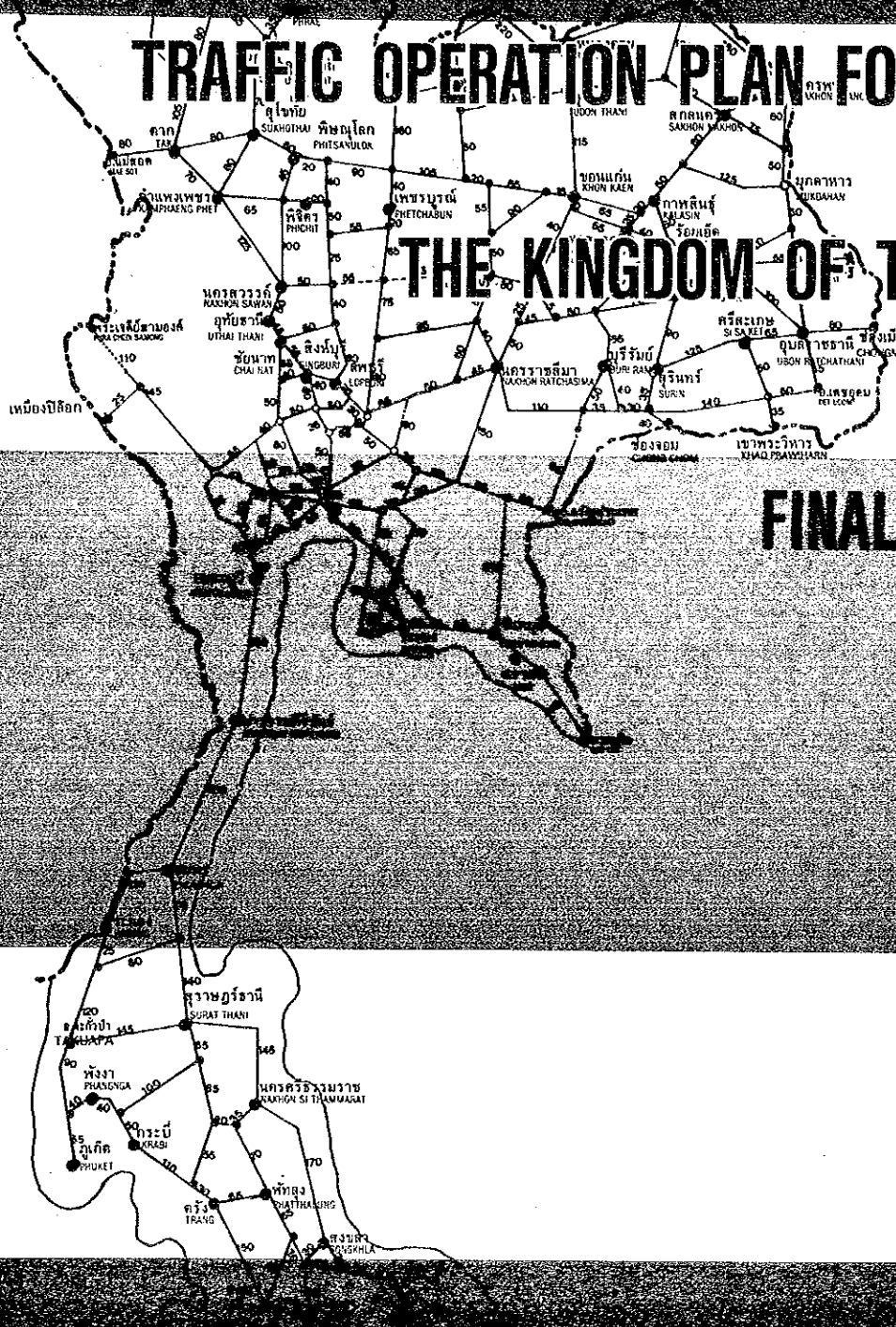
社会開発調査部報告書

TRAFFIC OPERATION PLAN FOR ROADS IN THE KINGDOM OF THAILAND



FINAL REPORT

MANUALS

JUNE 1990

TRAFFIC OPERATION PLAN FOR ROADS IN THE KINGDOM OF THAILAND
FINAL REPORT
MANUALS
JUNE 1990

THE STUDY ON TRAFFIC OPERATION PLAN FOR ROADS IN THE KINGDOM OF THAILAND

FINAL REPORT
MANUALS

JUNE 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

CONTENTS OF MANUALS

PART 1 - OD SURVEY MANUAL

PART 2 - TRAFFIC FORECAST MANUAL

PART 3 - TRAFFIC HANDLING MANUAL

PART 4 - GUIDE SIGN BOARD DESIGN MANUAL

PART 1

OD SURVEY MANUAL

TABLE OF CONTENTS

CHAPTER 1 THE ROADSIDE INTERVIEW OD SURVEY

1.1 Policy of Survey....1-1
1.2 Flow of Survey....1-2
1.3 Routes to Be Surveyed and Survey Spots....1-3
1.4 Vehicle Types to Be Surveyed....1-3
1.5 Method of Survey....1-3
1.6 The Sectional Traffic Volume Survey....1-4
1.7 Survey Day and Time....1-4
1.8 Stop Marking/Signs and Prevention of Traffic Accidents....1-4
1.9 Items to Be Surveyed....1-6
1.10 Working on Collected Survey Sheets....1-9
1.11 Summarizing Survey Results....1-10
1.12 Submission of Survey Results....1-10

CHAPTER 2 THE VEHICLE OWNER INTERVIEW OD SURVEY

2.1 Policy of Survey....1-16
2.2 Flow of Survey....1-17
2.3 Areas to Be Surveyed....1-18
2.4 Extraction of Vehicles to Be Surveyed....1-18
2.5 Method of Survey....1-18
2.5.1 Privately-Owned Vehicles....1-18
2.5.2 Business-Oriented Vehicles....1-20
2.6 Production of the Registered Vehicles Table....1-22
2.7 Survey Day and Time....1-23
2.7.1 Privately-Owned Vehicles....1-23
2.7.2 Business-Oriented Vehicles....1-23
2.8 Kinds of Survey Sheets and Items to Be Surveyed....1-24
2.8.1 Survey Sheets....1-24
2.8.2 Attributes of Vehicles to Be Surveyed....1-25
2.8.3 Vehicle Trips on the Survey Day....1-28
2.8.4 Detailed of Each Trip....1-29
2.9 Working on Collected Survey Sheets....1-33
2.10 Summarizing the Survey Results....1-33
2.11 Submission of the Survey Results....1-35
2.12 Screen Line Survey....1-35
2.12.1 Objective....1-35
2.12.2 Establishing the Screen Line....1-36
2.12.3 Survey Day and Time....1-37
2.12.4 Summarizing the Survey Results....1-37

CHAPTER 1 THE ROADSIDE INTERVIEW OD SURVEY

1.1 POLICY OF SURVEY

The roadside interview OD survey is conducted for vehicles passing the cordon line. It consists of a roadside OD survey through interview and a sectional traffic volume survey.

As a general rule, vehicles are surveyed on an individual basis. However, at observation spots with heavy traffic and insufficient roadside space, where individual survey of vehicles seems impossible, they may be surveyed on an extraction basis.

Generally, surveys are conducted on an individual basis. Should it become necessary to select an extraction survey, it should satisfy the requirements in Table 1.1. The common method of extraction employed is time extraction.

Table 1.1 Extraction Rate

Unilateral One-Lane		Unilateral Two-Lane	
Unilateral Hourly Traffic Volume	Extraction Rate	Unilateral Hourly Traffic Volume	Extraction Rate
Less than 200 vehicles	100 %	Less than 400 vehicles	100 %
200-400 vehicles	50% or more	400-800 vehicles	50% or more
400 or more vehicles	25% or more	800 or more vehicles	25% or more

1.2 FLOW OF SURVEY

Figure 1.1 shows the overall flow chart of the survey.

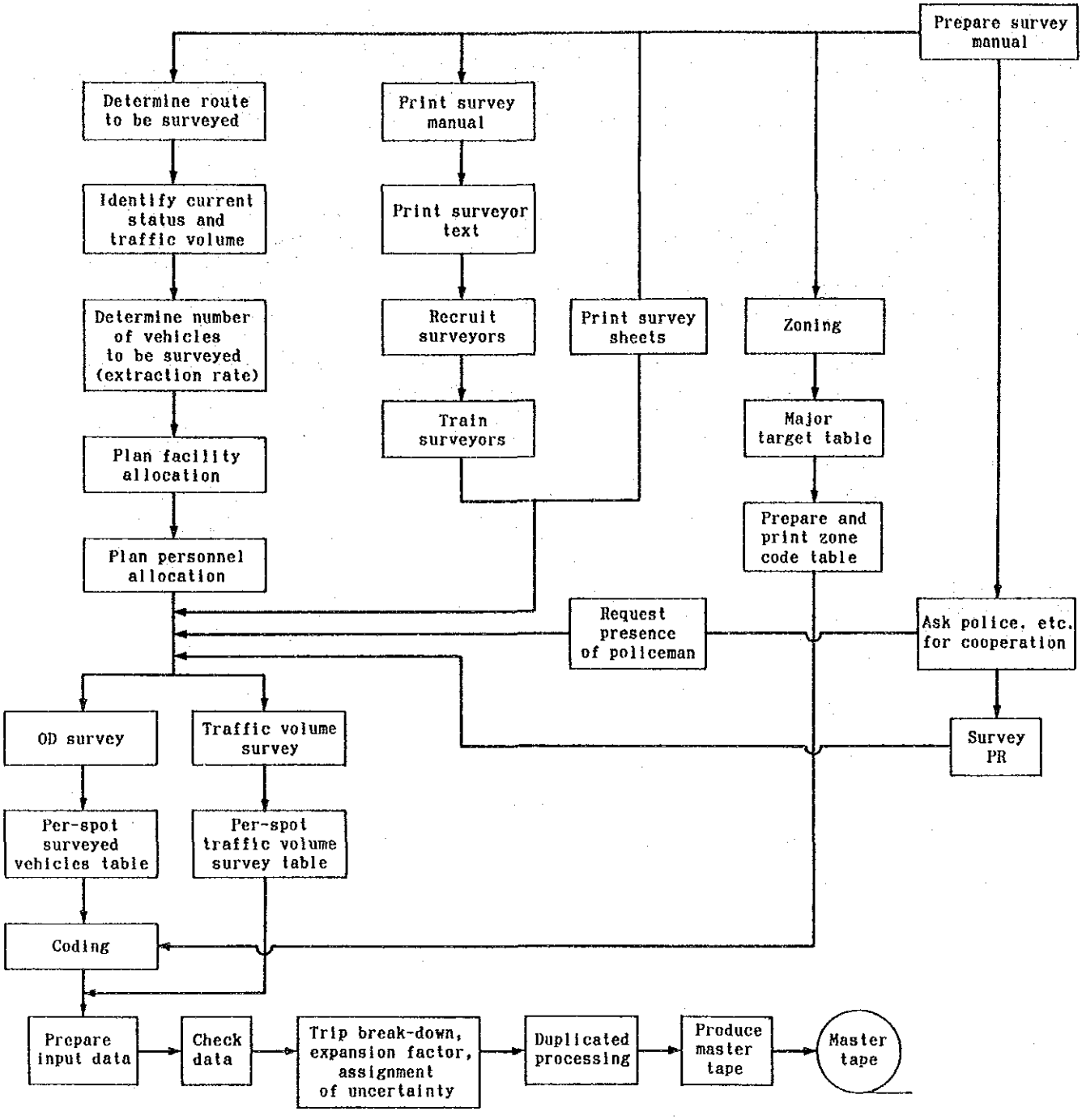


Figure 1.1 Flow Chart of the Roadside Interview OD Survey

1.3 ROUTES TO BE SURVEYED AND SURVEY SPOTS

As a general rule, all the routes (from provincial highway onwards) that cross the cordon line should be surveyed but those routes on which the traffic volume is extremely low may be omitted. Survey spots should be located near the points at which the routes cross the cordon line and where sufficient shoulder space is available.

If a ferry route crosses the cordon line, a survey should be conducted for motor vehicles which utilize the ferry.

If a route to be surveyed is on a freeway and it is found difficult to stop passing vehicles on its main lanes, a survey should be made on the access roads of the nearest interchange as a substitute for the OD survey of that route which crosses the cordon line.

1.4 VEHICLE TYPES TO BE SURVEYED

The types of vehicles to be surveyed are:

1) Motor-tricycle
2) Motorcycle
3) Passenger car
4) Light bus

Note that those vehicles that meet the emergency motor vehicle requirements (i.e., operate a siren and flashing red warning light) and those having unique license plate numbers (such as special vehicles, military vehicles and diplomatic vehicles) are not included.

Those ambulances, fire engines and police cars that have neither their siren nor red flashing light activated are not regarded as emergency motor vehicles and therefore are subject to the survey.

1.5 METHOD OF SURVEY

The survey is carried out in the presence of policemen from the relevant police station by temporarily stopping vehicles that pass the survey spot on the roadside if their types are found to be ones selected for the survey. The information the surveyor obtains through an interview with the driver at the roadside interview is recorded on the OD survey sheet (Survey Sheet 1).

For vehicles whose drivers refuse to cooperate, the surveyor must enter in the survey sheet all data that can be obtained visually and then notify the superintendent that the vehicle has rejected the survey so as to receive further instructions from the superintendent.

1.6 THE SECTIONAL TRAFFIC VOLUME SURVEY

For vehicles passing the survey spot whose type is one of those selected for the survey, traffic volume is observed with respect to direction, time of day, and vehicle type.

The results of the survey are summarized in the roadside per-spot traffic volume survey table (Form 1), which are used in determining the expansion factor.

1.7 SURVEY DAY AND TIME

The survey is carried out nationwide on a designated ordinary day, and lasts 24 hours from 10.00 am of that day until 10.00 am of the next day.

The roadside interview OD survey day can be any weekday except Monday, Friday, Saturday, Sunday, a national holiday, the day before and after a national holiday, a day of abnormal weather (e.g., heavy rain), and a day on which abnormal traffic conditions are expected. The survey usually starts at 10.00 am, which may be changed if necessary. In any case, the survey should last 24 hours.

It is good practice to conduct a preliminary survey (for 30 minutes to one hour before the actual survey starts) to allow the surveyors to get used to their duties.

Should it become difficult to continue the survey because of an accident or some other occurrence, the surveyors can discontinue the survey when so instructed by the superintendent. In this case, the survey will be carried out at a later time.

1.8 STOP MARKING/SIGNS AND PREVENTION OF TRAFFIC ACCIDENTS

The place to stop vehicles should be beyond an incline or curve, and should be provided, for both up and down vehicles, with temporary stop signs, sings requesting

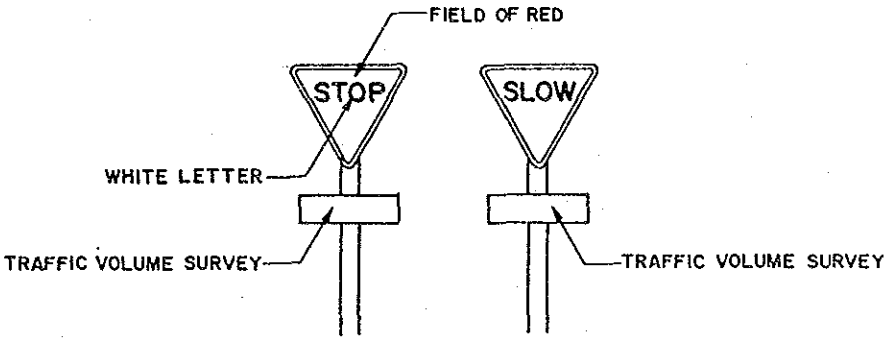
cooperation, red flashing lights and lighting devices (see Figure 1.2).

The surveyor who tries to stop a vehicle should clearly make his intention known to its driver using a red flag or red lamp, so as to prevent accidents.

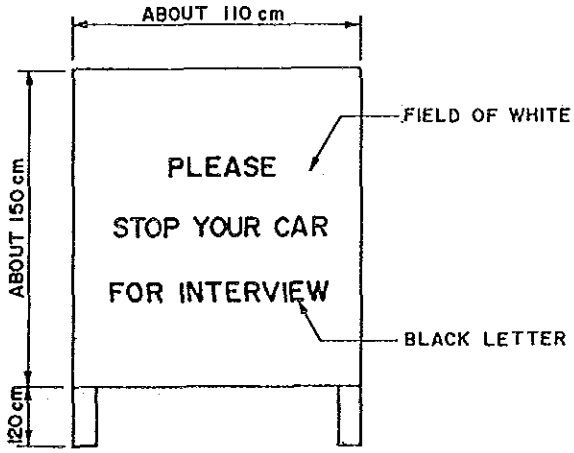
The surveyor and his assistant should wear a yellow arm band 10 cm wide. The surveyor and other persons engaged in the survey should all wear helmets.

To guide motor vehicles smoothly, lines may be drawn at the interview site using paint or lime.

Also, where traffic volume is high or traffic congestion is likely to occur because of limited survey space, measures must be taken which include assigning traffic control personnel. In the event of traffic congestion, driver cooperation must be requested using a loud-speaker, etc.



Temporary Stop Sign



Sign Requesting Cooperation

Figure 1.2 Roadside Interview OD Survey Signs

1.9 ITEMS TO BE SURVEYED

The items to be surveyed may be grouped into the time of day of interview, attributes of vehicles to be surveyed, and details of trip.

The items to be surveyed are shown in Table 1.2. Efforts should be made to reduce vehicle stop time as much as possible. Entry methods are as follows:

Table 1.2 Items to Be Surveyed

Classification	Survey Item	Entry Method		
		A	B	C
1. Identification number	1) Serial number (by inbound/outbound destination)	Entry after survey		
2. Survey spot	2) Spot number	o		
	3) Inbound/outbound destination	o		
3. Interview time	4) Interview time	o		
4. Vehicle attributes	5) Vehicle type		o	
	6) Type of ownership		o	
	7) Name suspection and registration		o	
5. Trip detail	8) Origin			o
	9) Destination			o
	10) Purpose of operation (privately owned vehicle only)			o
	11) Number of passengers in vehicle		(o)	o
	12) Item being carried (truck only)			o
	13) Weight being carried			o

Note: A: Entry should be made prior to driver interview.
B: Entry should be made by the surveyor who visually checks the vehicle.
C: Entry should be made by the surveyor who interviews the driver. (The number of persons in the vehicle should be entered before the interview, if it can be confirmed visually.)

1) Enter a serial number which starts at "1". A separate series of numbers is used for each survey spot and for inbound/outbound direction. Note that this number is entered after survey sheets have been collected.

2) Enter the inbound/outbound vehicle identification. Inbound/outbound identification is made based on the direction of a route; a outbound vehicle is one traveling in a starting-to-ending point direction of a route.

Table 1.3 Direction Codes

Direction	Code
Inbound	1
Outbound	2

3) Enter the hour at which the vehicle was surveyed. For instance, enter 8 if the vehicle was surveyed between eight and nine o'clock. This time is based on the time the interview is about to commence.

4) Enter the type of the vehicle surveyed according to the following table:

Table 1.4 Vehicle Type Codes

Vehicle type	Code
Motor-Tricycles	1
Motorcycles	2
Passenger Car	3
Light Bus	4
Heavy Bus	5
Light Truck or Pick-up	6
6 Wheel Truck	7
10 Wheel Truck or Trailer	8

5) Enter the type of ownership associated with the vehicle surveyed according to the following table:

Table 1.5 Ownership Codes

Type	Code
Privately-owned	1
Business-oriented	3

6) Enter the letters written on the vehicle's license number plate which identify motor vehicle inspection and registration office.

7) Enter the origin and destination of the trip and the "Tambon" name after confirming them from the interview. If the "Tambon" name is not immediately known, ask the driver to tell the name of a well-known place, building, station or bus stop which can serve as an identifier, so as to permit the use of the zone code.

8) For privately-owned vehicles (both passenger cars and trucks), enter the purpose of the trip according to the following table:

Table 1.6 Purpose-of-Trip Codes

Purpose	Code
Going to work	1
Going to school	2
Business A (not involving carriage of goods; not including "going back to office")	3
Business B (involving carriage of goods)	4
Housekeeping or shopping	5
Social, amusement, sightseeing or recreation	6
Going back to office	7
Going home	8

9) Enter the number of persons in the vehicle (including the driver) regardless of which lane the vehicle was in. For buses, an estimated number of persons may be entered.

10) For trucks (both privately-owned and business-oriented), enter the item the vehicle is carrying according to the following table. If the vehicle is carrying two or more different items, the one being carried in the largest quantity should be entered. If it is difficult to choose this representative item, the category of Unclassifiable Item should be used.

Table 1.7 Codes for Items Being Carried

Item	Code
Empty	1
Farm or marine product	2
Forest product	3
Mine product	4
Metal or machine product	5
Chemical product (including ceramics, and petroleum and coal products)	6
Light-industry product	7
Miscellaneous goods	8
Product of special kind	9
Unclassifiable item	10

11) For trucks (both privately-owned and business-oriented), enter the approximate weight (tons; in 0.1-ton increments) of the item being carried. If two or more different items are being carried, enter their total weight (tons).

1.10 WORKING ON COLLECTED SURVEY SHEETS

The agency in charge of the survey collects survey sheets at each survey spot. A series of numbers, starting at "1" for each survey spot, is entered in the margin of these collected survey sheets. The survey sheets also are supplied with the zone code.

Those survey sheets which do not have a clear description of (1) observation spot number, (2) inbound/outbound distinction, or (3) the "Changwat" name at origin or destination are treated as invalid sheets. After the removal of invalid sheets, a series of identification numbers are assigned to the remaining sheets again, and the number of vehicle surveyed is entered in the roadside per-spot surveyed vehicles table (Form 2) by direction, time of day and vehicle type.

In addition, the responsible person at each survey spot enters the survey day's weather, survey conditions, problems encountered, etc. in the roadside interview OD survey condition report (Form 4).

1.11 SUMMARIZING SURVEY RESULTS

Based on the collected survey sheets, the surveyed vehicle count and effective surveyed vehicle count by inbound/outbound direction, time of day and vehicle type obtained for each survey spot, the collection rate is calculated using the following equation. The results are then summarized in the per-spot roadside interview OD survey collection rate table (Form 3).

$$\text{Collection Rate} = \frac{\text{Effective Surveyed Vehicle Count}}{\text{Traffic Volume}}$$

The effective surveyed vehicle count refers to the vehicle count obtained from valid survey sheets only. The traffic volume refers to the sectional traffic volume at the survey spot. The collection rate (in percent) should be calculated to one decimal place.

1.12 PRESENTATION OF SURVEY RESULTS

The survey sheet collected for each survey spot are submitted together with the roadside OD interview survey per-spot traffic volume table (Form 1), the roadside interview OD survey per-spot surveyed vehicles table (Form 2), the roadside interview OD survey per-spot collection rate table (Form 3), and the roadside interview OD survey condition report (Form 4).

The surveyed vehicle count corresponds to the total number in the survey sheets, and the effective surveyed vehicle count is equal to the total number in the survey sheets minus the number in the invalid survey sheets (i.e., the number of vehicles in Form 2). The traffic volume refers to the sectional traffic volume at the survey spot (the number of vehicles in Form 1).

Sheet 1 Roadside Interview OD Survey Card

Identification No.	Survey Spot No.	Direction	Time	Vehicle Type	Ownership	Name of Inspection and Registration Office	Remarks
Serial No. for inbound and outbound	Check with survey point map	☐ 1 Inbound ☐ 2 outbound	Hour eg.(10:15→10) (13:30→13)	☐ 1. Motor-tricycle ☐ 2. Motorcycle ☐ 3. Passenger Car ☐ 4. Light Bus ☐ 5. Heavy Bus ☐ 6. Light Truck or Pick-up ☐ 7. 6 wheel Truck ☐ 8. 10 wheel Truck	☐ 1 Privately-Owned ☐ 2 Business-Oriented		
☐☐☐☐	☐☐	☐☐	☐☐	☐☐	☐	☐☐	

Origin	Destination	Trip Purpose	No. of Passenger	Type of Cargo	Capacity	Volume
Address <If not clear state the name of nearby wellknown place>	Address <If not clear state the name of nearby wellknown place>	☐ 1 Going to work ☐ 2 Going to school ☐ 3 Business A ☐ 4 Business B ☐ 5 Housekeeping or shopping ☐ 6 Social intercourse ☐ 7 Going back to office ☐ 8 Going home	No. of Passengers including Driver	☐ 1 Empty ☐ 2 Farm of marine ☐ 3 Forest product ☐ 4 Mine product ☐ 5 Metal or machine product ☐ 6 Chemical product ☐ 7 Light-industry product ☐ 8 Miscellaneous goods ☐ 9 Product of special kind ☐10 Unclassifiable item	Permission Capacity in ton	☐ 1 Full ☐ 2 3/4 ☐ 3 Half ☐ 4 1/4
☐☐☐	☐☐☐	☐	☐☐☐	☐	☐☐	☐

Form 1 Roadside OD Interview Survey Per-spot Traffic Volume Table

Road Classification		Route NO.	
Name of survey spot			

Serial number of survey spot | | | | |

Inbound/Outbound Identification (Inbound,Outbound,Total)

Vehicle / Hour	Passenger car	Light bus	Heavy Bus	Light Truck or Pick-up	6-wheel Truck	10-wheel Truck or Trailer	Motor Tricycle	Motorcycle	Total	Remark
10 - 11										
11 - 12										
12 - 13										
13 - 14										
14 - 15										
15 - 16										
16 - 17										
17 - 18										
18 - 19										
19 - 20										
20 - 21										
21 - 22										
22 - 23										
23 - 24										
24 - 1										
1 - 2										
2 - 3										
3 - 4										
4 - 5										
5 - 6										
6 - 7										
7 - 8										
8 - 9										
9 - 10										
Total										

Form 2 Roadside OD Interview Survey Per-spot Surveyed Vehicles Table

Road Classification		Route NO.	
Name of survey spot			

Serial number of survey spot | | | | |

Inbound/Outbound Identification (Inbound,Outbound,Total)

Vehicle / Hour	Passenger car	Light bus	Heavy Bus	Light Truck or Pick-up	6-wheel Truck	10-wheel Truck or Trailer	Motor Tricycle	Motorcycle	Total	Remark
10 – 11										
11 – 12										
12 – 13										
13 – 14										
14 – 15										
15 – 16										
16 – 17										
17 – 18										
18 – 19										
19 – 20										
20 – 21										
21 – 22										
22 – 23										
23 – 24										
24 – 1										
1 – 2										
2 – 3										
3 – 4										
4 – 5										
5 – 6										
6 – 7										
7 – 8										
8 – 9										
9 – 10										
Total										

Form 3 Roadside OD Interview Survey Per-spot Collection Rate

Road Classification		Route NO.	
Name of survey spot			

Serial number of survey spot

Inbound/Outbound Identification (Inbound, Outbound, Total)

Vehicle / Hour	Passenger Car				Light Bus				Heavy Bus				Light Truck or Pick-up				6-wheel Truck				10-wheel Truck or Trailer				Motor Tricycle				Motorcycle				Total			
	(A)	(B)	(C)	(D)	(A)	(B)	(C)	(D)	(A)	(B)	(C)	(D)	(A)	(B)	(C)	(D)	(A)	(B)	(C)	(D)	(A)	(B)	(C)	(D)	(A)	(B)	(C)	(D)	(A)	(B)	(C)	(D)	(A)	(B)	(C)	(D)
10 - 11																																				
11 - 12																																				
12 - 13																																				
13 - 14																																				
14 - 15																																				
15 - 16																																				
16 - 17																																				
17 - 18																																				
18 - 19																																				
19 - 20																																				
20 - 21																																				
21 - 22																																				
22 - 23																																				
23 - 24																																				
24 - 1																																				
1 - 2																																				
2 - 3																																				
3 - 4																																				
4 - 5																																				
5 - 6																																				
6 - 7																																				
7 - 8																																				
8 - 9																																				
9 - 10																																				
Total																																				

Note : (A) Traffic Volume
(B) Surveyed vehicle count
(C) Effective surveyed vehicle count
(D) Collection rate = (C)/(A)

Form 4 Roadside Interview OD Survey Condition Report

Route NO.			Name of survey spot		
Survey day and time			Responsible person name		
Problems in survey					
Problems in coding					
Survey condition	Item	Peak hour	Day time (7h – 19h)	Night time (19h – 7h)	Total
	Traffic volume	(veh/h)	(veh/12h)	(veh/12h)	(veh/24h)
	Surveyed vehicles	(veh/h)	(veh/12h)	(veh/12h)	(veh/24h)
	Interviewer	(veh/h)	(veh/12h)	(veh/12h)	(veh/24h)
	Assistant	(veh/h)	(veh/12h)	(veh/12h)	(veh/24h)
	Traffic control personel	(veh/h)	(veh/12h)	(veh/12h)	(veh/24h)
	Supervisor	(veh/h)	(veh/12h)	(veh/12h)	(veh/24h)
	Presence policeman	(veh/h)	(veh/12h)	(veh/12h)	(veh/24h)
	Total	(veh/h)	(veh/12h)	(veh/12h)	(veh/24h)
	Facility				
	Lenght of survey section	Inbound lane	(m.)	Outbound lane	(m.)
	Number of coding sheets	(sheets)	Number of checking sheets		(sheets)
	Number of coding days	(days)	Number of checking data		(days)
	Number of coding persons	(man–days)	Number of checking persons		(man–days)
Others					

CHAPTER 2 THE VEHICLE OWNER INTERVIEW OD SURVEY

2.1 POLICY OF SURVEY

The vehicle owner interview OD survey is conducted for vehicles extracted nationwide. Vehicle owners are visited and interviewed for information about trips made in their vehicles; those during a single ordinary day (24 hours from 3.00 am of that day until 3.00 am of the next day) in the case of privately-owned vehicles, and those during the first trip day during a period of three ordinary days (24 hours from 0.00 am of that day until 0.00 am of the next day) in the case of business-oriented vehicles. The screen line survey is also conducted to observe traffic volume within the selected area.

The OD survey typically is conducted as an extraction survey, and the original survey data is expanded such that the survey results are equivalent to those obtained by a survey conducted on an individual basis.

The screen line survey is carried out to determine the volume of traffic that crosses an established screen line. It permits checking the accuracy of vehicle owner interview OD survey results.

2.2 FLOW OF SURVEY

Figure 2.1 shows the overall flow chart of the survey.

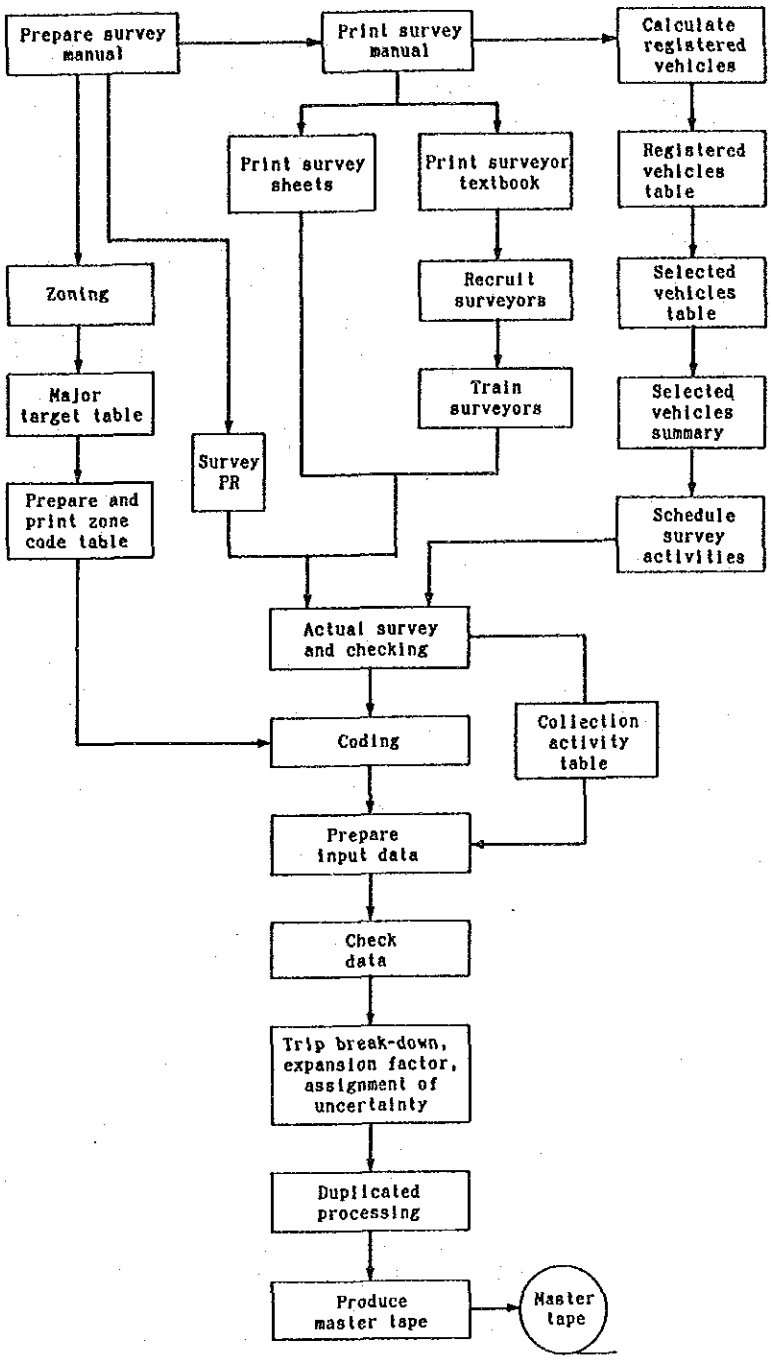


Figure 2.1 Flow Chart of the Vehicle Owner Interview OD Survey

2.3 AREAS TO BE SURVEYED

The entire areas of each "Changwat" have to be surveyed.

Islands connected to the mainland via bridges, etc. will be subjected to the survey.

2.4 EXTRACTION OF VEHICLES TO BE SURVEYED

Vehicles to be surveyed are extracted at random from motor vehicle registration files. This extraction should be conducted separately for each vehicle type and industry type, using extraction rates prescribed for each Changwat selected.

Vehicles that have been extracted are grouped according to Amphoe/Tambon distinction, vehicle type, and industry type to produce the vehicle owner interview OD survey selected vehicle list (Form 2) and the vehicle owner interview OD survey selected vehicle count table (Form 3).

The number of vehicles to be extracted for the survey should be 20 to 30% greater than that obtained by multiplying the number of registered vehicle by an applicable extraction rate. These additional vehicles may be used instead of those no longer in service or those which the owner might refuse to have surveyed.

2.5 METHOD OF SURVEY

2.5.1 Privately-Owned Vehicles

The procedure for conducting the vehicle owner interview OD survey is:

1) Using prescribed extraction rates, extract vehicles of the type to be surveyed which have their "base for use" within the area selected for the survey.

2) Fix the survey day for each of the vehicles to be surveyed. Have the surveyor visit the vehicle's user one or two days before the survey day. The surveyor should hand out a vehicle owner interview OD survey sheet to the user, explain the purpose of the survey, and ask the user to enter the vehicle trips on the survey day in the survey sheet.

3) Have the surveyor visit the user once again within a few days of the day after the survey day. The surveyor

should confirm the entries made by the user before collecting the survey sheet. If the surveyor finds any omissions, he should make necessary entries in the sheet by interviewing the user on the spot.

When asking vehicle users to enter necessary information in their survey sheets in the vehicle owner interview OD survey, it is necessary to hand out a pamphlet which should help the users understand the purpose of the survey. It also is good practice to send postcards asking for their cooperation before actually visiting them.

The surveyors, who actually carry out the survey, should be well trained so that they have a good knowledge of what they should do to achieve an accurate survey. A text-book explains how the survey should be done in an easy-to-understand manner must be made available for this training purpose.

The days on which the survey sheets will be distributed and collected must be fixed with due consideration given to the number of surveyors available and the distribution of the places where the vehicles have been registered.

For some of the items on the survey sheet, including registration number, user's name and address, vehicle base, vehicle type and survey day, the surveyor must make entries before visiting the users to ask for their cooperation in filling in the survey sheet.

There are two kinds of survey sheets; the passenger car survey sheet and the truck survey sheet. To distinguish between them, measures should be taken, such as using sheets different in color, or printing in different colors.

Once the survey day has been fixed, the surveyor is not allowed to change it at his discretion. When collecting the survey sheets, the surveyor must check to see that the sheet has been filled in completely and properly.

Should any trouble occur during the survey, notify it to the superintendent. The superintendent should take appropriate measures, such as those listed below, and select substitute vehicles from an additional sample, if necessary, to continue the survey.

1) Enter "refused" if the survey was refused.

2) Enter "out of service" if the vehicle is no longer in service.

3) If the vehicle is being used by a different user:

- Enter "transferred (address unknown)" if the vehicle has been transferred to some other person and his/her address is unknown.

- If the new user is in the same Amphoe or Tambon, change the name and address and visit him/her for a survey.

- If the new user is not in the same Amphoe or Tambon, enter "transferred (residing outside)".

Also, special attention should be paid to vehicles which are temporarily out of service. "Temporarily out of service" means that the vehicle made no trip at all on the survey day. Such vehicles should be considered as important as those that did make trips. The circumstances that have led to "temporarily out of service" must be investigated carefully.

Figure 2.2 shows the general flow of the survey procedure.

2.5.2 Business-Oriented Vehicles

The procedure for conducting the survey for business-oriented vehicles is:

1) Business interview survey

   (1) Using prescribed extraction rates, extract vehicles of the type to be surveyed which have their "base for use" within the area selected for the survey.

   (2) Have the surveyor visit the vehicle's business premises at the latest a week before the designated survey day. The surveyor should hand out a survey sheet, explain the purpose of the survey, and ask the business to enter the vehicle trips on the survey day in the survey sheet.

   (3) Have the surveyor visit the business again within a few days after the designated survey day. The surveyor should confirm the entries made by the business before collecting the survey sheet.

2) Route bus trip survey

   All vehicles are subject to the survey where they operate as route buses on all existing service routes.

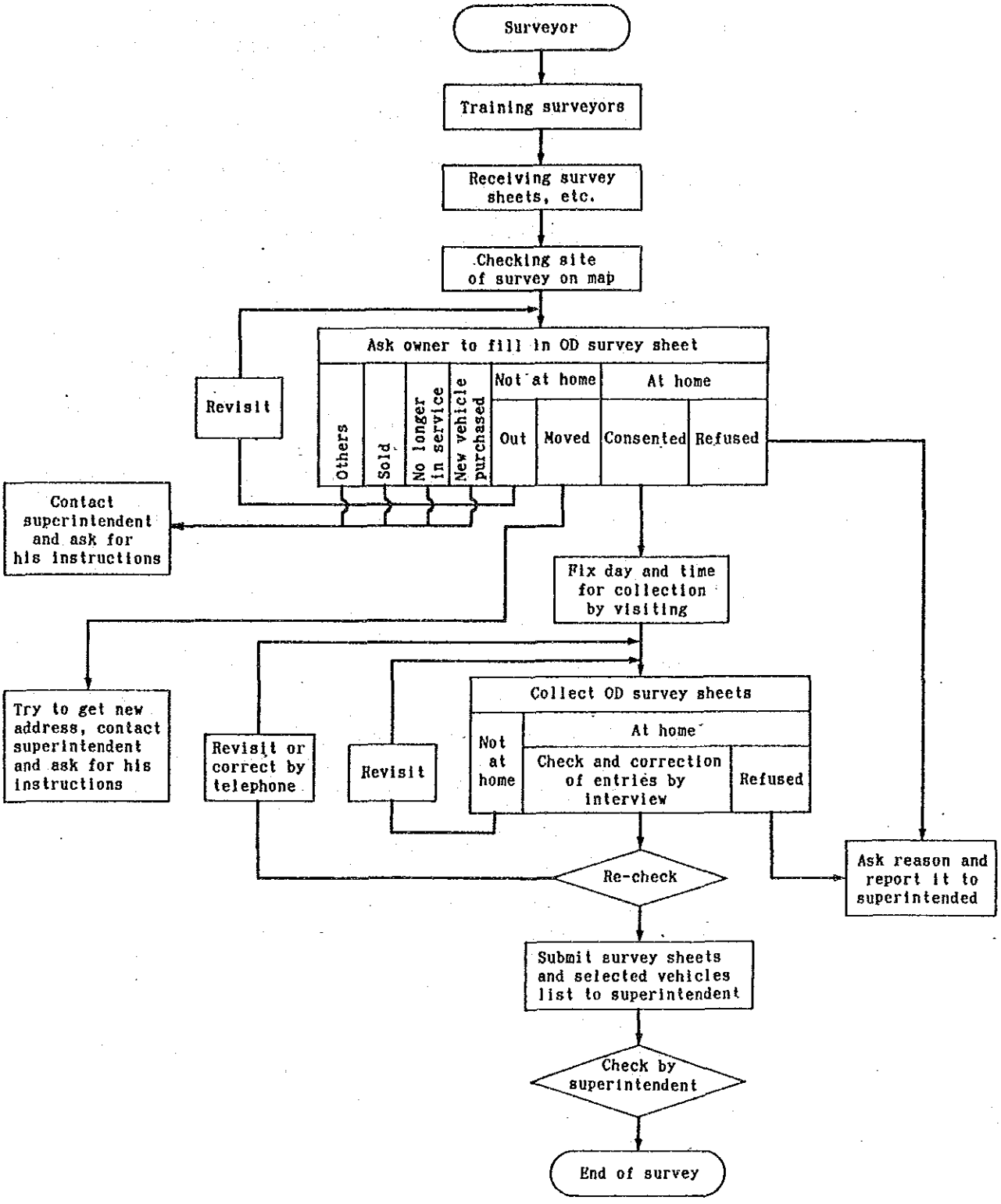


Figure 2.2 Survey Procedure

This explosion applies to the business interview survey. If a vehicle to be surveyed has already been de-registered or transferred and a vehicle acquired as a substitute is of the same vehicle type with the same carrying capacity and fuel type, then the substitute vehicle will be subjected to the survey. If no substitute is acquired for the vehicle or if a substitute acquired does not satisfy the three requirements, the vehicle is regarded as "no longer in service or changed". The surveyor must enter this fact in the survey sheet for the vehicle before collecting it.

A vehicle which is virtually no longer in service but has not yet been de-registered is considered to be "temporarily out of service". If a vehicle cannot be surveyed on the designated survey day, a substitute for it should be selected and surveyed according to the substitute vehicle selection principle mentioned above.

If no trip is made on the designated survey day, vehicle trips on the next day are surveyed. If no trip is made also on the next day, vehicle trips on the day after the next day are surveyed. If no trip is made during this three-day period, the survey is considered complete when "Distance traveled during the Day" is reached.

2.6 PRODUCTION OF THE REGISTERED VEHICLES TABLE

The number of vehicles of the type to be surveyed which have their "base for use" within the area selected for the survey is examined separately for Amphoe/Tambon distinction and for each vehicle type and industry type, and then entered in the registered vehicles table (Form 1).

The number of registered vehicles provides the basis on which the expansion factor, discussed later, is calculated. The registered vehicles table therefore must always be produced.

Vehicles of special kind should also be included in the table because it is difficult to distinguish those vehicles not subjected to the survey from those subjected to it. The "Changwat" total must always be entered.

2.7 SURVEY DAY AND TIME

2.7.1 Privately-Owned vehicles

An ordinary day is selected at random as the survey day for each of the vehicles to be surveyed. Trips that are made during the 24-hour period from 3.00 am of the survey day until 3.00 am of the next day are subjected to the survey.

A trip that started before 3.00 am of the survey day and ends during the survey period is not subject to the survey. The survey is conducted for any trips that start from their departure end (the destination of the previous day's last trip) at or after 3.00 am of the survey day. A trip that started before 3.00 am of the day after the survey day and does not end during the survey period is subject to the survey (until the trip reaches the arrival end).

A single day, from Tuesday through Thursday, should be selected at random as the survey day for each of the vehicles to be surveyed. This is necessary to ensure balance between zones. The survey day and the day before and after it should not fall on a national holiday.

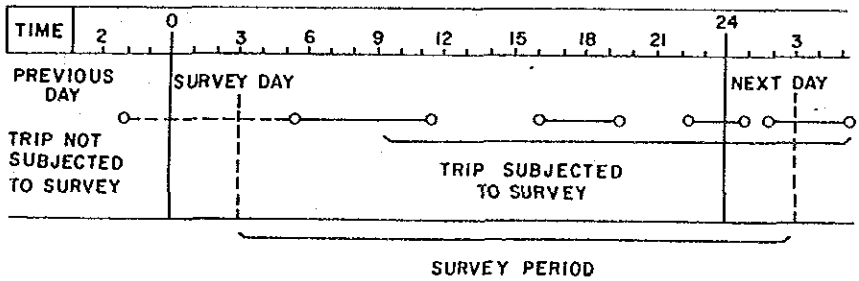


Figure 2.3 Trips Subjected to the Survey

2.7.2 Business-Oriented Vehicles

The survey day (period) and time depends on the kind of survey to be conducted as follows:

1) Business interview survey

An ordinary day is selected as the survey day. If no trip is made on the designated survey day, the next day will be selected as the survey day. If no trip is made also on the next day, the day after the next day will be selected.

The survey is conducted for any trips that are made during the 24-hour period from 0.00 am of the survey day until 0.00 am of the next day.

2) Route bus trip survey

The survey period is one year from October 1 of the year until the end of September of the next year.

Since the route bus trip survey is not a survey on a single ordinary day, its results will be converted to per-day results.

2.8 KINDS OF SURVEY SHEETS AND ITEMS TO BE SURVEYED

2.8.1 Survey Sheets

The survey is conducted to check the attributes of vehicles to be surveyed, vehicle trips on the survey day, and details of each of the trips.

The following six kinds of survey sheets are used:

1) Survey Sheet 2: Passenger Cars

This sheet is intended for privately-owned passenger motor vehicles (motorcycle, motor-tricycle, passenger cars, buses, light truck).

2) Survey Sheet 3: Trucks

This sheet is intended for privately-owned goods motor vehicles (light trucks, 6 wheel trucks, 10 wheel trucks).

3) Survey Sheet 4: Taxis

This sheet is intended for vehicles used by those who provide ordinary passenger motor vehicle services.

4) Survey Sheet 5: Goods motor vehicles

This sheet is intended for vehicles used by those who provide specific goods transportation services in the ordinary area.

5) Survey sheet 6: Chartered Buses

This sheet is intended for vehicles used by those who provide ordinary chartered passenger motor vehicle services.

6) Survey sheet 7: Route Buses

This sheet is intended for vehicles used by those who provide ordinary passenger motor vehicle services.

The items to be surveyed are shown in Table 2.1.

2.8.2 Attributes of Vehicles to Be Surveyed

1) Enter the registration number and the name of the user of the vehicle to be surveyed.

2) Enter a serial identification number which starts at "1". A separate series of numbers is used for each kind of survey sheet (passenger cars/trucks). Note that this number is to be entered when working on collected survey sheets.

3) Enter the sex of the primary driver. "Primary driver" refers to the person who made the largest number of trips during the day. If two or more persons fall under this category, the one with the longest total distance traveled will be selected.

4) Enter the age of the primary driver using a multiple of 10 (years). "Primary driver" refers to the person who made the largest number of trips during the day. If two or more persons fall under this category, the one with the longest total distance traveled will be selected.

5) Enter the location of the "base for use" of the vehicle to be surveyed (down to "Tambon" name). The location of the base for use is known down to city/town/village level. The surveyor should enter it in advance.

6) Enter the vehicle type according to the following table:

Table 2.1 Survey Items

		Sheet 2 Passenger cars	Sheet 3 Trucks	Sheet 4 Taxis	Sheet 5 Goods Motor vehicles	Sheet 6 Chartered buses	Sheet 7 Route buses	Route tracks
(1) Attributes of vehicles to be surveyed	1 Registration number	○	○	○	○	○		
	2 Serial identification number	○	○	○	○	○	○	
	3 Sex of the primary driver	○	○					
	4 Age of the primary driver	○	○					
	5 Location of the base for use	○	○	○	○	○	○	
	6 Vehicle type	○	○		○			
	7 Ownership	○	○					
	8 Industry type		○					
	9 Maximum loading capacity		○		○			
	10 Fuel Type	○	○	○	○	○		
	11 Operation type				○			
	12 Seating capacity			○		○		
(2) Vehicle trip on the survey day	1 Kilometers travelled on the survey day	○	○	○	○	○		
	2 Number of trip made on the survey day	○	○		○	○		○
	3 Vehicle type				○	○		
(3) Details of each trip	1 Departure point or destination	○	○	○	○	○	○	○
	2 Major point of passage on the service route						○	○
	3 Facility	○	○		○			
	4 Departure time	○	○	○	○	○		
	5 Distance travelled	○	○	○	○	○		○
	6 Purpose of trip	○	○					
	7 Number of persons in the vehicle	○	○	○	○	○		
	8 Parking lot	○	○					
	9 Carried item		○		○			
	10 Weight of carried item		○		○			
	11 Reason of using vehicle	○						
	12 Urban expressway use / non use	○	○	○	○	○		
	13 On / Off-interchange name	○	○	○	○	○		
	14 Length of the service route						○	
	15 Number of operations per day						○	
	16 Number of persons transported annually						○	
	17 Number of days operated annually						○	
	18 Number of kilometers travelly annually						○	
	19 Average distance transported per person						○	

Table 2.2 Vehicle Type Codes

		Vehicle Type	Code
Survey sheet 2	Passenger cars	Motorcycle	1
		Motor-tricycle	2
		Passenger Car	3
		Light Bus	4
		Heavy Bus	5
		Light Truck	6
Survey sheet 3	Trucks	Light Truck or Pick-up	1
		6-wheel Truck	2
		10-wheel Truck or Trailer	3
Survey sheet 5	Goods motor vehicles	Light Truck or Pick-up	1
		6-wheel Truck	2
		10-wheel Truck or Trailer	3

7) Enter the type of ownership of the vehicle to be surveyed according to the following table:

Table 2.3 Ownership Codes

Ownership		Code
Privately-owned	Individual-owned	1
	Corporation-owned	2

8) Enter the type of industry associated with the privately-owned truck according to the following table:

Table 2.4 Industry Type Codes

Type of Industry	Code
Agriculture, forestry or fishery	1
Mining	2
Construction	3
Manufacturing	4
Wholesale	5
Retail	6
Financial, insurance or real estate	7
Transportation or Communication	8
Public utility	9
Services	10
Official duties	11
Other	12

9) For a truck, enter the maximum loading capacity (in kg).

10) Enter the engine's fuel type according to the following table:

Table 2.5 Fuel Type Codes

Fuel Type	Code
Gasoline	1
Light oil	2
L P G	3
Electricity	4
Others	5

11) For a goods motor vehicle, enter the operation type according to the following table:

Table 2.6 Operation Type Codes

Operation Type	Code
Operated as route truck	1
Operated as non-route truck	2

12) For a taxi or chartered bus, enter the seating capacity.

2.8.3 Vehicle Trips on the Survey Day

1) Check the odometer readings (unit:km) at the start of the first trip and at the end of the last trip on the survey day. The total kilometers traveled on the survey day is obtained from the difference between the two readings.

2) Check the number of trips made on the survey day. A trip is a movement made from one place to another to achieve a given objective. Going for a newspaper, a pack of cigarettes or gasoline on the way to the destination does not terminate the trip. Moving about within the same lot also does not constitute a separate trip.

3) Survey vehicle trips during a 3-day period (the designated survey day, the next day, and the day after the next day).

2.8.4 Details of Each Trip

1) Enter the departure point and destination of each trip (including "Amphoe" or "Tambon" name). Also, if there is a well-known place, building, station or bus top located nearby which can serve as a target, ask the owner to enter it in the survey card so that zone code may be supplied after is collected.

2) For a route bus, enter the major point of passage on the service route.

3) Enter the type of facility at the departure point and destination according to the following table. If two or more facilities coexist, facility classification should be based on the purpose of the trip. For instance, if the purpose of the trip is to go home, a building intended for both housing and shopping should be classified as "housing". On the other hand, if the purpose of the trip is to do business, it should be classified as "business facility". "Others (8)" should be selected when a trip is made to a field.

Table 2.7 Facility Codes

Facility type	Code
Housing	1
Business	2
Office	3
Plant	4
Education/welfare	5
Traffic/transportation	6
Warehouse	7
Others	8

4) For passenger cars and trucks, enter the departure time (24 hour indicator) by each trip.

5) Enter the distance traveled (unit: km) from departure point to destination for each trip. Recording trip meter readings upon departure and arrival of each trip is recommended. If this is not feasible, ask the owner to get an estimated distance on the road map.

6) Enter the purpose of the trip according to the following table:

Table 2.8 Purpose-of-Trip Codes

Purpose	Code
Going to work	1
Going to school	2
Business A (not involving carrying of goods; not including "going back to office")	3
Business B (involving carrying of goods)	4
Housekeeping or shopping	5
Social intercourse, amusement, sightseeing or recreation	6
Going back to the office	7
Going home	8

7) Enter the number of persons in the vehicle (including the driver)

8) Enter the type of the parking lot at the destination according to the following table:

Table 2.9 Parking Lot Codes

	Parking Lot Type		Code
On-street	Free		1
	Toll		2
Off-street	Free	Home garage	3
		Office or store ground	4
		Station square	5
		Vacant lot, etc.	6
	Toll	Monthly-payable parking lot	7
		Unreserved parking lot	8
		Did not park	9

9) For a privately-owned truck, enter the item the vehi cle is carrying according to the following table. If the vehicle is carrying two or more items, the one being carried in largest quantity should be entered. If it is difficult to choose this representative item, "unclassifiable item" (see the table) should be entered.

Table 2.10 Codes for Items Being Carried (Privately-Owned Vehicle)

Item	Code
Empty	1
Farm or marine product	2
Forest product	3
Mine product	4
Metal or machine product	5
Chemical product (including ceramics, petroleum product or coal product)	6
Light industry product	7
Miscellaneous goods	8
Product of special kind	9
Unclassifiable item	10

10) For a business-oriented goods motor vehicle, enter the item the vehicle is carrying according to the following table. If the vehicle is carrying two or more items, the one being carried in largest quantity should be entered. If it is difficult to choose this representative item, "unclassifiable item" (see the table) should be entered.

Table 2.11 Codes for Items Being Carried (Business Oriented Vehicles)

Item	Code	Item	Code
Empty	1	Petroleum product	16
Grain	2	Chemical	17
Vegetable or fruit	3	Chemical fertilizer	18
Farm product	4	Other chemical product	19
Marine product	5	Paper or pulp	20
Other agricultural product	6	Textile industry product	21
		Food industry product	22
Lumber	7	Daily necessities industry product	23
Firewood or charcoal	8		
Metal Ore	9	Other manufacturing industry product	24
Nonmetal ore (for construction	10		
		Scrap	25
Nonmetal ore (for industry	11	Animal/vegetable feed or fertilizer	26
Metal	12	Waste mattes	27
Metal product	13	Carrying container	28
Machinery	14	Mired goods	29
Ceramics	15	Unclassifiable item	30

11) For a truck, enter the approximate weight (kg) of the item being carried. If the item is heavy, its weight may be entered using a multiple of 100 (kg). If the vehicle is carrying two or more items, enter their total weight (kg).

12) For a passenger car, enter the chief reason why the car was used according to the following table. This information must be entered on a trip-by-trip basis.

Table 2.12 Reason Codes

Reason	Code
There is no other means of transportation	1
There are other means of transportation, but - the car is faster, - there is no need for a change, - the car is more comfortable, - there is baggage to be carried, - there are many people, - the car is more economical, or - other.	 2 3 4 5 6 7 8
Because the car has to (or had to) be used for some other purpose.	9

13) Enter whether an urban expressway was used or not according to the following table:

Table 2.13 Urban Expressway Use Codes

Use	Code
Yes	1
No	0

14) If an expressway was used, enter the interchange name. If an expressway was used two or more times during a trip, enter the name of the first interchange.

15) For a route bus, enter the length (in kilometers) of the service route on which the trip is made. If the trip's departure point is not designated as its destination, the length of the service route should be entered without modification. However, if the trip's departure point is designated as its destination with a major point of passage between them, the trip must be broken down into four trips (starting point ——> point of passage ——> ending point ——> point of passage ——> ending point), and the length of the service route must be reduced to half.

16) For a route bus, enter the number of operations per day. Double the number of trips in the service schedule to enter it as its one-way equivalent.

17) For a route bus, enter the number of persons transported annually, using 1,000 persons as the unit. Any fractions should be rounded.

18) For a route bus, enter the number of days operated annually.

19) For a route bus, enter the number of kilometers traveled annually, using 1000 kilometers as the unit.

20) For a route bus, enter the average distance transported per person. The average number of kilometers traveled per person is usually based on a fact-finding survey conducted separately for each service route, but is can be an estimated value if no fact-finding survey has been carried out.

2.9 WORKING ON COLLECTED SURVEY SHEETS

Collected survey sheets should be put together to form the Amphoe and Tambon groups according to the location of base for use, and a serial number (starting at "1" for each "Changwat") should be entered in the upper left corner of each survey sheet. Also, the survey sheets should be supplied with a zone code according to the zone code entry rules.

Those survey sheets which do not have a clear description of (1) the name of Amphoe or Tambon at the location of base for use, (2) the vehicle type and industry type, or (3) the name of "Changwat" at the departure point and estimation, are treated as invalid sheets. After the removal of invalid sheets, a series of identification numbers should be entered in the upper right corner of the survey sheets.

2.10 SUMMARIZING THE SURVEY RESULTS

Based on the collected survey sheets, the collected vehicle count and effective collected vehicle count are determined separately for each vehicle type and industry type, and the collection rate and effective collection rate are computed using the following equations:

o Collection Rate $= \dfrac{\text{Collected Vehicle Count}}{\text{Actually Surveyed Vehicle Count}}$

o Effective Collected Vehicle Count = $\frac{\text{Effective Collected Vehicle Count}}{\text{Actually Surveyed Vehicle Count}}$

The results are then summarized, separately for each Amphoe and Tambon, in the vehicle owner interview OD survey collection result table (Form 4).

In addition, it is necessary to produce the vehicle owner interview OD survey condition report (Form 5-1 through 5-3) in which various situations and problems encountered during the survey are entered, grouped according to Amphoe and Tambon.

The table (Form 4), which is prepared separately for each Amphoe and Tambon, has the entries described below for vehicle type and industry type.

1) Registered vehicles

Enter the value given in the registered vehicles table (Form 1) produced in section 2.6.

2) Selected vehicles

Enter the number of vehicles selected for the survey in section 2.4.

3) Extraction rate

Enter the value obtained by dividing the number of vehicles to be surveyed by the number of registered vehicles, rather than the originally established extraction rate. The extraction rate (percent) should be calculated to one decimal place.

4) Actually surveyed vehicles

Enter the number of vehicles that were selected for the survey and for which the survey cards were actually distributed. Note that the actually surveyed vehicles do not include those vehicles that fall under the "out of service", "transferred (address unknown)" and "transferred (residing outside)" categories, and those vehicles whose users (or owners) were not found where they were expected to be.

5) Collected vehicle count

Enter the number of vehicles for which the survey cards were collected.

6) Collection rate

Enter the value obtained by dividing the number of collected vehicles by the number of actually surveyed vehicles. The collection rate (percent) should be calculated to one decimal place.

7) Effective collected vehicle count

Enter the number of vehicles obtained by subtracting from the collected vehicle count the number of vehicles for which the survey was refused and whose survey sheets were not filled in properly and therefore regarded as invalid. The effective collected vehicle count includes those vehicles that fall under the "temporarily out of service", "disabled" and "being inspected" categories.

8) Effective collection rate

Enter the value obtained by dividing the effective collected vehicle count by the number of actually surveyed vehicles. The effective collection rate (percent) should be calculated to one decimal place.

2.11 SUBMISSION OF THE SURVEY RESULTS

To report on the survey results, the survey sheets collected for each "Changwat" are to be submitted together with the vehicle owner interview OD survey collection result table (Form 4).

2.12 SCREEN LINE SURVEY

2.12.1 Objective

In an urban area where the OD survey is conducted, an imaginary line (screen line) is established within an urban area to survey the volume of traffic that crosses the line with respect to vehicle type, time of day and direction (inbound and outbound). Vehicles are grouped into three vehicle types; passenger cars, buses and trucks. The survey is not conducted for motorcycles and vehicles of a special kind.

This survey is conducted to verify the accuracy of the OD survey by comparing the volume of traffic obtained by the OD survey with the volume of traffic actually observed. Figure 2.4 shows the concept of the screen line.

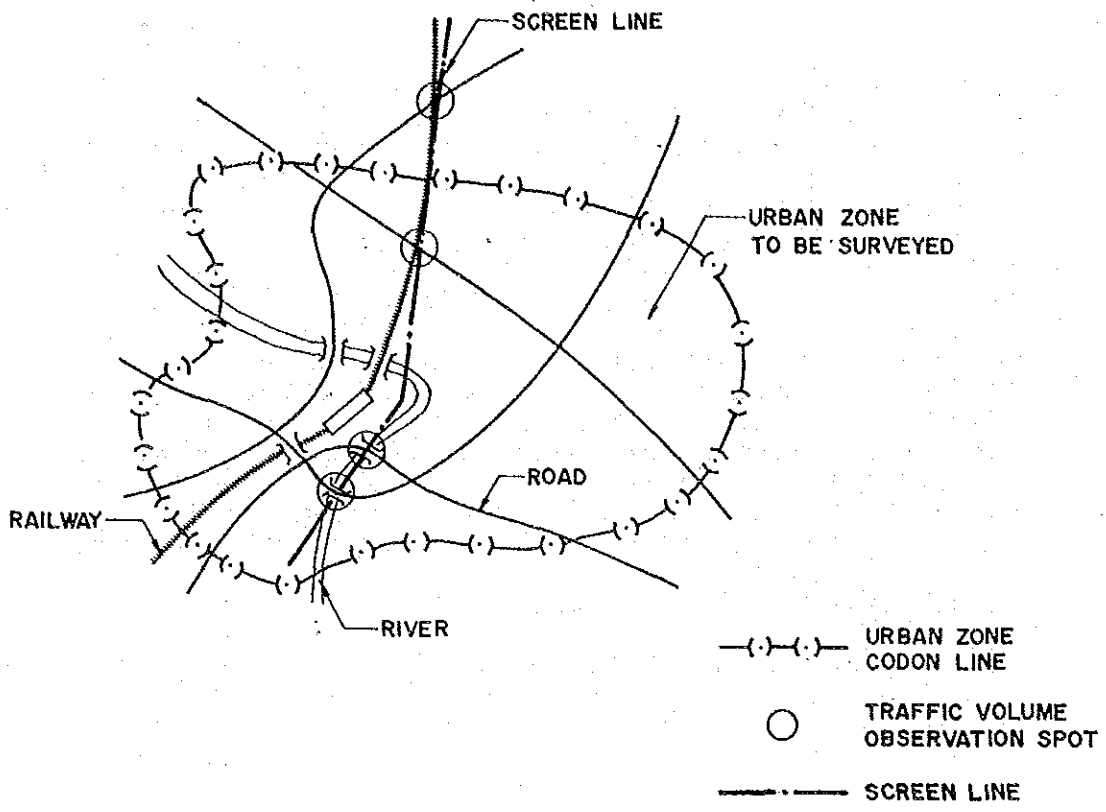


Figure 2.4 Screen Line

2.12.2 Establishing the Screen Line

The screen line should be a smooth line established along a geographical or artificial feature (such as a river or railway). It should not be a line that crosses the urban center or which runs near the outer periphery of the area to be surveyed. As a general rule, the screen line should run along the zone boundary. Generally, two screen lines are selected for an urban zone with a population of 200,000 or more, and one screen line for an urban zone with a population of less than 200,000.

The screen line survey is conducted to verify the accuracy of surveys, and therefore the screen line should be established so that most of internal traffic crosses it. However, it should not be such that a single trip crosses it several times.

As a rule, two screen lines are required for an urban area with a population of 200,000 or more. However, a geographical or artificial feature in a given area could inevitably reduce the number to one.

2.12.3 Survey Day and Time

This survey should be conducted on a single day within a period during which the vehicle owner interview OD survey is carried out in that urban area. The survey usually lasts 24 hours from 7.00 am of the survey day until 7.00 am of the next day. However, under certain traffic conditions, the survey may be conducted only for 12 hours from 7.00 am to 7.00 pm on the survey day, and later its results may be expanded to obtain their 24-hour equivalent.

Even if the survey day should inevitably be changed, an ordinary day should be selected as the survey day, which must still be within the interview survey period.

2.12.4 Summarizing the Survey Results

The screen line survey results must be summarized, on a spot-by-spot basis, in the screen line traffic volume survey table (Form 6). Also, the screen line crossing traffic volume table (Form 7) must be produced by estimating daily traffic volume from per-spot daytime 12-hour survey results and the ratio of daily traffic to daytime traffic.

Sheet 2 VEHICLE OWNER INTERVIEW OD SURVEY (PASSENGER CARS)

Registration number	User name	Serial identification number	Sex of the primary driver	Age of the primary driver	Location of the base for use	Vehicle type	Ownership	Fuel type	Kilometer travelled on the survey day	Number of trip made on the survey day
------- ------- -------	---------- ----------		1. Male 2. Female		---------- ---------- ----------	1. Motorcycle 2. Motor-tricycle 3. Passenger car 4. Light bus 5. Heavy bus 6. Light track	1. Individual -owned 2. Corporation -owned	1. Gasoline 2. Light oil 3. LPG 4. Electricity 5. Others	Km at the start ---------- Km at the end ----------	
		□□□□	□	□□	□□□	□	□□	□	km □□□	□□□

Travel mode	Departure point or destination and its facility		Departure time	Distance travelled	Purpose of trip	Number of persons in the vehicle	Parking lot	Reason of using vehicle	Urban expressway use		
	Facility code 1. Housing 2. Business 3. Office 4. Plant 5. Education/welfare 6. Traffic/transportation 7. Warehouse 8. Others	Facility			1. Going to work 2. Going to school 3. Business A 4. Business B (in volume carrying of goods) 5. Housekeeping/shopping 6. Social intercourse, etc. 7. Going back to the office 8. Going home		1. On-street (Free) 2. On-street (Toll) 3. Home garage (Free) 4. Office/store (Free) 5. Stations (Free) 6. Vacant lot (Free) 7. Monthly lot (Free) 8. Unreserved lot (Free) 9. Did not mark	1. No transportation 2. Faster 3. No change 4. More comfortable 5. Baggage to be carried 6. Many people 7. Economical 8. Others 9. Used for others	1. Yes 2. No	On-interchange name	Off-interchange name
1st	---------- ---------- □□□	□	hour □□	km □□	□	□□	□	□	□	------- ------- □□□	------- ------- □□□
2nd	---------- ---------- □□□	□	hour □□	km □□	□	□□	□	□	□	------- ------- □□□	------- ------- □□□
3rd	---------- ---------- □□□	□	hour □□	km □□	□	□□	□	□	□	------- ------- □□□	------- ------- □□□

Sheet 3 VEHICLES OWNER INTERVIEW OD SURVEY (TRUCKS)

Registration number	User name	Serial identification number	Sex of the primary driver	Age of the primary driver	Location of the base for use	Vehicle type	Ownership	Industry type	Maximum loading capacity	Fuel type	Kilometers travelled on the survey day	Number of trip made on the survey day
--- --- ---	--- ---		1. Male 2. Female		--- --- ---	1. Light truck 2. 6 wheel truck 3. 10 wheel truck or trailor	1. Individual -owned 2. Corporation -owned	1. Agriculture, Forestry & Fishery 2. Mining 3. Construction 4. Manufacturing 5. Wholesale 6. Retail 7. Financial Insurance & Real Estate 8. Transportatn & Communicatn 9. Public Utility 10. Services 11. Official Duties 12. Others		1. Gasoline 2. Light oil 3. LPG 4. Electricity 5. Others	Km at the start --- Km at the end ---	
									t kg		km	

Travel mode	Departure point or destination and its facility		Departure time	Distance travelled	Purpose of trip	Carried item	Weight of carried item	Number of person in the vehicle	Parking lot	Urban expressway use		
	Facility code 1. Housing 2. Business 3. Office 4. Plant 5. Education/welfare 6. Traffic/transportation 7. Warehouse 8. Others	Facility			1. Going to work 2. Going to school 3. Business A 4. Business B (involving carrying of goods) 5. Housekeeping/shopping 6. Social intercourse, etc. 7. Going back to the Office 8. Going home	1. Empty 2. Farm or Marine 3. Forest 4. Mine 5. Metal/machine 6. Chemical 7. Light industry 8. Miscellaneous 9. Special kind 10. Unclassifiable item			1. On-street (Free) 2. On-street (Toll) 3. Home garage (Free) 4. Office/store (Free) 5. Stations (Free) 6. Vacant lot (Free) 7. Monthly lot (Free) 8. Unreserved lot (Free) 9. Did not mark	1. Yes 2. No	On-interchange name	Off-interchange name
1st	---		hour	km			t kg				---	---
2nd	---		hour	km			t kg				---	---
3rd	---		hour	km			t kg				---	---

Sheet 4 VEHICLE OWNER INTERVIEW OD SURVEY (TAXIS)

Registration number	User name	Serial identification number	Seating capacity	Location of the base for use	Fuel type	Kilometer travelled on the survey day	Vehicle trips
----------	----------			----------		Km at the start	
----------	----------			----------		----------	
----------				----------		Km at the end	

		□□□□	□□	□□□	□	□□□ Km	

	Departure point	Arrival point	Departure time	Distance travelled	Number of persons in the vehicle	Charge	Urban expressway use		
							1. Yes 2. No	On-interchange name	Off-interchange name
Travel mode									
1st	---------- □□□	---------- □□□	□□ hour	□□□ Km	□□	□□□ ₩	□	□□□	□□□
2nd	---------- □□□	---------- □□□	□□ hour	□□□ Km	□□	□□□ ₩	□	□□□	□□□
3rd	---------- □□□	---------- □□□	□□ hour	□□□ km	□□	□□□ ₩	□	□□□	□□□

Sheet 5 VEHICLE OWNER INTERVIEW OD SURVEY (GOODS MOTOR VEHICLES)

Registration number	User name	Serial identification number	Location of base for use	Vehicle type	Maximum loading capacity	Fuel type	Operation type	Kilometers travelled on the survey day	Number of trips made on the survey day	Vehicle trips
				1. Light truck 2. 6-Wheel truck 3. 10-Wheel truck or trailer		1. Gasoline 2. Light oil 3. LPG 4. Electricity 5. Others	1. Route truck 2. Non-route truck	Km at the start Km at the end		
								km		

Travel mode	Departure point or destination and its facility		Departure time	Distance travelled	Carried item	Weight of carried item	Number of person in the vehicle	Urban expressway use		
	Facility code 1. Housing 2. Business 3. Office 4. Plant 5. Education/welfare 6. Traffic/transportation 7. Warehouse 8. Others	Facility			1. Empty 2. Grain 3. Vegetable/fruit 4. Farm 5. Marine 6. Other agri. 7. Lumber 8. Firemoad 9. Metal 10. Nonmetal (Construction) 11. Nonmetal (Industry) 12. Metal 13. Metal product 14. Machinery 15. Ceramics 16. Petroleum 17. Chemical 18. Fertilizer (Chemical) 19. Other chemical 20. Paper 21. Textile ind. 22. Food ind. 23. Daily ind. 24. Other ind. 25. Scrap 26. Fertilizer (Animal) 27. Waster 28. Carrying container 29. Mired goods 30. Unclassifiable			1. Yes 2. No	On-interchange name	Off-interchange name
1st			hour	km		t kg				
2nd			hour	km		t kg				
3rd			hour	km		t kg				

Sheet 6 VEHICLE OWNER INTERVIEW OD SURVEY (CHARTERED BUSES)

Registration number	User name	Serial identification number	Location of the base for use	Seating capacity	Fuel type	Kilometers travelled on the survey day	Number of trips made on the survey day	Vehicle trips
--------- --------- ---------	--------- ---------		--------- --------- ---------		1. Gasoline 2. Light oil 3. LPG 4. Electricity 5. Others	Km at the start --------- Km at the end ---------		
		□□□□	□□□	□□	□	□□□ Km	□□	

Travel mode	Departure point or destination and its facility		Departure time	Distance travelled	Number of persons in the vehicle	Urban expressway use		
	Facility code 1. Housing 2. Business 3. Office 4. Plant 5. Education/welfare 6. Traffic/transportation 7. Warehouse 8. Others	Facility				1. Yes 2. No	On-interchange name	Off-interchange name
1st	--------- --------- □□□	□	□□ hour	□□ km	□□	□	--------- --------- □□□	--------- --------- □□□
2nd	--------- --------- □□□	□	□□ hour	□□ km	□□	□	--------- --------- □□□	--------- --------- □□□
3rd	--------- --------- □□□	□	□□ hour	□□ km	□□	□	--------- --------- □□□	--------- --------- □□□

Sheet 7 VEHICLE OWNER INTERVIEW OD SURVEY (ROUTE BUSES)

Serial identification number		Office address		Remarks	

No.	Origin point	Major point of passage on the service route	Destination point	Length of the service route	Number of operations per day	Number of persons transported annually	Number of days operated annually	Number of kilometers travelled annually	Average distance transported per person
1.				Km		1000 persons	day	1000 km	km
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									

FORM 1 REGISTERED VEHICLE TABLE

Changwat_____

Vehicle Type / Amphoe Tambon	Passenger Cars												Trucks						Total		Remarks
	Motor-Cycle		Motor-Tricycle		Passenger Car		Light Bus		Heavy Bus		Light Truck		Light Truck		6 Wheel Truck		10 Wheel Truck				
	P/V	B/V	P/V	B/V	P/V	B/V	P/V	B/V	P/V	B/V	P/V	B/V	P/V	B/V	P/V	B/V	P/V	B/V	P/V	B/V	

(Note) P/V; Privately-owned vehicle B/V; Business-oriented vehicle

Form 2 Vehicle Owner Interview OD Survey Selected Vehicle List

Changwat Amphoe Tambon

Vehicle type Industry Privately-owned/Business-oriented Vehicle

Registration number	User name	User address	Location of the base for use	Fuel	Type of car body	Remarks

FORM 3 VEHICLE OWNER INTERVIEW OD SURVEY SELECTED VEHICLE

Changwat_____

Vehicle Type / Amphoe Tambon	Passenger Cars												Trucks						Total		Remarks
	Motor-Cycle		Motor-Tricycle		Passenger Car		Light Bus		Heavy Bus		Light Truck		Light Truck		6 Wheel Truck		10 Wheel Truck				
	P/V	B/V	P/V	B/V	P/V	B/V	P/V	B/V	P/V	B/V	P/V	B/V	P/V	B/V	P/V	B/V	P/V	B/V	P/V	B/V	

(Note) P/V; Privately-owned vehicle B/V; Business-oriented vehicle

FORM 4 VEHICLE OWNER INTERVIEW OD SURVEY COLLECTION RESULT TABLE

Changwat_____Amphoe_____

Vehicle Type / Item			Registered Vehicle Count (A)	Extracted Vehicle Count (B)	Extraction Rates (%) (C)=(B)/(A)	Actually Surveyed Vehicle Count (D)	Collected Vehicle Count (E)	Collection Rate (%) (F)=(E)/(D)	Effective Collected Vehicle Count (G)	Effective Collected Rate (%)H = (G)/(D)
	Motorcycle	P/V								
		B/V								
	Motor-Tricycle	P/V								
		B/V								
	Passenger Cars	P/V								
		B/V								
	Light Bus	P/V								
		B/V								
	Heavy Bus	P/V								
		B/V								
	Light Trucks	P/V								
		B/V								
	Light Trucks	P/V								
		B/V								
	6 Wheel Truck	P/V								
		B/V								
	10 Wheel Truck	P/V								
		B/V								
Total		P/V								
		B/V								

(Note) P/V; Privately-owned vehicle B/V; Business-oriented vehicle

Form 5-1 Vehicle Driver Interview OD Survey Condition Report (1)

Number of surveyoy		Registrated vehicle count		Surveyed vehicle count	
Problem in Preparation					
Problem in extraction					
Problem in actual survey					
Problem in checking and coding					
Method of PR.					
Date to be surveyed					
Survey organization chart					

FORM 5-2 VEHICLE OWNER INTERVIEW OD SURVEY CONDITION REPORT (2)

Items / Amphoe/Tambon	Extracted Vehicle Count	Surveyed Vehicle Count	Number of Surveyor		Effective Collected Sheet Count			No Effective Collected Sheet Count								Number of substitute vehicles
			Person	Total Man-day	Same Amphoe	Other Amphoe	Total	No longer in service	Refused	Transfer	Not at home	Not at home for a long time	More	Others	Total	
Total																

FORM 5-3 VEHICLE OWNER INTERVIEW OD SURVEY CONDITION REPORT (3)

Items / Amphoe/Tambon	Number of Survey Days				Number of Vehicles to be Revisited			Checking			Coding			Number of Survey Sheet to be Printed	Remarks
	Preparation	Delivery	Collection	Total	Two Times	More Than Three Times	Total	Number of Sheets to be Checked	Persons	Days	Number of Sheets to be Coded	Persons	Days		
Total															

FORM 6 SCREEN LINE TRAFFIC VOLUME SURVEY TABLE

Route No._____

Name of Survey Spot_____

Survey Spot No._____ Survey Day_____

Time	Direction	Passenger Cars	Buses	Trucks	Total
7 ~ 8	Inbound				
	Outbound				
	Total				
8 ~ 9	Inbound				
	Outbound				
	Total				
9 ~ 10	Inbound				
	Outbound				
	Total				
10 ~ 11	Inbound				
	Outbound				
	Total				
11 ~ 12	Inbound				
	Outbound				
	Total				
12 ~ 1	Inbound				
	Outbound				
	Total				
1 ~ 2	Inbound				
	Outbound				
	Total				
2 ~ 3	Inbound				
	Outbound				
	Total				
3 ~ 4	Inbound				
	Outbound				
	Total				
4 ~ 5	Inbound				
	Outbound				
	Total				
5 ~ 6	Inbound				
	Outbound				
	Total				
6 ~ 7	Inbound				
	Outbound				
	Total				
Total	Inbound				
	Outbound				
	Total				

Form 7 Screen Line Passage Traffic Volume Table

Urban zone name _____

Survey spot			Passage traffic volume (daytime 12-hour)				Passage traffic volume (daily volumes)			
Spot NO.	Route NO.	Spot name	Passenger cars	Buses	Trucks	Total	Passenger cars	Buses	Trucks	Total
Total										

PART 2

TRAFFIC FORECAST MANUAL

TABLE OF CONTENTS

CHAPTER 1 FUNDAMENTALS OF TRAFFIC FORECASTING

1.1 Introduction 2-1
1.2 Trip Generation 2-3
1.3 Trip Distribution 2-5
1.4 Model Split 2-7
1.5 Trip Assignment 2-8
1.6 Typical Traffic Study in DOH 2-11

CHAPTER 2 CASE STUDY OF TRAFFIC FORECASTING

2.1 Method of Traffic forecasts 2-14
2.2 Computer Processing System 2-22
2.3 Operational Procedure 2-27
2.4 Data Reduction 2-30
2.5 Input Form 2-33
2.6 Output List 2-36

APPENDIX ESTIMATION OF TRAFFIC FORECASTING PARAMETERS

CHAPTER 1 FUNDAMENTAL OF TRAFFIC FORECASTING

1.1 INTRODUCTION

(1) Objective

A. Formulation of theories, formulas, or models which will be needed to make estimates for future traffic patterns.

B. Estimate of future trip patterns based on future land use, population and economic levels.

C. Application of the estimated future trip patterns to a proposed transportation network to test the adequacy of the proposal.

(2) Definitions

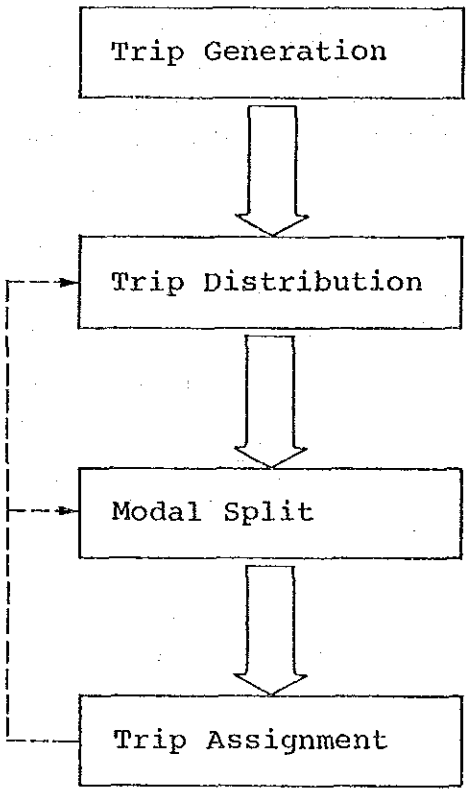
Trip Generation : Determination of the number of trip ends.

Trip Distribution : Determination of the number of trips between any two zones.

Modal Split : The division of person travel between highway and other transport modes such as railways and inland waterways.

Traffic Assignment: The allocation of traffic flows among routes available between any two zones.

(3) Procedure



1	2	3	Total	
0	0	0	0	1
	0	0	0	2
		0	0	3
			0	Total

1	2	3	Total	
0	0	0	T1	1
	0	0	T2	2
		0	T3	3
			ΣT	Total

1	2	3	Total	
T11	T12	T13	T1	1
	T22	T23	T2	2
		T33	T3	3
			ΣT	Total

1	2	3	Total	
$T11^P$	$T12^P$	$T13^P$	$T1^P$	1
	$T22^P$	$T23^P$	$T2^P$	2
		$T33^P$	$T3^P$	3
			ΣT^P	Total

P; Passenger Car

Figure 1.1 Procedure of Travel Forecast

1.2 TRIP GENERATION

(1) Purpose

The first step is to calculate the number of trips generated by each zone.

(2) Method

Factors determining generation in many past studies are as follows:

1) Population
2) Residential density
3) Car ownership
4) Family income

There are several methods of trip generation. The methods widely known are as follows:

a) Growth Factor Method

$$Ti = Tpi \cdot Gi \qquad (1.1)$$

where;
Ti : Future number of trips generated in zone i.
Tpi : Present number of trips generated in zone i.
Gi : f (growth rate of factors determining generation).

b) Specific Unit Calculation Method

Specific unit of trip generating power such as traffic volume per population and traffic volume per industrial output are first calculated for each area. Future trip generation can be estimated by applying the specific units to the forecasted population and industrial output.

c) Model Method

$$Ti = As + A_1X_1 + A_2X_2 + \ldots A_nX_n \qquad (1.2)$$

where
Ti : Future number of trips generated in zone i.
$X_1, X_2, \ldots X_n$: Future number of factors determining generation.
$A_0, A_1, \ldots X_n$: Parameters

A. Analysis is most commonly by multiple regression techniques.

B. Data sources are the O/D data, including the social and land use characteristics at each trip end.

C. The data are usually kept in person-trip units.

D. Calculations are made for the 24 hour cycle.

(3) Notes

The nature of trip generation varies considerably from one area to another. Trip generation has to be determined anew in each study area.

Changes in living and working patterns, communication systems, and transportation technology may have effects on trip making, which will not to be reflected by trip generation equations. Some allowance must be made.

1.3 TRIP DISTRIBUTION

(1) Purpose

This step is to distribute generated trips from each zone to all other zones.

(2) Method

The method for estimating the interchange (i.e. number) of trips between any two zones include two fundamental concepts:

A. Trip interchange is a function of the activity in each zone.

B. Trip interchange is a function of distance or time between zones.

There are three methods of trip distribution each using a different way in which they account for distance or time.

1) Present pattern method
2) Gravity method
3) Opportunity method

Gravity method is most commonly used. The method is as follows:

A. This method uses distance as an inverse proportion to trip volume.

B. Distance is usually stated in terms of travel time.

C. The gravity model developed by Voorhees is in this form:

$$Tij = Ti \frac{Sj/Dij^{\alpha}}{\sum_{k=1}^{n} (Sk/Dik^{\alpha})} \qquad (1.3)$$

where;
- Tij : Trips from zone i to zone j.
- Ti : Total trips originating at zone i.
- Dij : Distance from i to j.
- n : Number of zones.
- α : Friction exponent.
- Sj : "Attraction" factor at j.
- Sk : "Attraction" factor at k.

D. The "attraction" factor for work trips may be expressed as the number of jobs in the zone.

(3) Note

The gravity method specifically takes account of distance and interactance.

In the gravity method, the friction exponent is not uniform among different routes, and requires numerous adjustments.

1.4 MODAL SPLIT

(1) Purpose

This step is to calculate the proportion of total trips which will use highways and other transport modes such as railways and inland waterways.

(2) Method

There are two types of modal split model

a) Modal Split of Generation Data

A. The principal determinants are the social characteristics of each zone.

B. This method has the advantage of simplicity but does not permit testing the effect of proposals for new facilities in either mode.

b) Modal Split of Distribution Data

A. The principal determinants are relative travel time by each mode.

B. This method involve much more work than splitting generation data, but is more sensitive to adjustments in the networks being tested.

(3) Note

The calculation of modal split is more commonly undertaken on the distribution data.

1.5 TRIP ASSIGNMENT

(1) Purpose

This step is to assign the number of trips between all pairs of zones to routes of the highway or other transport network.

(2) Method

Assignment is made by identifying the path of minimum impedance for each O/D pair.

Impedance to travel may be measured in units of time, distance, cost, or a combination of these. Time is most commonly used.

There are several methods of trip assignment. The methods widely known are as follow:

a) Diversion Rate Method

This method can be performed by selecting the minimum path and the second minimum path, calculating a diversion rate, and loading all trips (see Figure 1.2).

$$P = f\left(\frac{F}{\Delta t}\right)$$

where;
P : Diversion rate
F : Fee of using road
Δt : Time saved ($=t_1-t_2$)

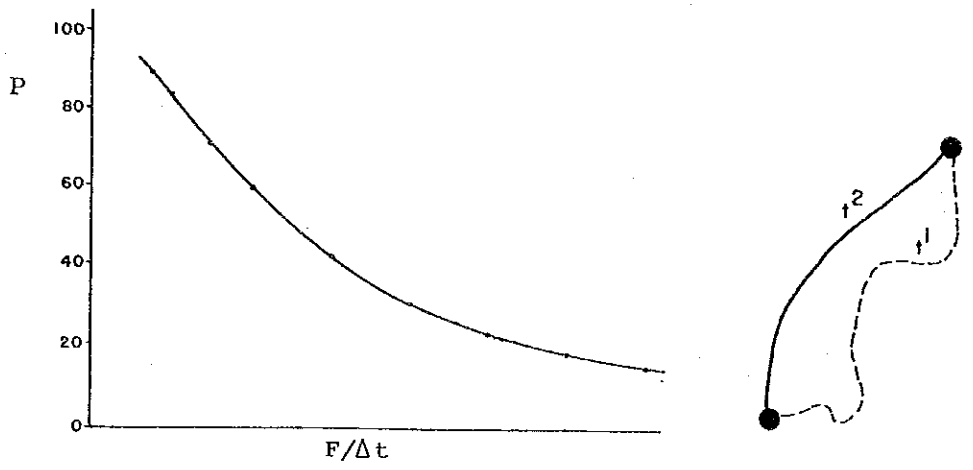


Figure 1.2 Division Rate Method

b) Network Simulation Method

This method can be performed by loading a fraction of all trips, re-evaluating the travel impedance, finding new minimum paths, and loading the next fraction (see Figure 1.3).

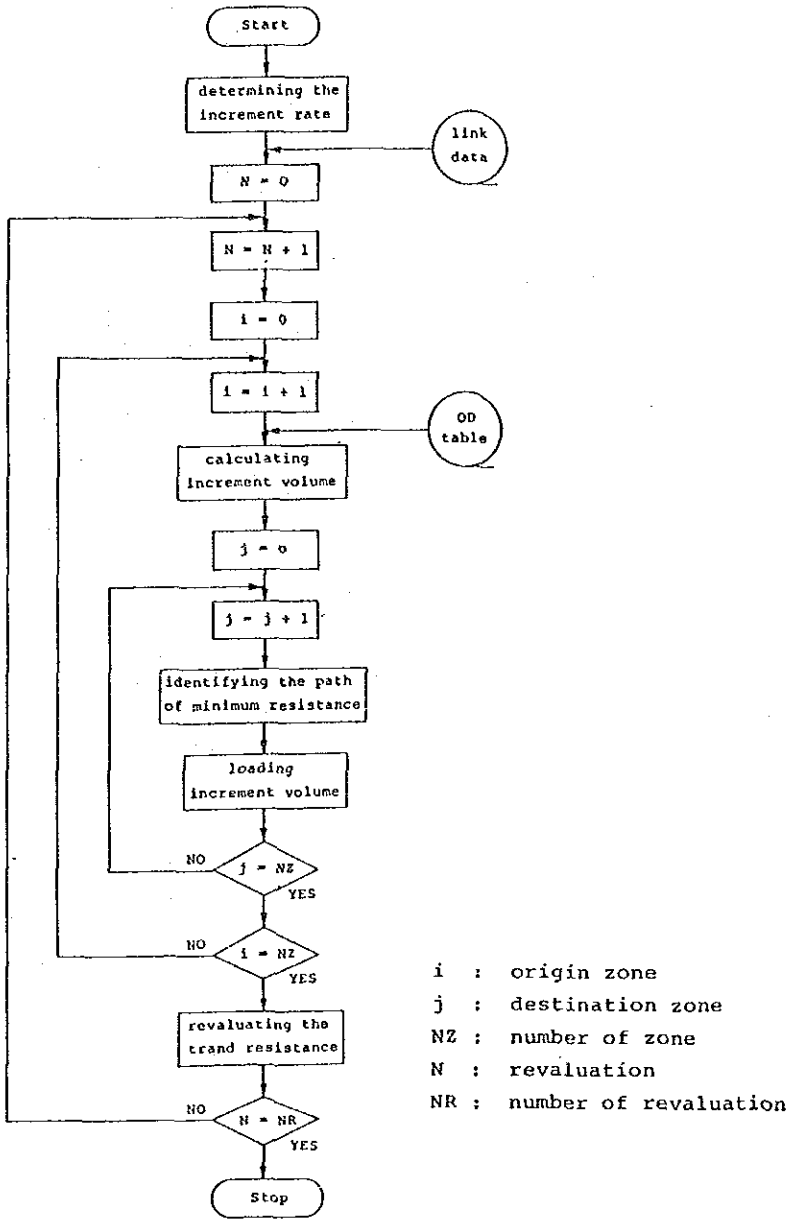


Figure 1.3 Network Simulation Method

If capacity is being approached, new, higher impedance are computed (see Figure 1.4).

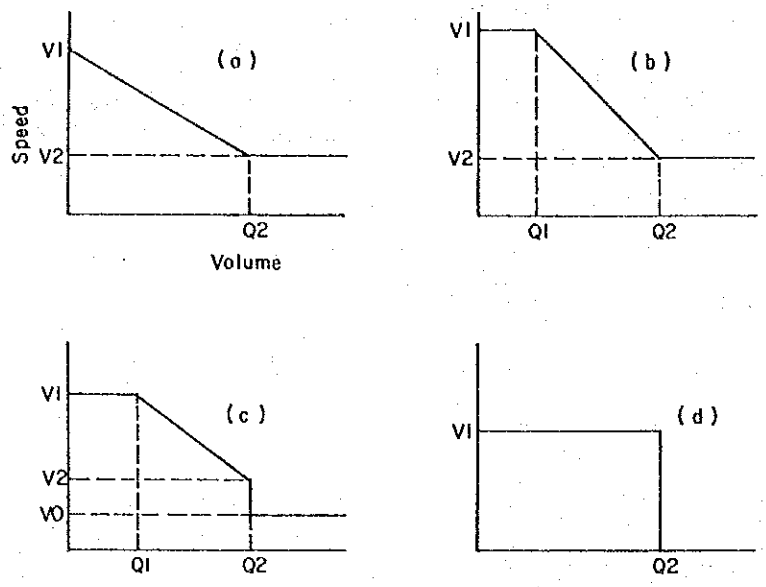


Figure 1.4 Traffic Volume - Speed Curves

(3) Note

For the automobile mode, person-trips must first be converted to vehicle-trips, using vehicle occupancy factors developed from O/D data.

If the final travel impedances on each link are quite different from those initially assumed, it may be necessary to repeat the distribution and modal split stages, using the new friction values.

1.6 TYPICAL TRAFFIC STUDY IN DOH

(1) Process of Traffic Study

This study is usually separated into three parts shown as follows:

1) Traffic Survey
2) Traffic Forecast
3) Economic Evaluation

The process of this study is illustrated in Figure 1.5.

(2) Basic Condition

a) Type of Traffic

1) Normal traffic

Normal traffic is defined as the traffic which takes place on an existing road, arising from the natural in crease of population and economic activities independent of any road improvement.

2) Diverted traffic

Diverted traffic is defined as the traffic which may change its routes due to the improvement or new construction of a road.

3) Induced traffic

Induced traffic is defined as the extra traffic which is newly generated as a result of improvement of transport condition such as a decrease in travel time and cost. In the estimation of induced traffic, only population with natural growth would be considered as a source of traffic, in other words, population increase by migration would be disregarded.

4) Developed traffic

Developed traffic is defined as the traffic which occurs in excess of natural growth of population and economic activities due to the agricultural development attributable to the road development.

b) Type of Vehicles

1) Motorcycle (M/C)

Motorcycle is 2-wheel vehicle with engine such as Honda JX 110 and Yamaha YL 2 GFM.

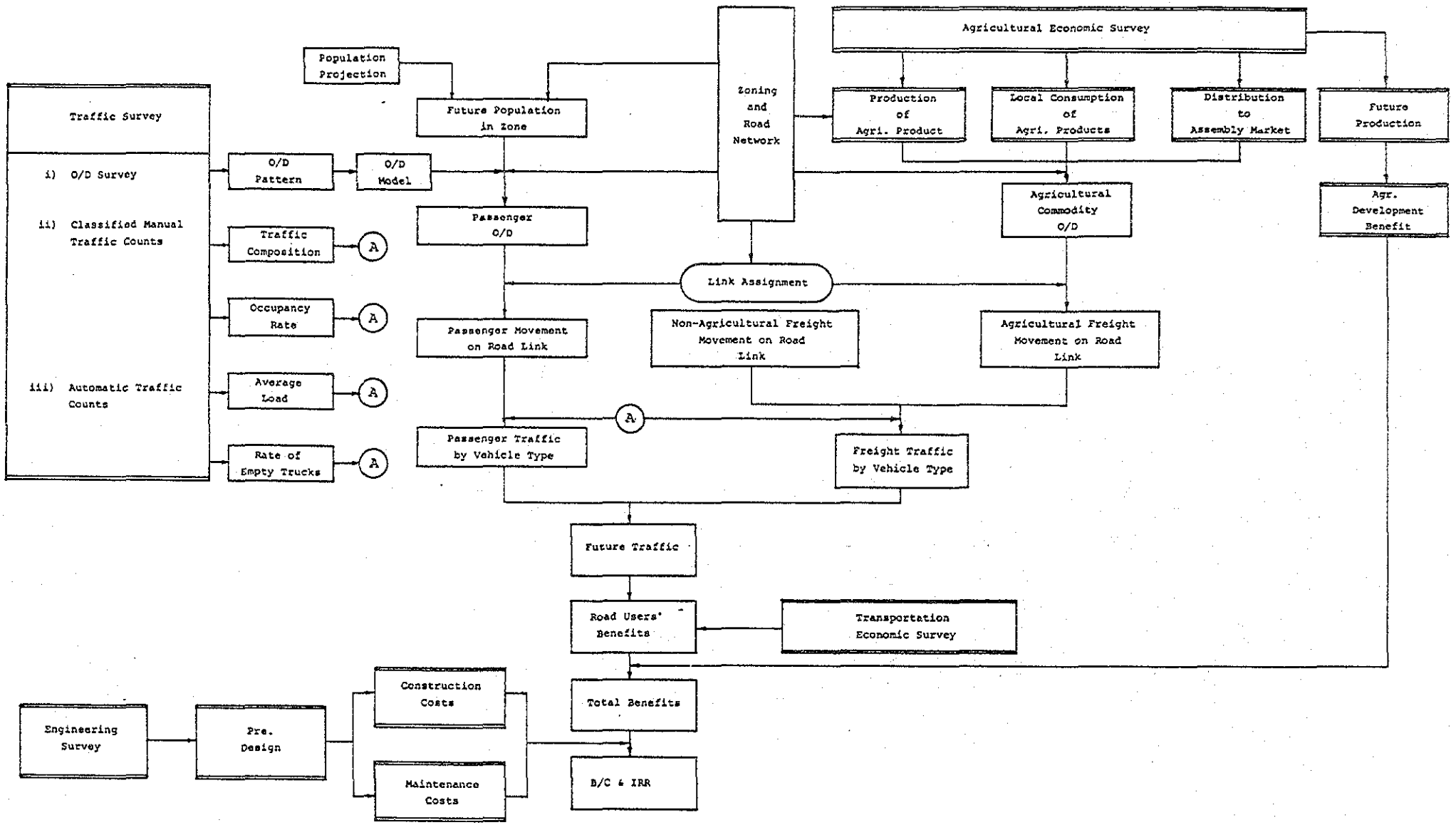


Figure 1.5 Process of Traffic Study

2) Passenger car (P/C)

Passenger car includes not only vehicles for personal use such as Toyota Corolla and Datsun 160J, but also 4-wheel-drive vehicles such as Land Rover, taxi and pickup truck used for personal use without freight transportation.

3) Light bus (L/B)

Light bus is a simple adoption of pickup with longitudinal bench seats and canopy of canvas. The seating capacity is 10 on average.

4) Heavy bus (H/B)

Heavy bus includes a wide range from a modified 6-wheel medium truck such as Toyota Dyna and Isuzu Elf with long bench seats to large tour buses such as Isuzu BD 61 and Hino BF 320. The seat capacity ranges from 20 to 40.

5) Light truck (L/T)

Light truck is a pickup truck for freight transportation such as Toyota Hilux and Datsun 1500, with a loading capacity of 2 tons.

6) Medium truck (M/T)

Medium truck is a 6-wheel double axle truck suck as Toyota Dyna and Hino KR 320, with a loading capacity up to 6 tons.

7) Heavy truck (H/T)

Heavy truck is a 10-wheel triple axle truck such as Isuzu TWD 80 HJ and Hino KT 920, with a loading capacity up to 13 tones.

c) Road Class

Table 1.1 Road Class

Class	Description
1	National highway (Primary)
2	National highway (Secondary)
3	Provincial highway (Paved)
4	Provincial highway (Unpaved)

CHAPTER 2 CASE STUDY OF TRAFFIC FORECASTING

2.1 METHOD OF TRAFFIC FORECASTS

(1) Purpose

Traffic forecasts are made to obtain traffic volume by traffic type to be used for the following:

1) Calculation of road users' cost
2) Calculation of road maintenance cost
3) Calculation of future ADT

(2) Procedure

A. Trip generation and trip distribution are forecast at the same time using a mathematical model of gravity type.

B. Modal split is not necessary, because this study route is planned to serve mainly local transportation.

C. Trip assignment is forecast by an all or nothing method using minimum travel times.

D. Traffic volume is estimated separately for the following items:

- Passenger traffic

- Freight Traffic
  * Agricultural freight traffic
  * Non-agricultural freight traffic

- Motorcycle Traffic

E. The process of traffic forecasting is illustrated in Figure 2.1.

(3) Preparation of Zoning and Road Network

a) Zoning

A. The traffic zoning is made for each proposed road considering the existing and proposed road network and Amphoe and Tambon boundaries.

B. The minimum unit of the traffic zone is taken at Tambon level.

$$*P_{ij} = 602 \times \frac{(Q_i \times Q_j)^{0.433}}{T_{ij}^{1.091}}$$

P_{ij} = Trip/Day (Exclude H/B)

Q_i, Q_j = Population

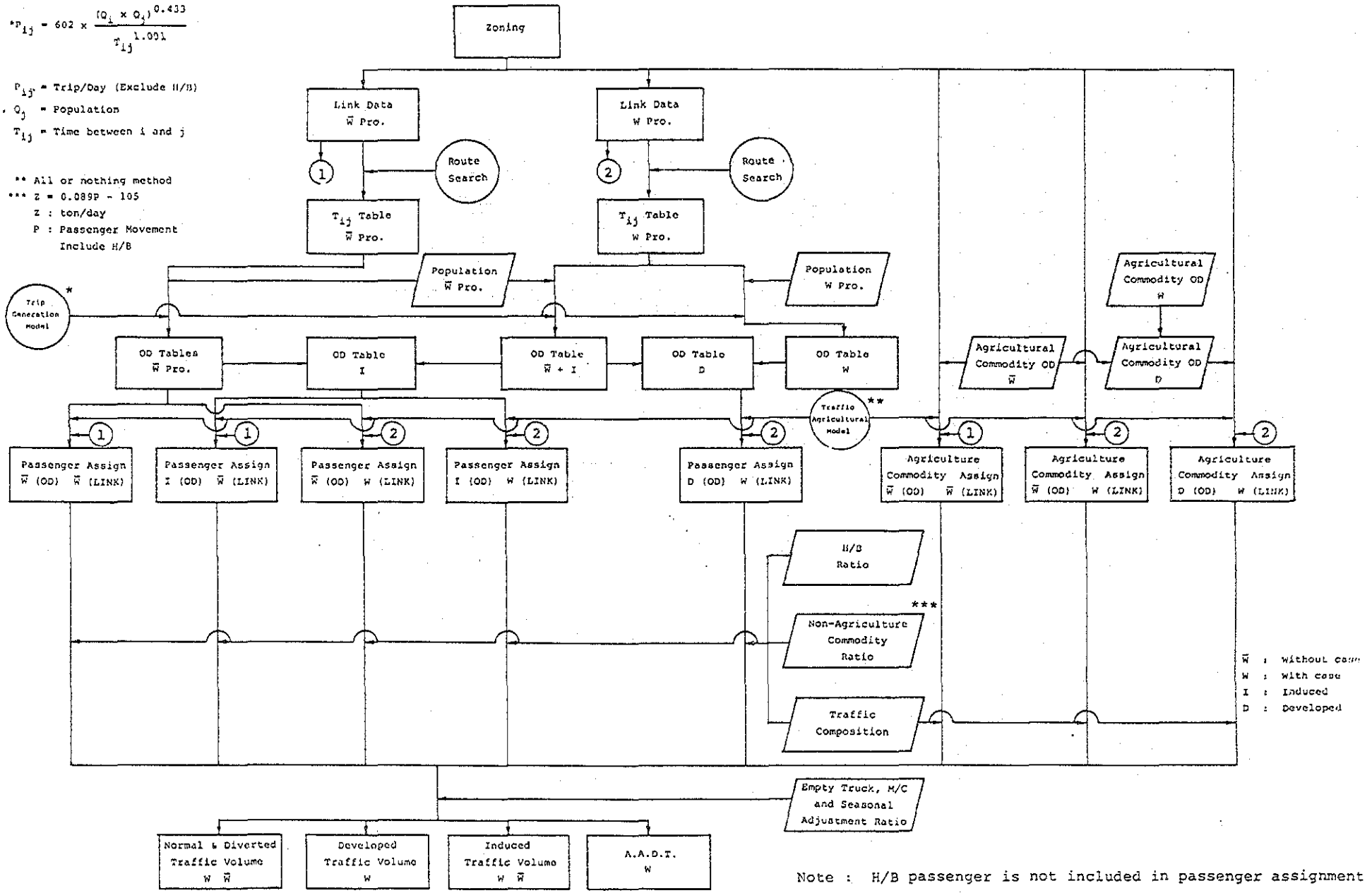
T_{ij} = Time between i and j

** All or nothing method

*** Z = 0.089P - 105

Z : ton/day

P : Passenger Movement Include H/B



Note : H/B passenger is not included in passenger assignment

Figure 2.1 Process of Traffic Forecast

b) Road Network

A. The zone node is set at the most developed area within the zone (zone centroid).

B. Dummy nodes are placed at the intersection of road links.

C. The existing and proposed roads in the project areas are divided into several road links by zone nodes and dummy nodes.

D. All road links are classified into one of 11 road grades, and travel speeds are estimated as shown next page:

Table 2.1 Road Grade

Unit : km/hr

Grade	Surface Condition	Average Speed	Traveling Speed by Type of Vehicle					
			P/C	L/B	H/B	L/T	M/T	H/T
1.	AC (flat)	80	88	80	80	80	72	72
2.	AC (rolling)	65	72	65	65	65	59	59
3.	AC (mountainous)	50	55	50	50	50	45	45
4.	BST (flat)	70	76	70	70	70	64	64
5.	BST (rolling)	55	59	55	55	55	51	51
6.	BST (mountainous)	40	43	40	40	40	38	38
7.	SA (flat)	40	41	40	40	40	38	38
8.	SA (rolling)	30	31	30	30	30	29	29
9.	SA (mountainous)	20	21	20	20	20	19	19
10.	EARTH	10	10	10	10	10	10	10
11.	TRACK.	5	5	5	5	5	5	5

Note : AC - Asphaltic Concrete
BST - Bituminous Surface Treatment
SA - Soil Aggregate

(4) Establishment of Case of Link Assignment

Assignment of the transportation demands by type to road links is carried out in the following five cases:

Table 2.2 Case of Link Assignment

Case	Transportation Demand 2/	Road Network 3/	Type of Traffic on Road Link
1	Vij(N)	$\bar{W}$	Normal
2	Vij(N)	W	Normal+Diverted
3	Vij(I)	W	Induced
4	Vij(DV)	W	Developed
5 1/	Vij(I)	$\bar{W}$	-

Note: 1/ Hypothetical case for use of benefit calculation.
2/ Vij(N) - Normal transportation demand between zone i and zone j.
Vij(I) - Induced transportation demand between zone i and zone j.
Vij(DV) - Developed transportation demand between zone i and zone j.
3/ $\bar{W}$ - Without project case
W - With project case

(5) Estimation of Passenger O/D

Transportation demand of passengers by type of traffic are expressed as shown in the following table:

Table 2.3 Transportation Demand by Type

Type	Description	Definition Formulae 1/
Normal (+ Diverted)	Corresponds to the population with natural growth	$V_{ij}^{(N)} = k \cdot \frac{(\bar{Q}_i \cdot \bar{Q}_j)^a}{\bar{t}_{ij}^b}$
Induced	Corresponds to the difference in the travel time between with and without project	$V_{ij}^{(I)} = k \cdot \frac{(\bar{Q}_i \cdot \bar{Q}_j)^a}{t_{ij}^b} - k \cdot \frac{(\bar{Q}_i \cdot \bar{Q}_j)^a}{\bar{t}_{ij}^b}$
Developed	Corresponds tp the migrated population due to accelerated agricultural land development by road improvement	$V_{ij}^{(DV)} = k \cdot \frac{(Q_i \cdot Q_j)^a}{t_{ij}^b} - k \cdot \frac{(\bar{Q}_i \cdot \bar{Q}_j)^a}{t_{ij}^b}$

Note: 1/ $V_{ij}^{(N)}$ - Normal transportation demand between zone i and zone j.

$V_{ij}^{(I)}$ - Induced transportation demand between zone i and zone j.

$V_{ij}^{(DV)}$ - Developed transportation demand between zone i and zone j.

$\bar{Q}i$ - Population in zone i of without project.

Qi - Population in zone i of with project.

t_{ij} - Minimum traveling time between zone i and and zone j of without project.

T_{ij} - Minimum traveling time between zone i and zone j of with project.

a, b, k - Model parameter

Parameter			Correlation
a	b	k	Coefficient
0.433	1.091	602.4	0.87

For population projection, all traffic zones are divided into three groups depending on their character, and future growth rate of population is estimated for each group, as shown in the table:

Table 2.4 Population Growth Rate

(percent per annum)

Group	Zones	1972-1978	1978-1986	1986-1992	1992-2000
1	Urbanized Zones	2.2	2.1	2.0	1.9
2	Migrating Zones	4.8	3.0	1.7	1.0
3	Others	1.7	1.0	0.8	0.6
Average1/		2.4	1.7	1.4	1.1

Note: 1/ Referred to the regional population growth rates projected in SRNT which bases on the projections by NSO.

(6) Assignment of Passenger O/D

The transportation demand of passengers estimated by O/D pair are assigned to each road link by all or nothing method using minimum travel times. (see Figure 1.3).

(7) Estimation of Passenger Traffic by Vehicle Type

The formulas for estimating the passenger traffic volume by vehicle type are as follows:

$$V_j = X_j / n_i \quad (2.1)$$

$$V\ P/C,j = \alpha_i * V_j \quad (2.2)$$

$$V\ L/B,j = \beta_i * V_j \quad (2.3)$$

$$V\ H/B,j = \left(\frac{1}{\Gamma_i} - 1\right) V_j \quad (2.4)$$

where;

X_j : Passenger movement on link j is estimated by gravity model

V_j : total volume of passenger car and light bus on link j

$V\ P/C,j$: volume of passenger car on link j

$V\ L/B,j$: volume of light bus on link j

$V\ H/B,j$: volume of having bus on link j

α_i, β_i, Γ_i, n_i : the following table

Table 2.5 Parameters of Passenger Traffic

Road Class	Given Factor from Traffic Composition 1/			2/ Occupancy
i	α	β	Γ	n
1	70.8	29.2	82.3	6.91
2	67.9	32.1	93.5	7.25
3	52.6	47.4	90.8	9.04
4	23.3	76.7	93.5	12.47

Note : 1/ see Appendix 3)
2/ see Appendix 4)

(8) Estimation of Non-agricultural Freight Traffic

Non-agricultural freight traffic is forecasted on the basis of the relationship between tonnage of non-agricultural freight and number of passenger.

The relationship is found as shown in the following formula (see Appendix 2).

$$Z_j = 0.089 * Y_j - 105 \qquad (2.5)$$

where;
Z_j : Tonnage of other fright on link j
Y_j : Movement of passenger on link j

The formula for estimating movement of passenger is as follow:

$$Y_j = X_j + 34.8 * V\ H/Bj \qquad (2.6)$$

where;
X_j : Passenger movement on link j is estimated by gravity model
V H/B, j : Volume of heavy bus on link j

Non-agricultural freight traffic by vehicle type is as follows:

$$V\ L/T,\ j = \alpha_i * Z_j/m_i \qquad (2.7)$$
$$V\ M/T,\ j = \beta_i * Z_j/m_i \qquad (2.8)$$
$$V\ H/T,\ j = \Gamma_i * Z_j/m_i \qquad (2.9)$$

where;
V L/T, j : Volume of light truck on link j
V M/T, j : Volume of medium truck on link j
V H/T, j : Volume of heavy truck on link j
α_i, β_i, Γ_i, m_i : the following table

Table 2.6 Parameters of Non-agricultural Freight Traffic

Road Class	Traffic Composition 1/ (%)			Non-agri. 2/ Freight Average Load (ton/vehicle)
	L/T	M/T	H/T	
i	α	β	Γ	m
1	42.3	31.7	26.0	4.78
2	54.2	24.8	21.0	4.11
3	49.2	36.7	14.1	3.77
4	52.4	33.7	13.9	3.67

Note : 1/ see Appendix 3)
2/ see Appendix 5)

(9) Estimation of Agricultural Freight Traffic

A. The agricultural freight O/D is forecasted from the results of the agro-economic survey on the flow of agricultural products.

B. The agricultural freight O/D is estimated for both cases of with and without projects.

C. The agricultural freight O/D is assigned to road link by all or nothing method taking minimum traveling time.

D. The formulas for estimating agricultural freight traffic volume by vehicle type are as follows:

$$V\ L/T, j = \alpha_i * Z_j/m_i \quad (2.10)$$
$$V\ M/T, j = \beta_i * Z_j/m_i \quad (2.11)$$
$$V\ H/T, j = \Gamma_i * Z_j/m_i \quad (2.12)$$

where;
V L/T, j : Volume of light truck on link j
V M/T, j : Volume of medium truck on link j
V H/T, j : Volume of heavy truck on link j
α_i, β_i, Γ_i, m_i : the following table

Table 2.7 Parameters of Agricultural Freight Traffic

Road Class	Traffic Composition 1/ (%)			Agricultural 2/ Freight Average Load (ton/vehicle)
	L/T	M/T	H/T	
i	α	β	Γ	m
1	42.3	31.7	26.0	4.75
2	54.2	24.8	21.0	4.07
3	49.0	36.7	14.1	3.97
4	52.4	33.7	13.4	3.81

Note : 1/ see Appendix 3)
2/ see Appendix 5)

(10) Estimation of Motorcycle Traffic

A. Motorcycle traffic is forecasted on the basis of the relationship between ADT and number of motorcycles on road link.

B. The relationship by road class is found as shown in the following formulas (see Appendix 7).

- On Paved Road
(number of motorcycles) = 0.557 x (ADT) - 85.1 (2.13)

- On Unpaved Road
(number of motorcycles) = 1.020 x (ADT) + 41.2 (2.14)

C. Motorcycle traffic is necessary to calculate road users' benefit.

2.2 COMPUTER PROCESSING SYSTEM

(1) Outline of Process

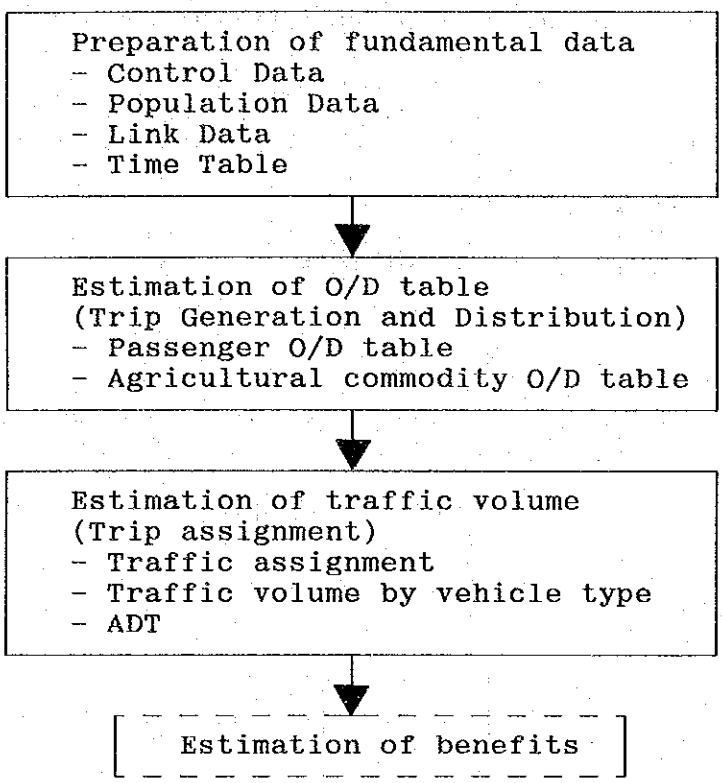


Figure 2.2 Computer Process I

(2) Programs

a) Preparation of Fundamental Data

Table 2.8 Programs I

Name of Program	Function of Program
CASEID	To write control data on file
LNKWIT	To write link data on file
LHKCHK	To check link data
TRQAA (1)	To calculate time table without project
TRQAA (2)	To calculate time table with project
ODTABA (1)	To print time table without project
ODTABA (2)	To print time table with project

b) Estimation of O/D Table

Table 2.9 Programs II

Name of Program	Function of Program
ODTABA (3)	To calculate O/D table ODO
ODTABA (4)	To calculate O/D table ODW and ODI
ODTABA (5)	To calculate O/D table ODF
ODINDD	To calculate O/D table ODD
ODTABLE	To write O/D table ODAO and ODAF
ODINDA	To calculate O/D table ODAD

c) Calculation of traffic volume

Table 2.10 Programs III

Name of Program	Function of Program
TRQAA (3)	To assign case 1 1/
TRQAA (4)	To assign case 2
TRQAA (5)	To assign case 5
TRQAA (6)	To assign case 3
TRQAA (7)	To assign case 1 (agri. commodity)
TRQAA (8)	To assign case 2 (agri. commodity)
TRQAA (10)	To assign case 4
TRQAA (11)	To assign case 4 (agri. commodity)
TRCDIN	To write road class data
VHCOMV	To calculate traffic volume by vehicle type
VHCOMA	To calculate ADT by year

Note : 1/ see Table 2.2

d) Others

Table 2.11 Programs IV

Name of Program	Function of Program
DATAWRITE	To write data
DATACHK	To check data

(Note) Kinds of O/D Table

Table 2.12 Passenger O/D Table

Population	Network	
	Without Project	With Project
Without Project	ODO	ODW
With Project		ODF

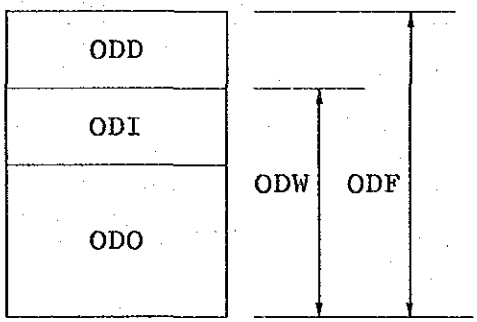


Figure 2.3 Passenger O/D Table

Table 2.13 Agricultural Commodity O/D Table

Without Project	With Project
ODAO	ODAF

$$ODAF - OADO = ODAD \qquad (2.15)$$

(3) Files

a) Preparation of Fundamental Data

Table 2.14 Files I

Name of File	Content of File
CASEIDIN	Control data
POPO/POPW	Population data without/with
LINKO/LINKW	Link data without/with
TIMEO/TIMEW	Time table without/with
JRO/JROW	Node chaine without/with

b) Estimation of O/D Table

Table 2.15 Files II

Name of File	Content of File
ODO	O/D Table ODO
ODW	O/D Table ODW
ODI	O/D Table ODI
ODF	O/D Table ODF
ODD	O/D Table ODD
ODAO	O/D Table ODAO
ODAF	O/D Table ODAF
ODAD	O/D Table ODAD

c) Calculation of Traffic Volume

Table 2.16 Files III

Name of File	Content of File
PASOO	Assignment results case 1 1/
PASOW	Assignment results case 2
PASIO	Assignment results case 5
PASIW	Assignment results case 3
COMAOO	Assignment results case 1 (agricultural commodity)
COMAOW	Assignment results case 2 (agricultural commodity)
PASDW	Assignment results case 4
COMADW	Assignment results case 4 (agricultural commodity)
TRCD	Road class for traffic composition
TRVOC	Traffic volume by vehicle type
GRATW	Traffic growth rate
TRADT	ADT by year

Note : 1/ see Table 2.2

(4) I/O Chart

Table 2.17 I/O Chart I

Programs \ Files	CASEID	POPO	POPW	LINKO	LINKW	TIMEO	TIMEW	JRO	JRW	ODO	ODW	ODI	ODF	ODD	ODAO	ODAF	ODAD	PASOO	PASOW	PASIO	PASIW	COMAOO	COMAOW	PASDW	COMADW	TRCD	TRVOC	GRATW	TRADT
CASEIDIN	O																												
LNKWIT				O	O																								
LNKCHK				I/O																									
TRQAA(1)	I			I		O		O																					
" (2)	I				I		O		O																				
QDTABA(1)	I					I																							
" (2)	I						I																						
" (3)	I	I				I				O																			
" (4)	I		I				I			I	O	O																	
" (5)	I		I				I						O																
QDINDD	I										I		I	O															
QDTABLE	I														O	O													
QDINDA	I														I	I	O												
TRQAA(3)	I			I				I		I								O											
" (4)	I				I				I	I									O										
" (5)	I			I				I				I								O									
" (6)	I				I				I			I									O								
" (7)	I			I				I							I							O							
" (8)	I				I				I						I								O						
" (11)	I				I				I					I										O					
" (12)	I				I					I							I								O				
TRCDIN	I																									O			
VHCOMV	I																	I	I	I	I	I	I			I	O		
VHCOMA	I																				I			I	I	I			
DATAWRZTE		O	O																									I	O
DATACHK																												O	

2.3 OPERATIONAL PROCEDURE

(1) Preparation of Fundamental Data

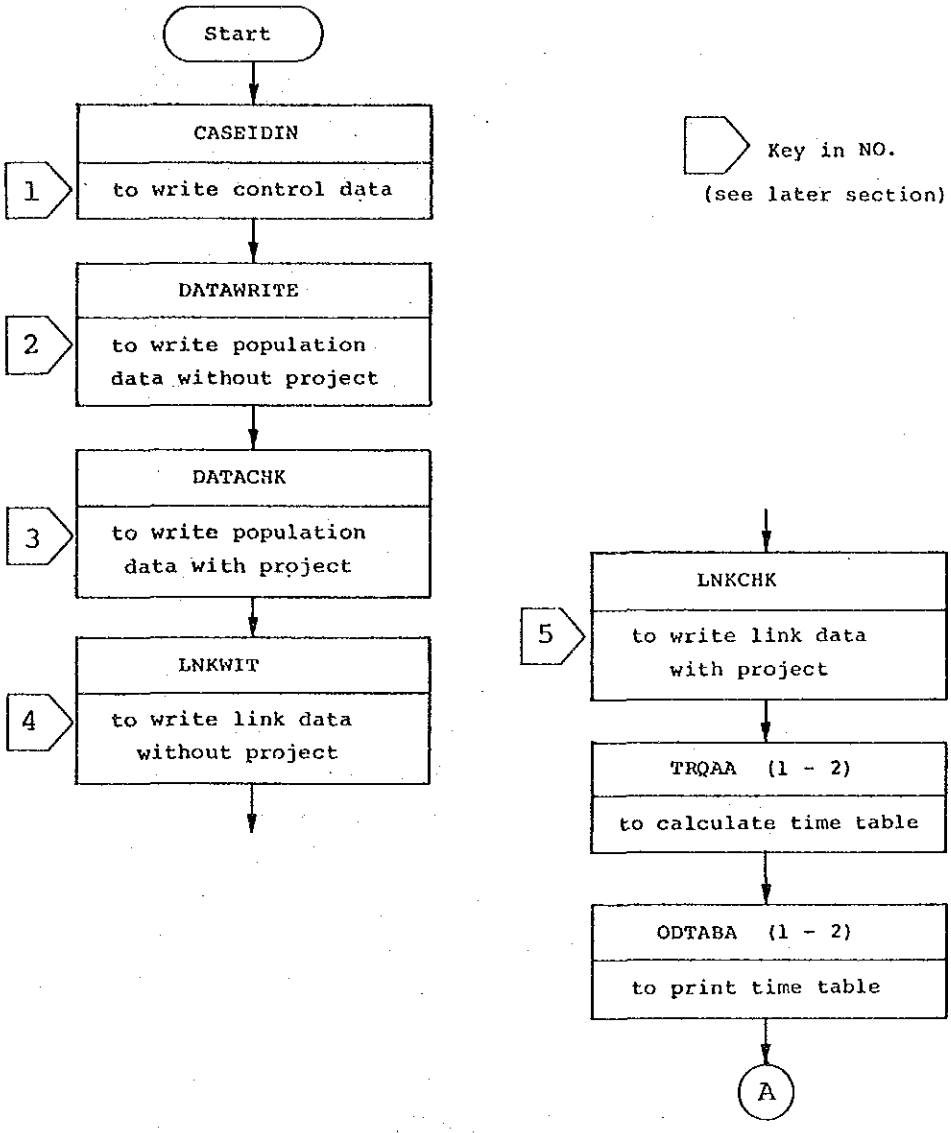


Figure 2.4 Operation Procedure I

(2) Estimation of O/D Table

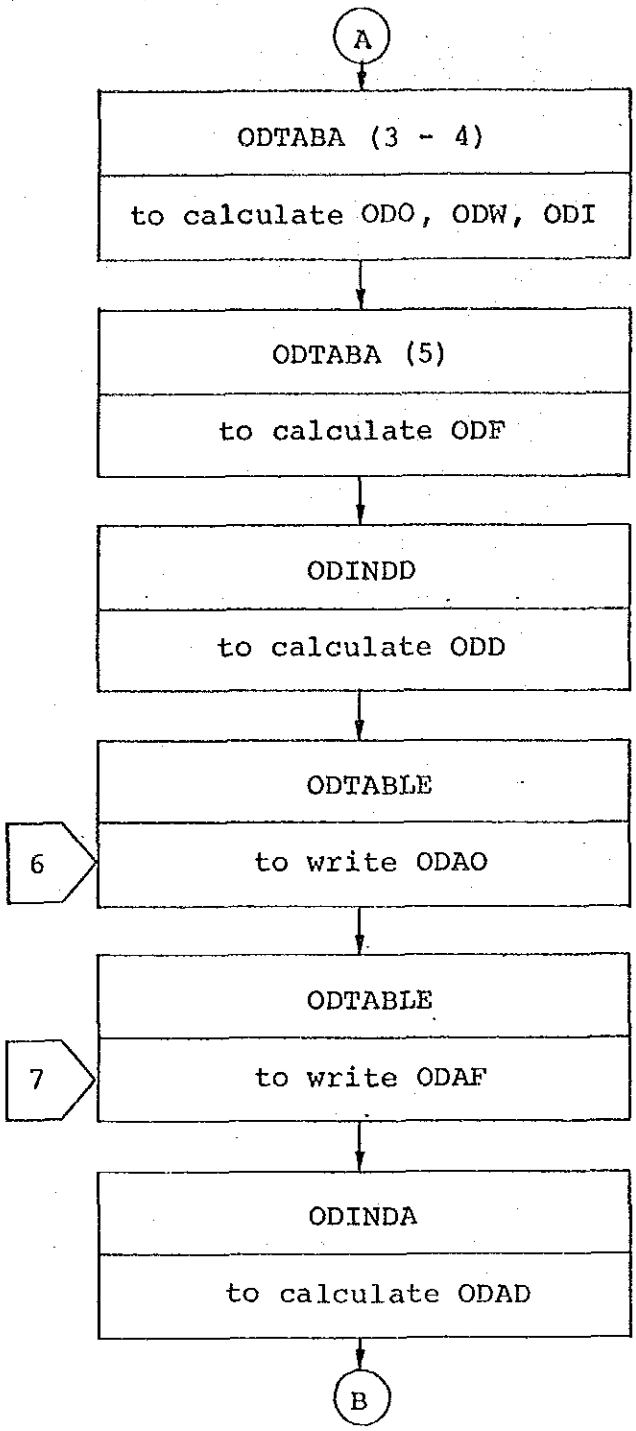


Figure 2.5 Operational Procedure II

(3) Calculation of Traffic Volume

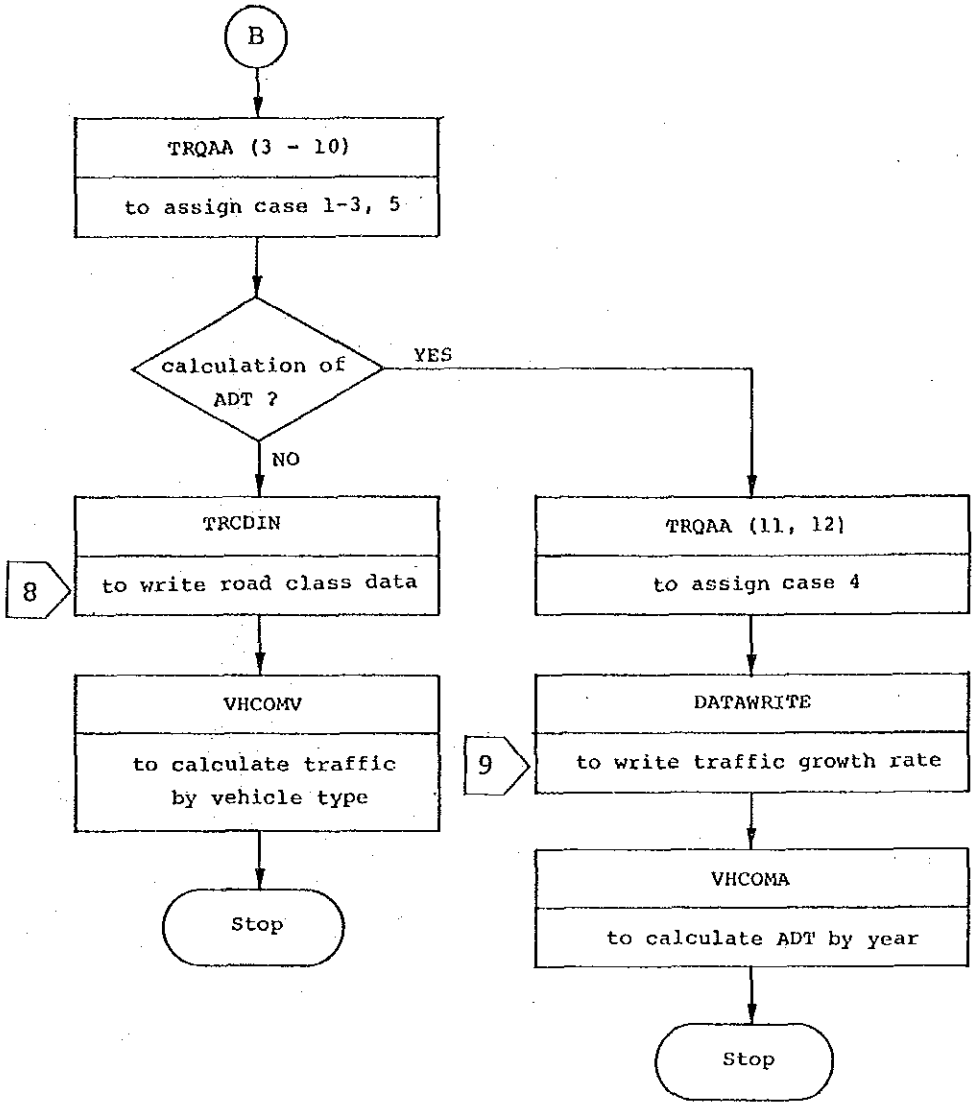


Figure 2.6 Operational Procedure III

2.4 DATA REDACTION

a) Map

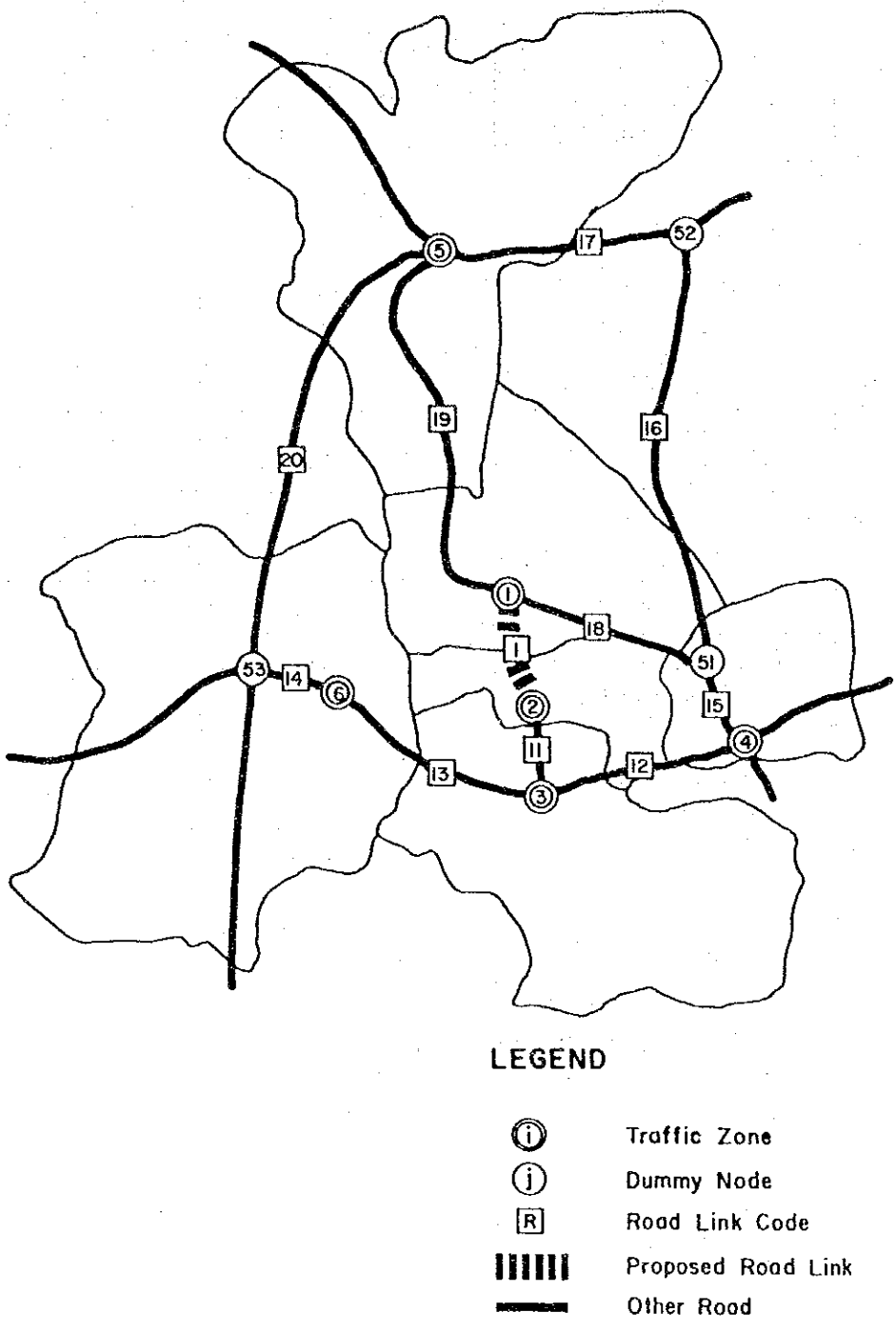


Figure 2.7 Map of Study Area

b) Traffic Zones

Table 2.18 Redaction Form I

Traffic Zone Code	Related Administrative Devisions		
	Changwat Name	Amphoe Name	Tambon Code
①			
②			
③			
④			
⑤			
⑥			
⑦			
⑧			

c) Road Link

Table 2.19 Redaction Form II

	Link Code	Node Pair: Origin	Node Pair: Distination	Project Case	Distance (Km)	Physical Grade	Speed (Km/h)	Administrative Grade	Remarks
Proposed Road	1	1	2	W̄	8.7	–	25	4	
				W	8.5	4	20	3	
	2			W̄					
				W					
	3			W̄					
				W					
	4			W̄					
				W					
Other Roads	11	2	3	W̄.W	5.5	4	70	3	
	12	3	4	W̄.W	16.5	1	80	2	
	13	3	6	W̄.W	16.6	4	70	2	
	14	6	53	W̄.W	6.5	4	70	2	
	15	4	51	W̄.W	7.5	1	80	1	
	16	51	52	W̄.W	30.7	1	80	1	
	17	5	52	W̄.W	22.0	1	80	1	
	18	1	51	W̄.W	14.0	4	70	3	
	19	1	5	W̄.W	40.7	4	70	3	
	20	5	53	W̄.W	29.4	4	70	3	
	21			W̄.W					
	22			W̄.W					
	23			W̄.W					
	24			W̄.W					
	25			W̄.W					
	26			W̄.W					
	27			W̄.W					
	28			W̄.W					
	29			W̄.W					

d) Population

Table 2.20 Redaction Form III

Traffic Zone Code	1979	Annual Growth Rate (%)			Without Project			With Project		
		1979 - 1986	1986 - 1992	1992 - 2000	1986	1992	2000	1986	1992	2000
1	55,800	1.0	0.8	0.6	59,800	62,700	65,800	Same as Without Project		
2	15,800	2.1	2.0	1.9	18,300	20,600	23,900			
3	82,700	2.1	2.0	1.9	95,700	107,800	125,300			
4	42,900	2.1	2.0	1.9	49,600	55,900	65,700			
5	189,700	2.1	2.0	1.9	219,400	247,100	287,300			
6	62,400	3.0	1.7	1.0	76,700	84,900	91,900			
7										
8										

e) Agricultural Products

Table 2.21 Redaction Form IV

Node Pair		1986		1992		2000	
Origin	Destination	W	$\overline{W}$	W	$\overline{W}$	W	$\overline{W}$
1	3	27	27	27	27	27	27
2	3	6	-	6	6	6	6

2.5 INPUT FORM

Table 2.22 Input Form I

Key in No.	1	2	3
File Name	CASEID	POPO	POPW
Input Data	TEST-A3 6	59.8 18.3 95.7 49.6 219.4 76.7	59.8 18.3 95.7 49.6 219.4 76.7
Remarks			Retouch the file "POPO"

Table 2.23 Input Form II

Key in No.	4	5	6
File Name	LINKO	LINKW	ODAO
Input Data	1 2 8.7 25 2 3 5.5 70 3 4 16.5 80 3 6 16.6 70 6 53 6.5 70 4 51 7.5 80 51 52 30.7 80 5 52 22 80 1 51 14 70 1 5 40.7 70 5 53 29.4 70	1 2 8.5 70 2 3 5.5 70 3 4 16.5 80 3 6 16.6 70 6 53 6.5 70 4 51 7.5 80 51 52 30 80 5 52 22 80 1 51 14 70 1 5 40.7 70 5 53 29.4 70	0 0 27 0 0 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Remarks		Retouch the file "LINKO"	

Table 2.24 Input Form III

Key in No.	7	8	9
File Name	ODAF	TRCD	GRATE
Input Data	0	4	.056
	0	3	.052
	27	3	0
	0	3	
	0	2	
	0	2	
	0	2	
	0	2	
	6	2	
	0	2	
	0	1	
	0	1	
	0	1	
	0	1	
	0	1	
	0	1	
	0	3	
	0	3	
	0	3	
	0	3	
	0	3	
	0		
	0		
	0		
	0		
	0		
	0		
	0		
	0		
	0		
	0		
	0		
	0		
	0		
	0		
	0		
Remarks		TRCD, TRGD DLL, DLH	

2.6 OUTPUT LIST

a) Time Table

OD TABLE OF A-3 FILE : 2:TIME0

	1	2	3	4	5	6
1	0	21	26	18	35	40
2	21	0	5	17	50	19
3	26	5	0	12	45	14
4	18	17	12	0	45	27
5	35	50	45	45	0	31
6	40	19	14	27	31	0

GRAND TOTAL= 805.23

OD TABLE OF A-3 FILE : 2:TIMEW

	1	2	3	4	5	6
1	0	7	12	18	35	26
2	7	0	5	17	42	19
3	12	5	0	12	45	14
4	18	17	12	0	45	27
5	35	42	45	45	0	31
6	26	19	14	27	31	0

GRAND TOTAL= 1513.98

b) O/D Table ODO

OD TABLE OF A-3 FILE : 2:OD0

PARAMETER:K= 602.447 ALPHA= .433 GAMMA= 1.091

	1	2	3	4	5	6
1	0	453	742	839	759	416
2	0	0	796	520	309	561
3	0	0	0	1227	706	1481
4	0	0	0	0	535	596
5	0	0	0	0	0	972
6	0	0	0	0	0	0

GRAND TOTAL= 12426.6

c) O/D Table ODW

ØD TABLE ØF A-3 FILE : 2:ØDW

PARAMETER:K= 602.447 ALPHA= .433 GAMMA= 1.091

	1	2	3	4	5	6
1	0	650	1330	839	759	657
2	0	0	796	520	369	561
3	0	0	0	1227	706	1481
4	0	0	0	0	535	596
5	0	0	0	0	0	972
6	0	0	0	0	0	0

GRAND TØTAL= 24424

d) O/D Table ODI

BASE ØD FILE : 2:ØDW

REDUCE ØD FILE : 2:ØDØ

	1	2	3	4	5	6
1	0	197	588	0	0	240
2	0	0	0	0	60	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0

GRAND TØTAL= 1084.81

e) O/D Table ODAO

ØD TABLE ØF A-3 FILE ←:ØDAØ

	1	2	3	4	5	6
1	0	0	27	0	0	0
2	0	0	6	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0

GRAND TØTAL= 33

f) O/D Table ODAF

ØD TABLE ØF A-3 FILE : 2:ØDAF

	1	2	3	4	5	6
1	0	0	27	0	0	0
2	0	0	6	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0

GRAND TØTAL= 33

g) Assignment Results of PASOO

A-3 (LINK ASSIGN)

CASE CONTROL : 3

GENERATING NODE COUNT= 6

1 2 3 4 5 6

DUMMY NODE COUNT= 3

51 52 53

LINK DATA COUNT= 22 FILE : 2:LINK0

OD FILE : 2:OD0

ROUTE FILE : 2:JR0

LINK ASSIGNMENT OUT FILE : 2:PAS00

LINK	ORIGIN	DEST.	VOLUME UP	& DOWN
1	1	2	1612	1612
2	2	1	0	
3	2	3	3345	3345
4	3	2	0	
5	3	4	1746	2343
6	4	3	596	
7	3	6	4070	4070
8	6	3	0	
9	6	53	1015	1987
10	53	6	972	
11	4	51	535	1374
12	51	4	839	
13	51	52	535	535
14	52	51	0	
15	5	52	0	535
16	52	5	535	
17	1	51	839	839
18	51	1	0	
19	1	5	759	759
20	5	1	0	
21	5	53	972	1987
22	53	5	1015	

h) Assignment Results of PASOW

A-3 (LINK ASSIGN)

CASE CONTROL : 4

GENERATING NODE COUNT= 6

1 2 3 4 5 6

DUMMY NODE COUNT= 3

51 52 53

LINK DATA COUNT= 22 FILE : 2:LINKW

OD FILE : 2:ODO

ROUTE FILE : 2:JRW

LINK ASSIGNMENT OUT FILE : 2:PASOW

LINK	ORIGIN	DEST.	VOLUME UP	& DOWN
1	1	2	1612	1921
2	2	1	309	
3	2	3	3036	3036
4	3	2	0	
5	3	4	1746	2343
6	4	3	596	
7	3	6	3761	3761
8	6	3	0	
9	6	53	706	1677
10	53	6	972	
11	4	51	535	1374
12	51	4	839	
13	51	52	535	535
14	52	51	0	
15	5	52	0	535
16	52	5	535	
17	1	51	839	839
18	51	1	0	
19	1	5	1068	1068
20	5	1	0	
21	5	53	972	1677
22	53	5	706	

i) Assignment of Results of PASIO

A-3 (LINK ASSIGN)

CASE CONTROL : 5

GENERATING NODE COUNT= 6

1 2 3 4 5 6

DUMMY NODE COUNT= 3

51 52 53

LINK DATA COUNT= 22 FILE : 2:LINK0

OD FILE : 2:ODI

ROUTE FILE : 2:JR0

LINK ASSIGNMENT OUT FILE : 2:PASI0

LINK	ORIGIN	DEST.	VOLUME UP	& DOWN
1	1	2	1025	1025
2	2	1	0	
3	2	3	888	888
4	3	2	0	
5	3	4	0	0
6	4	3	0	
7	3	6	300	300
8	6	3	0	
9	6	53	60	60
10	53	6	0	
11	4	51	0	0
12	51	4	0	
13	51	52	0	0
14	52	51	0	
15	5	52	0	0
16	52	5	0	
17	1	51	0	0
18	51	1	0	
19	1	5	0	0
20	5	1	0	
21	5	53	0	60
22	53	5	60	

j) Assignment Results of PASIW

A-3 (LINK ASSIGN)

CASE CONTROL : 6

GENERATING NODE COUNT= 6

1 2 3 4 5 6

DUMMY NODE COUNT= 3

51 52 53

LINK DATA COUNT= 22 FILE : 2:LINKW

OD FILE : 2:ODI

ROUTE FILE : 2:JRW

LINK ASSIGNMENT OUT FILE : 2:PASIW

LINK	ORIGIN	DEST.	VOLUME UP & DOWN	
1	1	2	1025	1085
2	2	1	60	
3	2	3	828	828
4	3	2	0	
5	3	4	0	0
6	4	3	0	
7	3	6	240	240
8	6	3	0	
9	6	53	0	0
10	53	6	0	
11	4	51	0	0
12	51	4	0	
13	51	52	0	0
14	52	51	0	
15	5	52	0	0
16	52	5	0	
17	1	51	0	0
18	51	1	0	
19	1	5	60	60
20	5	1	0	
21	5	53	0	0
22	53	5	0	

k) Assignment Results of COMA00

A-3 (LINK ASSIGN)

CASE CONTROL : 7

GENERATING NODE COUNT= 6

1 2 3 4 5 6

DUMMY NODE COUNT= 3

51 52 53

LINK DATA COUNT= 22 FILE : 2:LINK0

OD FILE : 2:ODA0

ROUTE FILE : 2:JR0

LINK ASSIGNMENT OUT FILE : 2:COMA00

LINK	ORIGIN	DEST.	VOLUME UP	& DOWN
1	1	2	27	27
2	2	1	0	
3	2	3	33	33
4	3	2	0	
5	3	4	0	0
6	4	3	0	
7	3	6	0	0
8	6	3	0	
9	6	53	0	0
10	53	6	0	
11	4	51	0	0
12	51	4	0	
13	51	52	0	0
14	52	51	0	
15	5	52	0	0
16	52	5	0	
17	1	51	0	0
18	51	1	0	
19	1	5	0	0
20	5	1	0	
21	5	53	0	0
22	53	5	0	

1) Assignment Results of COMAOW

A-3 (LINK ASSIGN)

CASE CONTROL : 8

GENERATING NODE COUNT= 6

1 2 3 4 5 6

DUMMY NODE COUNT= 3

51 52 53

LINK DATA COUNT= 22 FILE : 2:LINKW

OD FILE : 2:ODAO

ROUTE FILE : 2:JRW

LINK ASSIGNMENT OUT FILE : 2:COMAOW

LINK	ORIGIN	DEST.	VOLUME UP	& DOWN
1	1	2	27	27
2	2	1	0	
3	2	3	33	33
4	3	2	0	
5	3	4	0	0
6	4	3	0	
7	3	6	0	0
8	6	3	0	
9	6	53	0	0
10	53	6	0	
11	4	51	0	0
12	51	4	0	
13	51	52	0	0
14	52	51	0	
15	5	52	0	0
16	52	5	0	
17	1	51	0	0
18	51	1	0	
19	1	5	0	0
20	5	1	0	
21	5	53	0	0
22	53	5	0	

m) Assignment Results of PASDW

TEST (LINK ASSIGN)

CASE CONTROL : 11

GENERATING NODE COUNT= 6
1 2 3 4 5 6

DUMMY NODE COUNT= 3
51 52 53

LINK DATA COUNT= 22 FILE : 2:LINKW

OD FILE : 2:ODD

ROUTE FILE : 2:JRW

LINK ASSIGNMENT OUT FILE : 2:PASDW

LINK	ORIGIN	DEST.	VOLUME UP & DOWN	
1	1	2	0	0
2	2	1	0	
3	2	3	0	0
4	3	2	0	
5	3	4	0	0
6	4	3	0	
7	3	6	0	0
8	6	3	0	
9	6	53	0	0
10	53	6	0	
11	4	51	0	0
12	51	4	0	
13	51	52	0	0
14	52	51	0	
15	5	52	0	0
16	52	5	0	
17	1	51	0	0
18	51	1	0	
19	1	5	0	0
20	5	1	0	
21	5	53	0	0
22	53	5	0	

n) Assignment Results of COMADW

TEST (LINK ASSIGN)

CASE CONTROL : 12

GENERATING NODE COUNT= 6

1 2 3 4 5 6

DUMMY NODE COUNT= 3

51 52 53

LINK DATA COUNT= 22 FILE : 2:LINKW

OD FILE : 2:ODAD

ROUTE FILE : 2:JRW

LINK ASSIGNMENT OUT FILE : 2:COMADW

LINK	ORIGIN	DEST.	VOLUME UP & DOWN	
1	1	2	0	0
2	2	1	0	
3	2	3	0	0
4	3	2	0	
5	3	4	0	0
6	4	3	0	
7	3	6	0	0
8	6	3	0	
9	6	53	0	0
10	53	6	0	
11	4	51	0	0
12	51	4	0	
13	51	52	0	0
14	52	51	0	
15	5	52	0	0
16	52	5	0	
17	1	51	0	0
18	51	1	0	
19	1	5	0	0
20	5	1	0	
21	5	53	0	0
22	53	5	0	

o) Traffic Volume by Vehicle type

TRAFFIC VOLUME OF A-3 LINK COUNT= 11

		1	2	3	4	5	6	7	8	9	10	11
P/C	00	30	195	219	381	186	141	55	55	49	44	116
	10	19	52	0	28	6	0	0	0	0	0	3
	0W	112	177	219	352	157	141	55	55	49	62	98
	IW	63	48	0	23	0	0	0	0	0	3	0
L/B	00	99	175	104	180	88	58	23	23	44	40	104
	10	63	47	0	13	3	0	0	0	0	0	3
	0W	101	159	104	167	74	58	23	23	44	56	88
	IW	57	43	0	11	0	0	0	0	0	3	0
H/B	00	9	37	22	39	19	43	17	17	9	9	22
	10	6	10	0	3	1	0	0	0	0	0	1
	0W	22	34	22	36	16	43	17	17	9	12	19
	IW	12	9	0	2	0	0	0	0	0	1	0
L/T	00	116	305	135	295	102	78	0	0	0	0	109
	10	3	4	0	0	0	0	0	0	0	0	0
	0W	157	276	135	266	73	78	0	0	0	21	79
	IW	23	0	0	0	0	0	0	0	0	0	0
M/T	00	41	126	34	75	26	33	0	0	0	0	45
	10	1	2	0	0	0	0	0	0	0	0	0
	0W	65	114	34	68	19	33	0	0	0	9	33
	IW	9	0	0	0	0	0	0	0	0	0	0
H/T	00	16	46	28	60	21	25	0	0	0	0	16
	10	0	1	0	0	0	0	0	0	0	0	0
	0W	24	42	28	55	15	25	0	0	0	3	12
	IW	3	0	0	0	0	0	0	0	0	0	0
SUB-T	00	312	885	543	1031	442	378	94	94	102	92	412
	10	93	114	0	44	9	0	0	0	0	0	7
	0W	480	801	543	943	355	378	94	94	102	163	328
	IW	167	101	0	35	0	0	0	0	0	7	0
M/C	00	350	418	217	493	163	125	41	41	41	41	146
	10	104	54	0	21	3	0	0	0	0	0	3
	0W	204	371	217	443	112	125	41	41	41	39	98
	IW	71	47	0	17	0	0	0	0	0	2	0
TOTAL	00	662	1303	760	1523	605	503	135	135	143	134	558
	10	197	168	0	66	12	0	0	0	0	0	10
	0W	684	1172	760	1387	467	503	135	135	143	202	426
	IW	239	148	0	52	0	0	0	0	0	9	0

p) ADT Traffic Volume (1986)

TRAFFIC VOLUME OF A-3 (1986)

		1	2	3	4
P/C	N+D	145	230	285	458
	DV	0	0	0	0
	I	82	63	0	29
	TOTAL	227	292	285	487
L/B	N+D	131	207	135	216
	DV	0	0	0	0
	I	74	56	0	14
	TOTAL	205	263	135	230
H/B	N+D	28	44	29	47
	DV	0	0	0	0
	I	16	12	0	3
	TOTAL	44	56	29	50
L/T	N+D	204	359	176	346
	DV	0	0	0	0
	I	29	0	0	0
	TOTAL	234	359	176	346
M/T	N+D	84	148	45	88
	DV	0	0	0	0
	I	12	0	0	0
	TOTAL	97	148	45	88
H/T	N+D	31	54	36	71
	DV	0	0	0	0
	I	4	0	0	0
	TOTAL	35	54	36	71
ADT	N+D	624	1042	705	1226
	DV	0	0	0	0
	I	218	131	0	46
	TOTAL	842	1173	705	1272
M/C	N+D	265	482	282	576
	DV	0	0	0	0
	I	93	61	0	22
	TOTAL	358	543	282	598
TOTAL	N+D	889	1524	988	1803
	DV	0	0	0	0
	I	310	192	0	68
	TOTAL	1200	1716	988	1871

NOTE
N : NOMAL TRAFFIC
D : DIVERTED TRAFFIC
DV : DEVELOPED TRAFFIC
I : INDUCED TRAFFIC

q) ADT Traffic Volume (1992)

TRAFFIC VOLUME OF A-3 (1992)

		1	2	3	4
P/C	N+D	202	318	396	635
	DV	0	0	0	0
	I	114	87	0	41
	TOTAL	315	405	396	676
L/B	N+D	182	287	187	300
	DV	0	0	0	0
	I	103	78	0	19
	TOTAL	284	365	187	319
H/B	N+D	39	61	40	65
	DV	0	0	0	0
	I	22	17	0	4
	TOTAL	61	78	40	69
L/T	N+D	283	497	243	480
	DV	0	0	0	0
	I	41	0	0	0
	TOTAL	324	497	243	480
M/T	N+D	117	205	62	122
	DV	0	0	0	0
	I	17	0	0	0
	TOTAL	134	205	62	122
H/T	N+D	43	75	50	98
	DV	0	0	0	0
	I	6	0	0	0
	TOTAL	49	75	50	98
ADT	N+D	865	1445	978	1701
	DV	0	0	0	0
	I	302	182	0	64
	TOTAL	1167	1627	978	1764
M/C	N+D	368	668	391	799
	DV	0	0	0	0
	I	128	84	0	30
	TOTAL	497	753	391	829
TOTAL	N+D	1233	2113	1369	2500
	DV	0	0	0	0
	I	430	266	0	94
	TOTAL	1663	2379	1369	2594

NOTE
N : NOMAL TRAFFIC
D : DIVERTED TRAFFIC
DV : DEVELOPED TRAFFIC
I : INDUCED TRAFFIC

r) ADT Traffic Volume (2000)

TRAFFIC VOLUME OF A-3 (2000)

		1	2	3	4
P/C	N+D	302	478	593	953
	DV	0	0	0	0
	I	171	130	0	61
	TOTAL	473	608	593	1013
L/B	N+D	272	431	281	450
	DV	0	0	0	0
	I	154	117	0	29
	TOTAL	426	548	281	479
H/B	N+D	58	92	61	98
	DV	0	0	0	0
	I	33	25	0	6
	TOTAL	91	117	61	104
L/T	N+D	425	746	365	720
	DV	0	0	0	0
	I	61	0	0	0
	TOTAL	486	746	365	720
M/T	N+D	176	308	93	183
	DV	0	0	0	0
	I	25	0	0	0
	TOTAL	201	308	93	183
H/T	N+D	64	113	75	147
	DV	0	0	0	0
	I	9	0	0	0
	TOTAL	74	113	75	147
ADT	N+D	1298	2167	1467	2551
	DV	0	0	0	0
	I	453	273	0	96
	TOTAL	1751	2440	1467	2647
M/C	N+D	552	1003	587	1199
	DV	0	0	0	0
	I	193	126	0	45
	TOTAL	745	1129	587	1244
TOTAL	N+D	1850	3170	2054	3750
	DV	0	0	0	0
	I	646	399	0	141
	TOTAL	2495	3569	2054	3891

NOTE
N : NOMAL TRAFFIC
D : DIVERTED TRAFFIC
DV : DEVELOPED TRAFFIC
I : INDUCED TRAFFIC

Appendix

Estimation of

Traffic Forecasting Parameters

References

JICA, "The Kingdom of Thailand, Road Development Study in the Northern Region" 1981

APPENDIX
Estimation of Traffi Forecasting Parameters

(1) O/D Pattern

The Passenger O/D Model is estimated by applying a mathematical model of gravity type, of which variable are population in zones and travel time between zones.

The model is defined by the following formula:

$$V_{ij} = k * \frac{(Q_i * Q_j)^{\alpha}}{t_{ij}^{\beta}} \qquad (1)$$

where;
V_{ij} : Transportation demand of passenger traffic between zone i and zone j (person/day)
Q_i, Q_j : Population in zone i, zone j (10^3 person)
t_{ij} : Travel time between zone i and zone j (minute)
α, β, k : Model parameters

The model parameters α, β and k are determined by the least-square method based on the following data;

1) The actual passenger trips obtained from the O/D survey.
2) Present population in zone.
3) Traveling time under the existing road network.

Transformation for estimating α, β, k is defined by the following formula:

$$R_{ij} = \log \hat{V}ij - \log k - \alpha \log Q_i Q_j + \beta \log t_{ij} \qquad (2)$$

$$R = \Sigma_i \Sigma_j R_{ij}^2 = \Sigma_{ij} (\log \hat{V}_{ij} - \log k - \alpha \log Q_i Q_j + \beta \log t_{ij})^2$$

$$\frac{\partial R}{\partial \kappa} = 0, \quad \frac{\partial R}{\partial \alpha} = 0, \quad \frac{\partial R}{\partial \beta} = 0$$

where;
$\hat{V}_{ij}$ = Actual transportation demands of passenger traffic between zone i and zone j (person/day)

The data of actual transportation demands are carefully checked to obtain the inputs for the estimation of model parameters.

The estimated model parameters are as follows:

Table 1 O/D Model Parameters

SQ	Case	K	α	β	Correlation Coefficient
1	S2	-4.629	2.580	0.715	0.76
2	S4	0.505	1.323	0.864	0.83
3	S6	10.900	0.036	1.659	0.99
4	S1	0.501	1.022	0.937	0.99
5	S21	8.432	0.342	1.413	0.99
6	A11	6.401	0.433	1.091	0.87

Note : 1) k = log K
2) S2, S4 and S6 Stations are on unpaved provincial highways.
3) S1 and S21 Stations are on paved provincial highways.

25 data are selected among the results of surveys at 5 O/D stations, OD-1, OD2, OD-4, OD-6 and OD-21. The selected data are shown in Table 2.

Table 2 Input Data for Estimation of Model Parameters

O/D Station	SQ	O Code	D Code	V_{ij}	Q_i	Q_j	t_{ij}
S2	1	1	2	101	13.6	5.7	20
	2	1	3	227	13.6	9.9	20
	3	1	4	477	13.6	10.2	28
	4	3	5	48	9.9	8.6	50
S4	5	2	5	72	10.1	41.7	33
	6	3	5	465	17.5	41.7	56
	7	4	5	138	9.9	41.7	67
	8	5	8	354	41.7	8.5	18
	9	5	9	226	41.7	5.0	19
	10	5	10	154	41.7	3.7	21
	11	5	11	110	41.7	5.0	26
S6	12	1	3	157	189.7	14.1	42
	13	1	4	52	189.7	10.9	74
	14	2	3	711	33.0	14.1	15
	15	2	4	127	33.0	10.9	47
	16	2	9	60	33.0	11.4	66
S1	17	1	2	1,024	198.1	72.5	35
	18	1	4	341	198.1	45.4	65
	19	1	5	412	198.1	58.6	94
	20	1	7	213	198.1	59.4	136
	21	2	6	153	72.5	36.1	43
S21	22	1	2	350	101.0	164.5	67
	23	2	6	1,110	164.5	26.0	21
	24	2	8	373	164.5	47.3	48
	25	2	9	268	164.5	24.8	57

The actual transportation demands and that estimated are as follows:

Table 3 V_{ij}

SQ	Observation V_{ij}	Estimation V_{ij}
1	101	86
2	227	357
3	477	303
4	48	57
5	72	240
6	465	314
7	138	127
8	354	322
9	226	152
10	154	94
11	110	116
12	157	146
13	52	57
14	711	756
15	127	113
16	60	64
17	1,024	1,046
18	341	363
19	412	333
20	213	239
21	153	151
22	350	335
23	1,110	1,085
24	373	414
25	268	260

The correlation between the actual V_{ij} and the estimated V_{ij} are as follows:

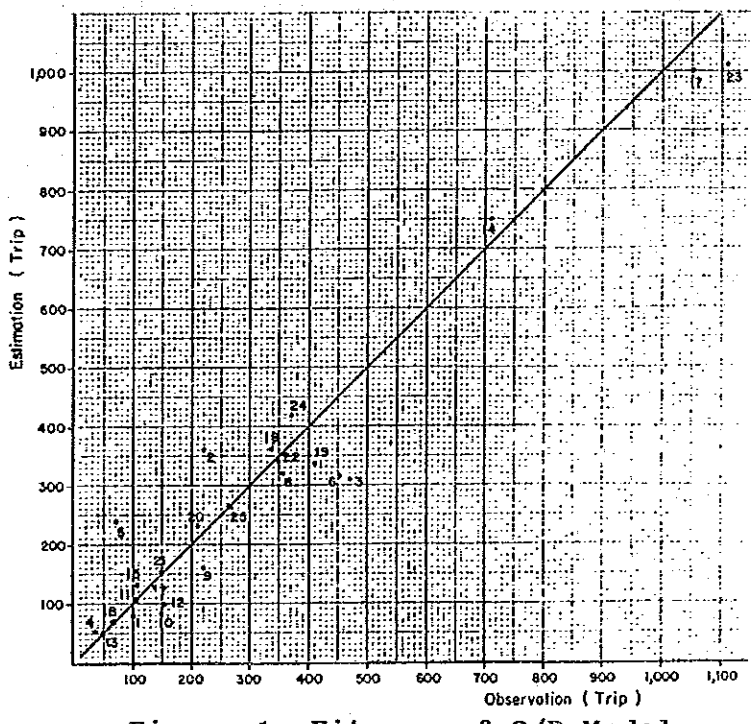


Figure 1 Fitness of O/D Model

(2) Non-Agricultural Freight Movement

Non-agricultural freight movement is forecasted on the basis of the correlation between the movement of passengers and tonnage of non-agricultural freight obtained from the roadside interviews survey data.

Movement of passengers at survey point is calculated in Table 4. And tonnage of non-agricultural freight at survey point is calculated in Table 5.

Table 4 Passenger Movement at Survey Point

Station Code	Passenger (Person)				Expansion Factor	Passenger Movement (Person/day)
	P/C	L/B	H/B	Total		
1	499	1,232	1,073	2,804	1.78	4,991
2	36	499	-	535	1.90	1,017
3	684	1,767	717	3,618	1.93	6,114
4	106	1,145	528	1,779	1.95	3,469
5	980	3,978	2,828	7,786	1.93	15,026
6	68	959	223	1,250	1.97	2,488
7	561	964	822	2,347	1.77	4,153
8	2,549	2,429	1,094	6,072	1.48	8,986
9	856	599	2,431	3,886	2.41	9,366
21	325	2,658	1,036	4,019	1.63	6,550
22	1,317	4,034	1,490	6,841	1.78	12,176

Table 5 Non-agricultural Freight Movement at Survey Point

Station Code	Non-agricultural Freight (Ton)				Expansion Factor	Non-agri. Freight Movement (Ton/day)
	L/T	M/T	H/T	Total		
1	22.4	29.8	54.0	106	1.78	189
2	7.5	2.8	30.0	40	1.90	77
3	39.0	102.0	314.6	456	1.93	456
4	-	6.0	39.3	45	1.95	88
5	53.5	372.9	610.6	1,037	1.93	2,001
6	10.8	48.1	9.7	69	1.99	137
7	43.5	35.9	178.2	258	1.77	456
8	33.8	67.3	206.4	308	1.48	455
9	66.7	78.0	168.9	314	2.41	756
21	16.5	271.4	99.4	387	1.63	631
22	14.7	70.9	125.2	211	1.78	375

The correlation is found as shown in the following formula:

$$Z_j = 0.089 * Y_j - 105 \qquad (3)$$

where;
Z_j : Tonnage of non-agricultural freight on link j
Y_j : Movement of passengers on link j

The correlation between Z_j and Y_j is as follows:

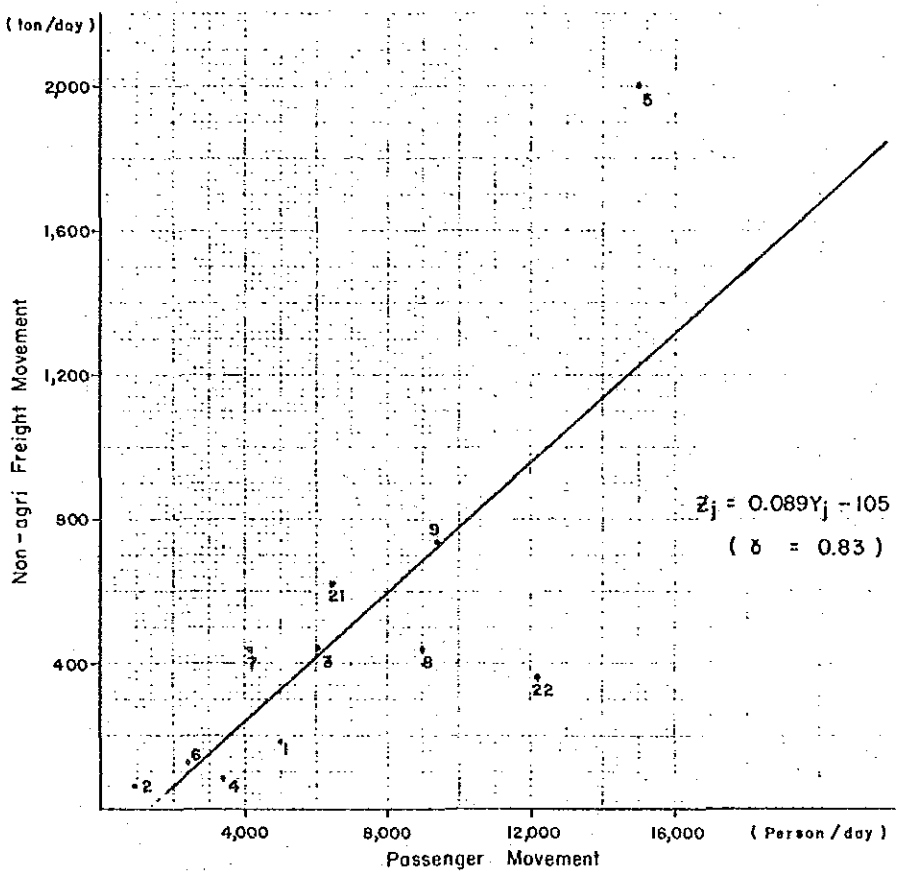


Figure 2 Relationship between Z_j and Y_j

(3) Traffic Composition Ratio

The traffic composition is calculated from the roadside interviews and the manual classified traffic counts data.

The traffic composition at the survey points is calculated in Tables 7 and 8.

They are summarized in the following table.

Table 6 Traffic Composition

Unit : %

Road Class	Passenger Traffic			Freight Traffic		
	P/C	L/B	H/B	L/T	H/T	H/T
1	(70.8) 58.3	(29.2) 24.0	(82.3) 17.7	42.3	31.7	26.0
2	(67.9) 63.6	(32.1) 30.0	(93.5) 6.5	54.2	24.8	21.0
3	(52.6) 47.8	(47.4) 43.0	(90.8) 9.2	49.2	36.7	14.1
4	(23.3) 21.8	(76.7) 71.7	(93.5) 1.5	52.4	33.7	13.9

Table 7 Traffic Composition at Survey Point (Passenger Traffic)

Survey Point	Road Class	Counted Traffic (vehicles)				Traffic Composition (%)		
		P/C	L/B	H/B	(Total)	P/C	L/B	H/B
1	3	128	78	25	(231)	55.4	33.8	10.8
2	4	8	39	-	(47)	17.0	83.0	-
3	2	228	137	28	(393)	58.0	74.9	7.1
4	4	38	106	15	(159)	23.9	66.7	9.4
5	1	363	234	25	(672)	54.0	34.8	11.2
6	4	19	51	8	(78)	24.4	65.4	10.5
7	2	165	81	26	(272)	60.7	29.8	9.6
8	2	554	163	32	(749)	74.0	21.8	4.3
9	1	214	45	83	(342)	62.6	13.1	24.3
21	3	116	151	22	(287)	40.1	52.2	7.6
22	3	454	246	38	(738)	61.5	33.3	5.2

Table 8 Traffic Composition at Survey Point II (Freight Traffic)

Survey Point	Road Class	Counted Traffic (vehicles)				Traffic Composition (%)		
		L/T	M/T	H/T	(Total)	L/T	M/T	H/T
1	3	89	52	27	(168)	53.0	36.0	16.0
2	4	62	20	61	(143)	43.4	14.0	42.6
3	2	273	89	135	(497)	54.9	17.9	27.2
4	4	59	26	25	(110)	53.6	23.6	22.8
5	1	251	283	168	(702)	35.8	40.3	23.9
6	4	62	53	6	(121)	51.2	43.8	5.0
7	2	110	53	44	(207)	53.1	25.6	21.3
8	2	229	109	82	(420)	54.5	26.0	19.5
9	1	183	87	106	(376)	48.7	23.1	28.2
21	3	246	230	66	(542)	45.4	42.4	12.2
22	3	178	98	53	(329)	54.1	29.8	16.1

(4) Occupancy Ratio

The average occupancy of passenger car and buses are calculated from the roadside interview data.

The average occupancy at the survey points is calculated below.

Table 9 Occupancy Ratio at Survey Point

Survey Point	Road Class	Passenger Car			Light Bus			Heavy Bus		
		Person	Vehicle	Occ.	Person	Vehicle	Occ.	Person	Vehicle	Occ.
1	3	499	128	3.9	1,232	78	15.8	1,073	25	42.9
2	4	36	8	4.5	499	39	12.8	-	-	-
3	2	684	228	3.0	1,767	137	12.9	717	28	25.6
4	4	106	38	2.8	1,145	106	10.8	528	15	35.2
5	1	980	363	2.7	3,978	234	17.0	2,828	75	37.7
6	4	68	19	3.6	959	51	18.8	223	8	27.9
7	2	561	165	3.4	964	81	11.9	822	26	31.6
8	2	2,549	554	4.6	2,429	163	14.9	1,094	32	34.2
9	1	856	214	4.0	599	45	13.3	2,432	83	29.3
21	3	325	116	2.8	2,582	151	17.6	1,036	22	47.1
22	3	1,317	454	2.9	4,034	246	16.4	1,490	38	39.2
Total	-	7,982	2,287	3.5	20,188	1,331	15.2	12,243	352	34.8

They are summarized in the following table.

Table 10 Occupancy Ratio

Road Class	Occupancy Ratio
1	6.91
2	7.25
3	9.04
4	12.47

(5) Average Load

The average loading rate of trucks is calculated from roadside interviews data. The average loading rate of trucks at the survey points is calculated in Tables 12 and 13.

They are summarized in the following table.

Table 11 Average Load

Road Class	Agricultural Freight Average Load	Non-Agricultural Freight Average Load
1	4.75	4.78
2	4.07	4.11
3	3.94	3.77
4	3.81	3.67

Table 12 Average Load at Survey Point I (Agricultural)

Survey Point	L/T			M/T			H/T		
	Freight	Vehicle	Load	Freight	Vehicle	Load	Freight	Vehicle	Load
1	11.1	3	3.7	82.5	11	7.5	51.0	6	8.5
2	9.0	6	1.5	2.1	3	0.7	24.0	3	8.0
3	2.4	4	0.6	23.5	5	4.7	93.0	10	9.3
4	1.6	2	0.8	0.6	1	0.6	21.0	2	10.5
5	7.8	6	1.3	43.0	10	4.3	51.1	7	7.3
6	13.0	5	2.6	46.8	9	5.2	-	-	-
7	6.3	7	0.9	49.0	7	7.0	96.6	7	13.8
8	10.8	12	0.9	109.2	14	7.8	134.0	10	13.4
9	12.0	8	1.5	31.2	6	5.2	36.5	5	7.3
21	14.4	16	0.9	189.2	43	4.4	202.4	22	9.2
22	16.0	8	2.0	66.0	15	4.4	68.0	8	8.5
Total	104.4	77	1.36	643.1	124	5.19	777.6	80	9.72

Table 13 Average Load at Survey Point II
(Non-Agricultural Freight)

Survey Point	L/T			M/T			H/T		
	Freight	Vehicle	Load	Freight	Vehicle	Load	Freight	Vehicle	Load
1	22.4	19	1.2	29.8	14	2.1	54.0	4	13.5
2	7.5	11	0.7	2.6	2	1.4	30.0	2	15.0
3	39.0	32	1.2	102.0	25	4.1	314.0	24	13.1
4	-	-	-	6.0	3	2.0	39.3	4	9.8
5	53.5	27	2.0	372.8	66	5.6	610.6	64	9.5
6	10.8	6	1.8	48.1	13	3.7	9.7	1	9.7
7	43.6	34	1.3	35.9	15	2.4	178.2	13	13.7
8	33.8	36	0.9	67.3	13	5.2	206.4	17	12.1
9	66.7	33	2.0	78.0	27	2.9	168.9	15	11.3
21	16.5	15	1.1	271.4	64	4.2	99.4	10	9.9
22	14.7	5	2.9	70.9	19	3.7	125.2	13	9.6
Total	308.4	218	1.4	1,085.0	261	4.2	1,835.7	167	11.0

(6) Empty Ratio

The empty ratio is calculated from the roadside interviews data. The transportation for a diversity of purposes such as shopping and business is included in the category of empty trucks.

The empty ratio at the survey points is calculated below.

Table 14 Empty Ratio at Survey Point

Survey Point	L/T			M/T			H/T		
	Empty Trucks	Total	Empty Ratio	Empty Trucks	Total	Empty Ratio	Empty Trucks	Total	Empty Ratio
1	67	89	75.3	27	52	51.9	17	27	63.0
2	45	62	72.6	15	20	75.0	56	61	91.8
3	237	237	86.8	59	89	66.3	101	135	74.8
4	57	59	96.6	22	26	84.6	19	25	76.0
5	218	251	86.9	238	283	84.1	97	168	52.7
6	51	62	82.3	31	53	58.5	5	6	83.3
7	69	110	62.7	31	53	58.5	24	44	54.5
8	181	229	79.0	82	109	75.2	55	82	67.1
9	142	183	77.6	54	87	62.1	86	106	81.1
21	215	246	87.4	142	230	61.7	34	66	51.5
22	165	175	92.7	64	98	65.3	32	53	60.4
Total	1,447	1,742	83.1	765	1,100	69.5	526	773	68.0

They are summarized in the following table.

Table 15 Empty Ratio

Type of Vehicle	Rate
Light Truck	83.1
Medium Truck	69.5
Heavy Truck	68.0

(7) Motorcycle Traffic Ratio

The motorcycle traffic is forecasted on the basis of the relationship between ADT and motorcycle volumes obtained from the classified manual traffic counts data (see Table 16).

The relationship is found as shown in the following two formulas:

- On Paved Road

(number of motorcycle) = 0.557 x (ADT) - 85.1 (4)

- On Unpaved Road

(number of motorcycle) = 1.020 x (ADT) - 41.2 (5)

The relationship between ADT and motorcycle volumes is as follows:

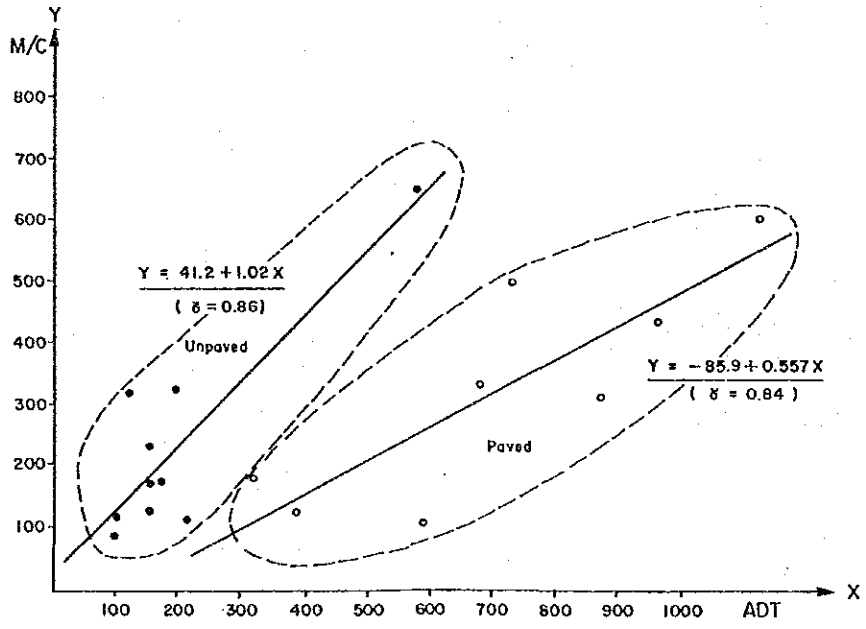


Figure 3 Relation between ADT and Volume of M/C

Table 16 Counted Traffic at Survey Station

Survey Station	Survey Point	Road Class	Volume of M/C	Traffic 1/ Volume
O/D Station	1	3	216	399
	2	4	272	190
	3	2	603	890
	4	4	631	269
	5	1	732	1,374
	6	4	205	199
	7	2	153	479
	8	2	535	1,169
	9	1	126	718
	21	3	408	831
	22	2	392	1,067
Manual Count Station	11	4	153	180
	12	4	778	698
	13	4	387	235
	14	4	200	185
	15	4	392	146
	16	4	142	107
	17	4	101	112

Note : 1/ M/C is not counted in traffic volume

PART 3

TRAFFIC HANDLING MANUAL

TABLE OF CONTENTS

CHAPTER 1 BASIC SCHEME OF TRAFFIC HANDLING

1.1 Measures for Traffic Handling 3-1
1.2 Basic Scheme for Traffic Handling 3-2
1.3 Phases in Traffic Handling 3-3
1.4 Basic Considerations of Traffic Handling 3-4

CHAPTER 2 DAY TO DAY TRAFFIC HANDLING

2.1 Basic Idea 3-7
2.2 Smooth Operation System 3-7
2.3 Safety Measures System 3-8

CHAPTER 3 EMERGENCY TRAFFIC HANDLING

3.1 Basic Idea 3-10
3.2 Congestion Relief System 3-11
3.3 Accident Disabled Car Handling System 3-14
3.4 Abnormal Weather Countermeasure System 3-15

CHAPTER 1 BASIC SCHEME OF TRAFFIC HANDLING

1.1 MEASURES FOR TRAFFIC HANDLING

Measures should be taken concerning demand structure, means of transportation, and alternative means to ensure proper traffic handling. Figure 1.1 shows proposed measures for road traffic handling.

Since the current undertaking is concerned with improving the road traffic flow, Figure 1.2 shows typical approaches for the improvement, which may be summarized as follows:

1) Improving road traffic facilities.
2) Improving motor vehicles.
3) Improving road use.

The traffic operation for DOH roads urges drivers to take either compulsory guided actions as stated in the foregoing section, and corresponds to Item 3 above.

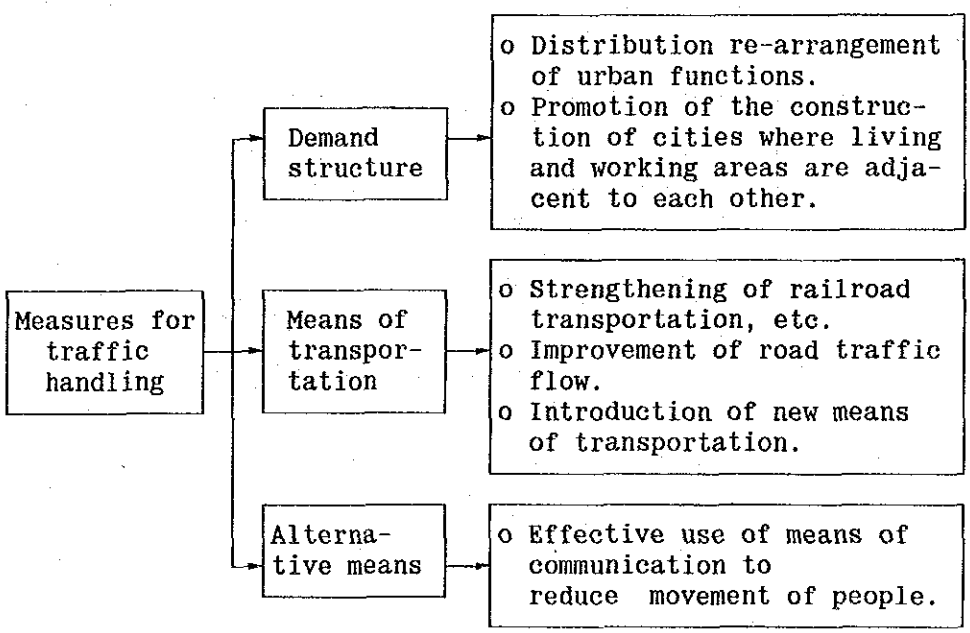


Figure 1.1 Measures for Traffic Handling

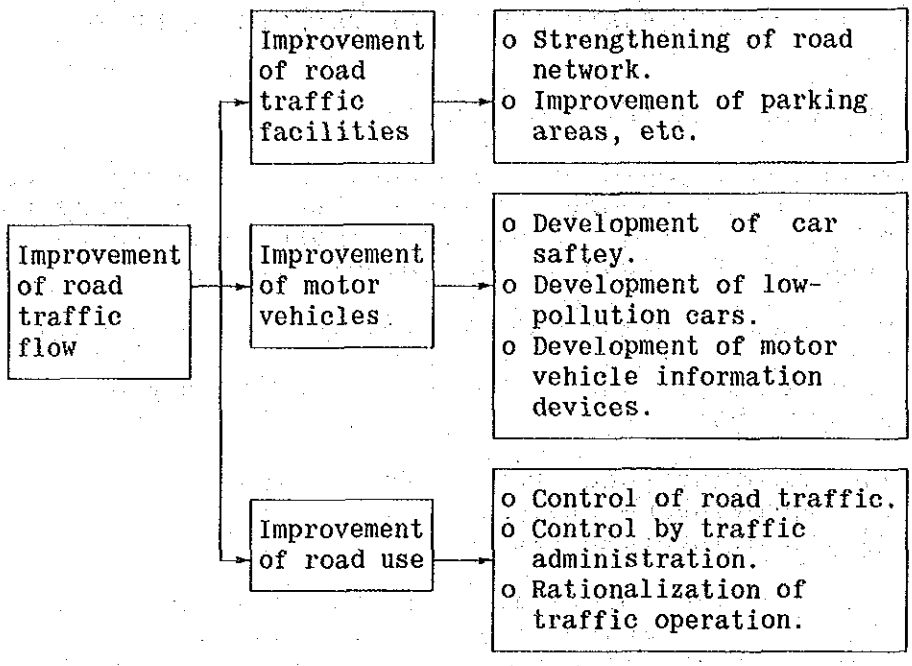


Figure 1.2 Improvement of Road Traffic Flow

1.2 BASIC SCHEME FOR TRAFFIC HANDLING

The objectives of the traffic handling which involves measures for traffic handling mentioned above for DOH and related roads are as follows:

1) Easing traffic congestion.
2) Ensuring traffic handling capability in a state of hostility.
3) Preservation of roadside environment.
4) Effective road use.

Easing traffic congestion is the prevention or reduction in the natural tendency for congestion. Ensuring traffic handling capability is by means of the use of detours to cope with traffic obstacles such as abnormal weather. The preservation of roadside environment concerns the measures to be taken against an increase in traffic volume on roads passing through densely built-up areas. Effective road use is aimed at proper distribution of traffic volume on roads so as to avoid localized concentration of traffic.

These objectives should be achieved by controlling traffic volume. In this approach, information collected with traffic counters is used to predict traffic situations (congestion level or travel time) in the near future for the purpose of avoiding a localized concentration of traffic. Figure 1.3 shows the method of

controlling traffic volume which is based on the basic scheme for the proposed traffic handling.

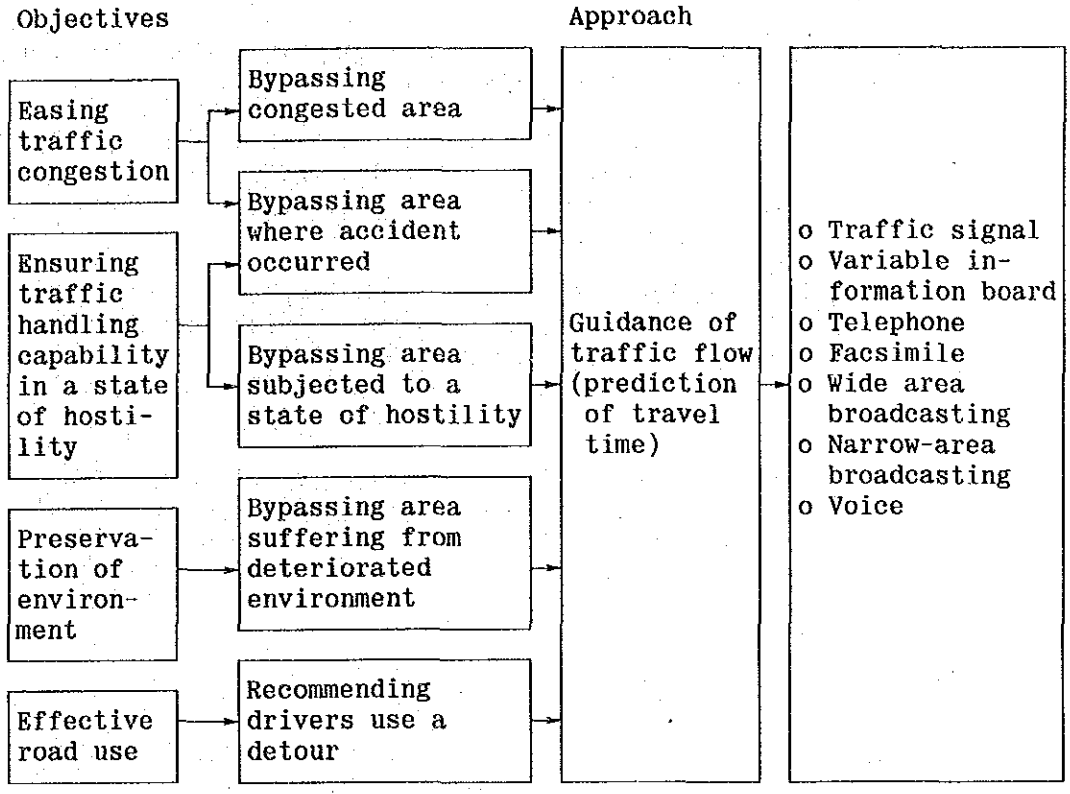


Figure 1.3 Basic Scheme

1.3 PHASES IN TRAFFIC HANDLING

As already stated, the traffic handling system expands progressively as the needs of society in general, drivers and road administrators, change and as technical progress is made as a result of the change. Table 1.1 shows the process of this system expansion.

The traffic handling approach currently being used on DOH and related roads represents only part of the first phase where police cars or emergency telephones are used to collect traffic-related information. Entry into the second phase as soon as possible is an urgent need.

For this reason, the current undertaking is concerned with the second half of the first phase and the first half of the second phase.

Table 1.1 Phases in Traffic Handling

Phase	Activity
First phase	Collection of information by patrol system, emergency telephone, toll collection system, etc.
Second phase	Introduction of information collection system, information service system and traffic regulation system. Human controllers are responsible for decision making.
Third phase	Introduction of control support system. The system utilizes an electronic computer which memorizes various traffic- and weather-related events and types of control selected for them, and inform the controllers they are responsible for decision making.
Fourth phase	Introduction of traffic-related event prediction system. The system predicts traffic-related events and evaluates results produced by a specific type of control to provide dynamic traffic flow control.

1.4 BASIC CONSIDERATION OF TRAFFIC HANDLING

Based on the foregoing discussion in this section, the basic considerations in implementing the proposed traffic handling may be itemized as follows:

a) Item 1 (Objectives of Handling)

The objectives of the traffic handling shall be as follows:

1) Normal-time

Ensuring proper distribution of traffic flow to prevent congestion.

2) Urgent-time

Minimizes congestion in a state of emergency to ensure smooth traffic flow.

b) Item 2 (Traffic Flow Reference Points)

Traffic flow reference points shall be installed to obtain parameters necessary for the traffic handling. The traffic flow reference points shall be equipped with traffic counters to collect the following data at specified intervals and transmit it to the control room:

1) Per-vehicle-type passage volume
2) Average running speed
3) Occupancy

c) Item 3 (Traffic Survey)

The following shall be surveyed to obtain information on traffic situations which is essential to the traffic handling:

1) Traffic volume

By season, day of the week, and time-period.

2) OD traffic volume

An OD survey for vehicle trips shall be conducted every five years to obtain trip information by season, day of the week, and at 30-minute time interval.

3) Travel time

Trip tests shall be conducted once a year on major routes to determine the average travel time at each control section on the major routes.

d) Item 5 (Weather Monitoring Points)

Weather monitoring points shall be installed at spots likely to have weather-related problems. Each monitoring point shall be equipped with a device associated with its specific weather-related problem (one of those listed below), so as to allow weather information to be transmitted to the control room at specific time intervals.

1) Fog detector
2) Heavy rain detector
3) Strong wind detector

e) Item 6 (Traffic Handling)

The traffic handling shall provide the following:

1) Route information service
2) Route guidance

f) Item 7 (Traffic Handling Parameters)

The following parameters shall be used to dictate the traffic handling:

1) Traffic information (congestion level, travel time)
2) Weather information (fog, rainfall, wind)

g) Item 8 (Driver Notification in Traffic Handling)

The traffic handling shall use the following means for driver notification:

1) Speaker installed at the toll-booth.
2) Car radio reception Via commercial broadcast.
3) Road information board on the approach to a diverging location.