
20.0	142.5		

FIG. E-1 ISOLINES FOR MEAN DEVIATION, SUKUMMIT ROAD



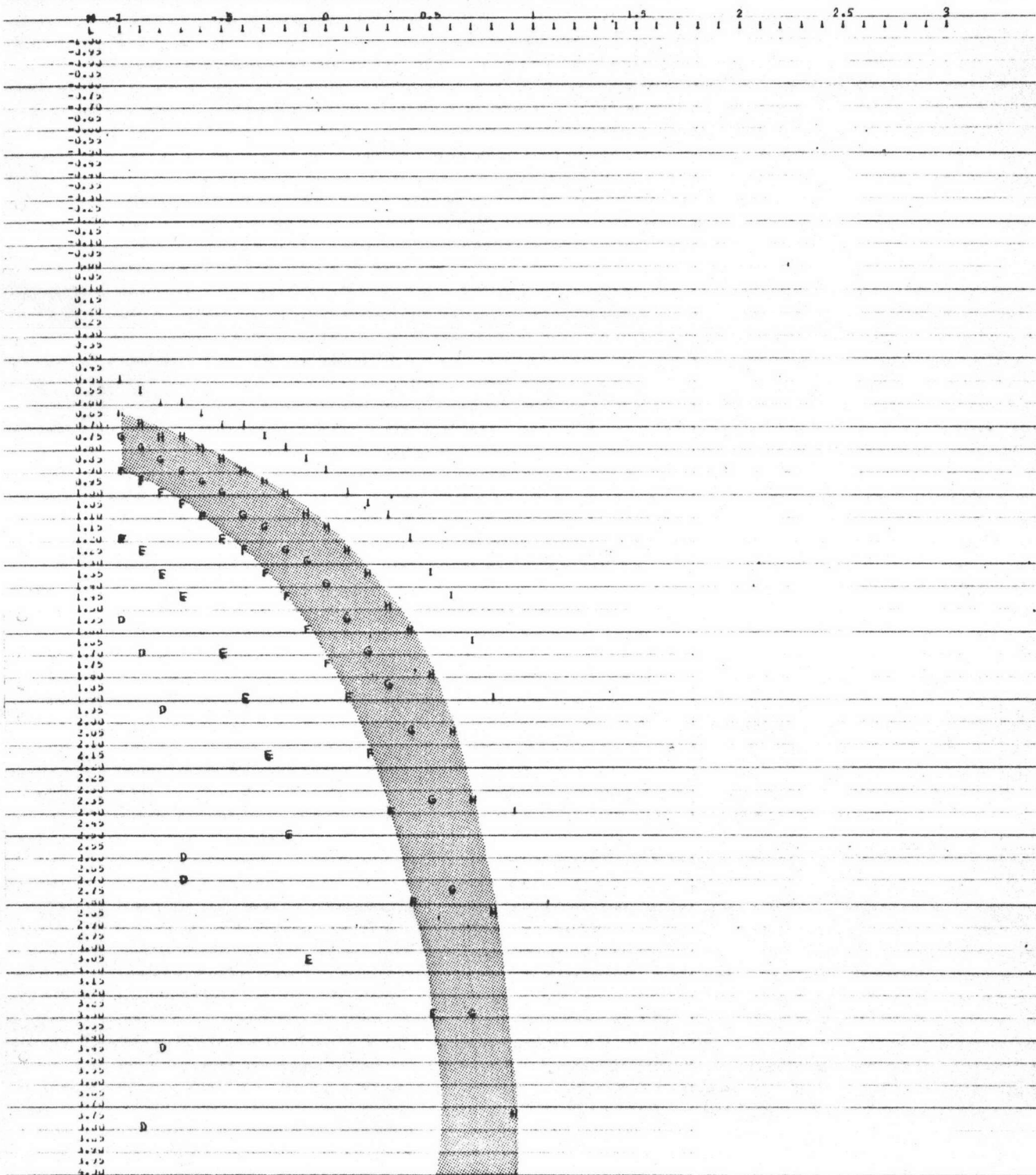
A	=	3.00
B	=	3.33
C	=	3.67
D	=	4.00
E	=	4.33
F	=	4.67
G	=	5.00
H	=	5.33
I	=	5.67
J	=	6.00
K	=	6.33
L	=	6.67
M	=	7.00
N	=	7.33
P	=	7.67

FIG E-2 ISOLINES FOR FREE FLOW VELOCITY, SUKHLUMMIT ROAD.



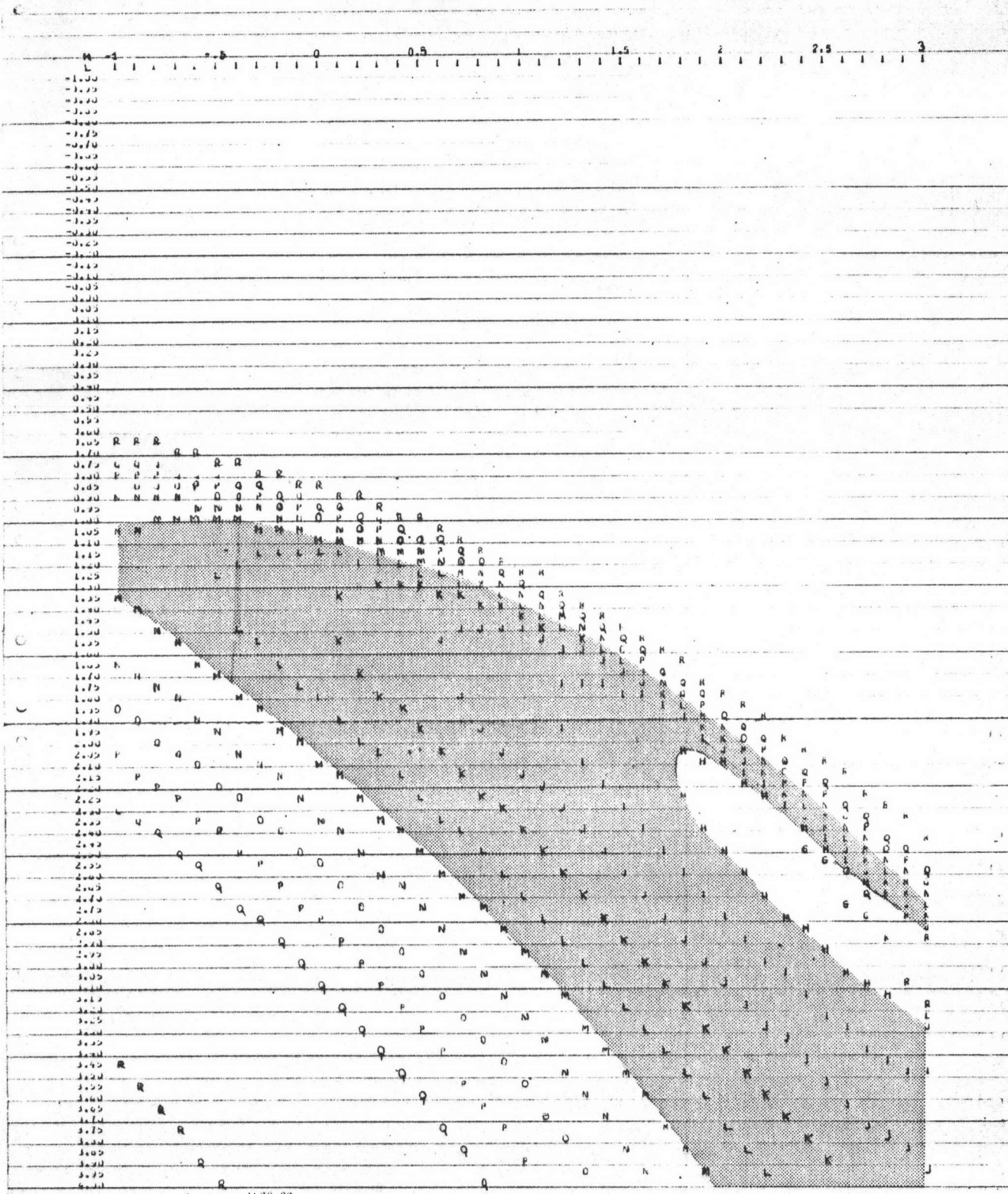
A	=	45.00
B	=	50.00
C	=	55.00
D	=	60.00
E	=	65.00
F	=	70.00
G	=	75.00
H	=	80.00
I	=	100.00
J	=	200.00

FIG E-3 ISOLINES FOR JAM DENSITY, BUKHUMIT ROAD.

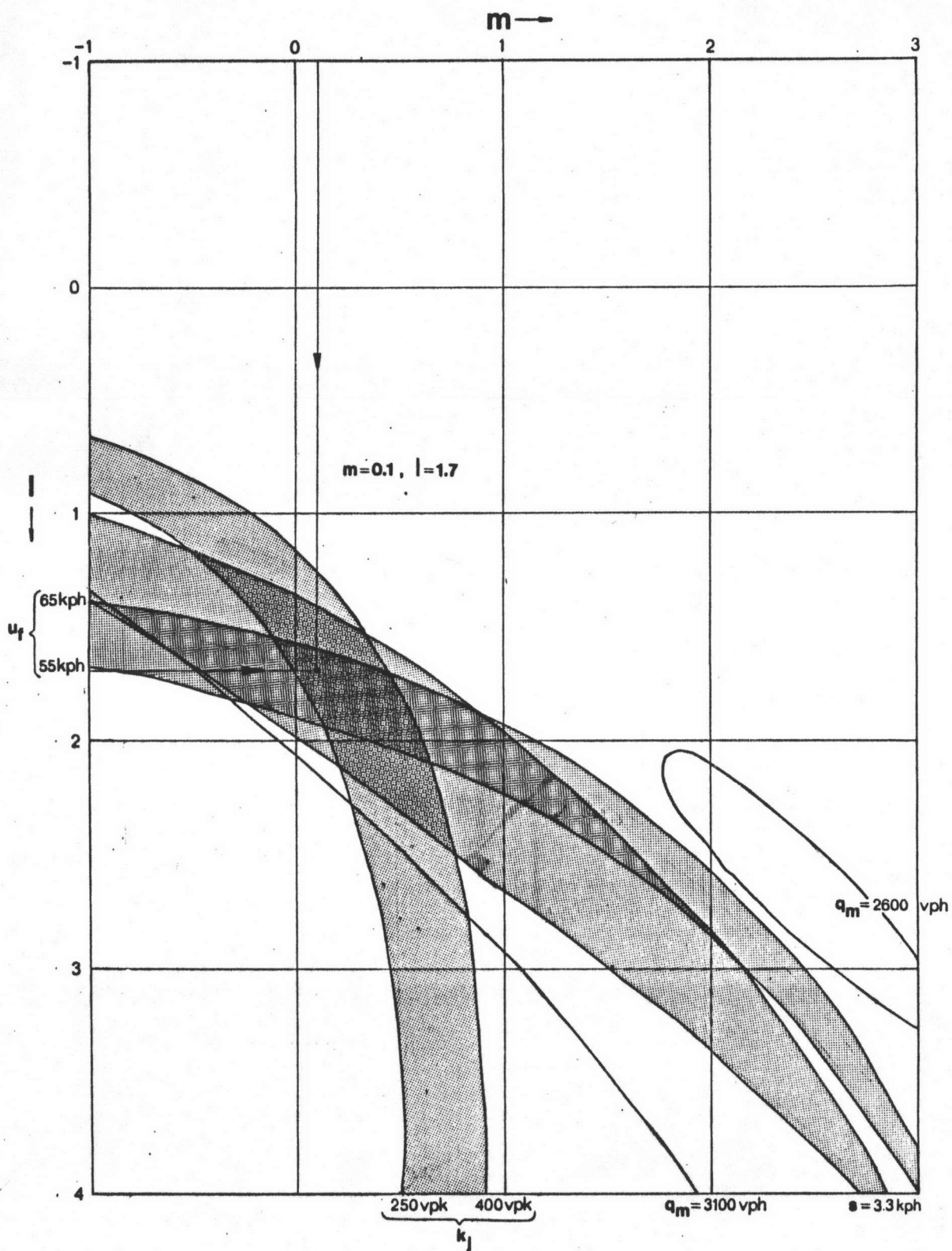


A	+	120.00
B	+	140.00
C	+	160.00
D	+	180.00
E	+	200.00
F	+	250.00
G	+	300.00
H	+	400.00
I	+	810.00

FIG. E-4 ISOLINES FOR MAXIMUM FLOW, BUCKHORN ROAD



A	*	1900.00
B	*	2033.00
C	*	2100.00
D	*	2200.00
E	*	2300.00
F	*	2400.00
G	*	2500.00
H	*	2600.00
I	*	2700.00
J	*	2800.00
K	*	2900.00
L	*	3000.00
M	*	3100.00
N	*	3200.00
O	*	3300.00
P	*	3400.00
Q	*	3500.00
R	*	3600.00



**Fig. F-5 Superposition of evaluation criteria.
Sukhumvit Road**

Method of Finding Selected Traffic Flow Models

After best m, l combination for Sukhumvit Road, as an example, are known. ($m = 0.1, l = 1.7$, from Fig.F-5) The selected traffic flow models can be obtained as described below.

From Table F-2, for $m = 0.1$ and $l = 1.7$, we obtain

$$A = 40.6426$$

$$B = -0.8023$$

From Table 3, for $m = 0.1$ and $l = 1.7$ ($m < 1, l > 1$), we obtain steady-state flow equation

$$u^{1-m} = ck_j^{l-1} + ck^{l-1} \quad \text{---} \quad \text{(F-1)}$$

But

$$A = ck_j^{l-1}$$

$$B = c$$

Substituting A, B, m, and l in Eq. F-1, then

$$u^{0.8} = 40.64 - 0.802 k^{0.7} \quad \text{---} \quad \text{(F-2)}$$

Since

$$q = uk$$

Then we obtain

$$q = k(40.64 - 0.802k^{0.7})^{1.11} \quad \text{---} \quad \text{(F-3)}$$

$$q = u(50.67 - 1.25u^{0.9})^{1.43} \quad \text{---} \quad \text{(F-4)}$$

VITA

Mr. Chaisit Gururatana was born on 18th September, 1954 at Lopburi and graduated B. Eng. in Civil Engineering from Chiangmai University in academic year 1976. Present position is civil engineer in Engineering Analysis Section, Technical and Planning Division, Expressway and Rapid Transit Authority of Thailand.

