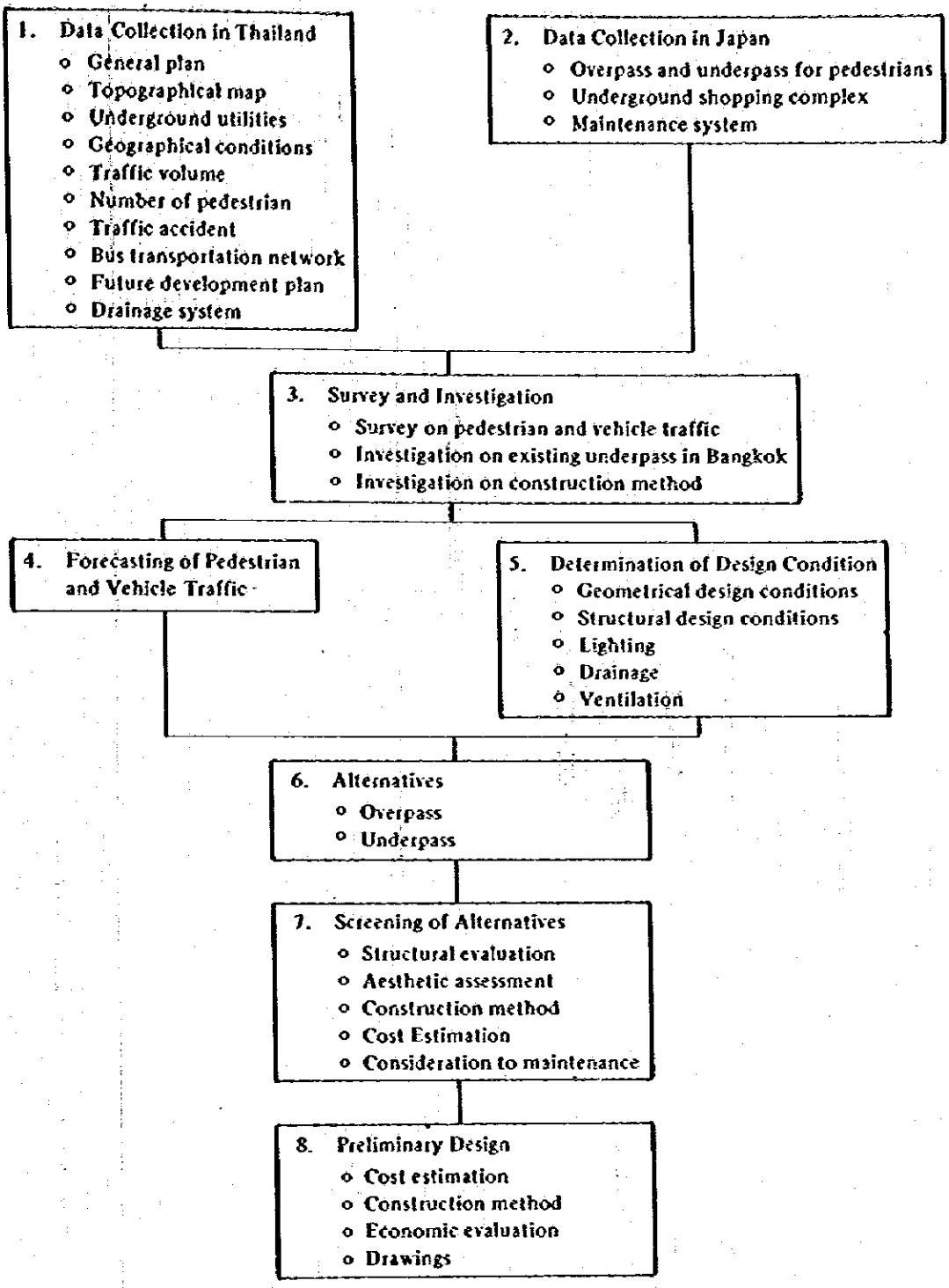
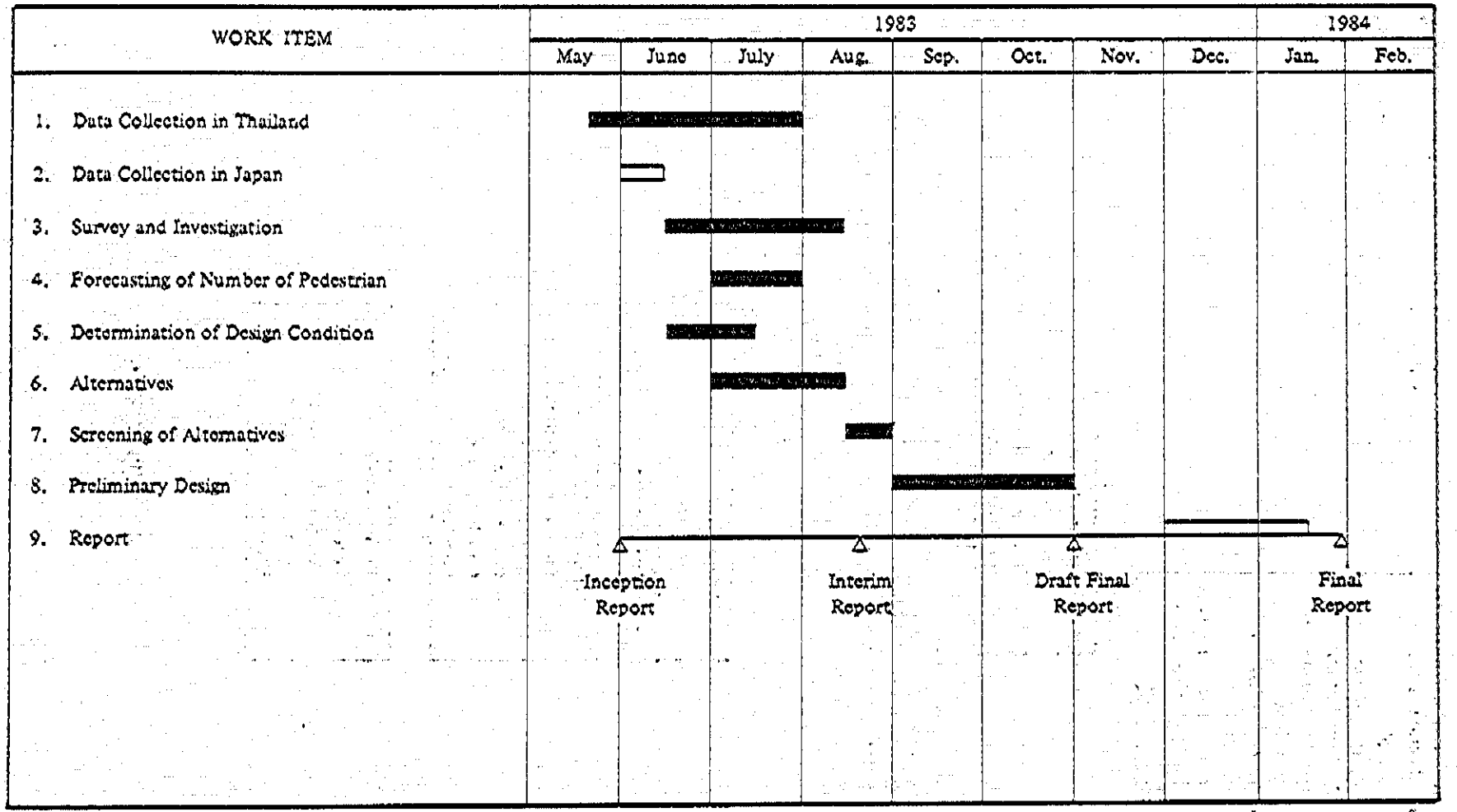
付属資料


1. Data Collection in Thailand
o General plan
o Topographical map
o Underground utilities
o Geographical conditions
o Traffic volume
o Number of pedestrian
o Traffic accident
o Bus transportation network
o Future development plan
o Drainage system
2. Data Collection in Japan
o Overpass and underpass for pedestrians
o Underground shopping complex
o Maintenance system
3. Survey and Investigation
o Survey on pedestrian and vehicle traffic
o Investigation on existing underpass in Bangkok
o Investigation on construction method
4. Forecasting of Pedestrian and Vehicle Traffic
5. Determination of Design Condition
o Geometrical design conditions
o Structural design conditions
o Lighting
o Drainage
o Ventilation
6. Alternatives
o Overpass
o Underpass
7. Screening of Alternatives
o Structural evaluation
o Aesthetic assessment
o Construction method
o Cost Estimation
o Consideration to maintenance
8. Preliminary Design
o Cost estimation
o Construction method
o Economic evaluation
o Drawings

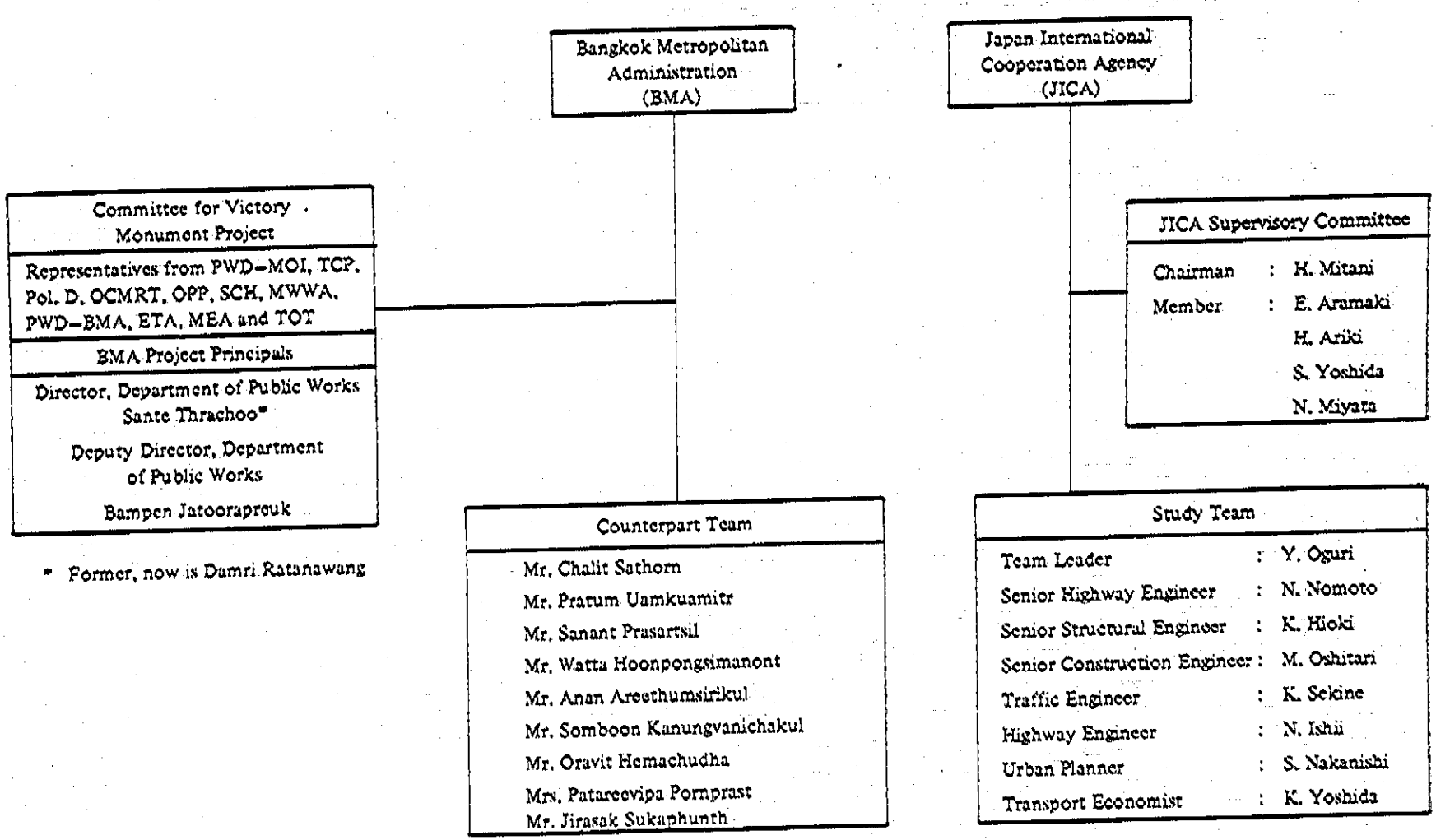
Study Flow

Work Schedule



Note: Work in Thailand Work in Japan

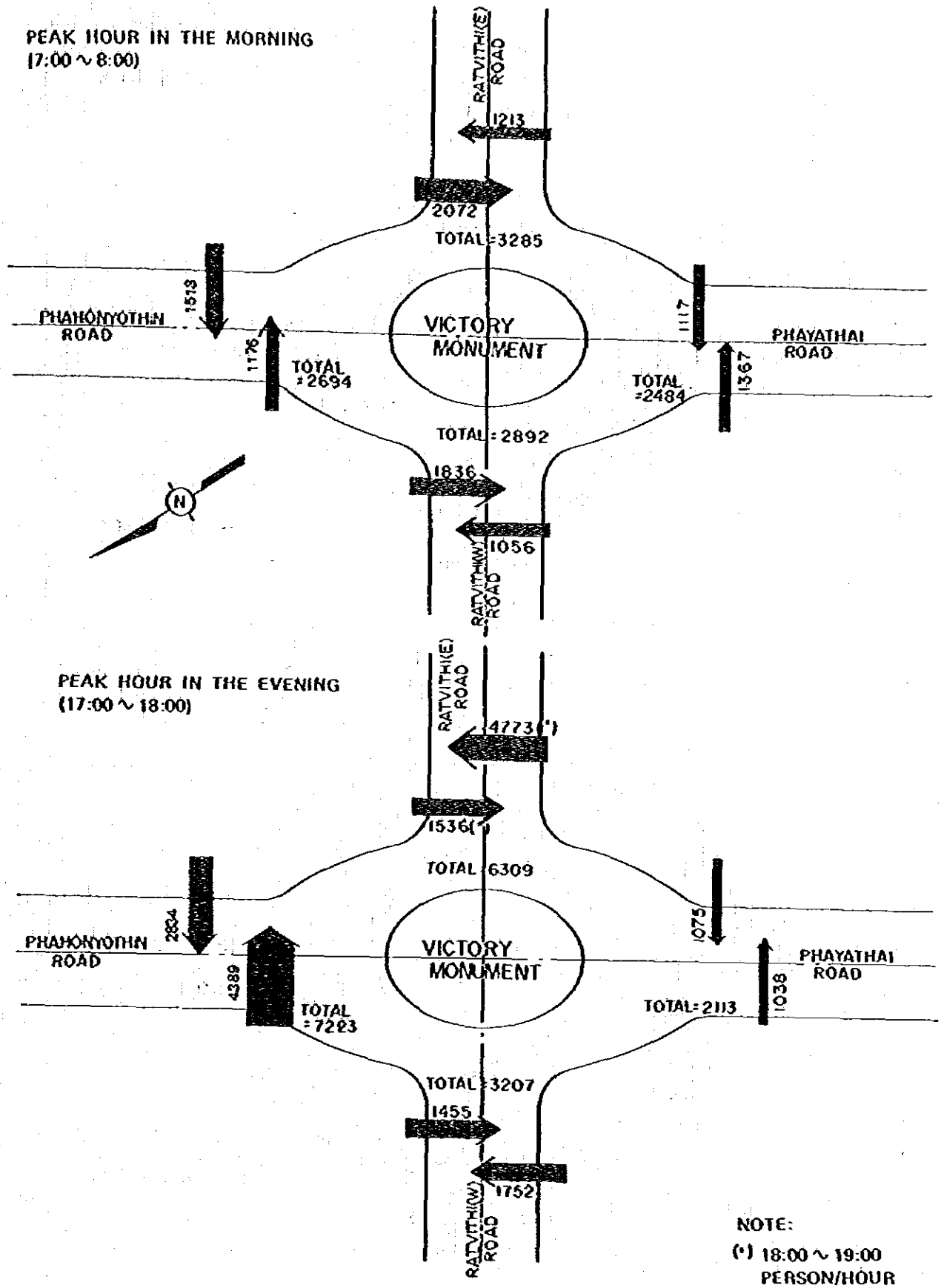
Organization for Study



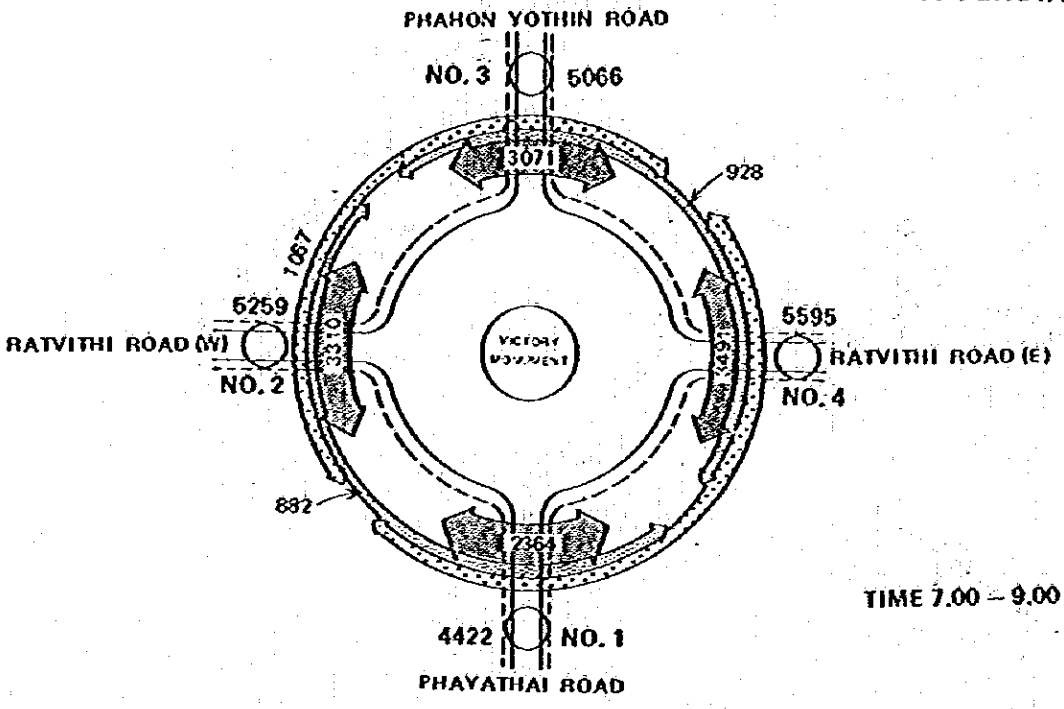
* Former, now is Damri Ratanawang

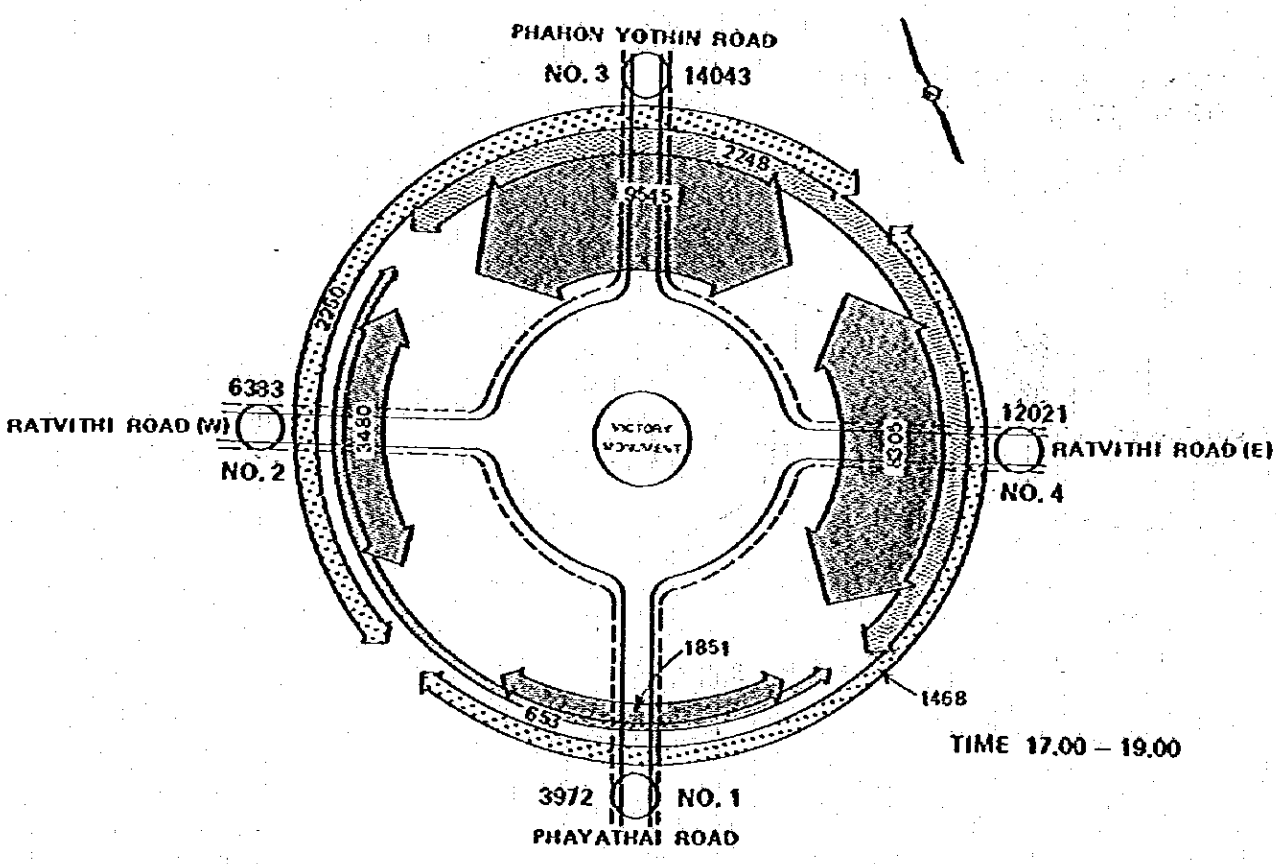
Number of Pedestrians

Time	Crossing Street				Total
	Phahonyothin	Ratvithi (E)	Phayathai	Ratvithi (W)	
07:00 – 08:00	2,694	3,285	2,484	2,892	11,355
08:00 – 09:00	2,372	2,310	1,938	2,367	8,987
09:00 – 10:00	2,907	2,356	1,644	2,470	9,377
10:00 – 11:00	2,613	2,130	1,435	2,332	8,510
11:00 – 12:00	2,968	2,553	1,482	2,361	9,364
12:00 – 13:00	3,840	5,793	2,012	2,150	13,795
13:00 – 14:00	3,747	4,323	1,709	2,139	11,918
14:00 – 15:00	2,950	2,749	1,548	2,220	9,467
15:00 – 16:00	3,715	2,987	1,471	2,087	10,260
16:00 – 17:00	5,639	4,853	1,972	3,105	15,569
17:00 – 18:00	7,223	5,712	2,113	3,207	18,255
18:00 – 19:00	6,820	6,309	1,859	3,176	18,164
Total	47,488	45,360	21,667	30,506	145,021

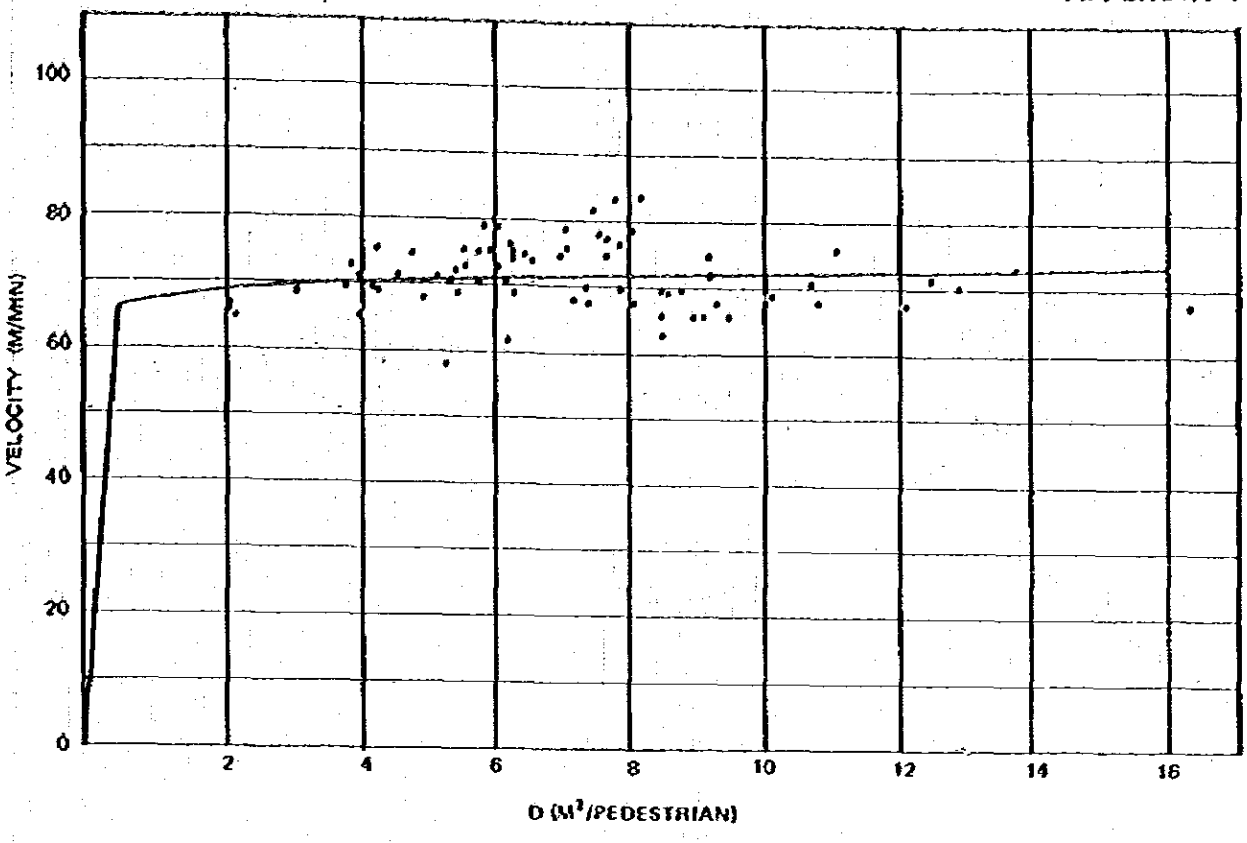


Crossing Pedestrian Volume at Peak Hour

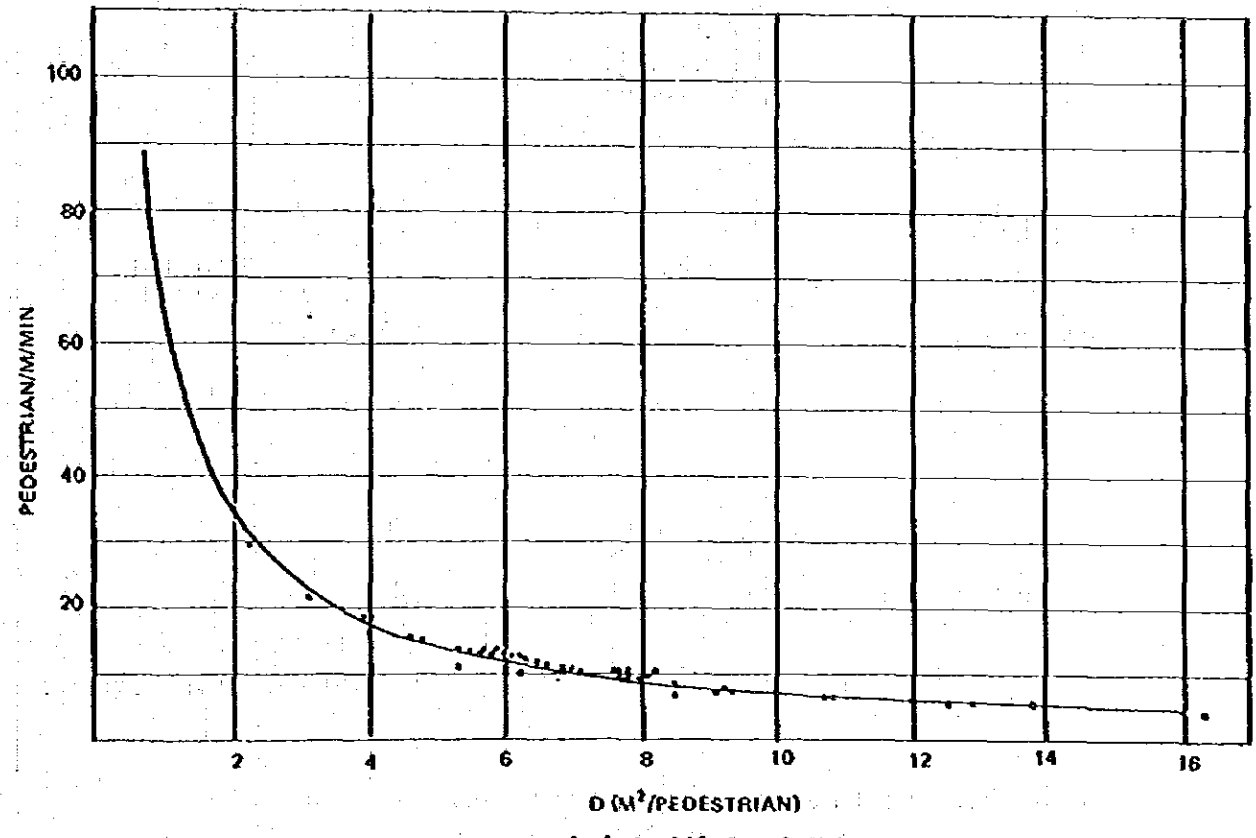




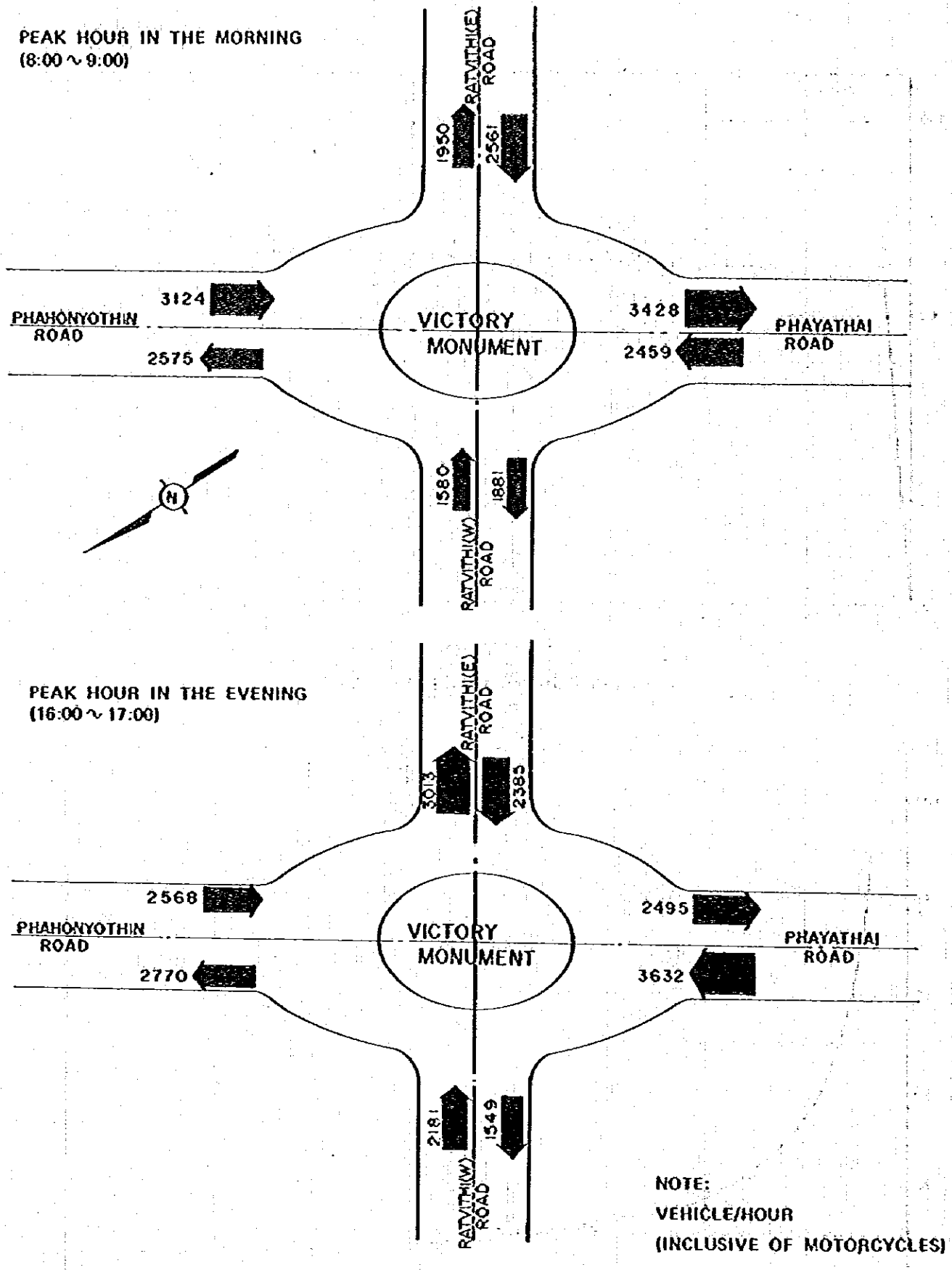
Pedestrian Flow Around Victory Monument



Walking Velocity VS D of all Samples



Pedestrian/m/min VS D of all Samples



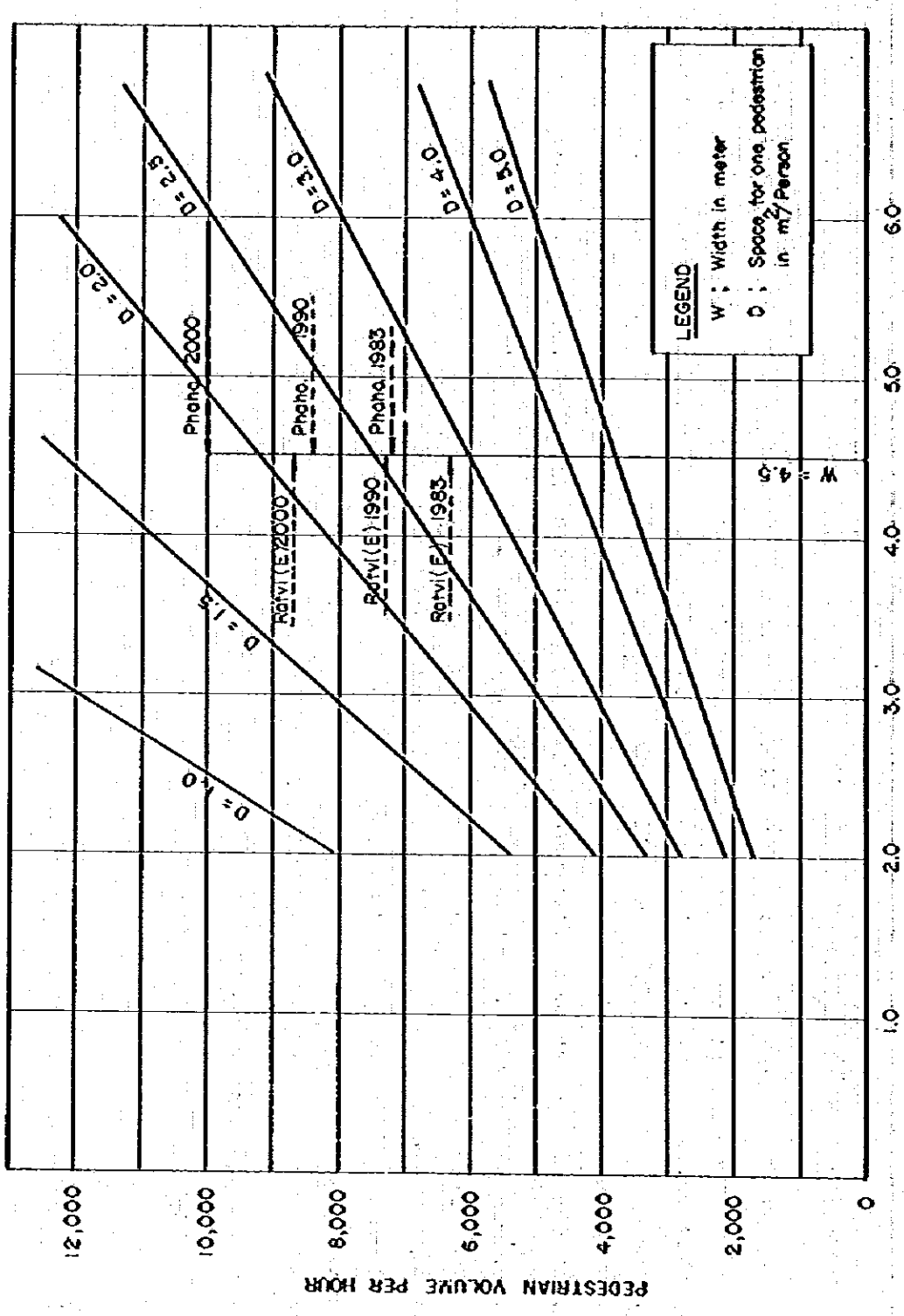
Traffic Volume of all Vehicle Types Around Victory Monument

Vehicle Composition of Traffic

Unit: Vehicles/day

Peak Period	Vehicle Types	Ratvithi (W) Rd.				Phayathai Rd.				Phahonyothin Rd.				Ratvithi (E) Rd.			
		WB	%	EB	%	SB	%	NB	%	NB	%	SB	%	EB	%	WB	%
AM Peak 08:00–09:00	1) Passenger Cars	888	47.2	575	36.4	1,801	52.5	1,070	43.5	1,043	40.5	1,533	48.8	668	34.3	1,185	46.3
	2) Taxis, Samlors	838	20.4	466	29.5	475	13.8	613	24.9	568	22.1	546	17.4	341	17.5	382	14.9
	3) BMTA, Mini Buses	194	10.3	143	9.1	361	10.7	204	8.3	316	12.3	411	13.1	446	22.9	294	11.5
	4) Trucks	99	5.2	67	4.2	25	0.7	31	1.3	97	3.7	135	4.2	24	1.1	148	5.7
	5) Motorcycles	317	16.9	329	20.8	766	22.3	541	22.0	551	21.4	519	16.5	471	24.2	552	21.6
	6) All traffic	1,881	100.0	1,580	100.0	3,428	100.0	2,459	100.0	2,575	100.0	3,144	100.0	1,950	100.0	2,561	100.0
PM Peak 16:00–17:00	1) Passenger Cars	685	44.2	1,220	55.9	1,155	46.3	1,796	49.4	1,415	51.1	930	36.2	1,470	48.8	954	40.0
	2) Taxis, Samlors	297	19.2	330	15.1	511	20.5	824	22.7	444	16.0	597	23.2	431	14.3	403	16.9
	3) BMTA, Mini Buses	192	12.4	157	7.2	303	12.1	315	8.7	273	9.9	307	12.0	382	12.7	322	13.5
	4) Trucks	82	5.3	117	5.4	29	1.2	43	1.2	121	4.3	145	5.7	83	2.7	160	6.7
	5) Motorcycles	293	18.9	357	16.4	497	19.9	654	18.0	517	18.7	589	22.9	647	21.5	546	22.9
	6) All traffic	1,549	100.0	2,181	100.0	2,495	100.0	3,632	100.0	2,770	100.0	2,568	100.0	3,013	100.0	2,385	100.0

Source: Traffic Survey on June 15th 1983.



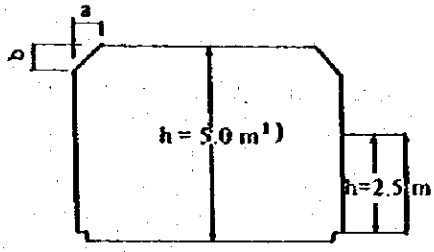
Pedestrian Volume and Width of Footpath

Geometric Design Conditions (1)

1. Clearance

Roadway clearance, pedestrian path clearance and other limits on planning of pedestrian footpath have been developed as shown in the below figures.

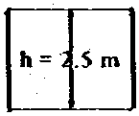
1) For Roadway and Sidewalk



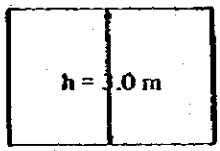
a = b = 0.8 m

[1]) 3.7 m. for bus lane

2) For Pedestrian Bridge and Tunnel



3) For Underground Commercial Sapce.



2. Profile and Crossfall

		Bridge		Tunnel
Profile	i ≥	1.0%	i ≥	0.2%
Crossfall	i ≥	2.0%	i ≥	1.0%

3. Stairways

The gradient of stairway shall be 1:2 as a standard. Landing shall be provided at half way of stairways, in case of the height is more than 3 meters.

The length of landing shall be as follows:

1) For straight stairway : more than 1.2 m
2) For other type of stairway : Width of stairway

4. Earthcoverage for Tunnel

To take advantage of underpass, it is desirable to plan structures as shallow as possible. To achieve this objective, earth coverage of underpass should be kept to minimum requirement. Giving consideration to above mentioned matters and existing underground utilities, 1 m is adopted for planning of the Study.

5. Extra Room

In case of underpass, following extra-rooms are equipped in addition to necessary clearance for footpath.

Overhead : 0.2 m
Lateral : 0.4 m (on each side) - (after screening this has been changed to 0.5 m)

The excess room is mainly for lighting, lining and wiring.

Structural Design Conditions (1)

1. Design Loads

Dead Load Bridge and Tunnel	Pavement 2.4 t/m³ , Soil (dry) 1.7 t/m³ Reinforced concrete 2.5 t/m³ Steel 7.85 t/m³
Live Load Bridge	Floor slab/Floor beam 500 kg/m² Main girder 500 kg/m² (l < 30 m) l : span length
Tunnel	Vertical load $Pv = \frac{4.60}{H + 0.1}$ t/m² (H < 3.5 m) Pv = 1.0 t/m² (H ≥ 3.5 m) H : Depth from ground surface Horizontal load Ph = 0.5 t/m² Impact 30% of Live loads Earth pressure Vertical Pve = γ · H Horizontal Phe = K · Pve K : Coefficient of earth pressure at rest (K = 0.5) γ : Specific gravity of Soil H : Depth from ground surface Water pressure Vertical Pvw = h t/m² Horizontal Phw = h t/m² h : Depth from water table

2. Allowable Stress

1) Reinforced Concrete

(1) Specified compressive strength : $f'c$ = 210 kg/cm²
240 kg/cm²

(2) Allowable extreme fibre compressive stress : fc = 0.375 $f'c$

Structural Design Conditions (2)

2) Prestressed Concrete

(1)	Design strength	:	σck =	350 kg/cm²
(2)	Compressive strength at time of initial prestress	:	σci =	280 kg/cm²
(3)	Allowable compressive stress			
	at temporary prestress	:	σcat =	160 kg/cm²
	at service load	:	σca =	125 kg/cm²
(4)	Allowable tensile stress (temporary)	:	σtat =	13.5 kg/cm²
(5)	Allowable shearing stress	:	σra =	5 kg/cm²
(6)	Allowable tensile stress (service)	:	σta =	9 kg/cm²

3) Reinforcing Bar

Allowable tensile stress			
for round bar	:	σsa =	1,200 kg/cm²
for deformed bar	:	σsa =	1,400 kg/cm² 1,800 kg/cm²

4) Wire for Prestressed Concrete

(1)	Ultimate tensile strength	:	σpu =	175 kg/cm²
(2)	Yield point stress	:	σpy =	150 kg/cm²
(3)	Allowable tensile stress			
	at service load	:	σpa =	105 kg/cm²
	at tensile stress	:	σpat =	123 kg/cm²
	at initial prestress	:	σpai =	135 kg/cm²

Structural Design Conditions (3)

5) Pile Foundation

Soil testing has not been executed at planning site, but some data in the area adjacent to the Victory Monument, which could be applicable for this study, have been obtained. According to the data, the upper strata from ground surface to some 13 m in depth is very soft and as such bridge design requires pile foundation. For tunnel, since the weight of it is lighter than soil, pile is not required from the standpoint of bearing capacity. But, to protect a tunnel from the damage caused by possible uneven settlement, pile foundation is also required. As the planned tunnel weight surpasses estimated uplift force due to buoyancy for uplifting action, no particular measures are necessary. The specification of pile used in this planning is as follows:

Classification	:	P.C. solid square section pile-35 (0.35 x 0.35 m)
Pile length	:	18 m to 23 m
Allowable bearing value:		35 t/each

6) Shape Steel (Sheet pile, Strut, Wale, Cover plate)

(1)	Allowable extreme fibre tensile stress		:	0.6 f_y kg/cm²
(2)	Allowable extreme fibre compressive stress		:	0.6 f_y kg/cm²
(3)	Yield point	f_y = 2,500 kg/cm²		(t ≤ 4 mm)
		f_y = 2,200 kg/cm²		(t > 4 mm)

3. Arrangement of Reinforcing Bar

1) Concrete Cover for Reinforcement

3 inch (or 8 cm)

when the concrete is permanently exposed to earth

2) Spacing Limit

Clear distance between bars shall be of the maximum among the followings;

1.5 times of bar diameter

1.5 times of the maximum size of coarse aggregate

1.5 inch (or 4 cm)

Structural Design Conditions (4)

4. Arrangement of Pile

1) Center to center distance of piles $S_c \geq 3d$

d : maximum dimension of the pile

2) Edge of footing to center of the extreme outer pile $S_e \geq d/2$

d : depth of footing

3) Minimum depth of footing F = 0.15 m

5. Safety Factor for Buoyancy

$F \geq 1.1$

Construction Quantities of Overpass (1)

Item	Unit	N-Bridge	S-Bridge	E-Bridge	W-Bridge	Sub-Total
Preparatory Works						
1) Removal of Pavement	m^2	140	140	150	55	485
2) Removal of Island	m^2	22	30	13	14	79
3) Relocation of Drainage	m	–	–	–	–	–
Substructure						
1) Excavation						
Steel sheet piles	t	60.9	60.9	69.0	32.4	223.2
Excavation	m^3	109	109	129	77	422
2) Piling						
P.C. Piles	No.	49	43	49	27	168
3) Footing						
Concrete A	m^3	39	34	39	24	136
Form	m^2	59	51	59	29	198
Reinforcing Bar	t	2.0	2.0	2.0	1.2	7.2
Lean Concrete	m^3	9	9	10	5	33
4) Pier						
Concrete B	m^3	16	15	16	11	58
Form	m^2	86	75	86	48	295
Reinforcing Bar	t	4.7	4.2	4.7	3.1	16.7
Finishing	m^2	78	68	78	43	267
Scaffold	m^3	60	70	60	60	250
Superstructure						
1) Main Structure						
Concrete B	m^3	102	72	91	21	286
Concrete C (P.C)	m^3	175	157	179	154	665
Form	m^2	971	852	987	584	3,394
Reinforcing Bar	t	25.1	22.3	25.6	14.0	87
Rolled steel (H)	t	–	–	–	–	–
P.C. Wire	t	5.6	6.4	5.0	3.5	20.5
Staging	m^3	1,482	1,264	1,556	970	5,272
Erection Girder	t	39	39	59	32	169
Others	L.S	1	1	1	1	4
2) Pavement	m^2	534	455	536	346	1,871
3) Finishing	m^2	950	832	962	569	3,313
4) Handrail	m	247	248	304	154	953
Utility Appurtenance						
1) Lighting	L.S	1	1	1	1	4
2) Others	L.S	1	1	1	1	4
Reconstruction	m^2	162	173	163	69	567

Construction Quantities of Overpass (2)

Item	Unit	N-E Deck	N-W Deck	S-E Deck	S-W Deck	Sub-total	Total
Preparatory Works							
1) Removal of Pavement	m^2	200	240	200	225	865	1,350
2) Removal of Island	m^2	47	30	22	–	99	178
3) Relocation of Drainage	m	–	–	110	70	180	180
Substructure							
1) Excavation							
Steel sheet piles	t	51.7	57.7	51.5	55.0	215.9	439.1
Excavation	m^3	207	259	207	215	888	1,310
2) Piling							
P.C. piles	No.	68	80	68	72	288	456
3) Footing							
Concrete A	m^3	59	72	59	62	252	388
Form	m^2	95	119	95	102	411	609
Reinforcing Bar	t	2.9	3.5	2.9	3.0	12.3	19.5
Lean Concrete	m^3	14	18	14	15	61	94
4) Pier							
Concrete B	m^3	16	27	16	16	75	133
Form	m^2	100	122	100	103	425	720
Reinforcing Bar	t	3.1	3.7	3.1	3.1	13.0	29.7
Finishing	m^2	88	107	88	91	374	641
Scaffold	m^3	100	120	100	100	312	562
Superstructure							
1) Main Structure							
Concrete B	m^3	410	519	447	486	1,862	2,148
Concrete C (P.C)	m^3	–	–	–	–		665
Form	m^2	1,340	1,657	1,600	1,810	6,407	9,801
Reinforcing Bar	t	101.7	128.8	112.1	123.3	465.9	552.9
Rolled Steel (H)	t	2.1	2.5	2.1	3.2	9.9	9.9
P.C. Wire	t	–	–	–	–	–	20.5
Staging	m^3	3,800	4,780	4,352	4,892	17,824	23,096
Erection Girder	t	–	–	–	–	–	169
Others	L.S	–	–	–	–	–	–
2) Pavement	m^2	951	1,195	1,088	1,113	4,347	6,128
3) Finishing	m^2	1,367	1,695	1,634	1,846	6,542	9,855
4) Handrail	m	175	252	223	243	893	1,846
Utility Appurtenance							
1) Lighting	L.S	1	1	1	1	4	8
2) Others	L.S	1	1	1	1	4	8
Reconstruction	m^2	247	270	222	225	964	1,531

Cost of Civil Works (Continuous Overpass)

Unit: 1,000 Baht

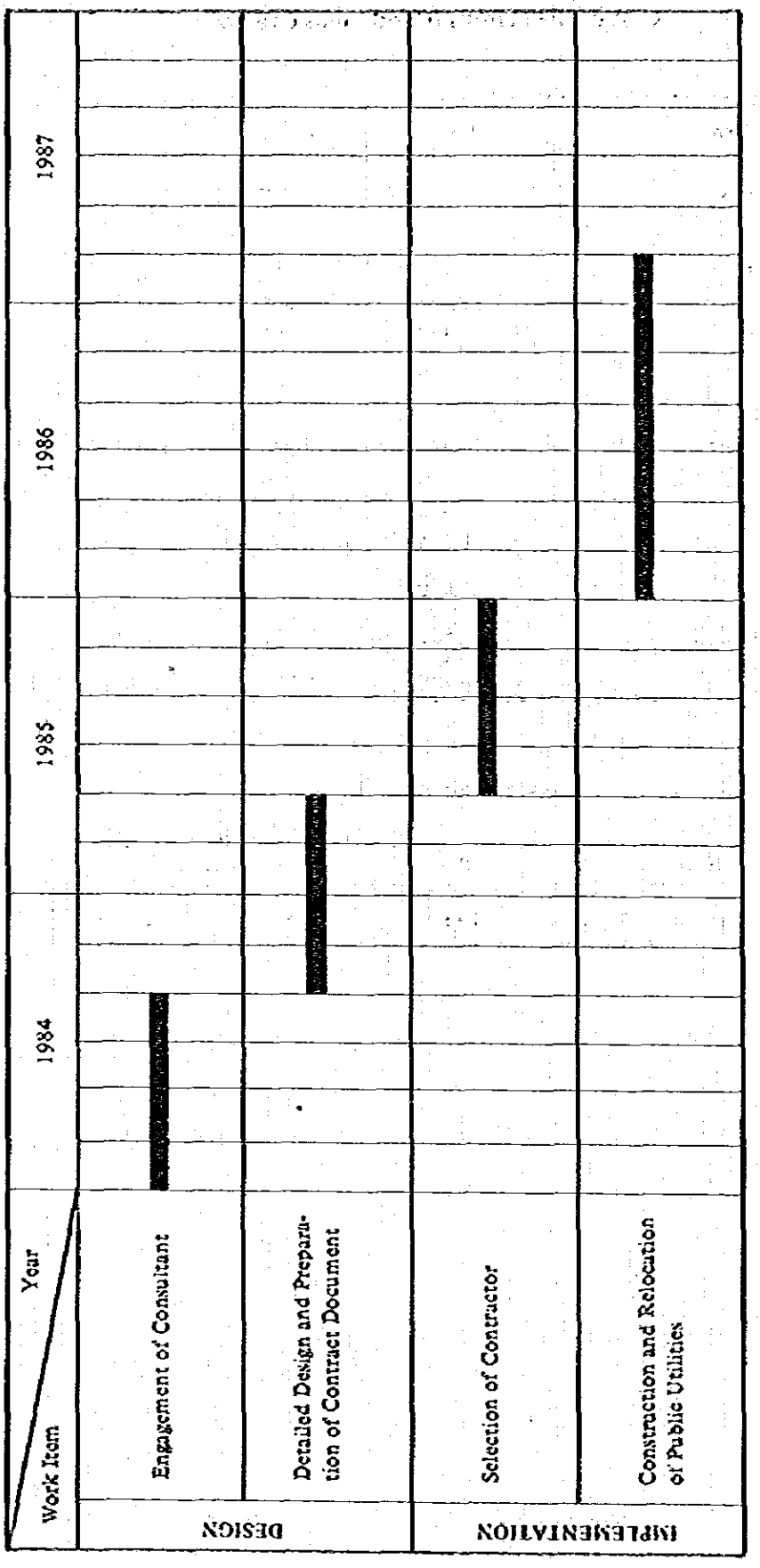
Item	Material	Labor	Equipment	Total
1. Preparatory Work	440	270	1,060	1,770
2. Substructure				10,560
1) Excavation	120	580	1,630	2,330
2) Piling	3,555	550	1,630	5,470
3) Footing	1,135	400	85	1,620
4) Pier	800	285	55	1,140
3. Superstructure				31,370
1) Main Structure	18,340	5,030	1,760	25,130
2) Pavement	2,600	930	200	3,730
3) Finishing	665	45	180	890
4) Handrail	1,295	245	80	1,620
4. Utility	1,090	170	40	1,400
5. Reconstruction of pavement	580	40	150	770
Total	30,720	8,545	6,605	45,870

Relocation of Utilities

Unit: 1,000 Baht

Item	Cost	Remarks
Drainage	1,660	S-E and S-W Quadrant

Draft Implementation Schedule
(For Alternative 2)

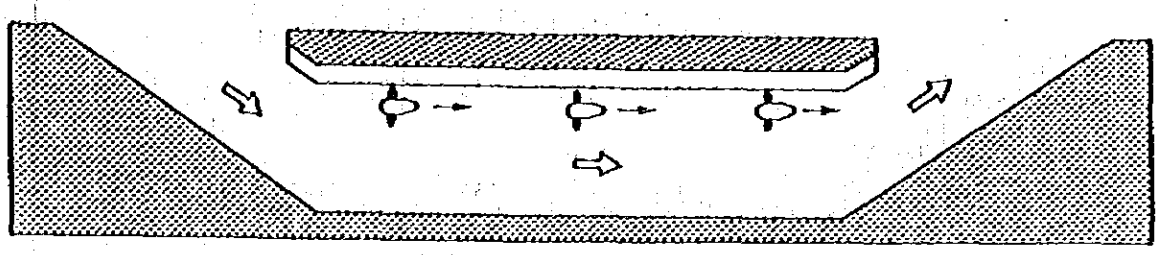


Unit Construction Cost
(Continuous Overpass)

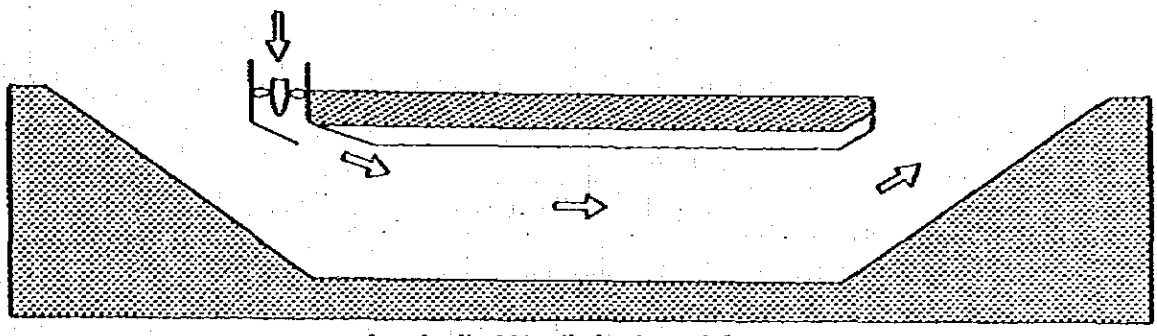
Item	Unit	Unit Cost in Baht
Removal of pavement	m^2	500
Sheet Pile	t	9,400
Earth Work		
1) Excavation	m^3	200
2) Backfill	m^3	250
Substructure		
1) P.C. pile ℓ = 22.5 m	piece	12,000
2) Concrete A (210 kg/cm^2)	m^3	2,000
3) Concrete B (240 kg/cm^2)	m^3	2,150
4) Form (Foundation)	m^2	200
5) Form (Pier)	m^2	300
6) Peinforcement	t	13,750
7) Scaffold	m^3	60
Superstructure		
1) Concrete B (240 kg/cm^2)	m^3	2,150
2) Concrete C (350 kg/cm^2)	m^3	2,500
3) Form	m^2	350
4) Reinforcement	t	14,350
5) P.C. Wire	t	70,000
6) Pavement	m^2	600
7) Finishing	m^2	300
8) Staging	m^3	140

Main Equipments
(Continuous Overpass)

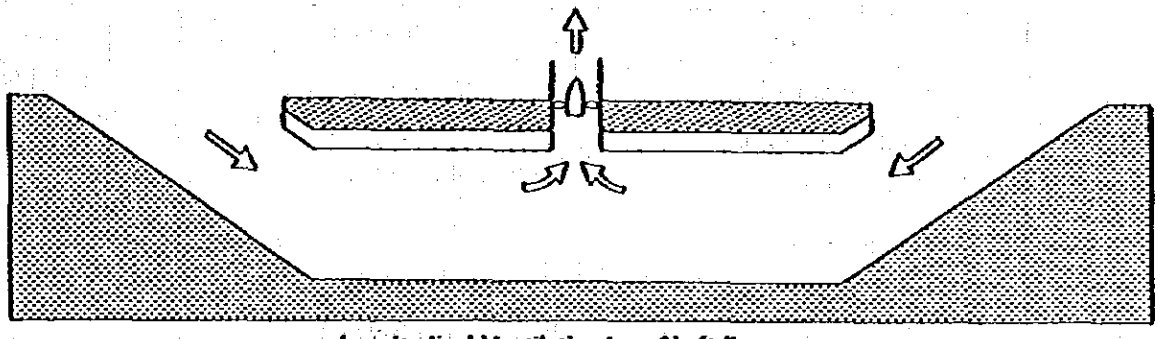
Name	Capacity	Work
Compressor	75 HP	Removal of pavement
Breaker		Removal of pavement
Back Hoe	15 HP	Excavation
Truck Crane	13 t	Unloading
Vibro Hammer	2,000	Driving sheet pile
Drop Hammer	4 t, H = 24 m	Driving pile and sheet pile
Dump Truck	15 t	Soil disposal
Bulldozer	D-3	Backfill
Transformer	50 KVS	All works
Generator	100 KW	All works
Tire Roller	14 t	Pavement
Baby Compressor	5.0 KW	Concrete work
Grout Pump		Grouting
Grout Mixer		Grouting
Freyssinet Jack		Prestressing
Freyssinet Pump		Prestressing



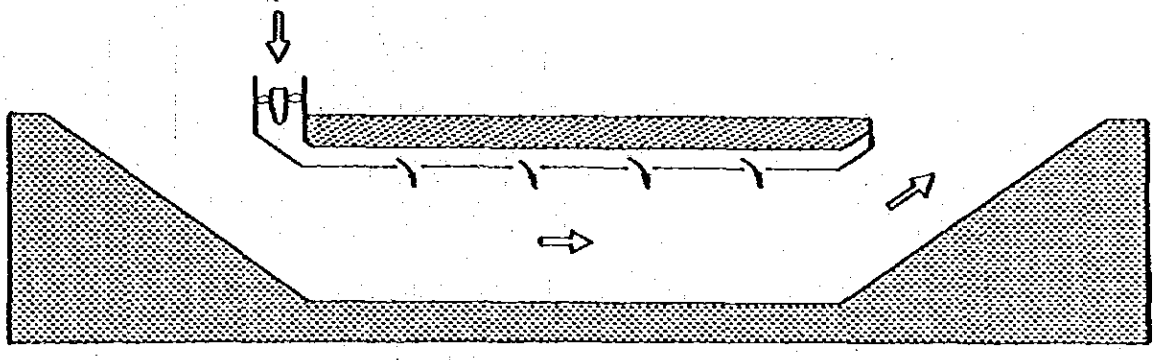
Longitudinal Ventilation by Booster Fans



Longitudinal Ventilation by an Inlet Fan



Longitudinal Ventilation by a Shaft Fan



Semi-Transverse Ventilation

Available Ventilation Methods

Cost of Civil Works
(Separate Underpass)

Unit: 1,000 Baht

Item	Material	Labour	Equipment	Total
1. Preparatory Work	535	315	1,250	2,100
2. Construction of underpass				
1) Wall protection	8,366	751	1,603	10,720
2) Earth work	330	1,650	4,630	6,610
3) Foundation	4,243	1,690	247	6,180
4) Box Culvert	14,265	3,980	1,695	19,940
5) Stair & Roof	7,190	2,010	850	10,050
6) Dewatering	198	67	65	330
3. Reconstruction of Pavement	1,830	123	487	2,440
4. Facilities	1,690	300	–	1,990
Total	38,647	10,886	10,827	60,360

Relocation Cost

Item	Cost in Baht
1. Telephone Cable	
Construction work	2,490,000.–
Cable work	13,000,000.–
2. Electric Cable	
Construction work	310,000.–
Cable work	2,260,000.–
Others	170,000.–
3. Watermain	8,670,000.–
4. Drainage	6,140,000.–
Total	33,040,000.–

Draft Implementation Schedule (For Alternative 3)

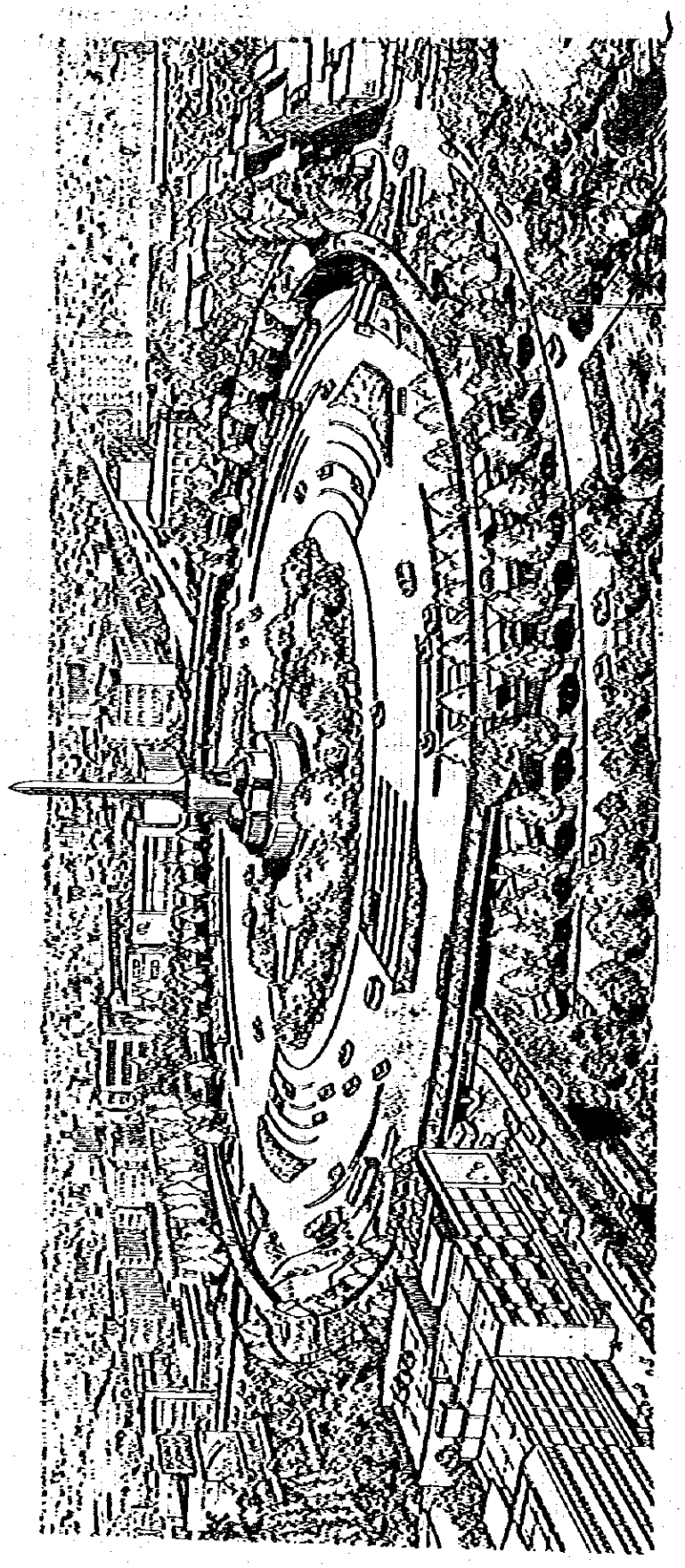
1) On the assumption that relocation of telephone cable and water pipes are completed prior to construction works.

Unit Construction Cost
(Separate Underpass)

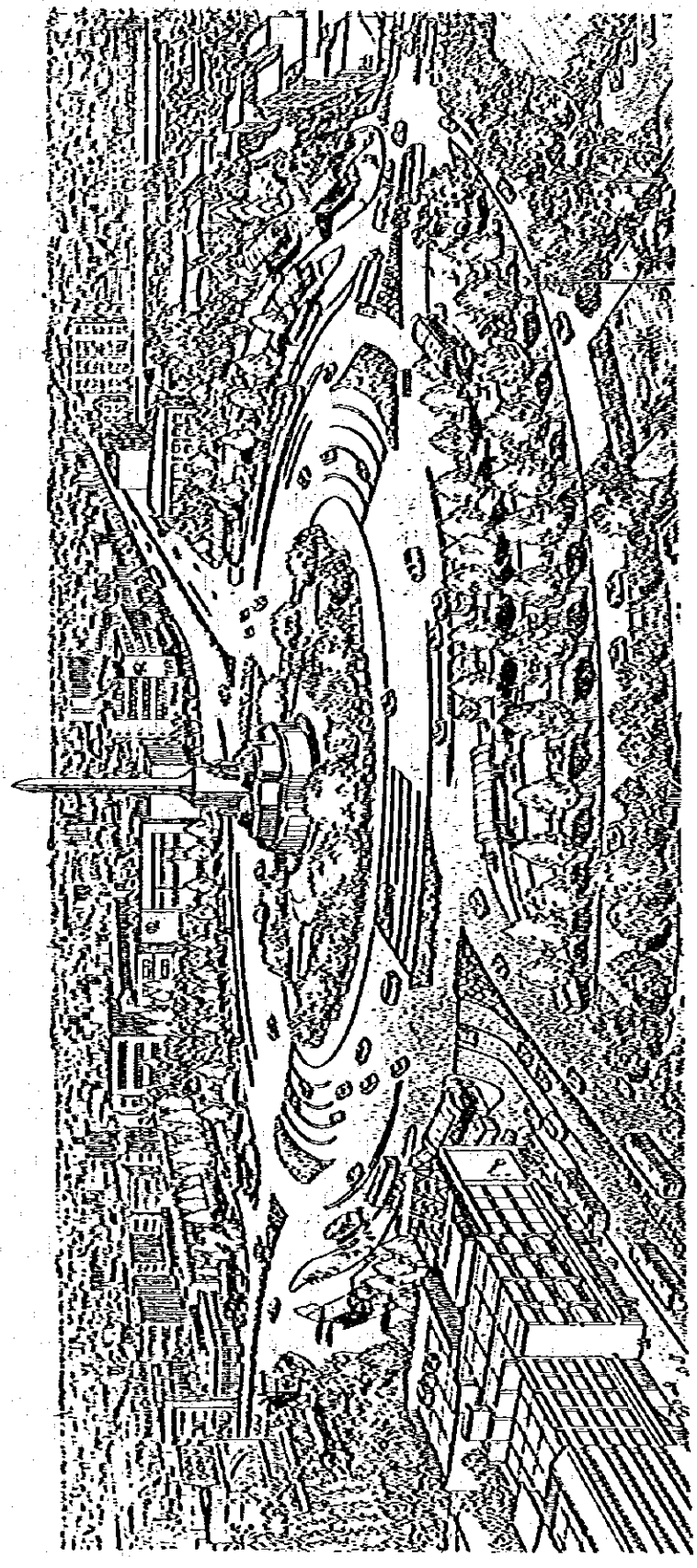
Item	Unit	in Baht
Removal of pavement	m^2	500
Wall protection		
1) Sheet pile	t	9,400
2) Strut, Wale	t	10,000
3) Coverplate	t	5,500
Earth Work		
1) Excavation	m^3	300
2) Backfill	m^3	250
Foundation		
1) P.C. pile l = 22.5 m	piece	12,000
2) P.C. pile l = 18 m	piece	9,600
3) Concrete (210 kg/cm^2)	m^3	2,000
4) Form	m^2	200
5) Reinforcement	t	13,750
Box culvert, Stairways		
1) Concrete	m^3	2,000
2) Form	m^2	280
3) Reinforcement	t	13,750
4) Lining	m^2	500
5) Ceiling	m^2	720
6) Pavement	m^2	500
7) Water proofing	m^2	600
8) Staging	m^3	30
Dewatering	day	1,000

Main Equipments
(Separate Underpass)

Name	Capacity	Work
Portable Compressor	6 m^3	Removal of pavement
Giant Breaker		Removal of pavement
Concrete Breaker		Removal of pavement
Back Hoe	0.45 m^3	Excavation
Truck Crane	15 t	Unloading
Crawler Crane	22 t	Unloading
Vibro Hammer	2,000	Driving sheet pile
Drop Hammer	4 t, H = 24 m	Driving pile
Bulldozer	D-3	Exc. Backfill
Bulldozer	D-4	Soil disposal
Clamshell	0.6 m^3	Excavation
Submersible pump	ϕ 4"	Dewatering
Submersible pump	ϕ 2"	Dewatering
Transformer	50 KVS	All works
Tire Roller	14 t	Pavement
Grader	W = 3,100	Pavement



Perspective – Alternative 2



Perspective – Alternative 3

BENEFIT-COST RATIO

1. Cost

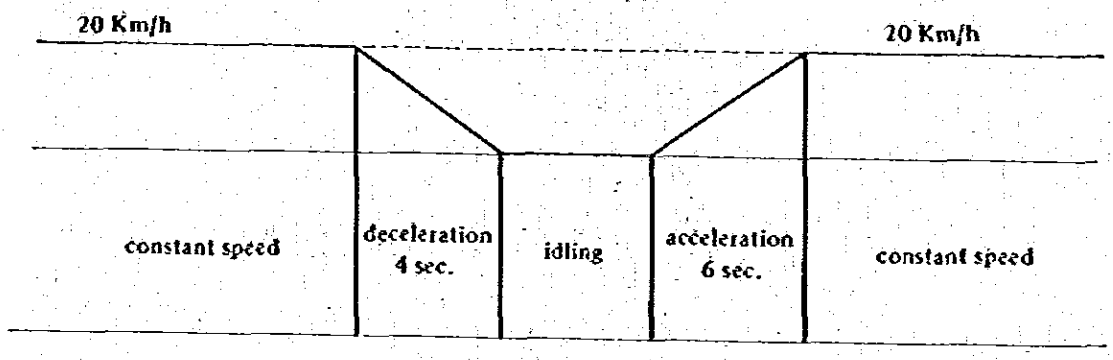
The costs in this economic analysis are construction cost and maintenance cost (in case of Alternative 3). Since the economic analysis is based on 1983 price, the cost for price escalation has been subtracted from the estimated project cost in Table–26 of Chapter 7 (See paragraph 164 and 187 in Chapter 6). The construction cost for Alternative 3 has been assumed to be disbursed equally in 1986 and 1987 when pedestrian project is expected to be implemented, while only in 1986 for Alternative 2.

2. Benefit

The additional operating cost caused by stopping due to pedestrians' crossing on streets at grade is equivalent to benefit when pedestrians' crossing at grade is eliminated with pedestrians' crossing at grade is eliminated with provision of grade-separated pedestrian crossing facility.

The additional operating cost varies with vehicle type and driving conditions, in particular, initial speed from where speed will be reduced to a halt and returned to. The average running speed of vehicles on the streets in the areas adjacent to the Victory Monument is about 20 Km/h.

For the following running mode, additional fuel consumption as compared to that of running at constant speed of 20 Km/h. can be calculated utilizing various studies on this field.



(Running Mode)

Table–1 in this appendix shows fuel consumption for the above mode of running by type of vehicles.

The waiting time and the number of vehicles which are supposed to stop at traffic signals of the junctions, should no pedestrian crossing facility be built, has been calculated based on the traffic signal system developed by OCMRT. (See Table–II and Table–III in this appendix)

Additional operating cost per vehicle and additional operating cost for one day which can be calculated from data in Table–I in this appendix and future traffic volume forecast in Chapter 3 (See paragraph 52) are also shown in Table–II and Table–III in this appendix.

It should be noted that the traffic volumes beyond year 1991 are leveled off without any increase taking into account the limited traffic capacity of the roundabout and its connecting streets.

3. Benefit-Cost Ratio

Table–IV in this appendix presents the cost and benefit stream for 15 years from 1986 to 2000. The cost and benefit are at 1983 price while the present values have been calculated with interest rate of 12% per annum.

Because Alternative 2 and Alternative 3 are same as far as the traffic movements of vehicles on the streets are concerned, the benefits accrued from the two alternatives can be assumed equal.

The benefit-cost ratios for Alternative 2 and Alternative 3 are 0.52 and 0.29, respectively as shown in Table–IV in this appendix.

Table–I Fuel Consumption by Vehicle Type[1])

(cc/sec)

Running Mode	Passenger Car	Mini Bus	Heavy Bus	Pick-up	Heavy Truck	Required Time
Constant (20 km/h)	0.67	1.50	3.76	0.72	2.89	–
Deceleration from 20 km/h	0.34	0.60	1.50	0.40	1.10	4 seconds
Idling (stop)	0.16	0.60	1.50	0.21	1.10	–
Acceleration to 20 km/h	1.30	3.40	10.01	1.47	9.25	6 seconds

1) 1. Heavy Bus and Heavy Truck : Diesel Engine
2. Mini Bus, Passenger Car and Pick-up : Gasoline Engine

Table—11 Additional Operating Cost per Day in 1987

(Baht)

Vehicle Type		Passenger Car	Mini Bus	Heavy Bus	Pick-up	Heavy Truck	Total
a. Traffic Volume (ADT)		123,900	9,000	15,600	7,000	3,100	158,600
In-bound traffic	b. Rate of vehicle to stop	20%	20%	20%	20%	20%	–
	c. Waiting time per vehicle	12 sec	12 sec	12 sec	12 sec	12 sec	–
	d. Additional operating cost per vehicle	0.098	0.285	0.457	0.118	0.410	–
	e. Number of vehicles to stop	24,780	1,800	3,120	1,400	620	31,720
	f. Additional Operating Cost (d x e)	2,427	513	1,427	165	254	4,786
Out-bound traffic	g. Rate of vehicle to stop	10%	50%	50%	10%	10%	–
	h. Waiting time per vehicle	6 sec	30 sec	30 sec	6 sec	6 sec	–
	i. Additional operating cost per vehicle	0.086	0.422	0.646	0.102	0.364	–
	j. Number of vehicles to stop	12,390	4,500	7,800	700	310	25,700
	k. Additional Operating Cost (i x j)	1,063	1,899	5,040	71	112	8,185
Total		3,490	2,412	6,467	236	366	12,971

Table—III Additional Operating Cost per Day in 1991

(Baht)

Vehicle Type		Passenger Car	Mini Bus	Heavy Bus	Pick-up	Heavy Truck	Total
a. Traffic Volume (ADT)		151,700	11,300	19,600	8,200	3,600	194,400
In-bound traffic	b. Rate of vehicle to stop	20%	20%	20%	20%	20%	–
	c. Waiting time per vehicle	12 sec	12 sec.	12 sec	12 sec	12 sec	–
	d. Additional operating cost per vehicle	0.098	0.285	0.457	0.118	0.410	–
	e. Number of vehicles to stop	30,340	2,260	3,920	1,640	720	38,880
	f. Additional Operating Cost (d x e)	2,971	644	1,793	194	295	5,897
Out-bound traffic	g. Rate of vehicle to stop	10%	50%	50%	10%	10%	–
	h. Waiting time per vehicle	6 sec	30 sec	30 sec	6 sec	6 sec	–
	i. Additional operating cost per vehicle	0.086	0.422	0.646	0.102	0.364	–
	j. Number of vehicles to stop	15,170	5,650	9,800	820	360	31,800
	k. Additional Operating Cost (i x j)	1,301	2,384	6,333	84	131	10,233
Total		4,272	3,028	8,126	278	426	16,130

Table-IV Cost Benefit Streams and Ratios

(Million Baht)

Year	Cost				Benefit	
	Alternative 2		Alternative 3		Alternative 2 and 3	
	Cost	Present value 1)	Cost	Present value 1)	Benefit	Present value 1)
1986	70.35	70.35	61.76	61.76	–	–
1987	–	–	61.85	55.22	4.73 (2.37) 2)	4.22 (2.11) 2)
1988	–	–	0.20	0.16	5.02	4.00
1989	–	–	0.20	0.14	5.31	3.78
1990	–	–	0.20	0.13	5.60	3.56
1991	–	–	0.20	0.11	5.89	3.34
1992	–	–	0.20	0.10	5.89	2.98
1993	–	–	0.20	0.09	5.89	2.66
1994	–	–	0.20	0.08	5.89	2.38
1995	–	–	0.20	0.07	5.89	2.12
1996	–	–	0.20	0.06	5.89	1.90
1997	–	–	0.20	0.06	5.89	1.69
1998	–	–	0.20	0.05	5.89	1.51
1999	–	–	0.20	0.05	5.89	1.35
2000	–	–	0.20	0.04	5.89	1.21
Total	70.35	70.35	126.21	118.12	79.56 (77.20) 2)	36.70 (34.59) 2)

1) Interest rate is 12% per annum.

2) As to Alternative 3, the benefit of year 1987 is a half of the figure in table, because the project is expected to be completed in mid 1987.

	Alternative 2	Alternative 3
Benefit/Cost Ratio	0.52	0.29

Table-II Additional Operating Cost per Day in 1987

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