SURVEY MANUALS-1.4

CODING MANUAL

C O N T E N T S

1. General

The purpose of coding is to translate the data collected by the interviewers into certain combinations of numbers, known as codes, which can be punched on cards to enable subsequent analysis by a computer.

To facilitate coding operations, the Interview Form is designed so that several of the entries made by the interviewers are self-coding, such answers to inquiries as occupation, industry, etc. Where answers to inquiries are in the form of addresses or other written statements, it is necessary to determine appropriate code numbers.

Complete and accurate information for analysis can be obtained only from correctly punched cards, and accuracy of the cards depends to a great extent upon the care used in coding operation. Proper code numbers for each item must be carefully selected. In writing code numbers, neatness and legibility are very important. Poorly formed or indistinct numerals are easily misinterpreted by punch operators, resulting in errors, ruined cards, and inefficient work.

2. Coding Operation

Coding operation will be divided into the following three steps:

Step-1. Coding --- Addresses and other written statements will be coded. Code numbers will be written on the Interview Form.

Step-2. Transcription --- Code numbers written on the Interview Form and self-coded will be transcribed on the Coding Form.

Step-3. Check of Transcription --- Errors in transcription will be checked.

3. Step-1 Coding

3-1. General Instruction

a) Distribution and Management of Interview Form

The interview forms, which are through with the 3rd check, will be distributed to the coders by the Traffic Engineer Supervisors. After completing coding, the coder must return them to the Traffic Supervisor. It is the responsibility of the Traffic Engineer Supervisor to manage the interview forms, therefore, the coders are always required to get and return the interview forms from and to the Traffic Engineer Supervisors. The interview forms must be always kept by household unit. Take care not to mix the interview forms from one household to another.

b) Use a red color pentel-pen for coding.

c) Different colors of ballpoint pen are used for First, Second and Third check and amendment of data might be made during the course of checking. When it is difficult to judge which amendment to be followed because of the overlapped amendment, the priority is given to the following order:

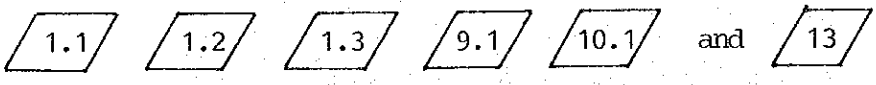
First Priority - - - Green Color (Third Check)
Second Priority - - Blue Color (Second Check)
Third Priority - - - Red color (First Check)

d) Code numbers will be written neatly and legibly on the interview form.

e) Code numbers for addresses, origin, destination and places where mode was changed will be obtained from Zone Code List. The coders must take at-most care to select correct code numbers.

f) Whenever the coder finds questionable items or mistakes of the data in the interview form, ask instruction of the Traffic Engineer Supervisor.

3-2. Detailed Instruction



These items will be coded. Code numbers are listed in Zone Code List. Zone Boundary Map can also be used.

Examples

	Code Numbers
Barangay 7, Poblacion	1042
University of Mindanao	1022
San Pedro Church	1024
Agdao, Buhangin District	3031
Cotabato City	7050
Manila (outside of Mindanao)	8000

When there is no entry for items /1.1/ /9.1/ and /10.1/ in the interview form, consult the Traffic Engineer Supervisor.

When there is no entry for items /1.2/ and/or /1.3/ in the interview form, there is no need to do coding.

When the entry is not complete, for example only District name is entered, use the following code numbers.

	Code Numbers
Poblacion	1000
Bunawan	2000
Buhangin	3000
Talomo	4000
Toril	5000

[2] SEX

	Code Numbers
Male	1
Female	2

When there is no entry, consult the Traffic Engineer Supervisor.

[3] AGE

Entry itself will be the code number. When age is more than 100, use 99.

Example

	Code Numbers
Age 35	35
Age 102	99

[4] OCCUPATION

[5] INDUSTRY

Encircle the corresponding number to the mark made in the block. When no entry is made, select and encircle the number 12. Jobless.

[7] /7.1.1/, /7.3/

Encircle the corresponding number to the mark made in the block.

/7.1.2/

Entry itself will be the code number.

/7.2/

Entry itself will be the code number. When the distance exceeds 10,000 meters, Use 9999. When time spent exceeds 100 minutes, use 99.

[8] TRIP NO.

Trip number itself is the code number. However, the last trip is coded as 99. When no trip is made, trip number is also coded as 99.

[9], [10] /9.2/, /10.2/ Entry itself will be the code number.

/9.3/, /10.3/ Code numbers for A.M. and P.M.

	Code Number
A.M.	1
P.M.	2

Examples:

		Code Number
A.M.	10:30	11030
P.M.	2:10	20210
A.M.	7:30	10703

Example:

In case of 4 trips

Trip No.	Code Number
1	01
2	02
3	03
4	99

In case of 1 trip

Trip No.	Code Number
1	99

In case of no trip

Trip No.	Code Number
no trip	99

11 , 12 Entry itself will be the code number

14 No. of persons in vehicle

Entry itself will be the code number
When there is no entry, use 00.
Did you drive?
Encircle the corresponding number to the mark made in the block. When there is no entry, use 0.

15 Entry itself will be code number.

When there is no entry, use 0.

20 Coding is not required.

21 Month and date will be coded. Year is not required to be coded.

Examples:

	Code Number
November 15, 1979	1115
December 3, 1979	1203
December 12, 1979	1212

4. Step-2 Transcription

After all information in the interview form has been translated into code numbers, these code number will be transcribed on the coding form.

4-1. General Instruction

a) Distribution and Management of Interview Forms and Coding Forms.

It is responsibility of the Traffic Engineer Supervisor to manage the interview forms and the coding forms, therefore, the coders are always required to get and return these forms from and to the Traffic Engineer Supervisors. These forms must be always kept by household unit. Take care not to mix these forms from one household to another.

b) Code numbers in the interview form will be transcribed on the coding form, neatly and legibly. Write numbers clearly so that any puncher can easily identify numbers.

c) Code numbers of certain item in the Interview form have to be placed at the designated portion of the coding form. Take care not to misplace code numbers.

d) Code numbers in the interview form are written by a red pentel pen. When there is any discrepancy between information given by red pentel pen and other color ballpint pens, select information given by a red pentel pen.

e) Code numbers which have fewer digits than are provided in the pertinent coding spaces on the coding forms must have sufficient zeros prefixed to fill the entire space allowed for each item.

Example:

Interview Form		Coding Form Correct Entry	Wrong Entry
[e]	No. of Trip 2	0 2	2
[4]	Occupation 3	0 3	3
[7.2]	Distance 50^{m}	0 0 5 0	5 0

4-2. Detailed Instruction

The first row of the coding form is for information of the interviewee's individual characteristics. The second to 8th rows are for trip information of the interviewee. One coding form can mostly contain information of two interview forms. When number of trips of an interviewee is more than eight (8), information on 8th trip and succeeding trips is entered on 10th row and succeeding rows.

The sequence of items in the Coding Form is different from that in the interview form. For example, information on Date will be entered right after /7.3/ monthly family income.

/7.1.1/, /7.1.2/ Vehicles Owned

Three types of vehicles can be entered. When the interviewee owns more than four, young number will governs for selection of three types of vehicle.

Example:

Interview Form

Plate classification		No. of units
1.	B	1
2.	L	1
3.	H	
4.	J	1
5.	S	1
6.	T	
TOTAL		4

Coding Form

7.1.1	7.1.2	7.1.1	7.1.2	7.1.1	7.1.2
1	0 1	2	0 1	4	0 1

[8] Trip No.

One row is for one trip.
The last trip number is entered as 99.
When no trip is made, trip number is entered as 99 and the succeeding items will be blank.

[12] , [13] Mode of travel

Example:

Interview Form

12	13
1	4 0 1 1
7	1 0 2 2
8	3 0 2 0
10	

Coding Form

12	13	12	13	12	13	12	13
1st		2nd		3rd		4th	
0 1	4 0	1 1	0 7	1 0 2 2		0 8	3 0 2 0	1 0	BLANK

SURVEY MANUALS-1.5

CORDON LINE SURVEY MANUAL

C O N T E N T S

1. General

Travels within the Person-Trip Survey area made by persons living outside the area will be obtained by the Cordon Line Survey, which supplements the Person-Trip Survey.

Principal objectives of the Survey are:

1. To determine the total number and character of all vehicles entering and leaving the survey area, and
2. To obtain origin and destination information from the passengers of the sampled vehicles entering the Survey area.

The first objective will be accomplished by the classified traffic count. The second objective will be accomplished by the roadside interview survey.

2. Location of Cordon Line and Cordon Station

2-1. Location of Cordon Line

The cordon line is set along the boundary of the Person-Trip Survey area.

2-2. Location of Cordon Station

The cordon stations are to be established on all important roads at points where they cross the cordon line.

There are 16 roads crossing the cordon line. Traffic volume, road width and road surface condition of each road were investigated. Selection of the cordon stations was made on the basis of estimated daily traffic volume. The road which has estimated daily traffic volume of less than 300 vehicles per day was excluded from the cordon station. As a result, six (6) cordon stations were selected.

These are as follows:

Station -1	Davao-Bukidnon Road (Talomo/Catalunan Pequeño Boundary)
Station -2	Buhangin-Lapanday Road (Buhangin/Tigatto Boundary)
Station -3	Davao-Cotabato Road (Lizada/Sirawan Boundary)
Station -4	Old Highway (Crossing Bayabas/Lubogan Boundary)
Station -5	Davao - Agusan Road (Lasang /Agusan Boundary)
Station -6	Lasang - Malabog Road (Lasang/Malabog Boundary)

Location of the interview station was selected at the section where the road is straight and level to secure safety for both the drivers and the surveyors.

The typical layout of the interview station is shown in Figure-1.

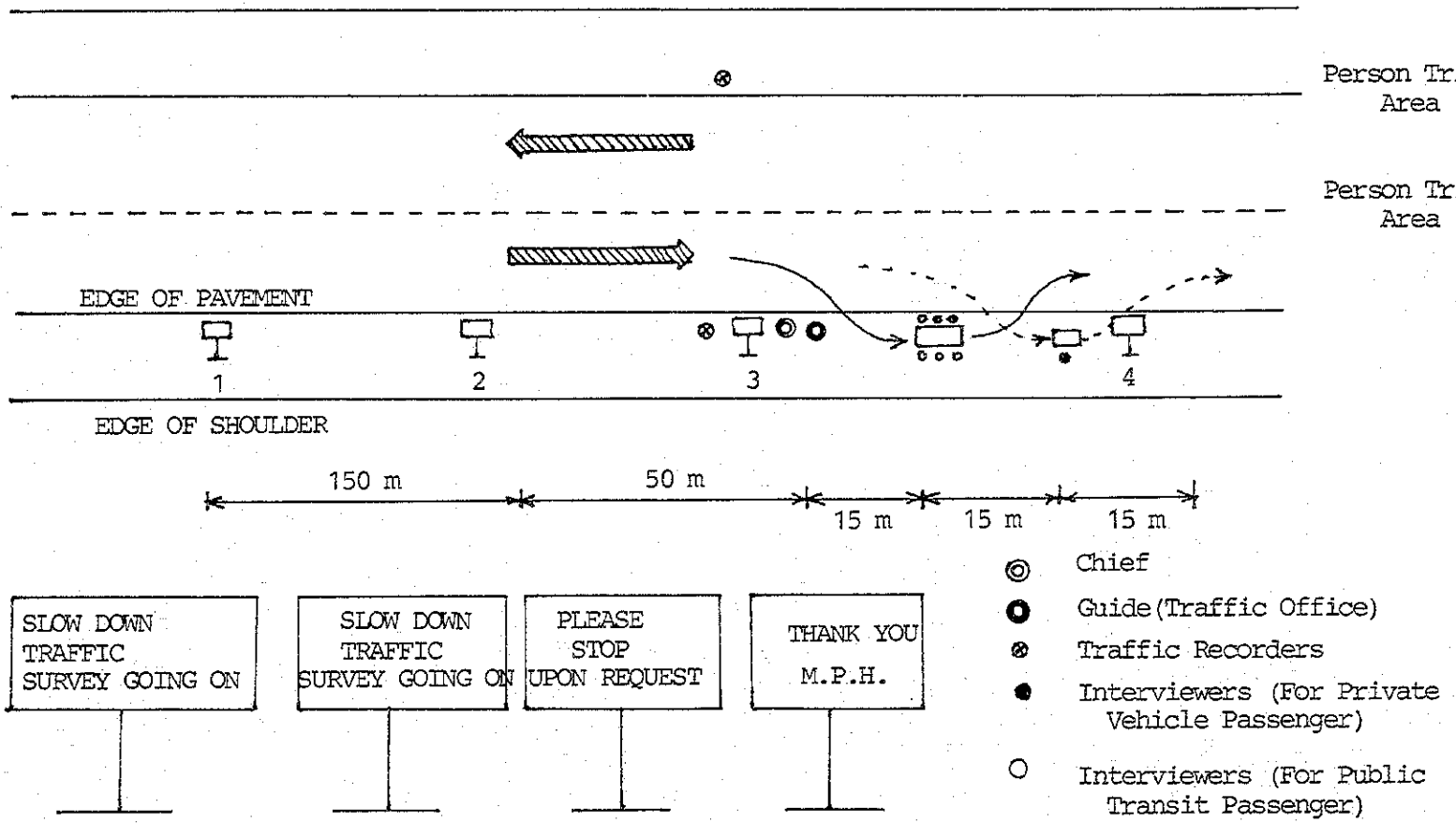


Fig.-1. LAYOUT OF INTERVIEW STATION

3. Survey Schedule

The Cordon Line Survey will be conducted during the Person-Trip Survey period, specifically on November 27, 28 and 29. Refer to Table -1 Cordon Line Survey Schedule.

Table -1. Cordon Line Survey Schedule

Date	Station No.	Location
November 27 (Tuesday)	Station 1	Davao-Bukidnon Road
	Station 2	Buhangin-Lapanday Road
November 28 (Wednesday)	Station 3	Davao-Cotabato Road
	Station 4	Old Highway
November 29 (Thursday)	Station 5	Davao-Agusan Road
	Station 6	Lasang-Malabog Road

Manual traffic count will be conducted for 15 hours from 6:00 A.M. to 9:00 P.M. A portable automatic traffic recorder will be installed at Station 3 and Station 5 to record 24 hours traffic volume.

Roadside interview will be conducted for 12 hours from 6:00 AM to 6:00 P.M.

4. Survey Organization

Organization for the Cordon Line Survey is shown in Table-2.

Table 2. Cordon Line Survey Organization

Station No.	Station -3 Station -5	Station -1	Station -2 Station -4 Station -6
Daily Traffic Volume	4,300 9,400 V/day	3,500 V/day	1,000 300 V/day
Chief	1	1	1
Aides for Traffic Count	4	2	2
Guide	1	1	1
Interviewer For Private Vehicles	2	2	1
For Public Utility Vehicles	8	6	2
For PU Passenger Count	1	1	1
Sub-Total	17	13	8
Extra Aides for shift	4	4	3
Total	21	17	11
Traffic Officer	2	2	2
Grand Total	23	19	13

Chief

The chief is responsible for all field details necessary for successful operation of the station and completion of the work.

The chief should assign the place for each member to work and see that each person is supplied with forms, pencils, writing boards, etc., and is ready to start at the scheduled time. He should advise the interviewers as necessary and offer suggestions that will help them to perform interviews in an efficient and courteous manner. He should make arrangements for shifting members. He should check the completed forms from time to time to see that the interviews are made correctly.

Aides for Traffic Count

All traffic passing in both directions, including vehicles stopped for interview are counted and classified at each station.

Traffic Officer and Guide

Traffic officers and a guide direct vehicles to the interviewers, or permit them to pass, as necessary in accordance with the interview speed.

The vehicles selected for interview should be proportionate to share of each vehicle type as much as possible. All types of emergency vehicles and buses are allowed to pass at all times. Bus passengers will be surveyed at the terminal on other days.

Interviewer

Two kinds of forms are prepared. One is for the passengers of private vehicle and PU taxi. The driver of private vehicle is interviewed as a representative of the passenger. In case of PU taxi, one of the passenger is interviewed. The other is for the passengers of public utility vehicles excluding PU taxi. The passengers are interviewed.

Interviewers should approach the passengers in a courteous manner and be as brief as practicable in getting the desired information so the passengers can be on their ways as soon as possible.

Some passengers may refuse to give the information requested, and, if so, explain that information obtained from them will be kept confidential. If they still refuse to answer, let them proceed without wasting time in argument.

Upon completing an interview, the interviewer should not fail to thank the passengers for their cooperation.

In making interviews, speed is desirable, but do not sacrifice accuracy or completeness for speed. If information is not recorded correctly and completely for every question, it may become necessary to throw away the entire interview. Complete and accurate information must be obtained or the time spent in getting the interview is wasted, both for the interviewer and the passengers.

For PU Vehicle Passenger Count

In this case, the public utility vehicle is limited to the PUJ, the AC and the Tricycle. One survey aide is assigned to this work and he counts number of passengers in the vehicle which is stopped for interviewing.

5. Interview Form

The interview forms (For Private Vehicle Passenger and For Public Transit Passenger) shown in Appendix 1-1, 1-2, have been designed for recording trip information.

5-1. Form For Private Vehicles Passenger

Motorcycle, Automobile, Truck and PU will be stopped. A driver of a motorcycle, an automobile and a truck will be interviewed as a representative of passengers. In case of a PU, one of the passengers of PU will be interviewed.

[1] TYPE OF VEHICLE

Check the block of corresponding type of the vehicle

[2] TIME

Time interviewed is entered by 30 minutes period. For example, when the interview is made at 9:18 AM, enter 9:00 AM.

[3] ADDRESS

To coordinate data obtained by the Cordon Line Survey with those by Person-Trip Survey, it is necessary to know whether the passenger lives within the Person-Trip Survey area.

Enter the home address, Barangay and Province/Municipality of the names of the interviewee.

[4] ORIGIN

Enter the address, Barangay and Province/Municipality of the Origin.

[5] DESTINATION

Enter the address, Barangay and District of the Destination.

[6] PURPOSE

From the list at the top of the form, enter the corresponding number.

[7] NO. OF PASSENGERS

Enter the number of persons in the vehicle including driver.

5-2. From for Public Transit Passenger

This form is for public transit passenger except bus and PU taxi passenger.

[1] TYPE OF VEHICLE

Check the block of corresponding type of the vehicle.

[2] TIME, [3] ADDRESS, [4] ORIGIN, [5] DESTINATION and [6] PURPOSE are entered in the same manner as the form for private vehicle passenger.

CORDON LINE INTERVIEW FORM (FOR PRIVATE VEHICLE PASSENGER)

STATION NO. _____ RECORDER _____

DATE _____

WEATHER _____

6 PURPOSE

1. Work (Office)	6. Eat Meal
2. School	7. Shopping
3. Business	8. Church
4. Medical and Dental	9. Home
5. Social and Recreation	

1 VEHICLE	2 T I M E	3 ADDRESS	4 ORIGIN	5 DESTINATION	6 PURPOSE	7 NO. OF PASSENGER
☐ 1. Motorcycle ☐ 2. Automobile ☐ 3. Truck ☐ 4. PU	☐ 1. AM ☐ 2. PM					
☐ 1. Motorcycle ☐ 2. Automobile ☐ 3. Truck ☐ 4. PU	☐ 1. AM ☐ 2. PM					
☐ 1. Motorcycl e ☐ 2. Automobile ☐ 3. Truck ☐ 4. PU	☐ 1. AM ☐ 2. PM					
☐ 1. Motorcycle ☐ 2. Automobile ☐ 3. Truck ☐ 4. PU	☐ 1. AM ☐ 2. PM					
☐ 1. Motorcycle ☐ 2. Automobile ☐ 3. Truck ☐ 4. PU	☐ 1. AM ☐ 2. PM					

CORDON LINE INTERVIEW FORM (FOR PUBLIC TRANSIT PASSENGER)

STATION NO. _____ RECORDER _____

DATE _____

WEATHER _____

6 Purpose

1. Work (Office)
2. School
3. Business
4. Medical and Dental
5. Social and Recreation
6. Eat Meal
7. Shopping
8. Church
9. Home

1 TYPE OF VEHICLE	2 T I M E	3 ADDRESS	4 ORIGIN	5 DESTINATION	6 PURPOSE
☐1. PUJ ☐2. AC ☐3. Tricycle	☐ 1. AM ☐ 2. PM				
☐1. PUJ ☐2. AC ☐3. Tricycle	☐ 1. AM ☐ 2. PM				
☐1. PUJ ☐2. AC ☐3. Tricycle	☐ 1. AM ☐ 2. PM				
☐1. PUJ ☐2. AC ☐3. Tricycle	☐ 1. AM ☐ 2. PM				
☐1. PUJ ☐2. AC ☐3. Tricycle	☐ 1. AM ☐ 2. PM				

SURVEY MANUALS-1.6

TRAVEL TIME SURVEY MANUAL

C O N T E N T S

1. OBJECTIVE

The objectives of the Travel Time Survey are to measure time spent for travelling between specified points on specific routes and to record causes of delays and stops during the travel. These information obtained from the survey will provide basis for determining the present level of service of streets and defining the problems of the existing street system. These information are useful in developing the Transportation Plan and in determining Project Priorities.

It is a well-known fact that the car driver measures the desirability of a route in terms of the total time involved in reaching his destination. In this sense, travel time is one of the most important factors in evaluating the efficiency of the street system service. The time lost in travelling due to congestion is a better indicator in translating additional travel cost.

In many cases, the results of the survey will determine the points of greatest delay and will suggest possible remedial measures. Many traffic control techniques are devoted primarily to ease the movement of traffic and their values are reflected in travel time saved.

2. USAGE OF TRAVEL TIME DATA

Travel time data obtained from the survey will be used for the following:

1) Evaluation of traffic characteristics in terms of travel time, causes of delays and stops in relation to volume count and other suplemental survey. These characteristics are influenced by the following factors:

   - o Mode of travel (private car, public transit)
   - o Peak hour, off peak
   - o Urban road, rural road
   - o Road surface type (paved, gravel) and condition (good, fair, bad)
   - o Traffic volume, congestion ratio

2) Traffic Management Study

- o Identification of the problem
- o Causes of delay
- o Causes of decreasing road capacity

3) Immediate implementation plan

4) Long range plan for street network and traffic management

3. SURVEY METHOD

3-1. Survey Route

The following factors are considered in selecting survey routes:

- o The routes covering the Person-Trip survey area
- o The routes with and without traffic signal controlled intersections
- o The routes for PUJ rerouting plan
- o The routes for AC and Tricycles
- o The paved and unpaved routes
- o The routes with heavy and light traffic
- o The routes inside and outside the CBD

After evaluating several routes based on these criteria, five (5) routes are selected. These selected routes are listed in Appendix 3. Each route is divided into sections and control points are established. Control points are mostly located at major intersections.

3-2. Survey Period

To determine the survey period, morning, evening and normal hours were interpreted from the hourly traffic variations curve. The curve is derived from the results of the traffic volume count survey undertaken by MPH in June 1979. The survey periods are:

- o Morning peak hour (7:00 - 8:00) AM
- o Normal hour (9:00 - 4:00) PM
- o Evening peak hour (5:00 - 6:00) PM

3-3. Survey Test Vehicles

Four types of vehicles are selected namely:

PC - Private Car
PUJ - Public Utility Jeep
AC - Auto Calesa
T - Tricycle

These vehicles are popular mode of transport in Davao City. The types of vehicles used for each route are shown in the following table.

Table-1. Test Vehicle and Routes

Route Number	Mode of Travel	
	1	2
1	Private Car	PUJ
2	Private Car	PUJ
3	Private Car	PUJ and Tricycle
4	Private Car	PUJ and Tricycle
5	Private Car	AC

3-4. Travel Time Survey Methods

1) Personnel

o Private Car - a driver, an observer and a recorder
o Public transit - an observer and a recorder

2) Equipment and Supplier

o A vehicle
o A stop-watch and a wrist watch
o Field survey forms

3) Procedure

o The starting point is to be determined by the Chief of Travel Time Survey team. The starting point is either the beginning or the end of a specified route. The team will board just before the intersection designated as starting point.

- The recorder fills in the field survey forms, see Appendix 2, with the following: route number, team number, date, weather and direction.

- As the run begins, enter the reading of the wrist watch of the Departure Time and Passing Time of Control Point 1 of Field Form No. 1.

- For public utility vehicle, confirm the route to be surveyed prior to the actual run.

- Take note of the slow downs and/or stops (See Appendix 1) that may occur during the travel from one control point to another. Enter the number of slow downs corresponding to the causes mentioned in the Field Form No. 1 by marking 1 for each slow down. Enter the duration of the stops corresponding to the causes listed in Field Form No. 2. The duration of the stops shall be counted by the stop-watch.

- When the test vehicle passes the control points, the reading of the wrist watch shall be recorded in the Field Form No. 1 and proceed to the subsequent control points, while recording all the slow downs and stops as mentioned above. The control points are located in the following strategic points; at the middle of intersection, at the bridge approach near the poblacion side and at locations where there is a remarkable change of surface type, like pavement to gravel surface.

- When the test vehicle arrives at the final control point, enter the reading of the wrist watch in the Arrival Time of the Field Form No. 1.

- Routes specified for the PUJ as in routes No. 3 and 4, the survey team has to change the mode of travel from PUJ to a tricycle or vice versa. Define the change of travel mode in the block of the control point where the change occur.

Example:

FIELD FORM NO. 1

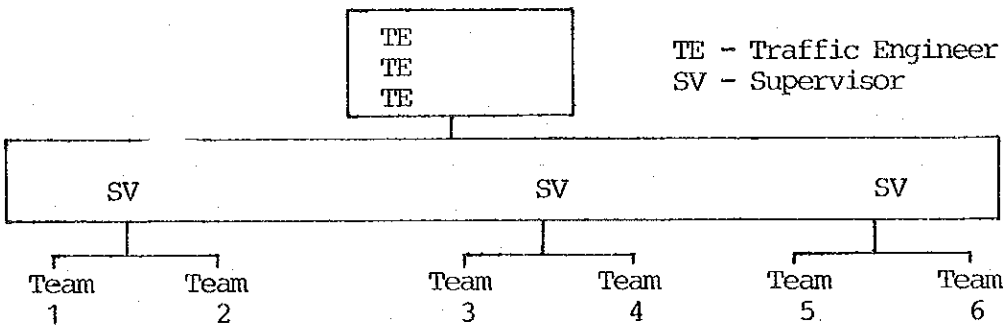
Control Point	1	6 Change mode PUJ	7 Change mode Tricycle	8
Passing Time		A Min. Sec.	B Min. Sec.	

A Time arrived at the control point when the mode of travel has changed.

B Time started after changing a ride. Field Form No. 2 shall be filled up similar to Field Form No. 1.

4. SURVEY ORGANIZATION

Travel Time Survey Coordinator - Montinola



APPENDIX-1.

DEFINITION

SLOW DOWN

Slow Down is the state wherein the driver is forced to reduce the speed of the vehicle to less than five (5) km/hr. according to the causes mentioned below. Slow Down includes the state when the vehicle stops for less than five (5) seconds and also, when the speed of the vehicle is reduced to normal walking speed or less.

Causes of Slow Down as reflected in Travel Time Survey Form -1:

1. Signal - Slow Down caused by signal is applicable only to signal controlled intersection. When the signal is out of order, not functioning due to brownouts or any other reasons, the cause of Slow Downs could not be classified as signal. The instance wherein signal is the cause of delay are as follows:

   o The vehicle approaching the intersection is forced to reduce speed or stop because of the saturated traffic ahead even when the signal light is green.

   o The vehicle making left turn is forced to reduce speed or to stop due to through traffic from the opposite direction.

   o The vehicle making right turn may slow down to wait for merging chance.

2. Right Turn - Slow Down occurs when the vehicle is making right turn maneuver and is obstructed by other vehicles at the intersection.

3. Left Turn - Slow Down occurs when the vehicle is making left turn maneuver and is obstructed by other vehicles at the intersection.

4. Vehicle Crossing - Slow Down occurs when the vehicle is going straight and is obstructed by other vehicles at the intersection and by vehicles trying to make U-turns.

5. Pedestrian - Slow Down occurs when pedestrians crossed or pedestrians are trying to cross the road.

6. Parked Vehicle - Slow Down is caused by parked vehicles and vehicles which are going to park.

7. Loading and Unloading (Other Vehicles) - Slow Down is caused by utility vehicles, such as PU Jeepney, Auto Calesa, PU Bus, PU Taxi and Tricycles, when these vehicles load and unload passengers.

8. Loading and Unloading (Test Vehicles) - Whenever the test vehicle loads and unloads, vehicle Slow Downs occur. These will be taken into account when the vehicle is for public utility use.

9. Loading and Unloading Baggage - Slow Down occurs when the vehicle is loading or unloading baggage. Vehicle loading and unloading baggage is not considered a parked vehicle.

10. Traffic Accident - Slow Down occurs when there is vehicle congestion brought about by traffic accident.

11. Vehicular Trouble - Vehicles are forced to Slow Down by another vehicle because of engine trouble and flat tire.

12. Road Surface - Bad surface condition of the road influence the Slow Down movement of vehicles.

13. Road Construction and Maintenance - Vehicles are forced to Slow Down because of road construction and maintenance activities.

14. Parade - may cause vehicles to Slow Down or Stop.

STOP

Stop is the state wherein the driver is forced to stop for not less than five (5) seconds by the causes mentioned below:

1. Signal (Through and Left turn traffic) - Vehicles are stopped by the red signal light at the intersection.

2. Left turn (No Signal) - Vehicles trying to make left turn maneuver are stopped by other vehicles at the intersection without signal. This case includes inter-

section with traffic signals but inoperative or malfunctioning.

3. Vehicle Crossing - Vehicle stops at intersection by other vehicles or by a vehicle negotiating a U-turn Movement.

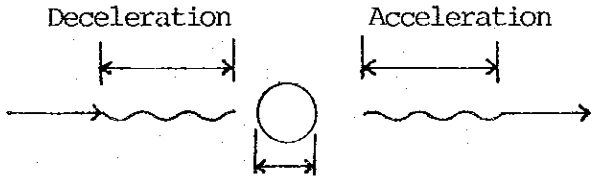
4. Traffic Accident - Vehicle stops when there is vehicle congestion brought about by traffic accident.

5. Road Construction and Maintenance - Vehicles stop because of road construction and maintenance work.

6. Others - When vehicles stop by causes other than what are already mentioned, the cause and duration of stops shall be recorded. The causes of stop shall also be referred to those listed on the Travel Time Survey Form No. 1.

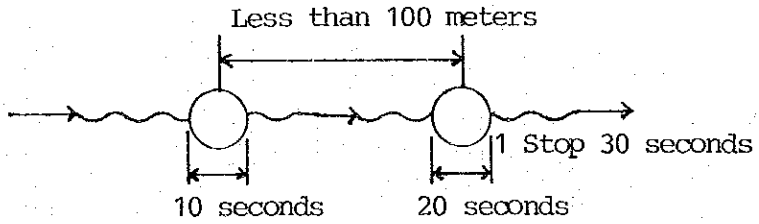
When the vehicle is forced to stop more than once within 100 meters distance by the same reason, this case is recorded as one stop and the duration of stop is the sum of stops of the vehicle. The illustration is shown below:

Example A



Stop for not less than 5 seconds

Example B



TRAVEL TIME SURVEY FORM -1

SLOW DOWNS

ROUTE NO. _____ DATE _____ DEPARTURE TIME _____ DIRECTION FROM _____ TO _____ MODE _____

TEAM NO. _____ WEATHER _____ ARRIVAL TIME _____ RECORDER _____

CONTROL POINT	1		2		3		4		5		6	
PASSING TIME	Min.	Sec.	Min.	Sec.	Min.	Sec.	Min.	Sec.	Min.	Sec.	Min.	Sec.
1. SIGNAL												
2. RIGHT TURN												
3. LEFT TURN												
4. VEHICLE CROSSING												
5. PEDESTRIAN												
6. PARKED VEHICLE												
7. LOADING AND UNLOADING (ANOTHER VEHICLE)												
8. LOADING AND UNLOADING (TEST CAR)												
9. LOADING AND UNLOADING (BAGGAGE)												
10. TRAFFIC ACCIDENT												
11. VEHICULAR TROUBLE												
12. ROAD SURFACE												
13. ROAD CONSTRUCTION OR MAINTENANCE												
14. PARADE												

TRAVEL TIME SURVEY FORM-2

STOPS

ROUTE NO. _____ DATE _____ DEPARTURE TIME _____ DIRECTION FROM _____ TO _____

TEAM NO. _____ WEATHER _____ ARRIVAL TIME _____ MODE _____ RECORDER _____

CONTROL POINT	1		2		3		4		5		6	
a) SIGNAL (Through Left Turn)	min./	sec.	min./	sec.	min./	sec.	min./	sec.	min./	sec.	min./	sec.
b) LEFT TURN (NO SIGNAL)												
c) VEHICLE CROSSING												
d) TRAFFIC ACCIDENT												
e) ROAD CONSTRUCTION OR MAINTENANCE												
f) OTHERS												

APPENDIX-3.

TRAVEL TIME SURVEY ROUTE

ROUTE 1 - TORIL - POBLACION

ROUTE 2 - BUNAWAN - POBLACION

ROUTE 3 - MATINA CROSSING - R. CASTILLO/J.P. LAUREL

ROUTE 4 - F. TORRES/J.P. LAUREL - J.P. LAUREL/A. IÑIGO

ROUTE 5 - SAN PEDRO/C.M.RECTO - C.M. RECTO/SAN PEDRO

TRAVEL TIME SURVEY CONTROL POINT

ROUTE 1 - DIRECTION 1 - LAPU-LAPU/DACUDAO-TORIL

DIRECTION 2 - TORIL-LAPU-LAPU/DACUDAO

CONTROL POINT	INTERSECTION
1	LAPU-LAPU/DACUDAO AVENUE
2	J.P. LAUREL/STA. ANA AVENUE
3	E. QUIRINO/A. PICHON ST.
4	MATINA CROSSING
5	MCARTHUR /DIVERSION BOUNDARY
6	TALOMO/CALINAN
7	BAGO GALLERA-DUMOY BOUNDARY
8	TORIL

ROUTE 2 - DIRECTION 1 - A. PICHON/E. QUIRINO-BUNAWAN

DIRECTION 2 - BUNAWAN - A.PICHON/E. QUIRINO

CONTROL POINT	INTERSECTION
1	A. PICHON/E. QUIRINO AVENUE
2	A. PICHON/C.M. RECTO AVENUE
3	SAN PEDRO/C.M. RECTO AVENUE
4	J.P. LAUREL/STA. ANA AVENUE
5	J.P. LAUREL/DACUDAO AVENUE
6	J.P. LAUREL/CABAGUIO ST.
7	J.P. LAUREL/R. CASTILLO ST.
8	DAVAO AGUSAN ROAD/AIRPORT ROAD
9	DAVAO AGUSAN ROAD/PANACAN
10	DAVAO AGUSAN ROAD/ILANG-MUDIANG
11	DAVAO AGUSAN ROAD/BUDBUD-MAHAYAG
12	DAVAO AGUSAN ROAD/BUNAWAN

ROUTE 3

DIRECTION 1 - MATINA CROSSING - R. CASTILLO ST./
J.P. LAUREL

DIRECTION 2 - R. CASTILLO/J.P. LAUREL - MATINA CROSSING

CONTROL POINT	INTERSECTION
1	MATINA CROSSING
2	BOLTON BRIDGE (POBLACION SIDE)
3	QUEZON BLVD./SAN PEDRO ST.
4	QUEZON BLVD./JACINTO ST.
5	QUEZON BLVD./MAGSAYSAY AVENUE
6	LEON GARCIA ST./LAPU-LAPU ST.
7	R. CASTILLO ST. (CHANGE OF SURFACE CONCRETE GRAVEL)
8	R. CASTILLO ST./J.P. LAUREL AVENUE

ROUTE 4

DIRECTION 1 - F. TORRES ST./J.P. LAUREL
J.P. LAUREL/ALEJANDRO IÑIGO ST.

DIRECTION 2 - J.P. LAUREL/ALEJANDRO IÑIGO ST.
F. TORRES/J.P. LAUREL AVENUE

CONTROL POINT	INTERSECTION
1	F. TORRES ST./J.P. LAUREL AVENUE
2	FR. SELGA ST./F. TORRES ST.
3	E. QUIRINO AVE./A. PICHON ST. C.M. RECTO AVE./A. PICHON ST.
4	SAN PEDRO ST./C.M. RECTO AVENUE
5	MAGSAYSAY AVE./C.M. RECTO AVENUE
6	C. BANGOY ST./MAGSAYSAY AVENUE C. BANGOY ST./SOLIMAN ST.
7	N. TORRES ST./LAPU-LAPU ST.
8	NICASIO TORRES ST./ALEJANDRO IÑIGO ST.
9	ALEJANDRO IÑIGO ST./J.P. LAUREL AVENUE

ROUTE 5

DIRECTION 1 SAN PEDRO/C.M. RECTO-C.M. RECTO/SAN PEDRO ST.

DIRECTION 2 C. M. RECTO/SAN PEDRO-SAN PEDRO/C.M. RECTO AVE.

CONTROL POINT	INTERSECTION
1	SAN PEDRO/C.M. RECTO AVENUE
2	SAN PEDRO/ILUSTRE ST.
	ILUSTRE/MT. APO ST.
	MT. APO/C. ARELLANO ST.
	C. ARELLANO/V. TIONKO AVENUE
	V. TIONKO/F. TORRES ST.
3	F. TORRES/E. JACINTO ST.
	E. JACINTO/C. BANGOY ST.
	C. BANGOY/M. ROXAS AVENUE
4	M. ROXAS AVE./C.M. RECTO AVENUE
5	C.M. RECTO AVE./SAN PEDRO ST.

TRAVEL TIME SURVEY SCHEDULE 1

ROUTE	Direction	15	16	17			18			19				22			23			24		
				M	N	E	M	N	E	M	N	E		M	N	E	M	N	E	M	N	E
ROUTE 1	D-1	Training		1 2 3 4		1 2 3 4		1 2 3 4														
	D-2				1 2		1 2 3 4		1 2 3 4													
ROUTE 2	D-1									1 2 3 4		1 2 3 4			1 2 3 4							
	D-2										1 2 3 4			1 2 3 4		1 2 3 4						
ROUTE 3	D-1			5 6		5 6		5 6		5 6		5 6			5 6							
	D-2													5 6		5 6						
ROUTE 4	D-1																1 2 3 4		1 2 3 4		1 2 3 4	
	D-2																	1 2 3 4		1 2 3 4		1 2 3 4
ROUTE 5	D-1																5 6		5 6		5 6	
	D-2																	5		5		5

M - Morning Peak (7:00-8:00)
N - Normal Hour (9:00-4:00)
E - Evening Peak (5:00-6:00)

1 - 6 - Team 1 - Team 6

D-1, D-2 - Direction 1, Direction 2

TRAVEL TIME SURVEY SCHEDULE 2

Team \ Date	15 16	17	18	19		22	23	24
Team 1 (Private Car)	Training	R-1 M(7:00)D-1 N(9:00)D-2 E(5:00)D-1	R-1 M(7:00)D-2 N(3:00)D-1 E(5:00)D-2	R-2 M(7:00)D-1 N(9:00)D-2 E(5:00)D-1		R-2 M(7:00)D-2 N(3:00)D-1 E(5:00)D-2	R-4 M(7:30) D-1 N(3:00) D-2 E(5:00) D-1	R-4 M(7:30)D-2 N(9:00)D-1 E(5:00)D-2
Team 2 (Public Transit)		R-1 M(7:00)D-1 N(9:00)D-2 E(5:00)D-1	R-1 M(7:00)D-2 N(3:00)D-1 E(5:00)D-2	R-2 M(7:00)D-2 N(3:00)D-2 E(5:00)D-1		R-2 M(7:00)D-2 N(3:00)D-1 E(5:00)D-2	R-4 M(7:00) D-1 N(9:00) D-2 E(5:00) D-1	R-4 M(7:00)D-2 N(9:00)D-1 E(5:00)D-2
Team 3 (Private Car)		R-1 M(7:00)D-1 N(9:00)D-2 E(5:00)D-1	R-1 M(7:00)D-2 N(3:00)D-1 E(5:00)D-2	R-2 M(7:00)D-1 N(9:00)D-2 E(5:00)D-1		R-1 M(7:00)D-2 N(3:00)D-1 E(5:00)D-2	R-4 M(7:00)D-1 N(9:00)D-2 E(5:00)D-1	R-4 M(7:00)D-2 N(9:00)D-1 E(5:00)D-2
Team 4 (Public Car)		R-1 M(7:00)D-1 N(9:00)D-2 E(5:00)D-1	R-1 M(7:00)D-2 N(3:00)D-1 E(5:00)D-2	R-2 M(7:00)D-1 N(9:00)D-2 E(5:00)D-1		R-2 M(7:00)D-2 N(3:00)D-1 E(5:00)D-2	R-4 M(7:30)D-1 N(9:00)D-2 E(5:00)D-1	R-4 M(7:30)D-2 N(9:00)D-1 E(5:00)D-2
Team 5 (Private Car)		R-3 M(7:30)D-1 N(9:00)D-2 E(5:00)D-1	R-3 M(7:30)D-1 N(3:00)D-2 E(5:00)D-1	R-3 M(7:30)D-2 N(9:00)D-1 E(5:00)D-2		R-3 M(7:30)D-2 N(3:00)D-1 E(5:00)D-2	R-5* M(7:00)D-1 N(9:00)D-1 E(5:00)D-1	R-5* M(7:00)D-2 N(9:00)D-2 E(5:00)D-2
Team 6 (Public Transit		R-3 M(7:30)D-1 N(9:00)D-2 E(5:00)D-1	R-3 M(7:30)D-1 N(3:00)D-2 E(5:00)D-1	R-3 M(7:30)D-2 N(9:00)D-1 E(5:00)D-2		R-3 M(7:30)D-2 N(3:00)D-1 E(5:00)D-2	R-5 M(7:00)D-1 N(9:00)D-1 E(5:00)D-1	R-5 M(7:00)D-1 N(9:00)D-1 E(5:00)D-1

M - Morning Peak (7:00 - 8:00)

N - Normal Hour (9:00 - 4:00)

E - Evening Peak (5:00 - 6:00)

(7:00) - The run starts at 7 o'clock

D-1 - Direction 1

D-2 - Direction 2

* - Two Times Trial

SURVEY MANUALS-1.7

PUBLIC TRANSPORTATION SURVEY

A. A BRIEF EXPLANATION OF PUBLIC TRANSPORTATION SERVICE IN DAVAO CITY

B. BUS SERVICE AND PASSENGER SURVEY

1. Objective
2. Survey Method
3. Existing Bus Terminals in Davao City
4. Survey Schedule

APPENDIX - B-1, Bus Driver Interview Form

APPENDIX - B-2, Bus Passenger Interview Form

C. PUJ Service Survey

1. Objective
2. Survey Method
3. Survey Schedule

APPENDIX - C-1, PUJ Driver Interview Form

A. A BRIEF EXPLANATION OF PUBLIC TRANSPORTATION SERVICES IN DAVAO CITY

At present, there are five modes of public transportation in Davao City. These are P.U. Jeepney, A.C. (Auto Calesa), PU Bus, Tricycle and PU Taxi. Their nature of services are as follows:

PU-Jeepney -- The PU-Jeepneys are serving intra-city travellers between Davao City Proper (Poblacion) and the neighboring areas like Matina, Talomo, Calinan, Sasa, etc. as well as within the Poblacion. The PU-Jeepneys are given two optional franchised routes which are the combination of the strong route and the weak route. (The strong route is defined as the route which provide PUJ more opportunities to pick up passengers than the weak route.)

Auto-Calesa -- Auto-Calesas offer services mainly within the City Proper (Poblacion) in as much the same way as shared taxi. They do not have fixed routes.

PU-Bus -- The PU-Buses offer services to connect Davao City with other major cities in Mindanao like Cotabato City, Gen. Santos City, Cagayan de Oro City, etc.. They do not serve intra-city traffic.

B. BUS SERVICE AND PASSENGER SURVEY

1. Objective

Objective of the survey is to obtain facts of the existing bus service system and the level of service. The study components and the survey items are as follows:

STUDY COMPONENT	SURVEY ITEM
1) Bus route network	O-D of buses
2) Service frequency	Number of buses leaving and arriving Davao City

3. Passenger load data . . . Number,O-D and trip purpose of passengers and their modes of travel after getting off a bus

4. Terminal facility . . . Area, Terminal facilities and number of bus companies and buses utilizing a terminal.

Data obtained by this survey will be combined with other data to evaluate the existing bus service system and the level of service, then problems will be identified.

2. Survey Method

As the bus service is used for inter-province transportation in this city, each bus terminal is selected as a survey station.

The survey is mainly conducted by interviewing bus drivers and passengers. Two survey forms are prepared. These are:

a. Bus Driver Interview Form

All bus drivers are interviewed and the following items are asked:

- o Name of the bus company
- o Origin and destination of the bus

Type of bus, time of arrival or departure and number of passengers at the terminal are recorded by a surveyor.

b. Bus Passenger Interview Form

About 15% of arriving passengers are to be sampled and interviewed concerning the following items:

- o Address
- o Origin and destination
- o Mode of travel after getting off a bus
- o Trip purpose

Type of bus and time of arrival are recorded by a surveyor.

3. Existing bus terminals in Davao City

The existing bus terminals, their approximate area and major bus companies are listed in Table-B-1.

Table-B-1 BUS TERMINALS IN DAVAO CITY

NAME OF TERMINAL	APPROXIMATE AREA (SQ.M.)	MAJOR BUS COMPANIES WHICH UTILIZE A TERMINAL
Magsaysay Terminal-1	1,780	o Villa Rhecar Bus Co. o NEMBUSCO
Magsaysay Terminal-2	100	o Reolsyl Bus Co. o Two Queens Bus Co.
San Pedro Terminal	4,160	o Filipinas Bus Co. o Padada Bus Co. o Mindanao Transway Co.
Bankerohan Terminal-1	4,550	o Ceres Bus Co. o Bachelor Bus Co. o Subusco Bus Co.
Bankerohan Terminal-2	1,900	o Mati Transway Co. o Yellow Bus Line o Hino JT Express
Sta. Ana Terminal	380	o Panabo Bus Co.
Quirino Ave. Terminal	1,080	o Mintranco Bus Co. o VAQ Co.
Agdao Terminal	300	o Sto. Tomas Bus Co. o Panabo Bus Co.

4. Survey Schedule

The survey schedule and number of survey aides are shown in Table B-2.

Table B-2. SURVEY SCHEDULE AND NUMBER OF SURVEY AIDES

TERMINAL	OPERATION DURATION				SURVEY DATE	SURVEY PERIOD	NUMBER OF SURVEY AIDES
	Departure		Arrival				
	First	Last	First	Last			
Magsaysay Terminal -1	3:30AM	3:30PM	7:00AM	7:30PM	Dec.11, 1979	3:00AM' 8:00PM	7
Magsaysay Terminal-2	8:30AM	11:00PM	8:30AM	11:00PM	Jan. 9, 1980	7:00AM' 11:00PM	10
San Pedro Terminal	4:00AM	8:30PM	6:00AM	9:00PM	Dec.11, 1979	3:30AM' 9:00PM	21
Bankerohan Terminal-1	3:00AM	3:30PM	7:00AM	10:00PM	Jan. 9, 1980	2:30AM' 10:00PM	8
Bankerohan Terminal-2	2:30AM	8:45PM	6:30AM	7:30PM	Dec.12, 1979	2:30AM' 9:00PM	18
Sta. Ana Terminal	5:30AM	3:00PM	10:00AM	7:00PM	Dec.12, 1979	5:00AM' 6:00PM	4
Quirino Ave. Terminal	2:30AM	0:30PM	10:15AM	8:15PM	Jan.10, 1980	2:30AM' 9:00PM	5
Agdao Terminal	5:30AM	5:00PM	7:00AM	7:00PM	Jan.10, 1980	5:00AM' 7:00PM	14

APPENDIX B-1 BUS DRIVER INTERVIEW FORM

STATION NO. _____ DATE _____ RECORDER _____

NAME OF BUS TERMINAL: _____

1 NAME OF COMPANY	2 TYPE OF BUS	3 T I M E	4 O R I G I N	5 DESTINATION	6 NO. OF PASSENGER
	1. BIG BUS 2. MINI BUS	1. A.M. 2. P.M.			
	1. BIG BUS 2. MINI BUS	1. A.M. 2. P.M.			
	1. BIG BUS 2. MINI BUS	1. A.M. 2. P.M.			
	1. BIG BUS 2. MINI BUS	1. A.M. 2. P.M.			
	1. BIG BUS 2. MINI BUS	1. A.M. 2. P.M.			

APPENDIX B-2 BUS PASSENGER INTERVIEW FORM

STATION NO. _____ NAME OF BUS TERMINAL _____

DATE _____

RECORDER _____

6 TRANSPORTATION MODE	7 PURPOSE	
1. Bus	1. Work (Office)	6. Eat Meal
2. PUJ	2. School	7. Shopping
3. AC	3. Business	8. Church
4. Tricycle	4. Medical & Dental	9. Home
5. PU	5. Social & Recreation	
6. Car		
7. Walking		

1 TYPE OF BUS	2 TIME	3 ADDRESS	4 ORIGIN	5 DESTINATION	6 TRANSPORTATION MODE OF CHANGE	7 PURPOSE
1. BIG BUS 2. MINI BUS	1. A.M. 2. P.M.					
1. BIG BUS 2. MINI BUS	1. A.M. 2. P.M.					
1. BIG BUS 2. MINI BUS	1. A.M. 2. P.M.					
1. BIG BUS 2. MINI BUS	1. A.M. 2. P.M.					
1. BIG BUS 2. MINI BUS	1. A.M. 2. P.M.					

C. PUJ SERVICE SURVEY

1. Objective

Objective of the survey is to obtain facts of the existing level of PUJ service. PUJ re-routing plan has been implemented since August, 1979. The PUJs are given two optional routes within Poblacion. It is a PUJ driver who decides a route to take for a trip. Therefore, it is not very clear, at present, how each route is provided PUJ service. The survey is planned to reveal the existing level of PUJ service of each route. The study components and the survey items are as follows:

STUDY COMPONENT	SURVEY ITEM
1. Service frequency of each route	PUJ O-D and its route
2. Passenger load data	Number of passengers
3. Terminal facility	PUJ O-D

Data obtained by this survey will be combined with P-T survey data and others to evaluate the existing PUJ service system and the level of service.

2. Survey Method

Five (5) survey stations are established as shown in Fig. C-1. These stations are selected to locate where PUJ traffic volume is suitable for interviewing and number of passengers to and from CBD (Poblacion) can be obtained.

The survey is mainly conducted by interviewing PUJ drivers. About 50% of PUJ of each direction are to be sampled. The following items are asked:

- o Origin and destination of PUJ
- o Route to be taken or to have been taken

Time and number of passengers are recorded by a surveyor.

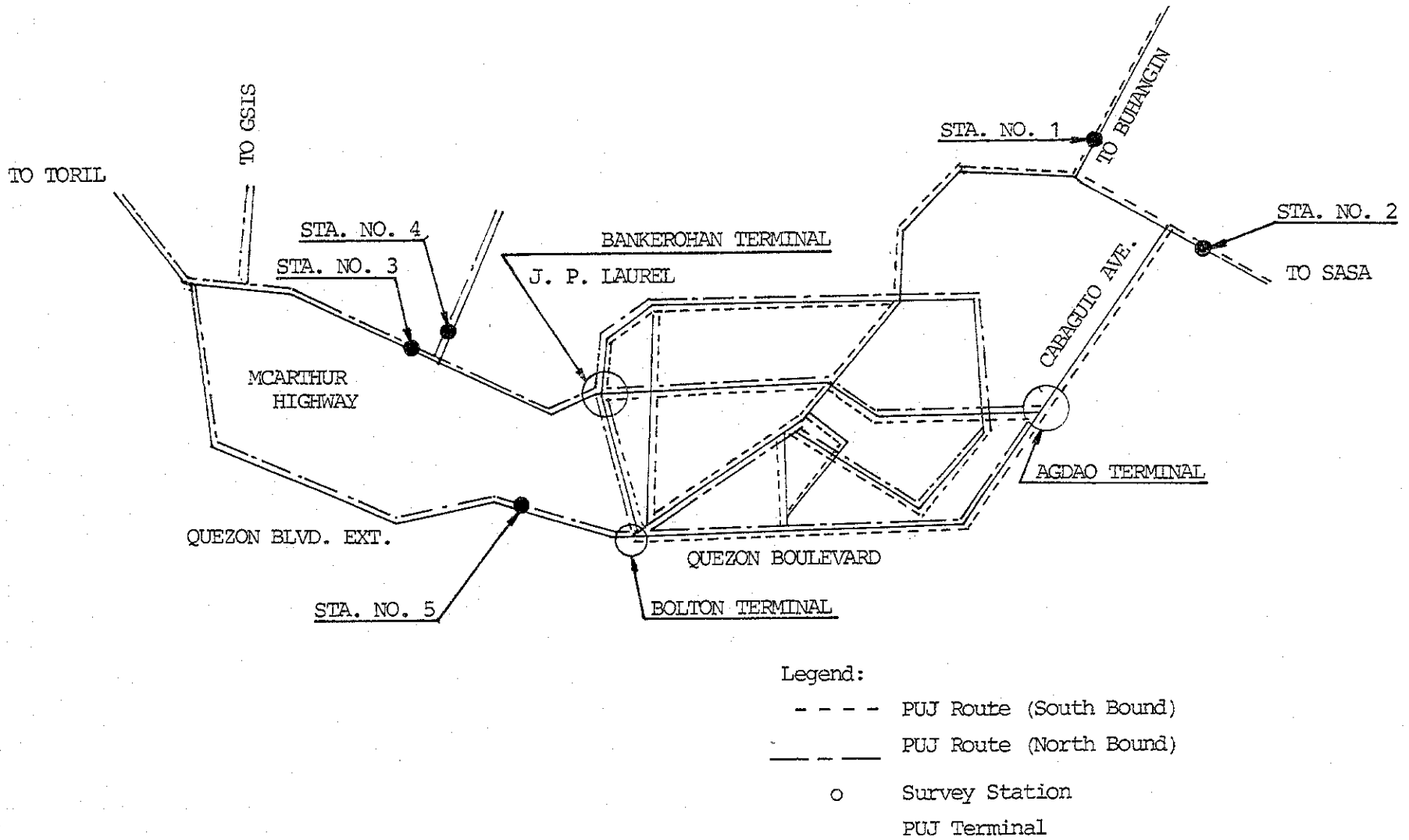


FIG. C-1. SURVEY STATION MAP

3. Survey Schedule

The survey schedule is shown in Table C-1.

TABLE C-1. SURVEY SCHEDULE

STATION NO.	LOCATION	SURVEY DURATION	SURVEY DATE	NO. OF AIDES (2-shift total)
1	BUHANGIN ROAD	6:00AM - 9:00PM (15 hrs.)	Jan. 14, 1980 (Monday)	18
2	J.P. LAUREL AVENUE	-ditto-	Jan.15, 1980 (Tuesday)	24
3	McARTHUR HIGHWAY	-ditto-	Jan. 16,1980 (Wednesday)	28
4	QUEZON BOULEVARD EXTENSION	-ditto-	Jan. 17, 1980 (Thursday)	8
5	MA-A ROAD	-ditto-	Jan. 17, 1980 (Thursday)	8

APPENDIX C-1 P.U.J. DRIVER INTERVIEW FORM

STATION NO. _____ DATE _____ RECORDER _____

NAME OF ROAD _____

DIRECTION: FROM _____ TO _____

1 TIME	2 Where did you start?	3 Where will you go?	4 Route No.	5 No. of Passengers
1. A.M. 2. P.M.				
1. A.M. 2. P.M.				
1. A.M. 2. P.M.				
1. A.M. 2. P.M.				
1. A.M. 2. P.M.				

SURVEY MANUALS-1.8

PARKING SURVEY

C O N T E N T S

1. OBJECTIVE

The objective of the survey is to obtain data concerning the supply and the usage of parking space. Two kinds of survey are planned. These are the Private Parking Lot Inventory Survey and the On-street Parking Survey.

Private Parking Lot Inventory Survey

This survey is to get the supply of parking space provided by the private sector.

On-Street Parking Survey

This survey is to get the facts of the degree of utilization of the supply, the time pattern and duration of use, and the violation of existing regulations.

As the parking problem is most critical in the Central Business District (C.B.D.), the survey area is limited in this area.

The data obtained by this survey will be combined with the result of P-T survey and others, then the problems will be identified.

2. PRIVATE PARKING LOT INVENTORY SURVEY

2-1. Survey Method

The Central Business District is divided into five (5) zones. Two surveyors are assigned to each zone. The surveyors are sent to the field and they visit every parking lot to record the following:

- o Name of a parking lot
- o Pay parking lot or free parking lot
- o Parking fee, in case of a pay parking lot
- o Parking space in terms of car unit
- o Location of a parking lot

2-2. Survey Schedule

The survey dates are scheduled on January 28 and February 1, 1980.

3. ON-STREET PARKING SURVEY

3-1. Street Selection for survey

All streets are classified into four (4) in accordance with the current parking regulation enforced in Davao City. These are:

a. Parking allowed
b. No Parking on one side
c. No parking on both sides
d. Regulated parking

Five (5) streets are selected for the survey, one street from each classification and the rest one from combination of c and d.

TABLE -1. SELECTED STREETS AND PARKING REGULATION

NAME OF THE STREET	PARKING REGULATION
C. Bangoy Street	Parking allowed
San Pedro St.	No parking on one side
A. Pichon St.	No parking on both sides
C.M. Recto Avenue	Regulated parking
R. Magsaysay Avenue	No parking on both sides (F. Sales St.-Quezon Blvd.)
	Regulated Parking (C.M. Recto-F. Sales St.)

3-2. Survey Method

Each surveyor is assigned to a street section which consists of one or two blocks. Each surveyor is required to patrol the section every fifteen (15) minutes to record each plate number of the parked vehicles and check time.

REFER TO APPENDIX-1. ON-STREET PARKING SURVEY FORM

3-3. Survey Schedule and Number of Surveyor

The survey schedule and number of surveyor are shown in Table-2.

TABLE-2. SURVEY SCHEDULE AND NUMBER OF SURVEYOR

NAME OF STREET	LENGTH (KM.)	SURVEY DATE	DURATION	NO. OF SURVEYOR
C. Bangoy St. (San Pedro St. -Roxas Ave.)	0.86	Feb. 7, 1980	7:00AM -7:00PM	5 x 2 shifts = 10
San Pedro St. (Quirino Ave.-Quezon Blvd.)	0.97	Feb. 5, 1980	-ditto-	7 x 2 shifts = 14
A. Pichon St. (Quirino Ave.-C.M. Recto Ave.)	0.86	Feb.7, 1980	-ditto-	5 x 2 shifts = 10
C.M. Recto Ave. (San Pedro St.-Sta. Ana Ave.)	1.26	Feb. 6, 1980	-ditto-	7 x 2 shifts = 14
R. Magsaysay Ave. (C.M. Recto Ave.-Quezon Blvd.)	1.45	Feb. 8, 1980	-ditto-	10 x 2 shifts = 20

APPENDEX -1. ON-STREET PARKING SURVEY FORM

NAME OF STREET _____ DATE _____ WEATHER _____

FROM _____ TO _____ NAME OF SURVEYOR _____

	PLATE NO.		7-8				8 - 9					6 - 7		CODING					
	Class	Number	00	15	30	45	00	15	30	45		30	45	A.M. P.M.	Hour	Min.	A.M. P.M.	Hour	Min.

2. Technical Reports

TECHNICAL REPORTS-2.1

INSTRUCTION MANUAL

OF

MASTER MAGNETIC TAPE PROGRAM

- C O N T E N T S -

1. Outline of Master Magnetic Tape Program

1-1. Purposes

This program edits data obtained from questionnaires such as the Person Trip Survey into applicable data, and stores them on magnetic tapes.

1-2. Description of Contents

Since a large quantity of data is obtained from the questionnaires, it can not be stored directly on punched cards. Accordingly, the data must be stored on magnetic tape after editing.

Although the magnetic tape should be the final master magnetic tape, data errors may occur at two stages while making the master magnetic tape. These errors are "mis-coding" when the data from questionnaires are copied on coding sheets and "mis-punching" of data in the coding sheets by a puncher.

After correct data have been gathered, the master magnetic tape is completed by adding expansion factors of samples to cover the population.

1-3. Work Flow

This manual describes the work ranging from making "punched data magnetic tape" is loaded in the form of a punch data image, to making a "master magnetic tape." Figure 1-1 shows the work flow.

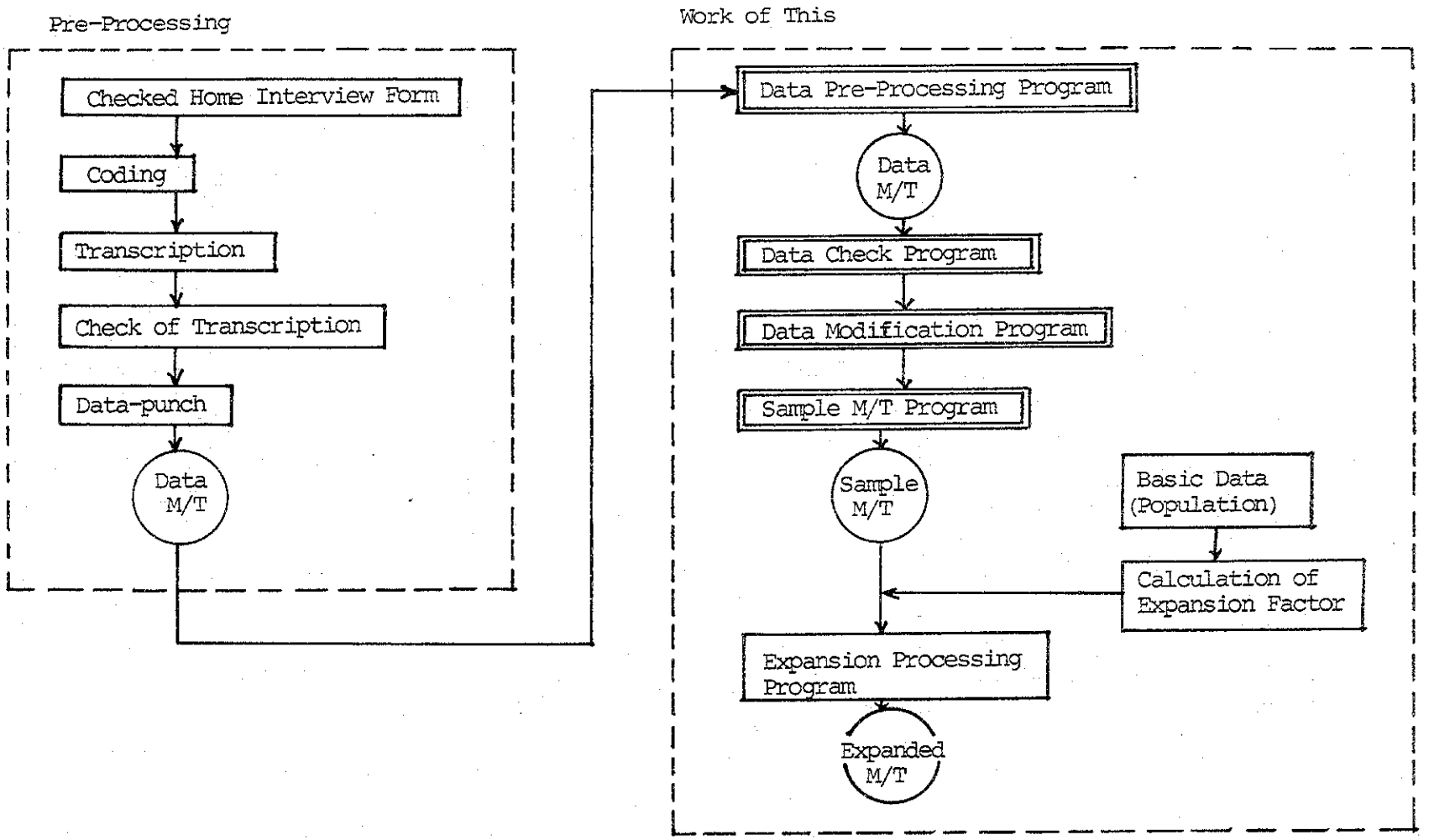


Fig. 1-1 Flow of Work

1-4. Program Configuration

After completion of the punched data magnetic tape for questionnaires, data processing of the survey data magnetic tape, the sample magnetic tape and the Expanded master magnetic tape is perform in this sequence. To make a master magnetic tape, the following five programs must be executed.

(1) Data Pre-Processing Program (Data M/T Program)
(2) Data check program
(3) Data modification program
(4) Sample magnetic tape program
(5) Expansion program

Data processing flow is shown in Figure 1-2.

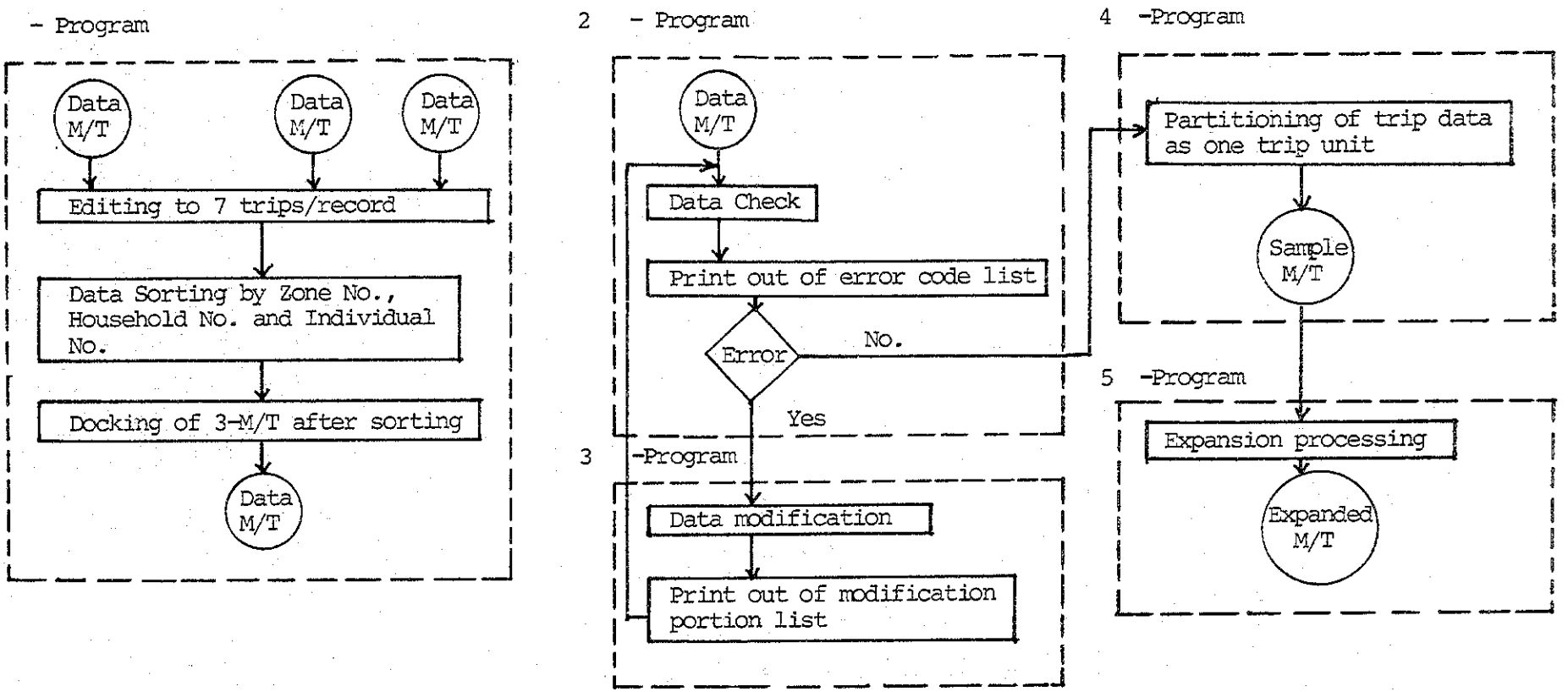


Fig. 1-2 Flow of Data Processing

2. Survey Data Magnetic Tape Program

2-1. Outline

As the first step in making a master magnetic tape a survey data magnetic tape suitable for checking and modification of error data occurring in coding and data punching is built up from the punched-data magnetic tape.

2-2. Description of Work

A survey data magnetic tape is made from the punched-data tape, in the following sequence:

(1) Editing of the punched-data magnetic tape
(2) Data sorting
(3) Docking of magnetic tapes

Figures 2-1 shows the format of the punched-data magnetic tape.

2-2-1. Editing of the punched-data magnetic tape

The punched-data magnetic tape contains individual character data and trip data, which is output to a magnetic tape for every record of individual character data and seven trips of data. For data exceeding seven trips, data for the eighth trip is stored on the next record. In this case, individual character data are not omitted, that is, the same data are written onto the next record.

Data are stored on magnetic tapes in binary notation (object code converted into machine language).

2-2-2. Data sorting

Survey data after editing are sorted according to Zone No., Household No. and Individual No., which are, arranged in low number sequence.

2-2-3. Docking of magnetic tapes

Sorted data are written onto multiple magnetic tapes because there are a large quantity of data in the questionnaires. The contents of these tapes are integrated into one magnetic tape, that constitutes a survey data magnetic tape.

Figure 2-2 shows the format of the survey data magnetic tape.

(1) (Coding Format)

Zone No.			Household No.	Individual No.	No. of trip	Home			Office			School			Sex	Age	Occupation	Industry	Licence	Classifi.	Vehicle					Distance	Time	Income
A-Zone	B-Zone	C-Zone				A-Zone	B-Zone	C-Zone	A-Zone	B-Zone	C-Zone	A-Zone	B-Zone	C-Zone							No. of Unit	Classifi.	No. of Unit	Classifi.	No. of Unit			
1	2 3	4	5 6 7	8 9	10 11	12	13 14	15	16	17 18	19	20	21 22	23	24	25 26	27 28	29 30	31	32	33 34	35	36 37	38	39 40	41 42 43 44	45 46	47

Date		Origin			Institution
Month	Day	A-Zone	B-Zone	C-Zone	
48 49	50 51	52	53 54	55	56

(2)

Trip No.	Trip begin			Trip end			Institution	Trip end			Purpose	Person	Drive	Parking	Mode	1st Zone No.			2nd Mode	2nd Zone No.			3rd Mode	3rd Zone		...	8th Zone No.			...
	AM. PM.	Hour	Minute	A-Zone	B-Zone	C-Zone		AM. PM.	Hour	Minute						A-Zone	B-Zone	C-Zone		A-Zone	B-Zone	C-Zone		A-Zone	B-Zone		A-Zone	B-Zone	C-Zone	
1 2	3	4 5	6 7	8	9 10	11	12	13	14 15	16 17	18	19 20	21	22	23 24	25	26 27	28	29 30	31	32 33	34	35 36	37	38 39		67	68 69	70	← column

Fig. 2-1 Punched Data M/T Format

2-3 Restrictions

(1) Punched-data on magnetic tape is coded in EBCDIC (extended binary coded decimal interchange code).

(2) The blocking factor is one record

(3) The record length is 80 bytes.

2-4. Input data

2-4-1. Outline

The punched-data magnetic tape contains individual character data and trip data which are intermixed. To check and modify data, it is desirable for the individual character data and trip data to be collected to some extent. Accordingly, the survey data magnetic tape is partitioned every seven trips.

2-5. Output data

The survey data magnetic tape partitioned every seven trips is output to a new magnetic tape, as shown in Figure 4-1.

3. Data Check Program

3-1. Outline

The data check program reads data from a survey data magnetic tape as the second step in making a master magnetic tape, then checks the data (range check and correlation check) for each variable, and prints out error codes. In addition, machine correction (or automatic correction) is performed for modifiable data.

3-2. Description of Work

Collected questionnaires are checked at checking and editing stages by a checker. Data from the questionnaires are copied to coding sheets and input to magnetic tapes by the card punch method. Since, in this process, errors such as inspection faults, coding errors and punch errors may occur, a machine inspection is carried out and errors are recovered on the basis of the machine inspection text to give more complete data.

Figure 3-1 shows the machine inspection text.

The printer prints out the record No., zone No., household No., individual No. and trip No. of data errors if they occur, then prints out the error codes specified in the machine inspection text. However, a message is not printed-out when machine correction has been completed.

Figure 3-2 shows an example of messages printed-out.

Fig. 3-1. Error Code List

(1) Individual Character Inspection

No.	Error Code	Inspection item	Kind of inspection	Inspection method	Remarks
1	1	Zone No.	Range check	Other than Survey Area zone code	
2	4	Duplicated	Duplication Check	More than one person with the same zone No., household No. and individual No.	
3	5	Kind of vehicles	Range check	Other than 0 to 6	
4	6	Number of vehicle	Range check	Number of vehicles 90	
	7		Correlation check	Kind of vehicle=1 to 6 and number of vehicles =0	
	1007 2007 3007		Correlation check	Kind of vehicle = 0, Number of vehicle 0	Set 0
5	8	Date surveyed	Range Check	Other than data code surveyed	
6	9	Home address	Range Check	Other than survey area zone code	
	1009		Correlation check	Not the same zone code	
7	10	Office address	Range check	Other than zone code	
8	11	School address	Range check	Other than zone code	
9	12	Sex	Range check	Other than 1 and 2	
	1012		Correlation check	Occupation = 11, and sex = 1	Set 2
10	13	Age	Range check	Other than 7 to 90 years old	
11	14	Distance walked	Range check	Distance walked 9000 m	
12	15	Time Walked	Range check	Time walked 90 minutes	
13	16	Income	Range check	Other than 0 to 5	

No.	Error Code	Inspection item	Kind of inspection	Inspection method	Remarks
14	17	Occupation	Range check	Other than 1 to 12	
15	18	Industry	Range check	Other than 1 to 12	
	118		Correlation check	Other than 1 to 8 for occupation 1 to 8	
	2018			Other than 9 for occupation 9	Set 9
	3018			Other than 10 for occupation 10	Set 10
	4018			Other than 11 for occupation 11	Set 11
	5018			Other than 12 for occupation 12	Set 12
16	19	License	Range check	Other than 1 to 2	
17	1020	Total trips	Count check	Number of total trips ≠ maximum trip No.	

(2) Trip Inspection

No.	Error Code	Inspection item	Kind of inspection	Inspection method	Remarks
1	24	Origin	Range check	Other than zone code	
2	26	Origin facilities	Range check	Other than 1 to 9	
3	27	Time started	Range check	Other than 1 (AM) and 2 (PM)	
	28		Range check	Other than 0 to 11 (o'clock)	
	29		Range check	Other than 0 to 59 minutes	
	30		Correlation check	Later than time-arrived of the same trip	
	31		Correlation check	Earlier than time-arrived of the previous trip	

No.	Error Code	Inspection item	Kind of inspection	Inspection method	Remarks
4	32	Time arrived	Range check	Other than 1 (AM) and 2 (PM)	
	33		Range check	Other than 0 to 11 (o'clock)	
	34		Range check	Other than 0 to 59 minutes	
5	35	Destination facilities	Range check	Other than 1 to 9	
	36		Correlation check	Other than 5 at "Purpose = 2 (school institution)	
6	41	Destination	Range check	Other than zone code	
	42		Correlation check	Other than office add. "purpose = 1 (work)"	
	43		Correlation check	Other than school add. at "purpose =2 (school)	
7	45	Purpose	Range check	Other than 1 to 9	
	46		Correlation check	Purpose 1 to 3 at occupation=12 (jobless)	
8	52	Mode of travel	Range check	Other than 1 to 11	
9	56	Transfer place	Range check	Other than zone code	
10	60	Passengers	Correlation check	Passenger 0 at "Mode of travel = 4 or 5"	
11	61	Driving or not	Range check	Other than 1 to 2	
	2061		Correlation check	1 at Possession of driver's license-2"	Set 2
	3061		Correlation check	2 at "Number of passengers = 1"	Set 1
	4061		Correlation check	1 at "number of passengers = 0"	Set 2
12	1062	Kind of parking	Correlation check	Other than 1 to 4 "Driving or not = 1"	
	2062		Correlation check	1 to 4 at "Driving or not = 2"	Set 0

```
RECORD-NO. =      70    ZONE-NO. = 1 11   HOUSE HOLD -NO. =   1   INDIVIDUAL =  1   DATE = 1115   SEQ-NO. = 1
注1.)
 TRIP-NO= 3
 ERROR-CODE :   41

RECORD-NO. =      75    ZONE-NO. = 1 11   HOUSE HOLD -NO. =   3   INDIVIDUAL =  1   DATE = 1123   SEQ-NO. = 1
 ERROR-CODE :   17    11    12    18

RECORD-NO. =      90    ZONE-NO. = 1 11   HOUSE HOLD -NO. =   6   INDIVIDUAL =  1   DATE = 1231   SEQ-NO. = 1
 ERROR-CODE :   17     8    18

 TRIP-NO= 1
 ERROR-CODE :   24    29    32    34    41   152

RECORD-NO. =      91    ZONE-NO. = 1 11   HOUSE HOLD -NO. =   6   INDIVIDUAL =  2   DATE = 1123   SEQ-NO. = 1

 TRIP-NO= 1
 ERROR-CODE :  152
```

Figure 3-2

Example of Error Codes Output
for Survey Data

3-3. Restrictions

If one data item contains an error in a correlation check (data check of associated item), the correlated data item is not checked.

For example, if occupation data is checked, then, sex distinction data is checked, as in the sex distinction error code 1012, the correlation check of sex distinction will not be performed if there is an error in the occupation data.

3-4. Input data

3-4-1. Outline

Various kinds of data checks are carried out after reading data from a survey data magnetic tape.

The check range is specified by a parameter card on program execution.

3-4-2. Description (Parameter card)

(i) Columns 1 to 10

Record No. at which checking is to start is specified.

(ii) Columns 11 to 20

Record No. at which checking is to end is specified.

3-5. Output Data

3-5-1. Outline

After data checking, error codes and individual character data are printed out.

Data, after checking, are output to a new magnetic tape to allow automatic correction.

4. Data Modification Program

4-1. Outline

As the third step in making the master magnetic tape, correct data for the error codes output by the data check program are input through cards, and complete survey data are prepared.

4-2. Description of Work

The survey data magnetic tape is modified with correct data by referring to the questionnaires for data errors output by the data check program and by referring to the error code table.

Inputs for modifying data are as follows. They are punched card inputs.

- Record No. of data to be modified.
- Number of data item to be modified within the record.
- Word location of data to be modified.
- Value of correct data

As the word location of data to be modified, word No. is input in the survey data format shown in Figure 4-1. The word No. is used as it is for individual character data words 1 to 32.

Example: Word position of trip data

The word position value of trip data is a 3-digit numeric.

Word No. of the 1st trip

Trip No.

'148' ... Purpose data of trip No. = 1
'251' ... Parking place data of trip No. = 2
'548' ... Purpose data of trip No. = 5

Complete survey data after data modification are printed out for all data items.

4-3. Restrictions

(1) Up to 300 records can be modified in one program execution.
(2) Up to 100 variables can be modified in one record.

Zone					Date			Home			Office			School																	
A-Zone	B-Zone	C-Zone	H.H-No.	Indivi. No.	Month	Day	No. of trip	A-Zone	B-Zone	C-Zone	A-Zone	B-Zone	C-Zone	A-Zone	B-Zone	C-Zone	Sex	Age	Occupation	Industry	Licensé..	Classifi.	Unit	Classifi.	Unit	Classifi.	Unit	Distance	Time	Income	Seque. No.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

No. of trip	Origin							Distination											1st				2nd				3rd			
	Zone			Institution	Time			Zone			Institution	Time			Purpose	Passenger	Drive	Parking	Mode	A-Zone	B-Zone	C-Zone								
	A-Zone	B-Zone	C-Zone		AM. PM.	Hour	Minute	A-Zone	B-Zone	C-Zone		AM. PM.	Hour	Minute																
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63

4th				5th				6th				7th				8th			
64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83

Number of word

1st trip

Fig. 4-1 Sample Data Format

4-4. Input data

4-4-1. Outline

Punched card data for data modification are prepared to complete the survey data for error items in the survey data.

Figure 4-2 shows an input specification sheet for data modification.

4-4-2. Description

(i) Columns 1 to 10

Record No. of data to be modified is specified.

(ii) Columns 11 to 20

Number of data modification items within a given record is specified.

(iii) Columns 21 to 80

Word position of data items to be modified and correct data values are specified, each in 5 columns.

Note: Up to 6 items can be modified per card. If the number of modification items specified in columns 11 to 20 exceeds 6, they are specified on the next and succeeding cards. In such a case, columns 1 to 10 and 11 to 20 should be blanks.

4-5. Output data

Completed survey data, after data Modification, are printed out for all the items shown in Figure 4-5.

REC-NO.	ZONE	H.H	INDI	MMDD	TRIP	HOME	OFFICE	SCHOOL	SEX	AGE	OCC.	INDU	LICENSE	VEHICLES	DIS.	TIME	MONEY
138	1 11	5	3	1122	5	1 11	1 22	1 21	2	22	3	5	2	0 0 0 0 0 0	0	0	0

TRIP NO.	ORIGIN ZONE	ORIGIN INST.	ORIGIN TIME	DISTINATION ZONE	DISTINATION INST.	DISTINATION TIME	PURPOSE	PERSON	111111 ZONE	222222 ZONE	333333 ZONE	444444 ZONE	555555 ZONE	666666 ZONE	777777 ZONE	888888 ZONE
1	1 11	1	1 8 0	1 22	3	1 8 15	1	0 0 0	11 11 101 11	10 00	00 00	00 00	00 00	00 00	00 00	00 00
2	1 22	3	1 11 59	1 11	1	2 12 15	6	0 0 0	11 11 101 11	10 00	00 00	00 00	00 00	00 00	00 00	00 00
3	1 11	1	2 1 0	1 22	3	2 1 15	1	0 0 0	11 11 101 11	10 00	00 00	00 00	00 00	00 00	00 00	00 00
4	1 22	3	2 5 0	1 21	5	2 5 10	2	0 0 0	10 00	00 00	00 00	00 00	00 00	00 00	00 00	00 00
99	1 21	5	2 9 0	1 11	1	2 9 15	9	0 0 0	71 11 101 11	10 00	00 00	00 00	00 00	00 00	00 00	00 00

Fig. 4-5 Sample of print out after Data Modification

5. Sample Magnetic Tape Program

5-1. Outline

As the fourth step in making a master magnetic tape a sample magnetic tape is made by partitioning survey data for every trip from the complete survey data magnetic tape after data checking and data correction.

5-2. Description of work

On the survey data magnetic tape, each record is composed of individual character data and data for seven trips. The individual character data and data for one trip are partitioned from the data for seven trips, and are restored to a magnetic tape as a data unit. A tray key is set at the end of each data item as a delimiter of individual data.

5-3. Restrictions

None

5-4. Input Data

5-4-1. Outline

Data for seven trips are read from the survey data magnetic tape after completion of data correction, then divided into seven units. In addition, a tray key is added to the partitioned data as an individual delimiter.

5-5. Output data

Data partitioned each trip is output to a new magnetic tape. An expansion factor has not yet been set.

6. Expansion Processing Program

6-1. Outline

As the final step in making an expanded master magnetic tape, a survey data master magnetic tape that can be tabulated is made by addition of expansion factors for the population for surveyed data and the effective sample number.

6-2. Description of work

The sample magnetic tape is an all effective trip data file , not subjected to expansion processing (expansion factor=1). The effective sample number, sample number for each zone and individual character are tabulated from the trip data file. Expansion processing is performed by inquiring an expansion method, arranging exogenous data and calculating expansion factors. A magnetic tape after completion of expansion processing is a master magnetic tape.

Calculation of expansion factors is basically carried out for "zone and individual characters," as described below.

Expansion factor = (Population for each zone and individual character)/(Sample number for each zone and individual characters)

The format for making a master magnetic tape is shown in Figure 6-2. The expansion factor is set to expansion factor (2) of word 85.

Note:
- The format shown in Figure 6-2 is common to the master magnetic tape and the sample magnetic tape.
- Expansion factor (1) has not been applied in expansion processing of the sample magnetic tape, and has been set to 1.
- Expansion factor (2) has been set as an expansion factor for processing the master magnetic tape.
- Expansion factor (3) applies where the result of expansion factor correction is set. It is a dummy when making the master magnetic tape.

6-3. Restrictions

None

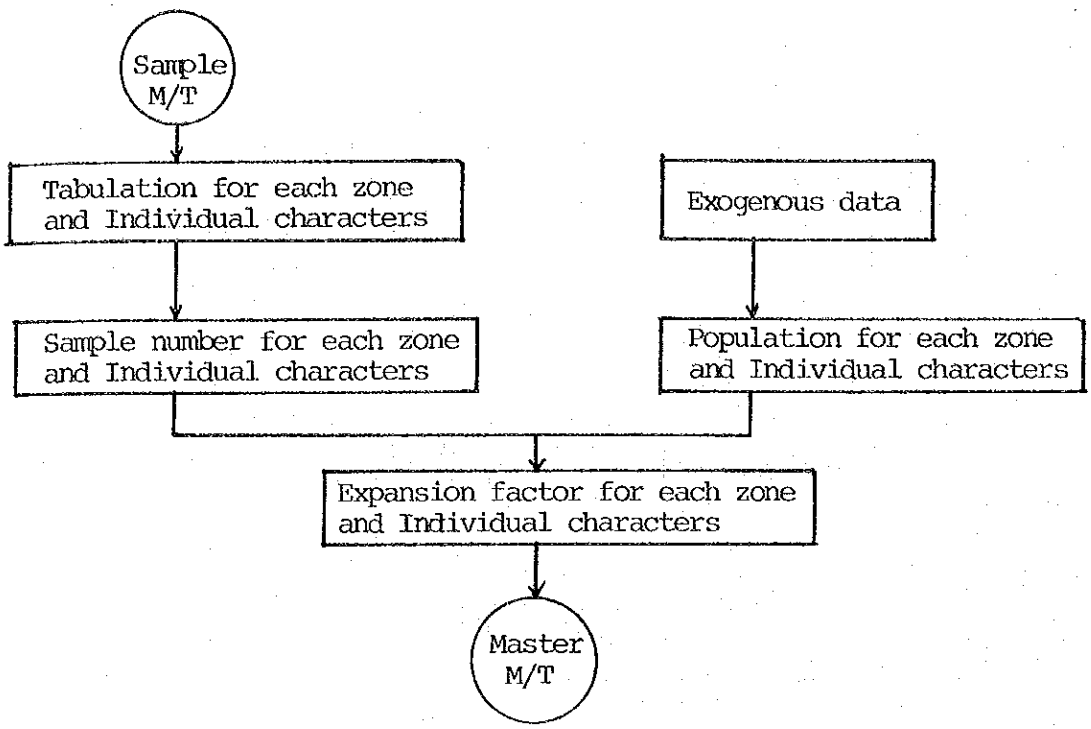


Fig. 6-1 Processing Flow

Zone					Date			Home			Office			School																	
A-Zone	B-Zone	C-Zone	H.H-No.	Indivi. No.	Month	Day	No. of trip	A-Zone	B-Zone	C-Zone	A-Zone	B-Zone	C-Zone	A-Zone	B-Zone	C-Zone	Sex	Age	Occupation	Industry	License	Classifi.	Unit	Classifi.	Unit	Classifi.	Unit	Distance	Time	Income	Seque. No.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

No. of trip	Origin							Distination							1st								2nd				3rd			
	Zone			Institution	Time			Zone			Institution	Time			Purpose	Passenger	Drive	Parking	Mode	Zone										
	A-Zone	B-Zone	C-Zone		AM. PM.	Hour	Minute	A-Zone	B-Zone	C-Zone		AM. PM.	Hour	Minute						A-Zone	B-Zone	C-Zone								
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63

4th				5th				6th				7th				8th				Expansion (1) Facter	Expansion (2) Facter	Expansion (3) Facter	Tray Kay
64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87

Fig. 6-2 Master M/T format

6-4. Input data

6-4-1. Outline

A sample magnetic tape partitioned every trip is read, and the population is totalized for a given category, and then expansion processing is performed using population data predicted in advance.

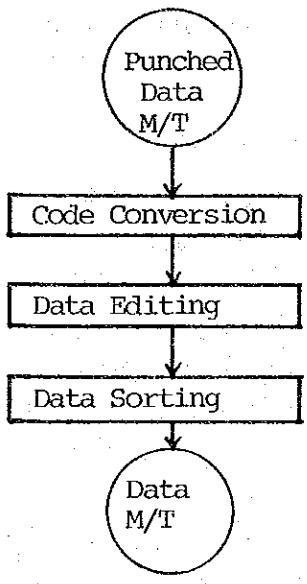
6-5. Output data

Data after expansion processing is output to a new magnetic tape, and the tabulated results are printed out.

7. Description of Program

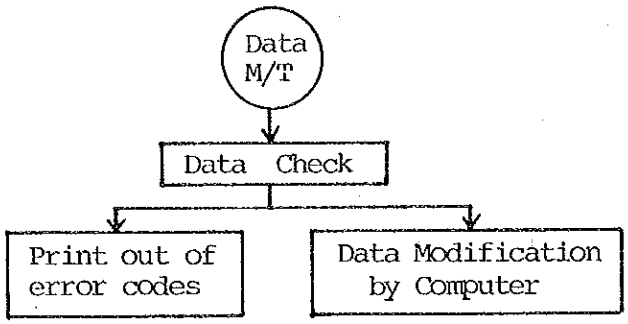
7-1. Survey data magnetic tape program

This program, in COBOL, reads a punched-data magnetic tape, performs code conversion and edits data.



7-2. Data check program

This program reads a survey data magnetic tape and checks survey data. It is composed of the following sub-programs.



7-2-1 KOPEN

This sub-program carries out preparation processing to read data from a survey data magnetic tape.

7-2-2 KREAD

This sub-program reads data for each record from a survey data magnetic tape.

7-2-3 KWRITE

This sub-program writes read-data from a survey data magnetic tape to a magnetic tape.

7-2-4 KCLOSE

This sub-program performs processing after all data have been read from a survey data magnetic tape.

7-2-5 ACINIT

This sub-program declares definitions for the mixed use of FORTRAN and COBOL programs.

7-2-6. TRPCHK

This sub-program counts trip numbers in trip data.

7-2-7. RENZOK

This sub-program checks trip data exceeding seven trips.

7-2-8. NORIKA

This sub-program counts the number of travel modes changed in one trip (transfer number).

7-2-9. CHK

This sub-program carried out data checking shown in the machine inspection text.

CHK 001

Subroutine number corresponding to a code in the error code table. Subroutines are prepared for as many as the number of inspection items.

7-2-10. ZONECK

This sub-program checks zone codes. If switch data is equal to 1, a zone code check is carried out, and if 2, a survey area zone code check is carried out.

7-2-11. TIME

This sub-program calculates time by switching a.m. and p.m. data.

7-2-12. FERROR, TERROR

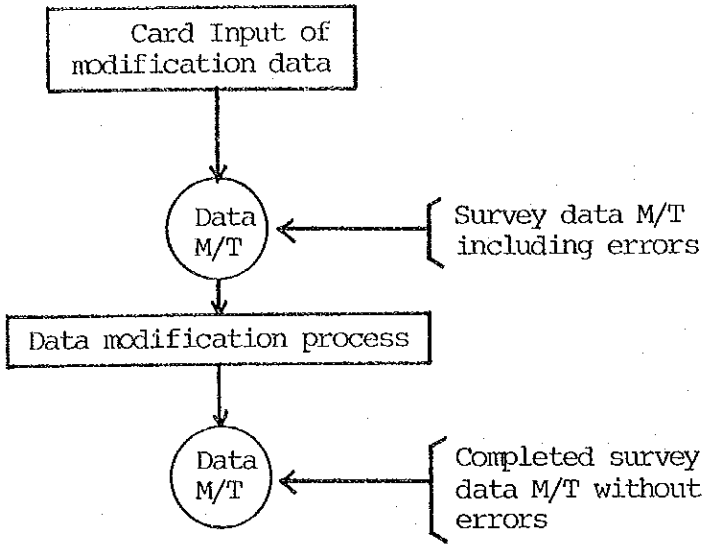
This sub-program sets error codes and counts the number of errors.

7-2-13. ECPRT

This sub-program prints out error codes for data errors.

7-3. Data Modification Program

This program modifies the contents of a survey data magnetic tape. It consists of the following sub-programs.



7-3-1. PREAD

This sub-program reads punched cards for modification.

7-3-2. PWRITE

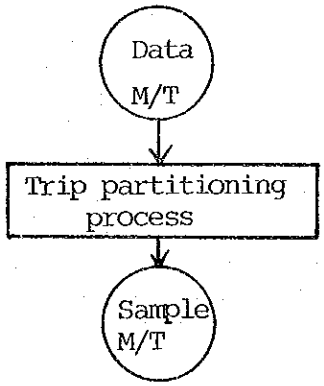
This sub-program prints out the contents of punched cards for modification.

7-3-3. PWDATE

This program prints out the survey data for a specified individual of all items after modification.

7-4. Sample magnetic tape program

This program divides individual data delimited every seven trips into seven unit trips. In addition, tray keys are added as individual delimiters. The program is composed of the following sub-programs.



7-4-1. KOPEN

This sub-program carries out preparation processing to read data from a survey data magnetic tape.

7-4-2. KREAD

This sub-program reads data every record from a survey data magnetic tape.

7-4-3. KRITE

This sub-program writes read data from a survey data magnetic tape to a magnetic tape.

7-4-4. KCLOSE

This sub-program performs processing after all data has been read from a survey data magnetic tape.

7-4-5 ACINIT

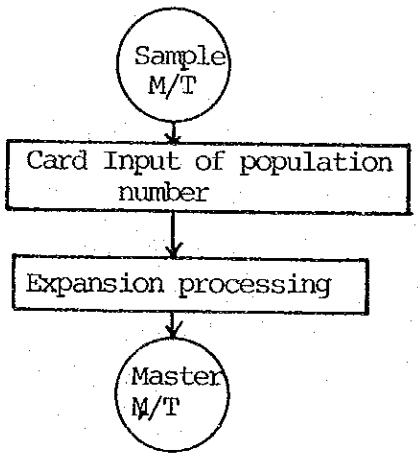
This sub-program declares definitions for mixed use of FORTRAN and COBOL programs.

7-4-6. TRPCHK

This sub-program counts trip numbers in trip data.

7-5. Expansion processing program

This program adds expansion factors to a sample data magnetic tape, It is composed of the following sub-programs.



7-5-1. KOPEN

This sub-program carries out preparation processing to read data from a survey data magnetic tape.

7-5-2. KREAD

This sub-program reads data every record from a survey data magnetic tape.

7-5-3. KWRITE

This sub-program writes read-data from a survey data magnetic tape to a magnetic tape.

7-5-4. KCLOSE

This sub-program performs processing after all data has been read from a survey data magnetic tape.

7-5-5. ACINIT

This sub-program declares definitions for mixed use of FORTRAN and COBOL programs.

TECHNICAL REPORTS - 2.2

FUTURE TRANSPORTATION DEMAND ESTIMATION

1. Outline

1.1 Purpose

Planning always involves the establishment of past trend and present situation, and, based on them, the forecasting of future situation. DCUTCLUS has the objectives of solving the existing transportation problems and of planning a transport system and a road/street network that will support and meet the demand created by the future socio-economic development in Cavao City. This Study will make recommendations of:

(i) Road/Street Network Plan
(ii) Public Transport System Plan
(iii) Traffic Management System Plan

for the target years of 1990 (medium range plan) and 2000 (long range plan). The purpose of future forecasting is to offer, for use in the formulation of these plans, necessary and sufficient information on the movement of people and vehicles in each of the target years, as estimated based on the contemplated future land use, the predicted future socio-economic framework, and population allocation plan recommended.

1.2 Forecast Conditions

1) Basic Data

Basic data on transportation demand is obtained from the findings of the Person-Trip Survey conducted by the DCUTDLUS Team in 1979. This Survey, which covered only the trips of residents of the Survey Area (residents), is supplemented by the data on the trips of residents outside the Survey Area (non-residents), as revealed through the Cordon Line Survey conducted at the same time. Person-trip survey is a typical tool of urban

transportation planning, along with car O-D survey and commodity flow survey. Because it directly reveals the travel of people, the very source of trip generation, person-trip survey is capable of showing the mechanism of man's modal preference (what means of transportation would man use under what condition) and is therefore most suitable for use in the formulation of a comprehensive urban transportation plan encompassing not only road/street network plan but also public transport plan.

2) Area Subject to Estimation

The Project Area, for which the future land use plan has been established, is eight zones larger than the Person-Trip Survey Area. The same demographic indicators (population, number of persons at work, etc) predicted for the Survey Area are also predicted for the additional eight zones, and, based on these predictions, future traffic demand is estimated for the eight zones using the same techniques and same models used for the Survey Area.

3) Estimation of Cargo Vehicle Trips

The estimation of future cargo vehicle trips is accomplished separately from that of person-trips, because demographic indicators (night population, number of those at work, etc., which are useful variables to explain the behavior of person-trip) do not explain cargo vehicle trips that is to be stimulated by commodity flow, it is rather common and appropriate to use the value of GRDP, which shows the level of regional economic activities, and other economic indicators for the prediction of future level of cargo vehicle travel. Also, it is expected that cargo vehicle trips that will be generated in and attracted to the industrial estates to be developed in the future will show not only different generation/attraction pattern but also different O-D pattern

from those existing. Therefore, the types of industries in each of such industrial estates have been predicted, and the future cargo vehicle transportation demand has been estimated based on commodity flow predicted in accordance with the types of industries and interrelationship between the estates.

4) Future Land Use and Transportation Demand

The future land use recommended by this Plan envisages the development of a multi-center urban complex, wherein socio-economic sphere is to be formed around the core of each block. Accordingly, it is expected that, with regard to people's travel, a transportation sphere will also be formed centering around each block core. Models which consider the formation of these sphere have been built for the estimation of transportation demand (particularly of trip distribution) in order that the estimation will be coherent with the future land use plan concept.

5) Alternative Public Transport Modes

In order to identify the major mode of public transport and its service system most suitable to the Project Area, the following alternative plans addressing to different public transport modes have been devised, compared, and analyzed for the formulation of a Master Plan:

Alternative A: Introduction of rail-transit service
Alternative B: Introduction of bus service
Alternative C: Reliance on the existing PUJs

Different choices of the primary mode of public transport will result in different modal splits of demand. In this Study, demand sharing between car and public transport, (at large), is first obtained based on the level of public transport service, and, then,

the split between various modes of public transport is estimated.

Table 1 Transportation Plan and Trip Demand

Transportation Plan \ Transportation Demand (O-D)			1979	1990		2000		
				Introduction of Bus Service	Reliance on the Existing PUJs	Introduction of Rail-Transit Service	Introduction of Bus Service	Reliance on the Existing PUJs
1979			Existing		Do Nothing Case 1990			Do Nothing Case 2000
1990 (Medium Term)				Transportation Plan in 1990				
2000 Long Term	Alternatives	Introduction of Rail-Transit Service				Alternative Case = A		
		Introduction of Bus Service					Alternative Case = B	
		Reliance on the Existing PUJs						Alternative Case = C
	Masterplan						Masterplan	

1.3 Process of Forecast

The so-called 4-step method (trip generation/attraction, trip distribution, modal split, and traffic assignment) -which offers a relatively simple process of estimation and affords the opportunity of checking the estimated values in visible manner at each step, and, for this reason, commonly used in urban transportation planning- is adopted for this Study. Largely, two types of modal split model are available under the 4-step method: trip-end model (modal split forecast precedes the trip distribution forecast) and trip-interchange model (modal split forecast follows trip distribution forecast). Whereas modal split characteristics and future trip distribution fluctuations by origindestinationpair are not considered under trip-end model, trip-interchange model is able to consider such elements by the use of O-D trips as an input data which was obtained

in the step of distribution trip forecast. For this reason, it is advantageous the trip-interchange model is to be used as the estimation model for DCUTCLUS Study (see Figure 1).

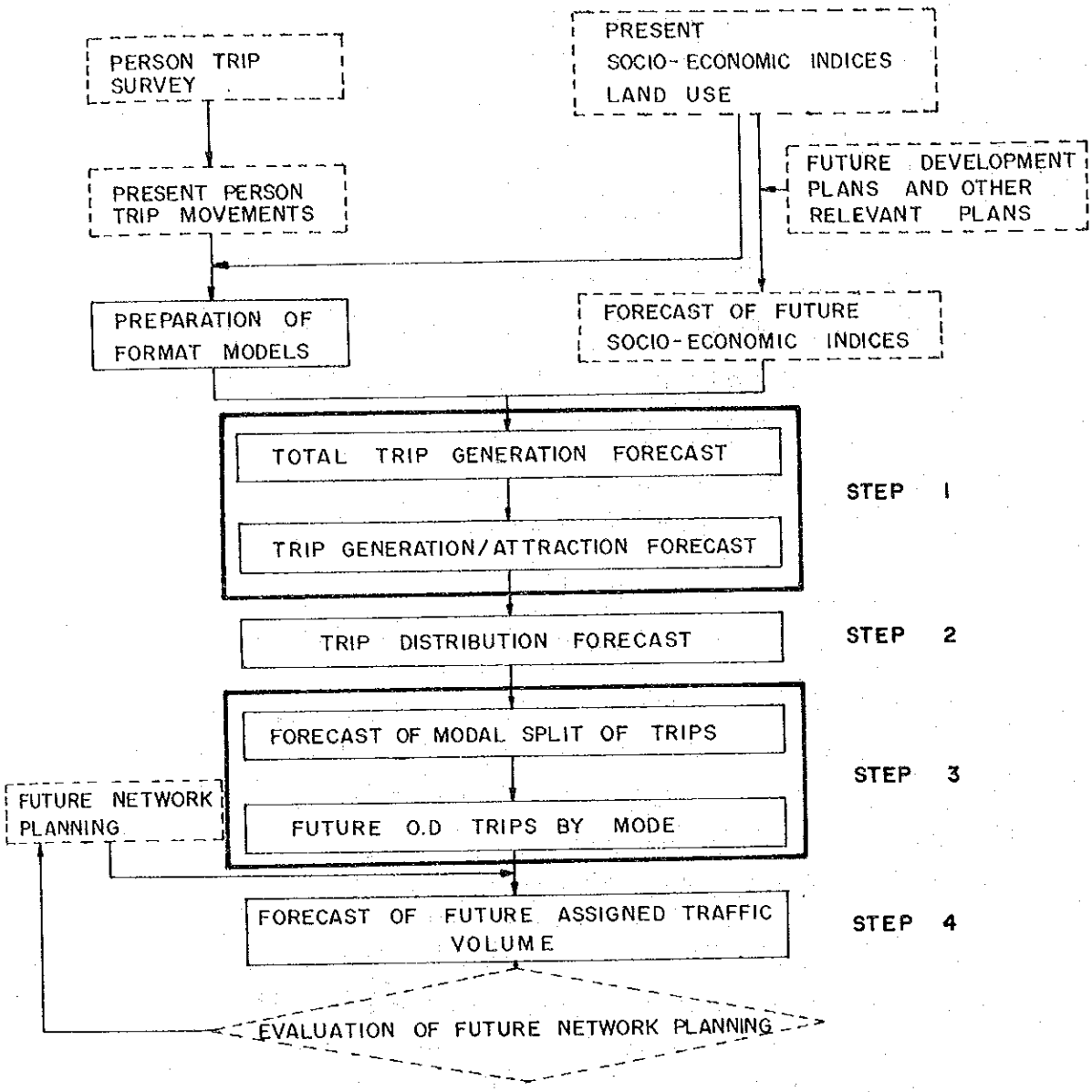


Fig. 1 FUTURE TRAFFIC VOLUME FORECAST PROCESS

Step 1 "How many trips?"

This is done in two sub-steps

Sub-Step 1-1 "Project area as a whole?"

This is the estimation of total generated trips in the project area, the data being used as a control total.

Sub-Step 1-2 "By Zone?"

This is the estimation of generated/ attracted trips by zone.

Step 2 "Where will these trips go?"

This is the estimation of distributed trips.

Step 3 "What mode of travel?"

This is the estimation of number of trips by mode of travel.

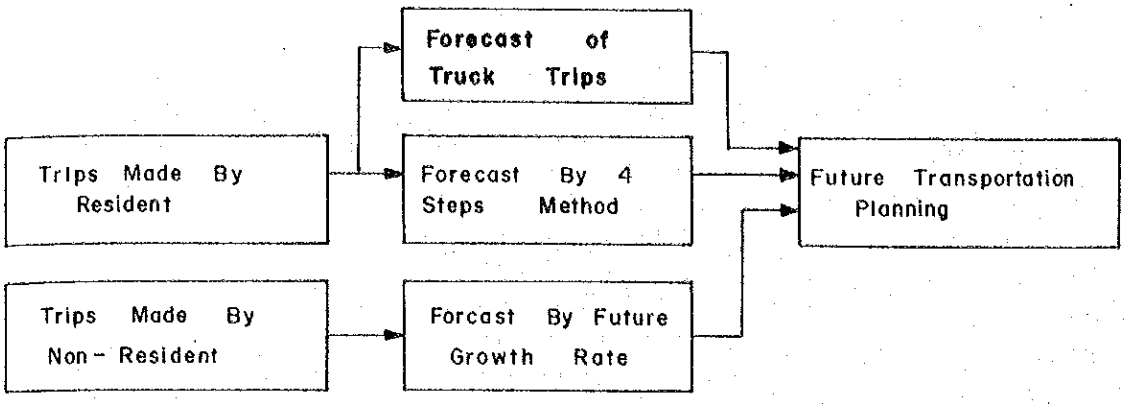
Step 4 "Through which route?"

This is the estimation of assigned traffic.

1.4 Forecast Models Application

As residents of the Survey Area will increase faster than non-residents, the ratio of non-residents trips (presently 63,000 trips/day) to total trips in the Survey Area will decline from the present 8% in the future. Therefore, in view of the small load of non-residents trips on the transportation plan as a whole, a simple growth rate method is conveniently used for the estimation of non-residents transportation demand. The forecast of residents transportation demand is to be accomplished by the use of carefully constructed forecast models explained hereunder.

Also, noting the fact that people's trip behavior is substantially affected by the purpose of the trip, models are built by the trip purposes and future demand forecast also by trip purposes.



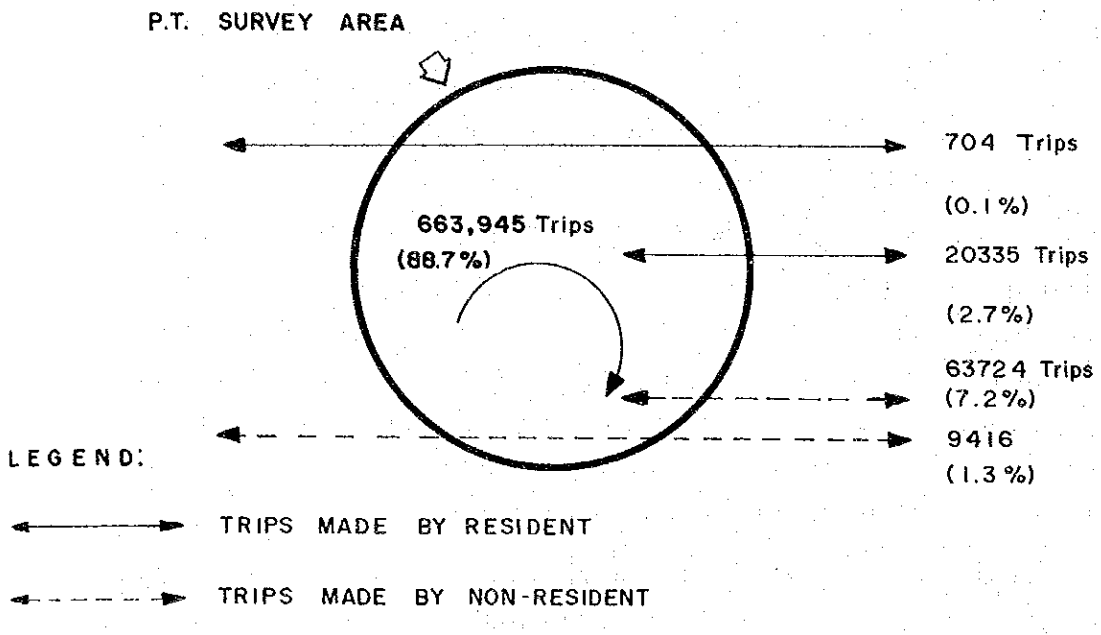


Fig. 2 APPLICATION OF FOUR-STEPS METHOD

2. Trip Generation/Attraction Forecast

2.1 Total Trip Generation Forecast

(1) Outline

Forecast methods to predict total generated trips in the Project Area are as follows;

a) Projection method based on the past trend analysis;
b) Forecast method using socio-economic indicators as explanatory variables;
c) Focusing on a person as the minimum unit of trip generator, the method is to get per capita trip rate for various personal attributed, then to forecast by multiplying trip rate by future population.

Projection method based on the past trend analysis cannot be applied because of non-availability of past survey data. Although forecast method using socio-economic indicators (i.e. GNP, Value of manufacturing producers' shipment, etc.) has good possibility to convert a tendency of economic activities into trips, this method has been avoided because:

i) Values of socio-economic indicators have rather wide allowable range, and
ii) When future industrial structure change drastically compared to the present, forecast made by this method will produce rather inaccurate results

Analysis of the person trip survey data made by the DCUTCLUS team and other Transport Studies have also proved that per capita trip rate has fairly stable accuracy, therefore, the forecast method using per capita trip rate has been selected.

The forecasting of total trip generation by trip generation rate follows the process shown in Figure 3.

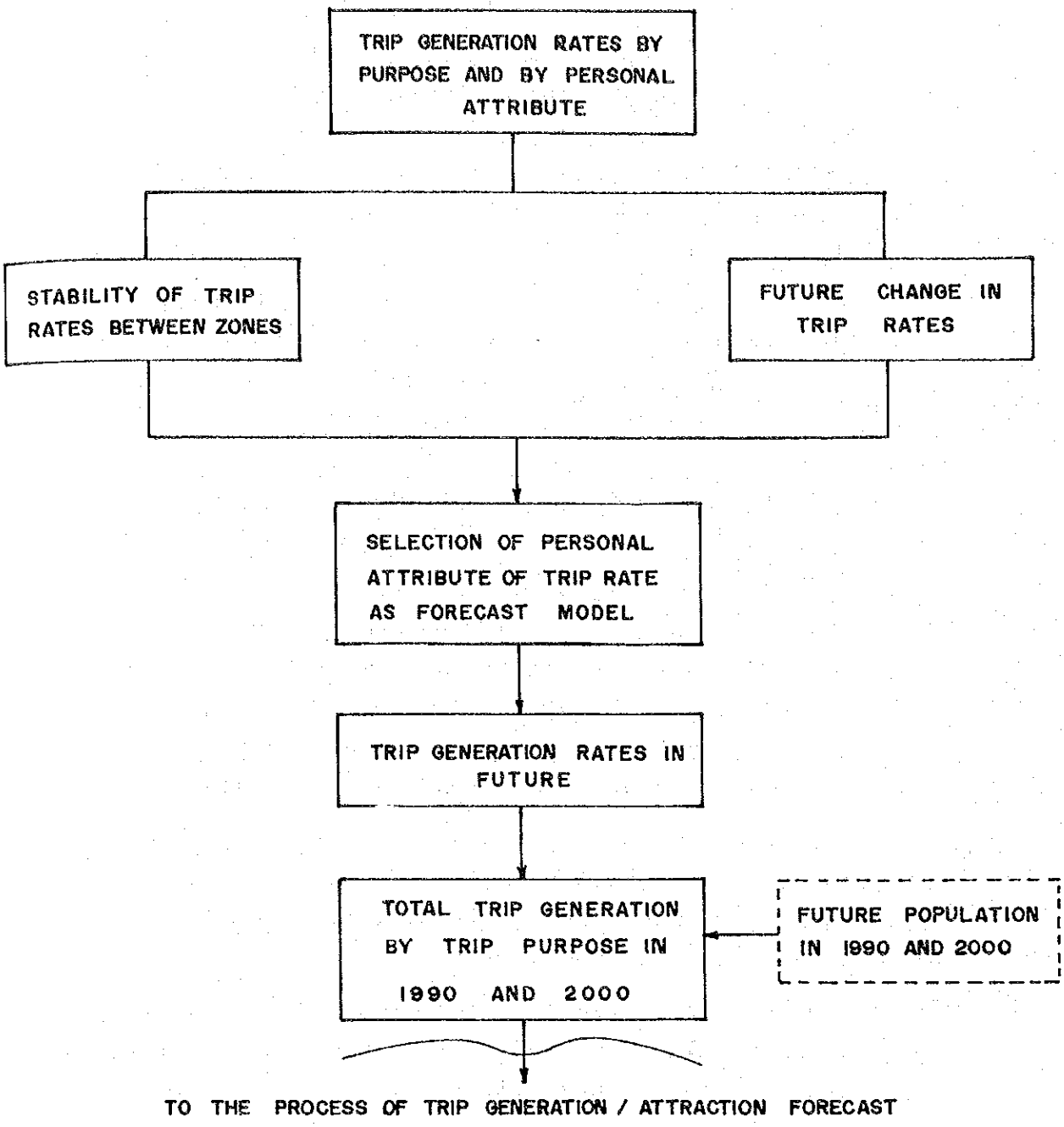


Fig. 3 PROCESS OF TOTAL TRIP GENERATION FORECAST

(2) Selection of Personal Attribute

Various attributes of a person affect or determine his trip rate. In the Person Trip Survey, such personal attributes were surveyed as place of Living, sex, age, occupation, industry engaged in, car ownership and income, all of which have been revealed by analyses to have substantial influences on trip rate. (See figure 4 , 5 , 6.)

Trip rate of male is higher by 1.33 times than that of female. Age group of 30s and 40s of male has the highest trip rate, then age group of 10 to 14 of both sexes come next. In case of female, trip rate of over 20 years old is considerably low, however, that of male up to the age of 50 is high, which implies that they are still active.

As for trip rate by industry engaged in, people engaged in the tertiary industry shows the highest rate, followed by people engaged in the secondary industry, students and pupils. On the other hand, trip rate of housewives and the jobless is substantially low.

Car ownership also gives big impact on trip rate. At present, trip rate of family members who belong to a car owned household is higher by 1.84 times than that of non-car owned household members.

However, an attribute which meets the following conditions should be selected as that which will support the prediction of future trip rate:

- o The attribute which shows little dispersions in the trip generation rates between zones and will show little dispersions between now and future, and
- o Such attribute that population composition by attribute is expected to change substantially

in the future, affecting the volume of transportation demand, and

- o Such attribute that future population can be forecast by attributive differences.

No drastic change of age and sex structure will be expected in the future. Forecast of employment by occupation and of income level is quite difficult. Therefore, personal attributes such as age, sex, occupation and income level are not suitable for forecast of total trip generation.

In the future, it is expected that industrial structure will change drastically, i.e. switch-over of primary industry to secondary and/or tertiary industry, increase of employment rate and increase of school attendance rate. These changes give so big influence on total trip generation that trip rate by industry has been selected for forecast. Factor of Car ownership will be considered when developing modal split model.

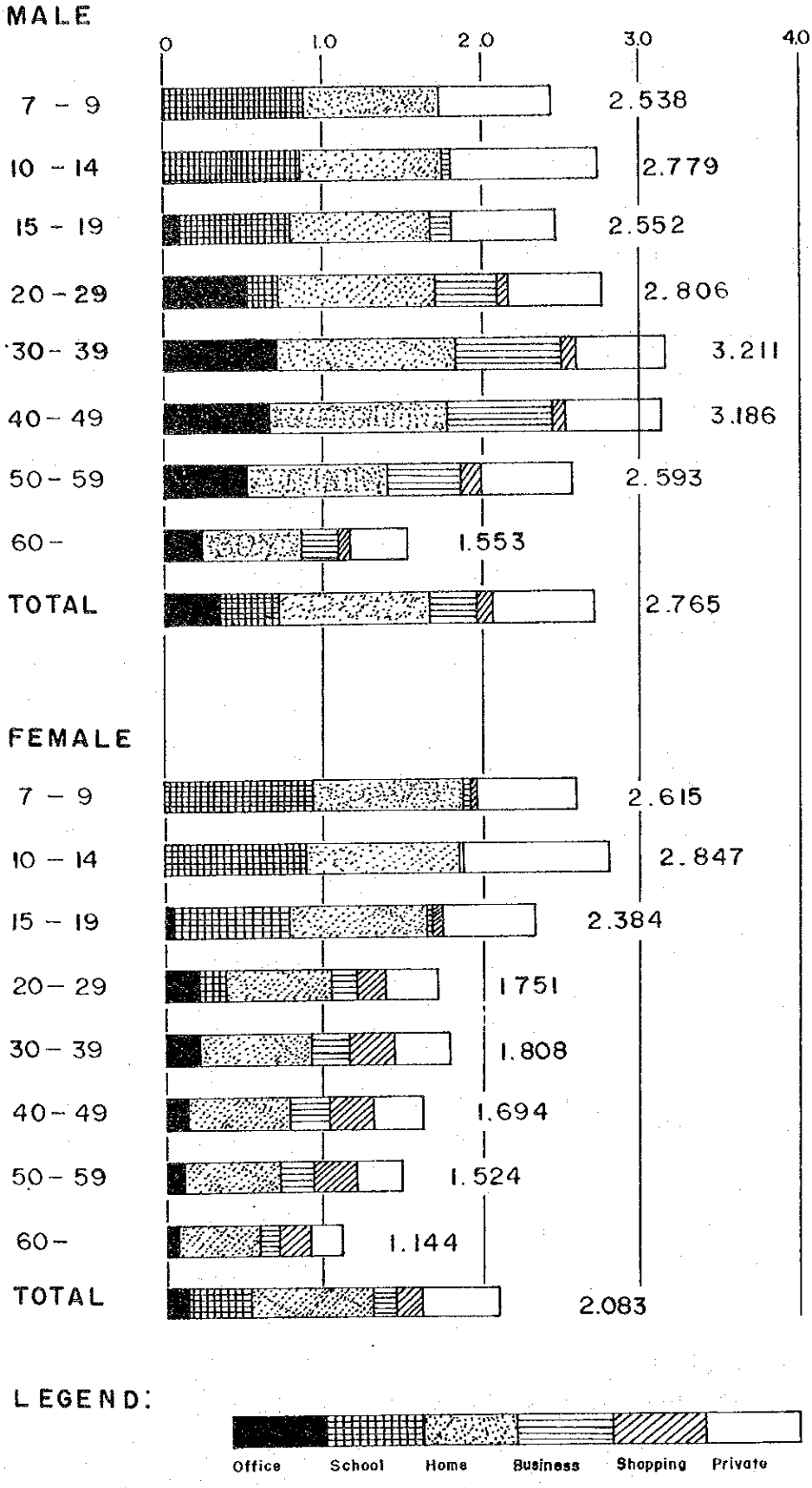


Fig. 4 TRIP GENERATION RATE BY SEX & BY AGE (PERSON TRIPS/PERSON/DAY)

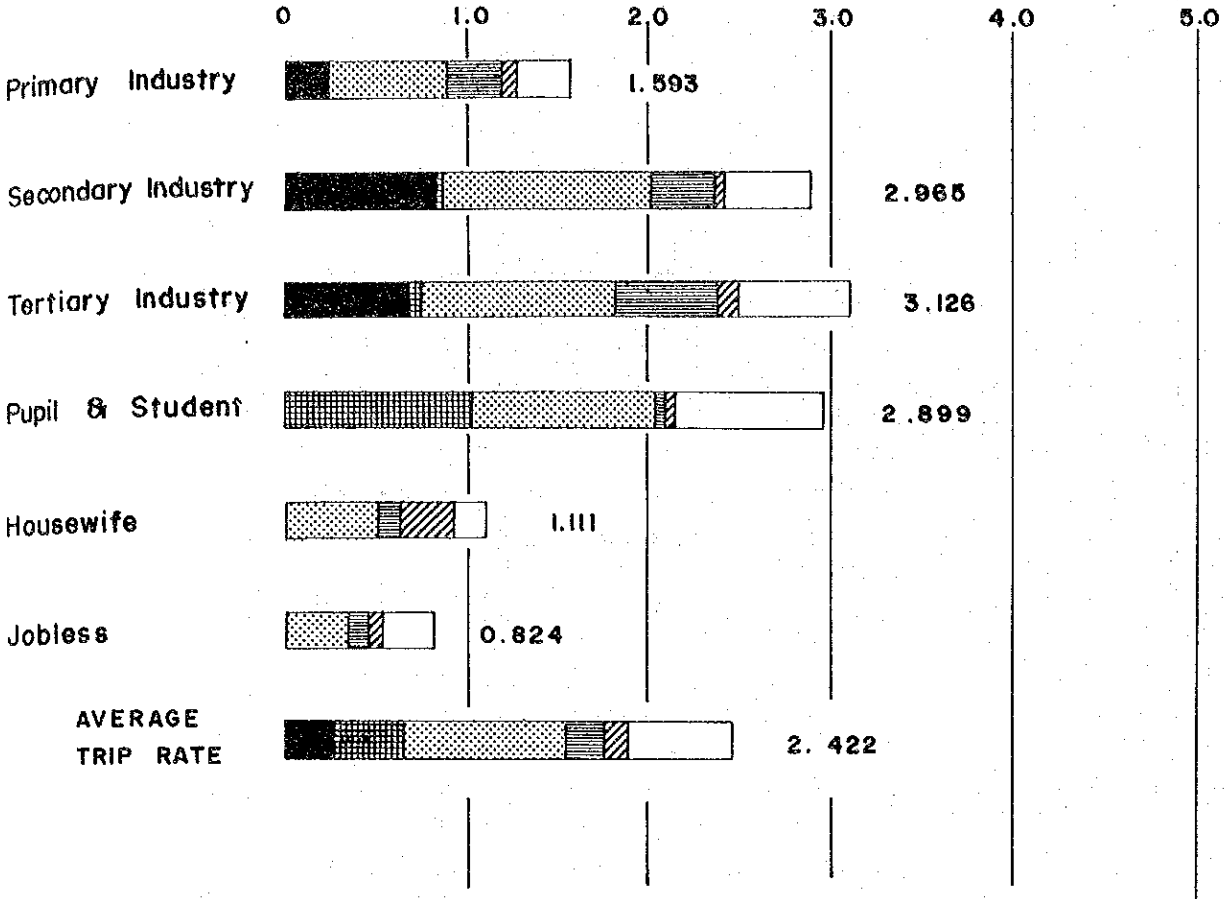


Fig 5 TRIP GENERATION RATE BY INDUSTRY (PERSON-TRIPS/DAY)

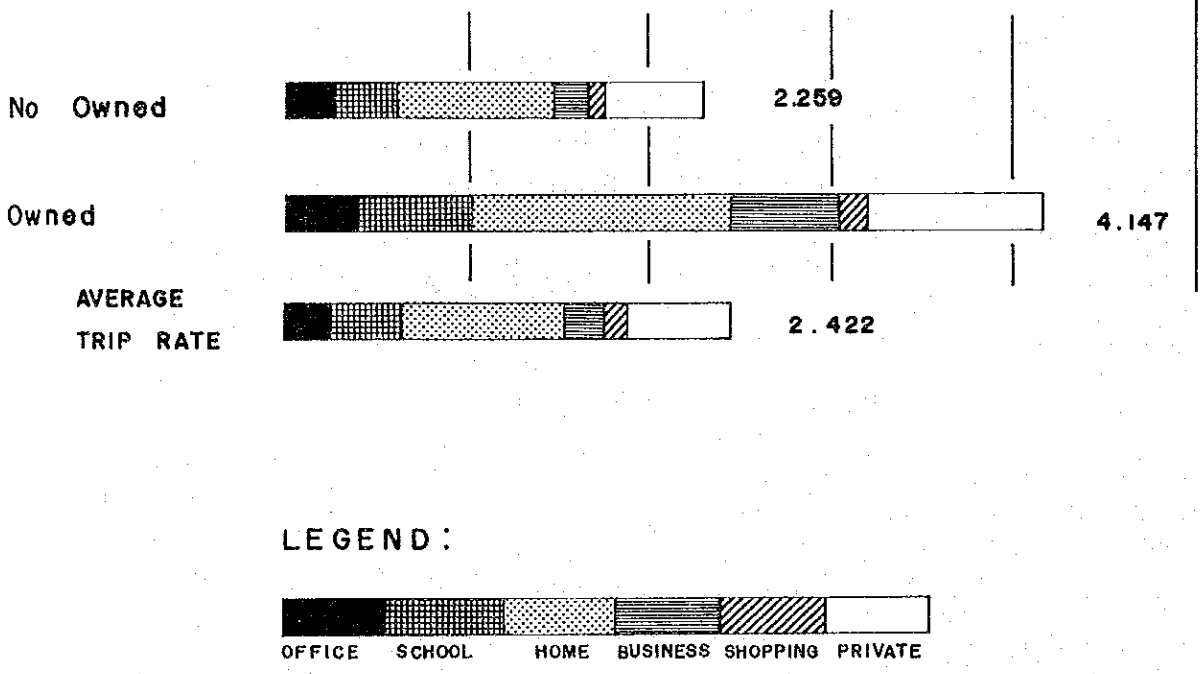


Fig 6 TRIP GENERATION RATE BY VEHICLE OWNED (PERSON-TRIPS/DAY)

Table 2 FUTURE POPULATION BY INDUSTRY

INDUSTRY	1979		2000	
	Number	Share (%)	Number	Share (%)
Population	360,000	100.0	900,000	100.0
Population Below 5 Years	77,400	21.5	193,000	21.4
Primary Industry	24,000	6.7	9,000	1.0
Secondary Industry	21,900	6.1	88,000	9.8
Tertiary Industry	69,100	19.2	227,000	25.2
Pupil and Student	109,700	30.5	288,000	32.0
Housewife	36,700	10.2	60,000	6.7
Jobless	21,200	5.9	35,000	3.9

(3) Future Trip Generation Rate

Currently the per capita trip rates (trip generation rates) of housewives and the jobless are much lower than rates of those in other categories, because the trip maker ratio (the ratio of those who made at least one trip to the population) of housewives is 41% and that of the jobless is only 29%, as against 80% to 90% of those of other categories. When only the trip makers are compared, the trip generation rates of housewives and the jobless are little different from the rates of others. Trip maker ratio is generally believed to rise as the mode of life is diversified and as the utilization of transportation becomes easier, and, as a phenomenon, such ratio is greater in urbaminzed areas than in sub-urban areas. The trip maker ratios of housewives and the jobless in Poblacion are presently about 1.5 times those in sub-urban areas, where the ratios will rise to the Poblacion level in the future when urbanization will progress. For those of other categories, whose need to make trips is high, little geographic variance is noted in trip making ratios.

For the purpose of estimation hereby, the trip generation rates of housewives and the jobless are adjusted under assumption that the trip making ratios of housewives and the jobless will rise to Poblacion level in the future (with trip generation rates of those in other categories unadjusted.)

Table 3 TRIP MAKER RATIO BY PERSONAL ATTRIBUTE

	TRIP MAKER RATIO (%)	NET. TRIP RATE	GROSS TRIP RATE
PRIMARY INDUSTRY	53.9	2.96	1.59
SECONDARY INDUSTRY	83.4	3.56	2.97
TERTIARY INDUSTRY	78.6	3.98	3.13
PUPIL & STUDENT	90.1	3.22	2.90
HOUSEWIFE	41.1	2.70	1.11
JOBLESS	28.5	2.89	0.82
TOTAL	71.4	3.39	2.42

GROSS TRIP RATE = Net Trip Rate x Trip Maker Ratio

Where :

TRIP MAKER RATIO = Those who made at least one trip ÷ Total Population

Table 4 FUTURE TRIP GENERATION RATES

(UNIT : TRIP/PERSON)

	PRIMARY	SECONDARY	TERTIARY	PUPIL & STUDENT.	HOUSEWIFE	JOBLESS	TOTAL
TO OFFICE	0.239	0.838	0.696	0.022	0.011 0.013	0.005 0.007	
TO SCHOOL	0.017	0.037	0.043	0.974	0.007 0.009	0.008 0.011	
TO HOME	0.630	1.161	1.097	1.014	0.488 0.595	0.351 0.493	
BUSINESS	0.310	0.362	0.561	0.025	0.126 0.154	0.113 0.159	
SHOPPING	0.104	0.060	0.104	0.028	0.298 0.363	0.099 0.139	
PRIVATE	0.293	0.507	0.625	0.836	0.181 0.221	0.248 0.348	
TOTAL	1.593	2.965	3.126	2.899	1.111 1.355	0.824 1.157	2.422 2.768

UPPER: Existing Trip Rate

LOWER: Future Trip Rate. If this column is blank, future trip rate is equal to existing one.

2.2 Trip Generation/Attraction Forecast

(1) Outline

Trip generation/attraction is forecast by zone and by different purpose, based on the total trip generation in the Project Area, as estimated in the previous step.

Generally, trip generation/attraction forecast methods are grouped into two.

a) Method by generated/attracted trip rate per unit of each land use (unit is expressed as trips per hectare) determined in accordance with land use classification;

b) Method by models which are developed by statistical techniques such as multiple regression model and principal component analysis model, using population as independent variables.

Forecast method based on land use has an advantage in that a future land use plan can directly be reflected on traffic demand forecast however, its disadvantage is that it does not always provide required accuracy. The more accurate forecast is required, the more accurate unit rate (trips per hectare) must be determined, which necessitate a lot of work to do. In case that types of present land use are mixed up and there is no areal unity by type of land use, it is also quite hard to determine accurate unit rate. Application of this method is not easy under the circumstance that there would be big differences between the present and the future land use pattern as in the case of this Project. The forecast method based on land use should be applied where urbanization has already been developed.

Models using population indices as independent variables have been selected for forecasting generated/attracted trips in view of the following aspects; i) they are stable in accuracy and ii) they can reflect

ideals of a future land use plan as future population framework is determined on the basis of a future land use plan.

Among function models, multiple regression model has been selected because its structure is simple and clear, its application is easy and it is commonly used.

Of population indices, which represent the very source of trip generation and which can easily be estimated for the future, those which are deeply related to the quantity of trip have been selected by correlation analysis in formulating the following linear multiple regression model:

$$T_i = a_0 + a_1X_{i1} + a_2X_{i2} + \ldots + a_mX_{im}$$

Where: T_i = the quantity of trip generation (or attraction in zone number i)

$X_{i1}, X_{i2} \ldots X_{im}$ = The value of the index of the zone (1, 2, ... m)

$a_0, a_1 \ldots a_m$ = Constant

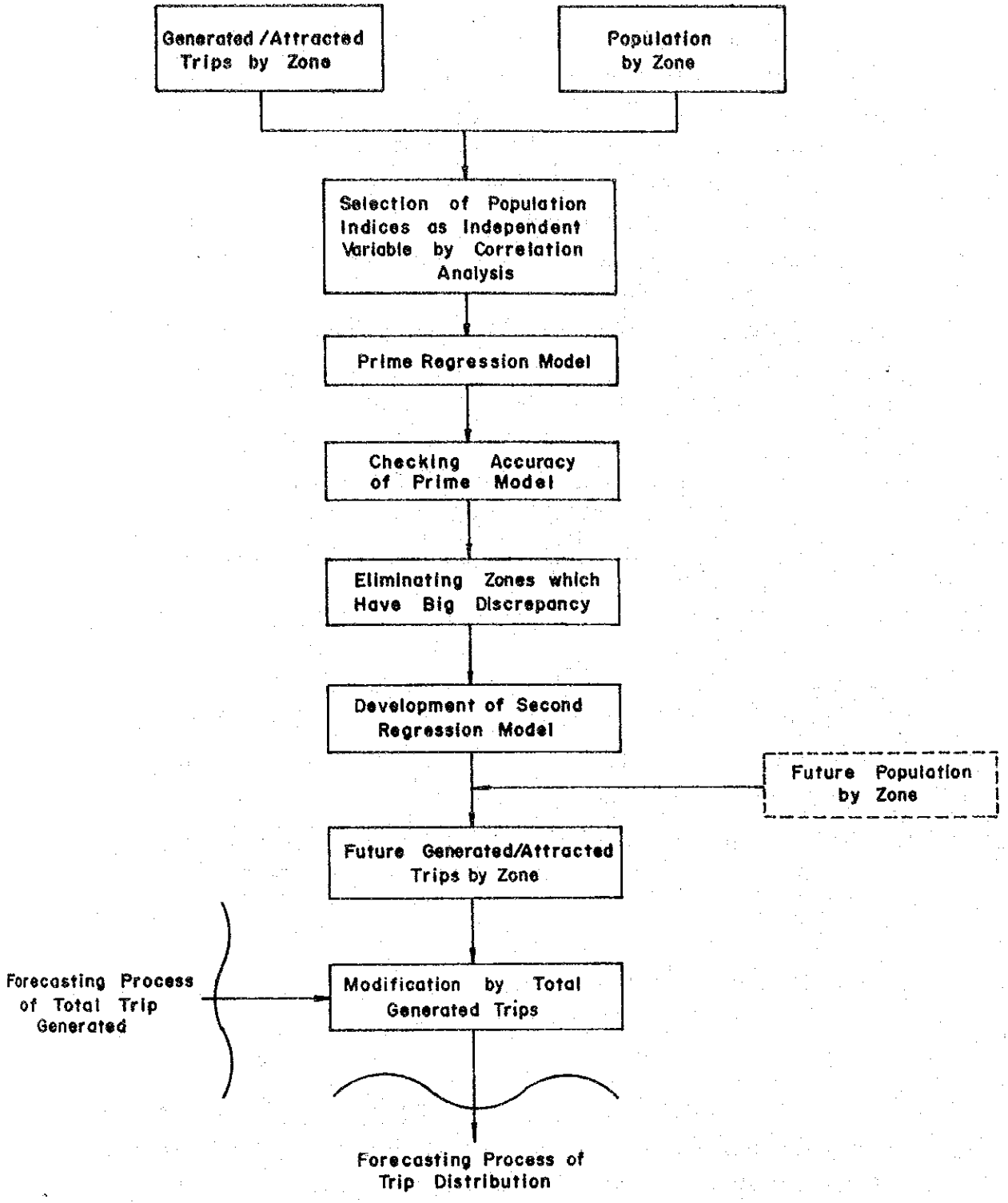


Fig 7 PROCESS OF TRIP GENERATION/ATTRACTION FORECAST

(2) Selection of Independent Variables

When selecting independent variables for multiple regression model, only those indices which satisfy the conditions that current values are available for all the zones and that their future values (for the year 1990 and 2000) can be forecasted must be considered. In the Person Trip Survey, population by sex, age, occupation and industry for each zone have been obtained. Judging from the appropriateness as independent variables and the possibilities to forecast future values, population by night and by day in relation to industry have been selected as indices.

Table 5 Indices Explaining Trip Generation/Attraction

Day 1/	Night 2/
o Day Population	o Night Population
o Total workers	o Total workers
o Secondary Industry Workers	o Secondary Industry Workers
o Tertiary Industry Workers	o Tertiary Industry Workers
o Total of Secondary and Tertiary Industry Workers	o Total of Secondary and Tertiary Industry Workers
o Pupils and Students	o Pupils and Students

NOTE:

1/ By place of work/school

2/ By place of abode

Indices which are deeply related with trip generation/attraction have been selected through analysis using correlation coefficient matrix (Refer to Table 6). The preliminary models have been developed using those selected indices and accuracy of models has been checked.

Appropriateness of indices has also been confirmed by analizing the Person Trip Survey results (i.e. Mechanism of trip generation/attraction has been analized and indices have been checked if each of them explains the mechanism revealed by the analysis). Taking the trip purpose of "going to office" as an example, generated trips of this purpose by zone are determined by number of workers who reside in the zone, regardless of their places of work. Attracted trips of this purpose by zone are determined by the power of employment opportunities which the zone possesses, in other word, by the number of workers in the zone. Therefore, it is reasonable to assume that generated trips are explained by the number of workers by the place of residence and attracted trips by the number of workers by the place of work. These assumptions have been proven by the analysis of the Person Trip Survey results.

Table 6 CORRELATION COEFFICIENT MATRIX

	INDICES	OFFICE Generation	OFFICE Attraction	SCHOOL Generation	SCHOOL Attraction	HOME Generation	HOME Attraction	BUSINESS Generation	BUSINESS Attraction	SHOPPING Generation	SHOPPING Attraction	PRIVATE Generation	PRIVATE Attraction
NIGHT	NIGHT POPULATION	0.95	0.38	0.97	0.47	0.45	0.98	0.83	0.42	0.79	0.24	0.73	0.64
	TOTAL WORKERS	0.92	0.35	0.95	0.44	0.43	0.96	0.82	0.40	0.78	0.24	0.72	0.63
	SECONDARY INDUSTRY WORKERS	0.71	0.28	0.69	0.22	0.24	0.72	0.55	0.20	0.58	0.11	0.45	0.37
	TERTIARY INDUSTRY WORKERS	0.95	0.46	0.95	0.56	0.56	0.96	0.87	0.54	0.83	0.35	0.78	0.70
	TOTAL of SECONDARY and TERTIARY INDUSTRY Workers	0.95	0.44	0.94	0.50	0.51	0.96	0.85	0.49	0.82	0.31	0.74	0.66
	PUPILS and STUDENTS	0.95	0.43	0.98	0.52	0.58	0.98	0.85	0.47	0.82	0.26	0.77	0.68
DAY	DAY POPULATION	0.81	0.88	0.86	0.86	0.85	0.84	0.93	0.78	0.94	0.48	0.93	0.90
	TOTAL WORKERS	0.56	0.90	0.62	0.77	0.85	0.60	0.81	0.81	0.83	0.55	0.83	0.82
	SECONDARY INDUSTRY WORKERS	0.31	0.71	0.31	0.41	0.51	0.31	0.44	0.45	0.49	0.28	0.39	0.39
	TERTIARY INDUSTRY WORKERS	0.55	0.94	0.58	0.85	0.94	0.56	0.82	0.91	0.85	0.63	0.86	0.87
	TOTAL of SECONDARY and TERTIARY INDUSTRY Workers	0.53	0.96	0.56	0.80	0.90	0.54	0.79	0.86	0.82	0.59	0.80	0.81
	PUPILS and STUDENTS	0.52	0.83	0.57	0.99	0.92	0.53	0.76	0.82	0.81	0.48	0.86	0.89

$$\gamma = \frac{\Sigma(A-\bar{A})(B-\bar{B})}{\sqrt{\Sigma(A-\bar{A})^2 \ \Sigma(B-\bar{B})^2}}$$

γ : Correlation Coefficient

A, B : Index

TABLE 7 INDEPENDENT VARIABLES OF FUNCTION MODELS

TRIP PURPOSE		INDICES I 1/	INDICES II 2/
OFFICE	GENERATION	3/ o Population o Tertiary 5/ o Secondary and Tertiary 6/	o Secondary and Tertiary
	ATTRACTION	4/ ▲ Secondary and Tertiary	▲ Secondary and Tertiary
SCHOOL	GENERATION	o Population o Pupils and Students	o Pupils and Students
	ATTRACTION	▲ Pupils and Students	▲ Pupils and Students
HOME	GENERATION	▲ Pupils and Students ▲ Tertiary ▲ Secondary and Tertiary	▲ Pupils and Students ▲ Secondary and Tertiary
	ATTRACTION	o Population o Pupils and Students o Tertiary o Secondary and Tertiary	o Population
BUSINESS	GENERATION	o Tertiary ▲ Population ▲ Tertiary ▲ Secondary and Tertiary	▲ Secondary and Tertiary
	ATTRACTION	▲ Tertiary ▲ Secondary and Tertiary	▲ Secondary and Tertiary
SHOPPING	GENERATION	▲ Population	▲ Population
	ATTRACTION	▲ Tertiary	▲ Tertiary
PRIVATE	GENERATION	▲ Population	▲ Population
	ATTRACTION	▲ Population	▲ Population

1/ Indices which are deeply related with generated/attracted trips and appropriate as independent variables

2/ Indices which are selected for second models

3/ o indicates population indices at night

4/ ▲ indicates population indices in the day time

5/ "Tertiary" shows Tertiary Industry Workers

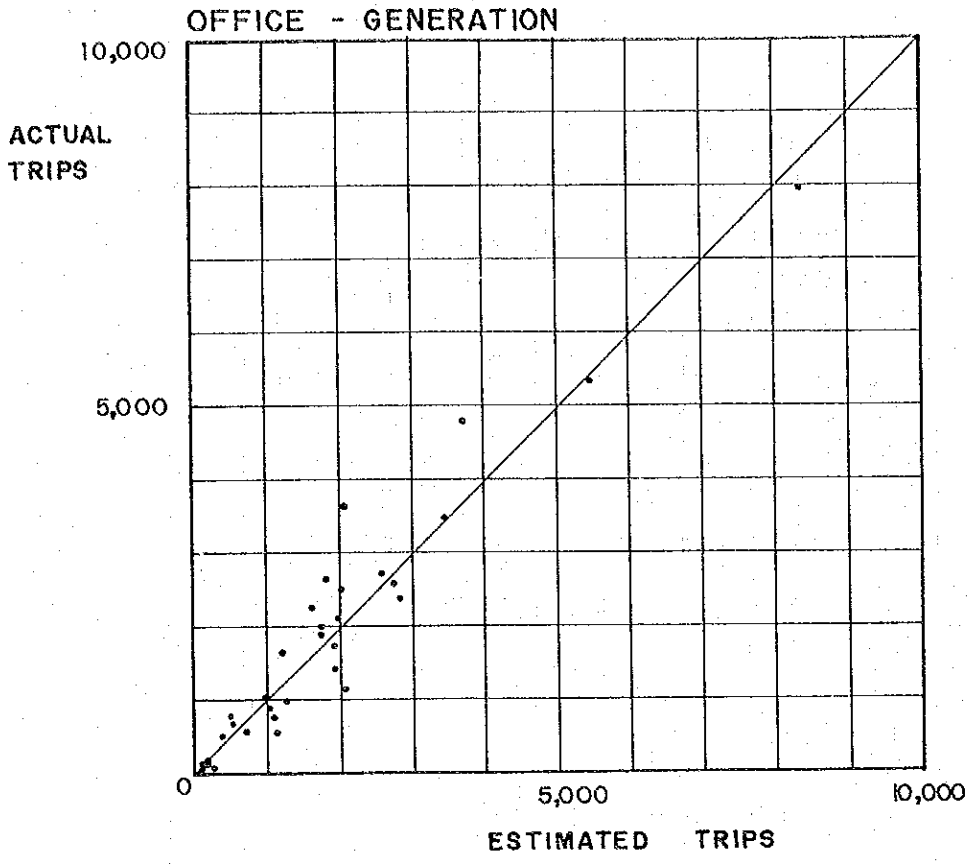
6/ "Secondary and Tertiary" shows Secondary and Tertiary Industry workers

(3) Multiple Regression Model

Using indices which have been selected by correlation analysis, function models have been developed. Although multiple regression model could be improved by means of increasing the number of independent variables, it is desirable that models are simple and clear. When a coefficient of correlation of model is more than 0.9, model is judged to be satisfactory. As a result, generation model for the trip purpose of "going home" have been required to have two independent variables. The rest of models have been satisfactory with one independent variable. All multiple regression models with a high coefficient of correlation have been developed. Models at this stage are called preliminary models.

Discrepancy between current value (Person Trip Survey results) and estimated values (computed by inputting base year data in preliminary models) has been checked. Current values and estimated values have been plotted on the figure as shown in Fig. 8. Accuracy of estimated values and the existence of zones which could not be explained by preliminary model have been checked. When zones of which estimated value largely differ from current value exist, the structure of model might be distorted. Preliminary models have been modified by eliminating these zones and modified multiple regression models which are called second models have been developed. Forecast of trip generation/attraction has been made by using second models. Table 8 shows second models.

As for zones of which estimated value largely differs from current value, forecast has been made separately by taking into consideration the number of generated/attracted trips which could not be explained by model.



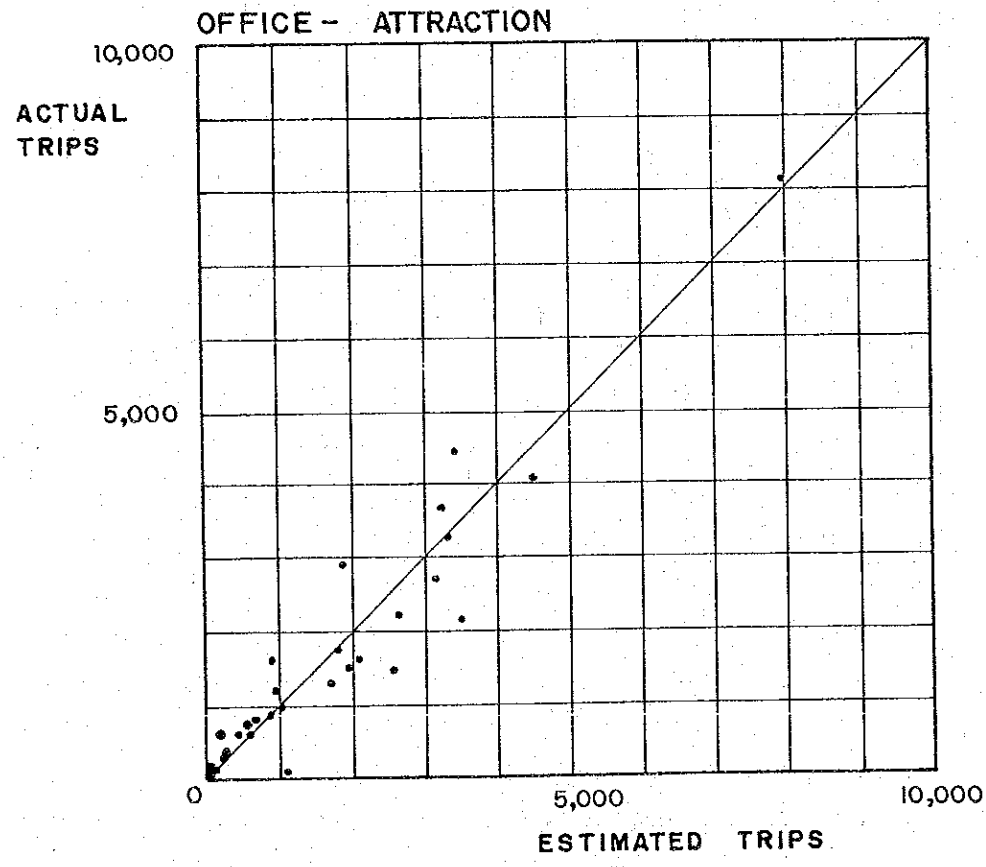


FIG. 8 GENERATED / ATTRACTED TRIPS ESTIMATION DIAGRAM

Table 8 REGRESSION MODEL BY PURPOSE (FINAL MODEL)

		INDEPENDENT VARIABLE	FORMULA	MULTIPLE CORRELATION
OFFICE	GENERATION	SECONDARY & TERTIARY (Night)	$Y = 0.6648X + 134$	0.971
	ATTRACTION	—DO— (Day)	$Y = 0.8223X - 163$	0.975
SCHOOL	GENERATION	PUPILS & STUDENTS (Night)	$Y = 0.9904X + 11$	0.987
	ATTRACTION	—DO— (Day)	$Y = 1.003X - 24$	0.999
HOME	GENERATION	(1) SECONDARY & TERTIARY (Day) (2) PUPILS & STUDENTS (Day)	$Y = 1.0940X_1 + 1.2542X_2 - 728$	0.993
	ATTRACTION	POPULATION (Night)	$Y = 0.6713X - 438$	0.984
BUSINESS	GENERATION	SECONDARY & TERTIARY (Day)	$Y = 0.4268X + 278$	0.908
	ATTRACTION	—DO— (Day)	$Y = 0.6918X - 341$	0.962
SHOPPING	GENERATION	POPULATION (Day)	$Y = 0.1022X - 253$	0.943
	ATTRACTION	TERTIARY (Day)	$Y = 0.4777X - 353$	0.903
PRIVATE	GENERATION	POPULATION (Day)	$Y = 0.4563X - 365$	0.962
	ATTRACTION	—DO— (Day)	$Y = 0.3981X - 8$	0.937

3. Trip Distribution Forecast

3.1 Outline

O-D values are fundamental data necessary for formulating transportation facility planning and transportation policy. Forecast of O-D values in terms of person trips is the objective of this step. Future O-D values (trip distribution) by purpose is to be obtained from future generated/attracted trips by purpose as estimated in the preceding step.

O-D values are grouped into three categories as illustrated in Fig. 9.

a) Zone pair trips
b) Intrazonal trips
} Internal trips - Trips inside the Project Area

c) External and through trips - Trips outside the Project Area

O-D values should not be forecasted by one kind of model or method but preferably by different kinds of model or method suitable for each O-D category.

One of the characteristics of the Person Trip Survey which aims at obtaining all trips made by a person is that share of intrazonal trips is substantially high. Most of intrazonal trips are short distance trips which are mostly made by walking. Generally, it is known that forecast of intrazonal trips by zone pair model produces inaccurate results. It is decided that forecast of intrazonal trips be made by intrazonal model.

Number of external and through trips is much less than that of internal trips (The Project Area must be determined so as to result in small number of external and through trips). As the result of the Person Trip Survey shows, share of external and through trips in 1979 is about 3% of total trips. Impact of these trips on traffic facility planning is estimated to be very minor, therefore, forecast of O-D value for external and through trips is to be made by simple method using population growth rate.

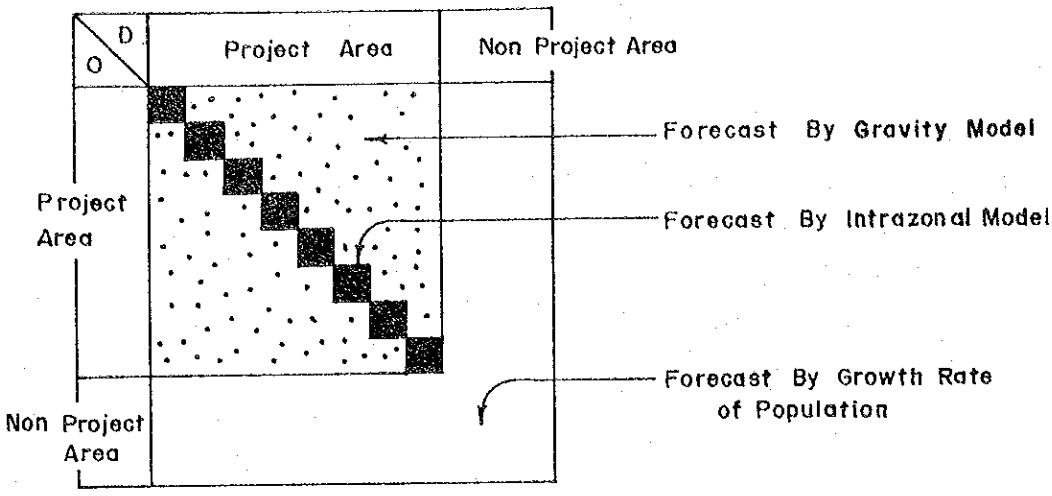


Fig. 9 MODEL SPHERE OF FORECAST

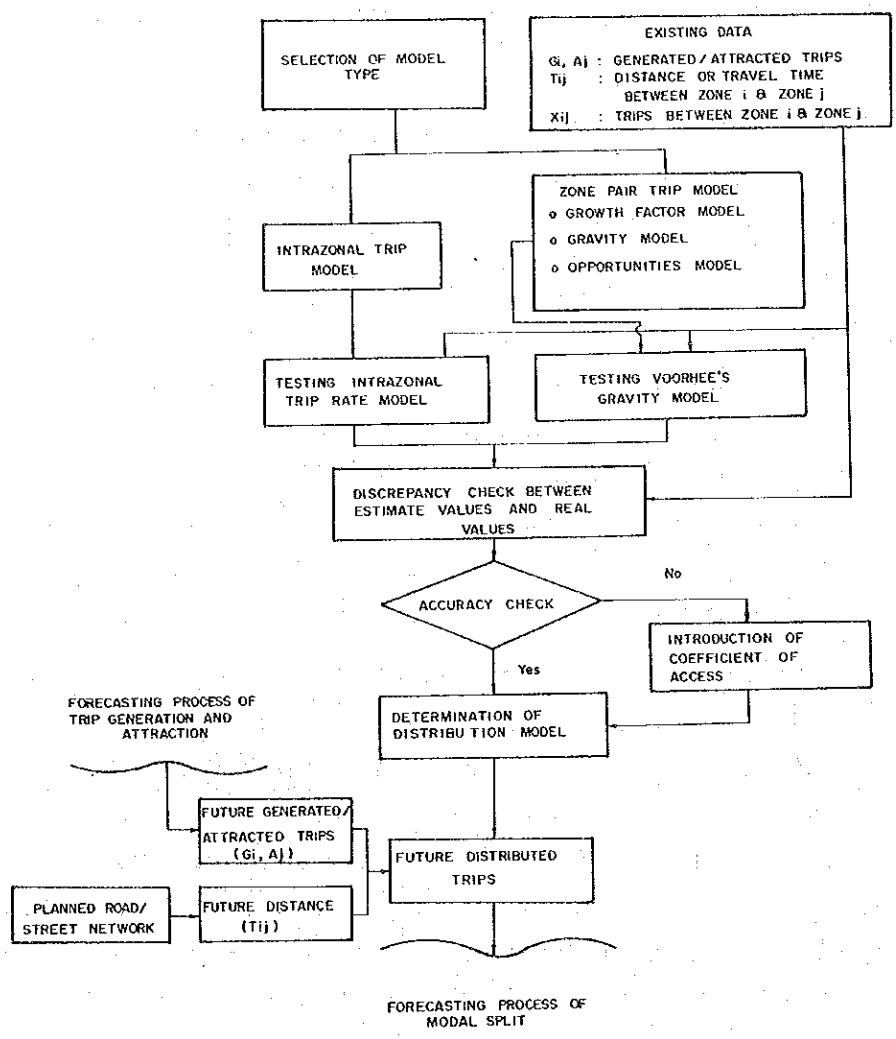


Fig. 10 PROCESS OF TRIP DISTRIBUTION FORECAST

3.2 Zone Pair Model

1) Selection of Gravity Model

Zone pair models are classified largely into the following 3 methodological types:

(i) Present pattern model - Future O-D values are projected by expanding present O-D pattern.

(ii) Gravity model - This is the application of Newton's law of gravity to trip distribution.

(iii) Opportunity model - This is one of probability models. Distance between zones is substituted as the order of nearness of a zone.

The selection of model for the forecast of future trips distribution depends on the degree of future transportation facilities development and changes in land use and industrial structure. When little change is expected of such facilities and trip distribution pattern, the most likely candidate is a present pattern model, while, when substantial changes are expected, as in this Project, gravity models and opportunity models are more suitable.

Between gravity models and opportunity models, the former compare favorably to the lattern in that the former have simpler model structures and easily handled, while the latter are suited to generally urbanized areas rather than areas where zones with different degress of urbanization co-exist, as in the Project Area. Therefore, the forecast hereby is to rely fundamentally on a gravity model.

2) Structure of zone pair model

The gravity model is formulated on the assumptions that number of trips between zones is proportionate to number of generated trips and attracted trips of each zone and is inversely proportionate to resistance

(distance) between zones. Basic Formula of the gravity model is expressed below:

$$X_{ij} = K \cdot \frac{G_i^{\alpha} \cdot A_j^{\beta}}{T_{ij}^{\gamma}}$$

where: X_{ij} = number of trips between Zones i and j

G_i = generated trips of zone i

A_j = attracted trips of zone j

T_{ij} = distance between zones i and j

K, α, β, γ = parameter

There are several definitions as to distance between zones. It is defined in this Study to be the distance of the minimum path route between zones on road network which is searched by simulation.

As the structure of model is simple and clear and application is easy, the basic gravity model mentioned above is likely to be used, however, the disadvantage of the model is that long distance trips tend to be over-estimated. In this Study, land use pattern is defined as multi-center type in 2000, that is each block will have a sub-center creating a small size of sphere of life. When we try to reflect concept of land use on traffic demand forecast, it is not desirable if long distance trips are over estimated. Therefore, modification of gravity model became necessary.

Finally, the model selected for distribution model is the modified gravity model which is basically Voorhee's gravity model developed by A.M. Voorhee and is additionally taken into consideration as factor of zonal linkage. It is illustrated by the following formula:

$$X_{ij} = B_{MN} \cdot G_i \cdot \frac{A_j \cdot T_{ij}^{-\gamma}}{\sum_{\substack{j=1 \\ (j \neq i)}}^{n} A_j \cdot T_{ij}^{-\gamma}}$$

where:

B_{MN} = coefficient of access which expresses the intensity of zonal linkage between blocks M and N

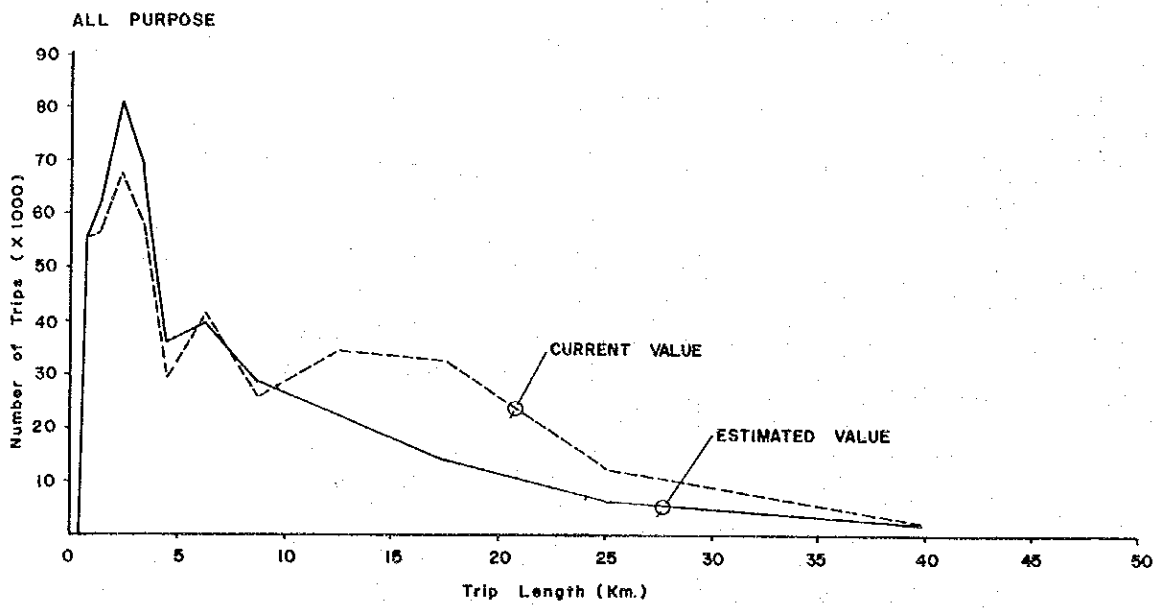


Fig. II DISCREPANCY BETWEEN CURRENT VALUE AND ESTIMATED VALUE BY GRAVITY MODEL

3) Determination of Parameter

i) Determination of γ

When determining γ, repeated computation based on the current O-D table has been conducted by a computer until γ has been found which made discrepancy between estimated values and current values minimum. The resulting values for γ and the corresponding coefficients of models are shown in Table 9. Coefficients of correlation of any models have been more or less 0.9, so that it is judged that all models have enough accuracy.

TABLE 9 γ AND MULTIPLE CORRELATIONS DISTRIBUTION MODELS

PURPOSE	γ	MULTIPLE CORRELATION
OFFICE	0.76	0.888
SCHOOL	1.42	0.914
HOME	0.52	0.905
BUSINESS	0.50	0.847
SHOPPING	0.88	0.892
PRIVATE	0.70	0.897

ii) Determination of coefficient of access

Coefficient of access which expresses intensity of zonal linkage in the future has been determined by taking into account current coefficient of access and concept of future land use plan. As a prior step in determining coefficient of access, sphere of influence of a block by trip purpose which is closely related to intensity of zonal linkage has been defined. As intensity of zonal linkage is dependent on a trip purpose,

therefore, sphere of influence for each trip purpose has been defined.

Explanation is made below how sphere of influence has been defined. Fig. 12 shows the area which has strong linkage with a specific block.

① Trip purpose of "going to office" and "business"

Trips of these two purposes have relatively longer trip length, accordingly sphere of influence is wider. Poblacion will still be the center of business. In addition to Poblacion, sub-centers of business will be created in Blocks I, II and VI. Within those Blocks, concentration of trips of these two purposes in Block II will be intensive, So spheres of influence of Poblacion and Block II are considered to be fairly wide, on the other hand, those of Blocks I and VI are considered not to be very wide.

② Trip purpose of "going to school"

Trips of this purpose have short trip length. Compared to trip purpose of "going to office", most trips of this purpose are completed within the Block, therefore sphere of influence is expected to be small. Only adjacent Blocks are considered to have strong linkage with the Block.

③ Trip purpose of "shopping"

Currently most shopping trips are concentrated in Poblacion. Concentration in Block VI is also observed, although number of trips is quite small.

Even though a commercial center will be developed in each Block in the future, tendency of concentration of shopping trips in Poblacion will be expected to remain, therefore all of the Project Area are considered to have strong linkage with Poblacion.

④ Trip purpose of "private"

Trips of this purpose have a high rate of completing themselves within the Block. Future generated/attracted trips are also forecast to have the same nature as present. Only adjacent Blocks are considered to have strong linkage with the Block.

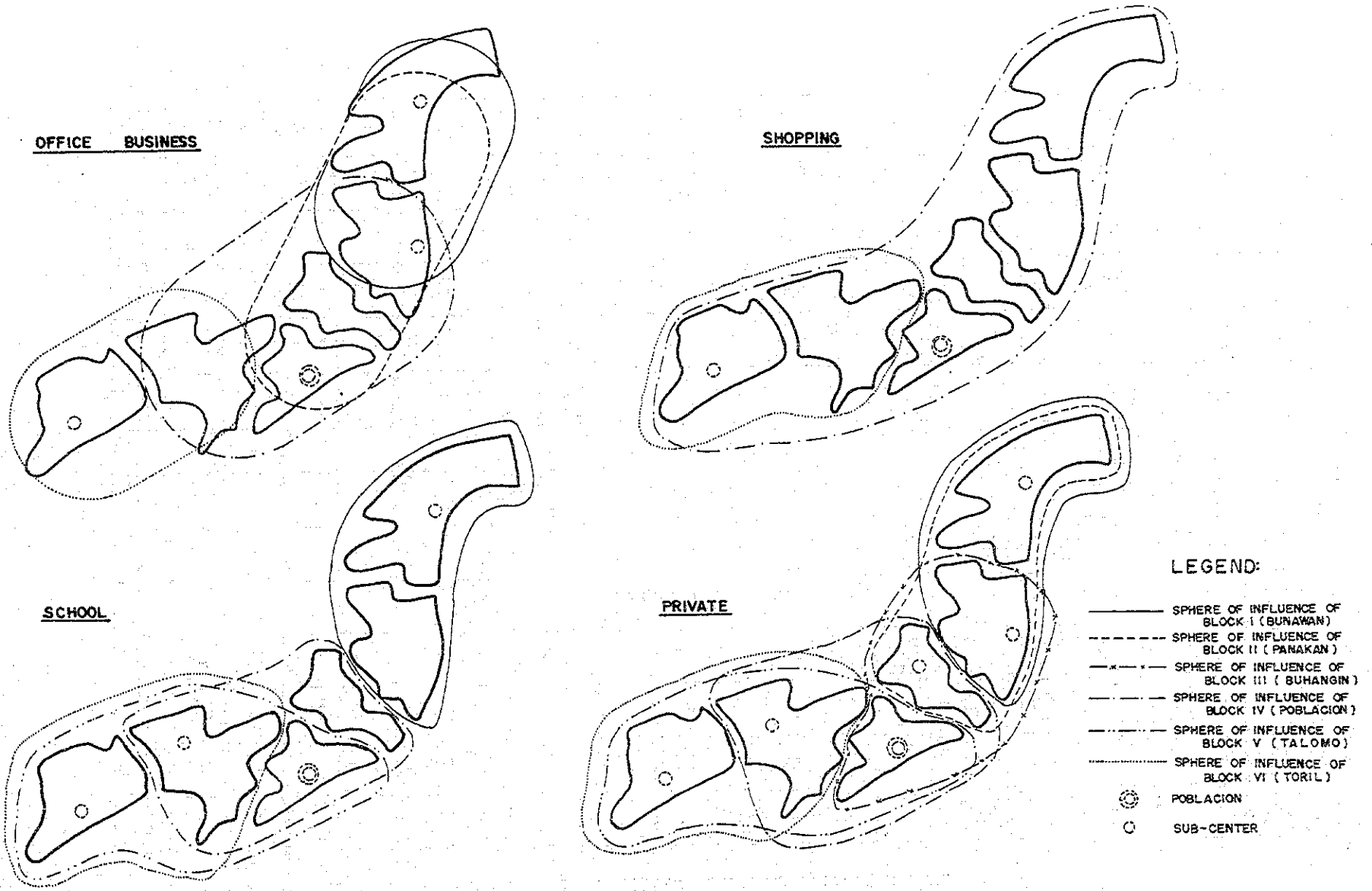


Fig. 12 SPHERE OF INFLUENCE OF EACH BLOCK IN FUTURE (2000)

TABLE 10 ACCESS COEFFICIENT BETWEEN BLOCKS (B_{MN})

OFFICE	1	2	3	4	5	6
1	1.0	1.0	0.6	0.4	0.0	0.0
2	1.0	1.0	0.8	0.8	0.4	0.0
3	0.6	0.8	1.0	1.0	0.6	0.0
4	0.4	0.8	1.0	1.0	1.0	0.6
5	0.0	0.4	0.6	1.0	1.0	0.8
6	0.0	0.0	0.0	0.6	0.8	1.0

HOME	1	2	3	4	5	6
1	1.0	0.8	0.6	0.4	0.0	0.0
2	0.8	1.0	0.6	0.6	0.2	0.0
3	0.6	0.6	1.0	0.8	0.6	0.0
4	0.4	0.6	0.8	1.0	0.8	0.6
5	0.0	0.2	0.6	0.8	1.0	0.8
6	0.0	0.0	0.0	0.6	0.8	1.0

SHOPPING	1	2	3	4	5	6
1	1.0	0.4	0.0	0.6	0.0	0.0
2	0.4	1.0	0.4	0.6	0.0	0.0
3	0.0	0.4	1.0	1.0	0.2	0.0
4	0.6	0.6	1.0	1.0	1.0	0.6
5	0.0	0.0	0.2	1.0	1.0	0.6
6	0.0	0.0	0.0	0.6	0.6	1.0

SCHOOL	1	2	3	4	5	6
1	1.0	0.6	0.4	0.2	0.0	0.0
2	0.6	1.0	0.4	0.4	0.0	0.0
3	0.4	0.4	1.0	0.4	0.4	0.0
4	0.2	0.4	0.4	1.0	0.4	0.4
5	0.0	0.0	0.4	0.4	1.0	0.6
6	0.0	0.0	0.0	0.4	0.6	1.0

BUSINESS	1	2	3	4	5	6
1	1.0	1.0	0.2	0.6	0.2	0.2
2	1.0	1.0	0.8	0.8	0.4	0.2
3	0.2	0.8	1.0	1.0	0.6	0.2
4	0.6	0.8	1.0	1.0	1.0	0.6
5	0.2	0.4	0.6	1.0	1.0	0.8
6	0.2	0.2	0.2	0.6	0.8	1.0

PRIVATE	1	2	3	4	5	6
1	1.0	0.6	0.0	0.2	0.0	0.0
2	0.6	1.0	0.6	0.4	0.0	0.0
3	0.0	0.6	1.0	1.0	0.4	0.0
4	0.2	0.4	1.0	1.0	1.0	0.2
5	0.0	0.0	0.4	1.0	1.0	0.6
6	0.0	0.0	0.0	0.2	0.6	1.0

3.3 Intrazonal Trip Model

Intrazonal Trips are to be forecast separately from zone pair trips by developing intrazonal trip model.

Intrazonal trip models are classified into two types; one is intrazonal trip ratio model which determines the ratio of intrazonal trips to generated/attracted trips and the other is intrazonal trip model which directly determines number of intrazonal trips. Previous studies have not given any answer as to which is the better model. Application of intrazonal trip model to the area where future trips will increase substantially as in the case of this Project will result in rather inaccurate forecast. Intrazonal trip ratio model has been judged to provide relatively stable accuracy and selected for intrazonal trip forecast.

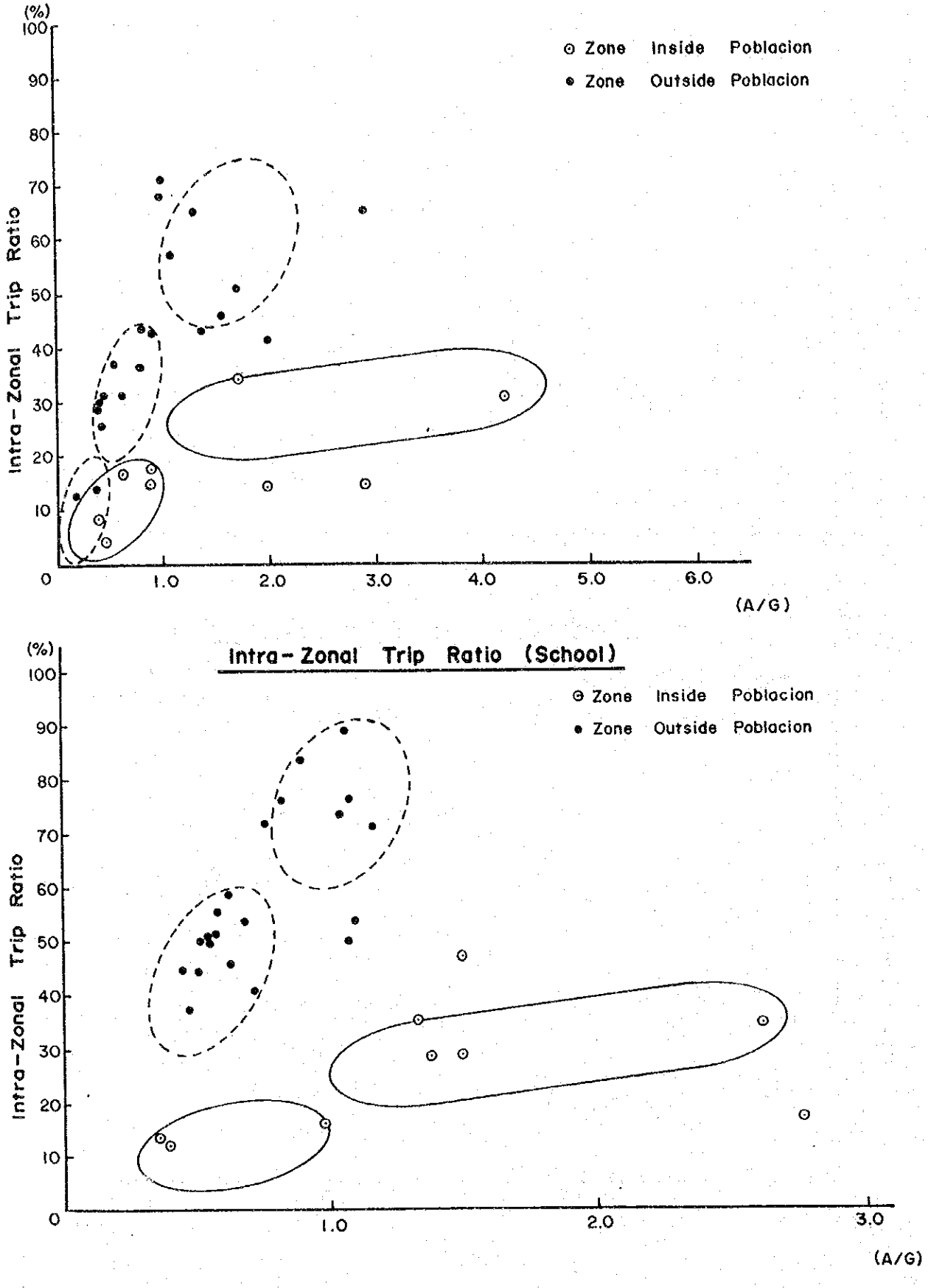
Although zone area and population density are considered to be typical independent variables, the conformity of the model which used these variables was poor. Models have been developed through trial and error processes using a great variety of independent variables and checking their accuracy. Of these models, that of which independent variable is the ratio of attracted trips to generated trips (Ai/Gi) showed the highest accuracy for all trip purposes except trip purpose of "private". Index which explains degree of access to other zones (accessibility coefficient) has been selected as an independent variable for model of trip purpose of "private".

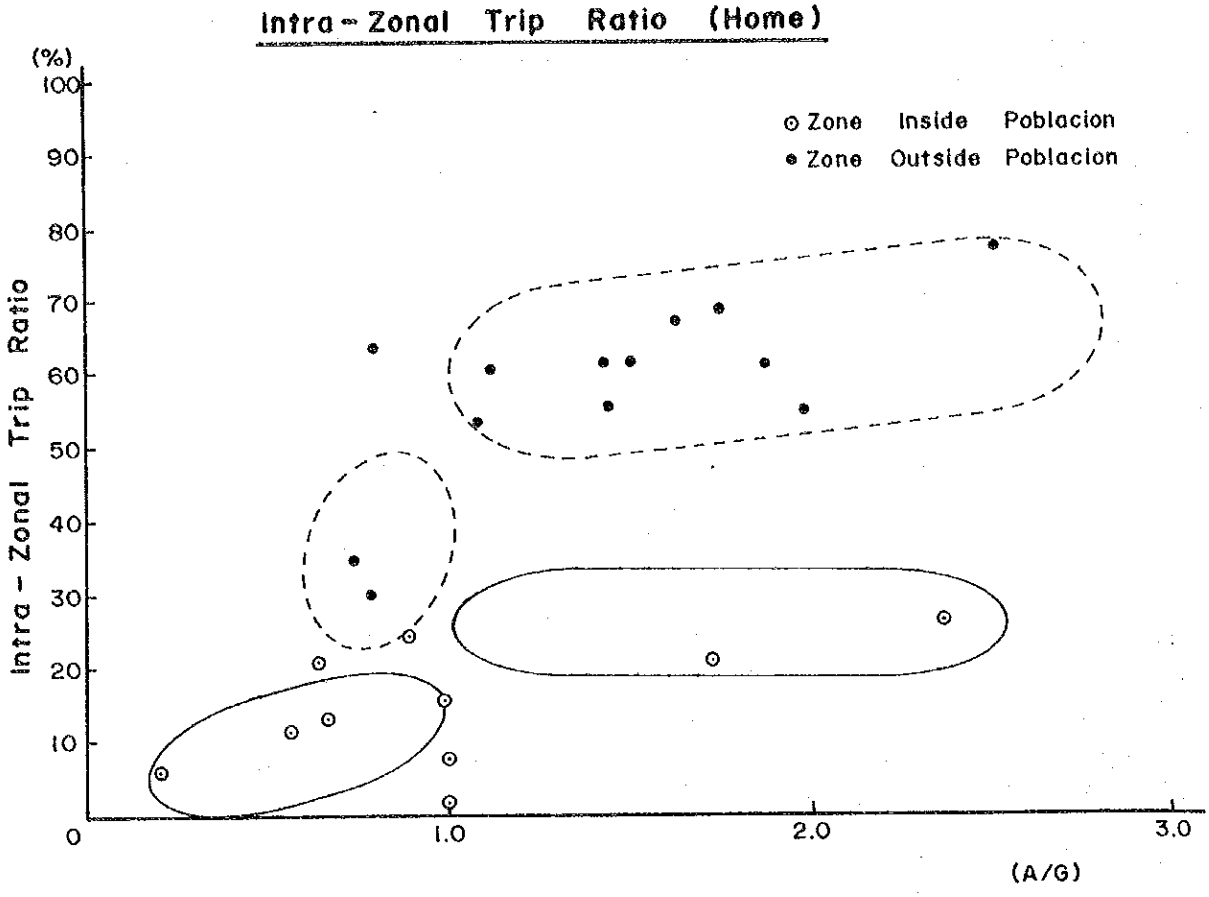
As shown in Fig. 13, intrazonal trip ratio of Poblacion is quite different from that of zones other than Poblacion. Intrazonal trip ratio model has been developed separately for Poblacion and for the rest of the zones.

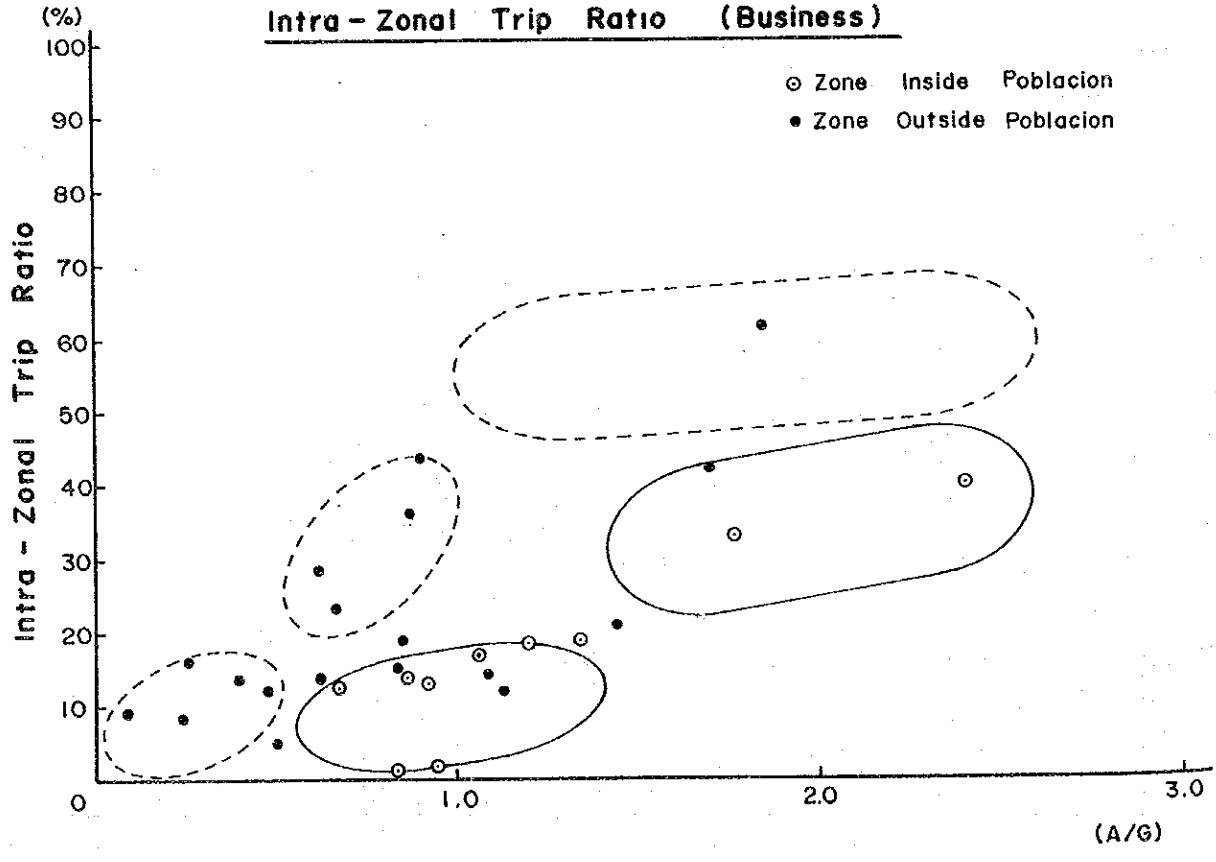
As Fig. 13 indicates, ratio of attracted trips to generated trips becomes high, intrazonal trip ratio also

becomes high. As for accessibility coefficient, when it becomes high, intrazonal trip ratio becomes low. Intrazonal trip ratios have been determined by grouping some of zones as shown in Table 11.

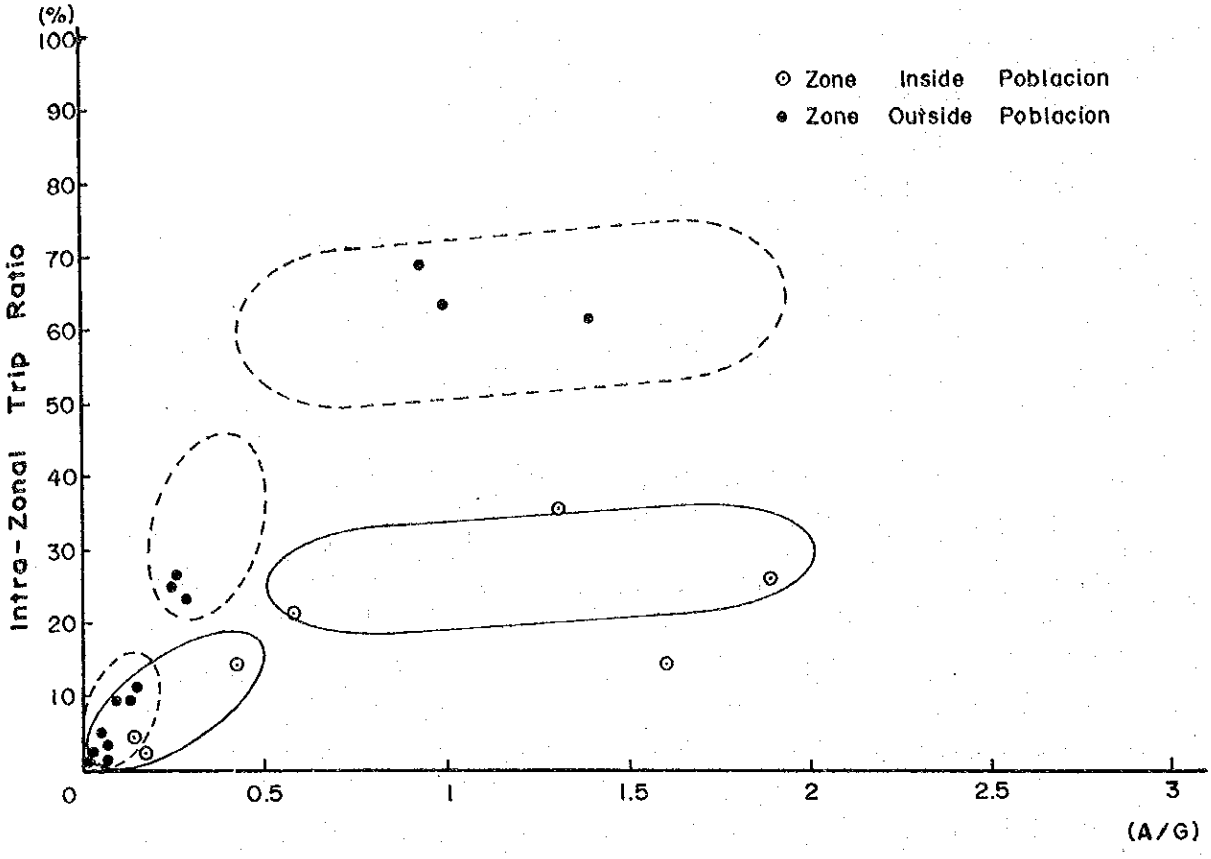
Fig. 13 Distribution of Intra - Zonal Trip Ratio by Zones




Intra - Zonal Trip Ratio (Home)
(%)
100
90
80
70
60
50
40
30
20
10
0
Intra - Zonal Trip Ratio
⊙ Zone Inside Poblacion
• Zone Outside Poblacion
1.0
2.0
3.0
(A/G)


Intra - Zonal Trip Ratio (Business)
(%)
100
90
80
70
60
50
40
30
20
10
0
Intra - Zonal Trip Ratio
⊙ Zone Inside Poblacion
• Zone Outside Poblacion
1.0
2.0
3.0
(A/G)

Intra - Zonal Trip Ratio (Shopping)



Intra - Zonal Trip Ratio (Private)

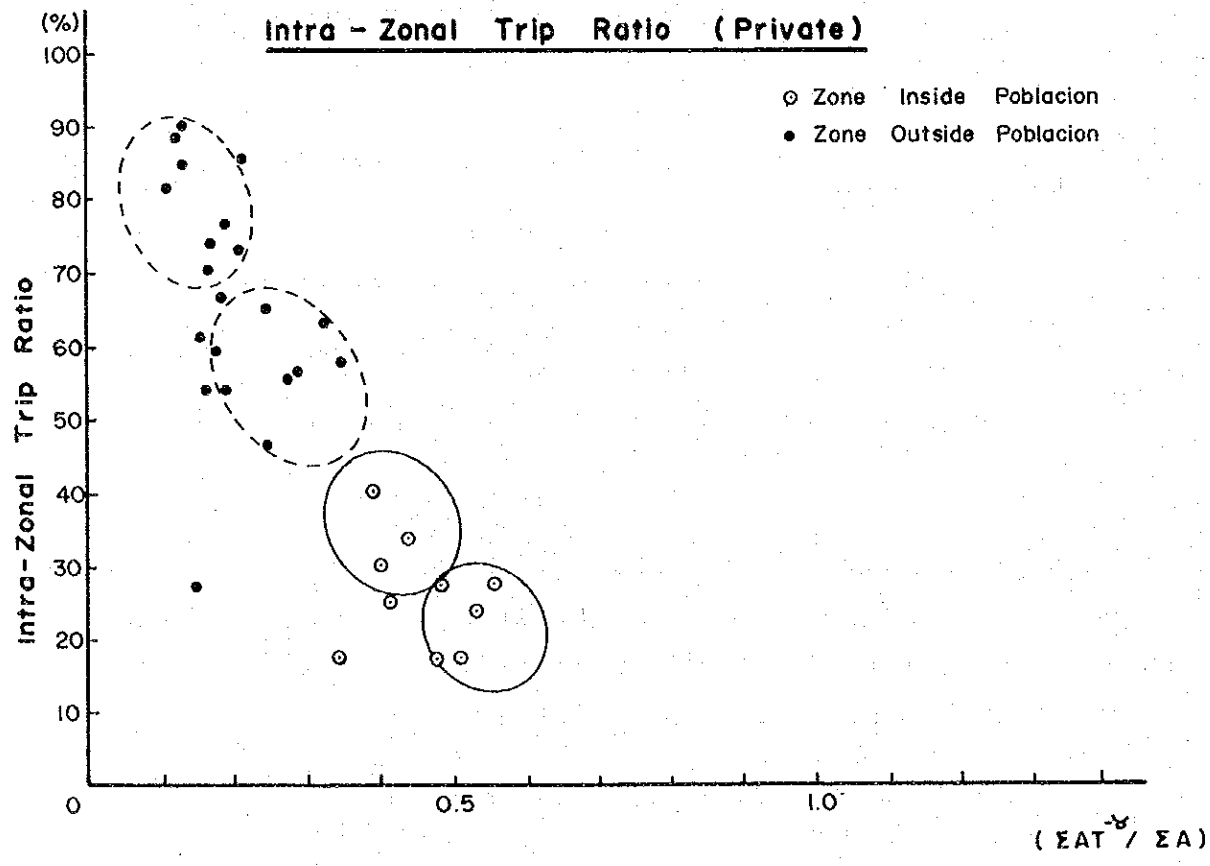


Table 11 Intra-Zonal Trip Ratio

	Purpose	Explanatry Factor	Range of Explanatry Factor	Ratio	Remarks
Zone Inside Poblacion	Office	Ai/Gi	- 1.0	10 %	Residential Area
			1.0 -	30%	Commercial Area
	School	Ai/Gi	- 1.0	15 %	Residential Area
			1.0 -	35%	
	Home	Ai/Gi	- 1.0	10.%	
			1.0 -	25%	Residential Area
	Business	Ai/Gi	- 1.4	15 %	
			1.4 -	35%	Commercial Market Area
	Shopping	Ai/Gi	-0.5	10 %	Residential Area
			0.5-	25%	
	Private	$\frac{\Sigma Aj Tij^{-\gamma}}{\Sigma Aj}$	-0.5	35%	Commercial Area
			0.5-	20%	
Zone Outside Poblacion	Office	Ai/Gi	-0.5	15 %	
			0.5-1.0	35%	
			1.0 -	60%	Industrial, Commercial Area
	School	Ai/Gi	-0.8	45%	
			0.8	75%	
	Home	Ai/Gi	- 1.0	35%	Industrial, Commercial Area
			1.0 -	65%	
	Business	Ai/Gi	-0.5	10%	
			0.5-1.0	30%	
			1.0-	55%	Industrial, Commercial Area
	Shopping	Ai/Gi	-0.2	10%	
			0.2-0.5	35%	
			0.5-	60%	Market Area
	Private	$\frac{\Sigma Ai Tij^{-\gamma}}{\Sigma Aj}$	-0.2	80%	
			0.2-	55%	

Ai : Trips attracted to zone i
Gi : Trips generated from zone i
Tij : Distance between zone i and zone j
γ : Parameter

4. Modal Split Forecast

4.1 Outline

Modal split models manifest people's behavioral pattern of selecting the mode of transport for use to go from a place to a place. This pattern is much affected by how the integral transport system (road network, public transport facilities) is developed. Thus, the modal split model finds the envisaged future transport system as its base for the quantitative estimation of future modal split.

Modal split models are classified as briefly described hereunder, depending on where modal split estimation takes place in the flow of process from trip generation/attraction estimation to assigned traffic estimation.

(1) Trip-End Model

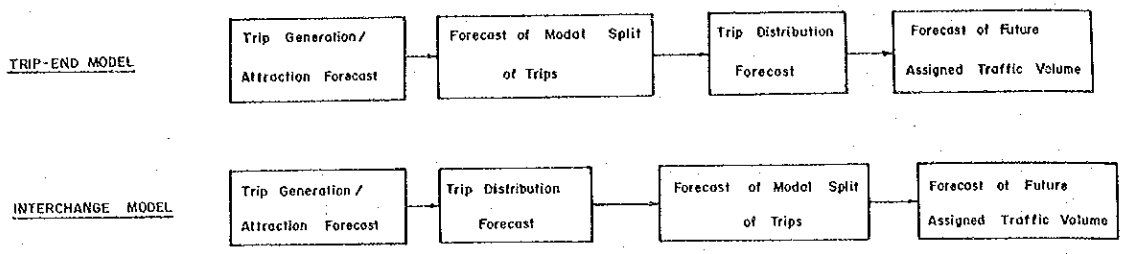
Modal split estimation taking place between trip generation/attraction estimation and assigned traffic estimation, this model explains modal selection by the peculiarity of each zone as usually described by such independent variables as car ownership ratio, road density, and bus arrival/departure frequency.

(2) Interchange Model

Modal split estimation taking place between distributed trip estimation and assigned traffic estimation, this model explains modal selection by the peculiarity of relationship between each pair of zones as usually described by such independent variables as interzonal distance, travel time required with each mode, and the car ownership ratios of the zones.

With the trip-end model, future trip distribution pattern changes and future transport system changes by road and public transport facilities improvement/development are hardly reflected on the quantity of modal split

as estimated. The interchange model, which reflects such changes on the estimation, is used for the purpose of this Study.



The interchange model can be further broken down into split ratio curve model (which shows the modal split of transport demand by split ratio curves) and multi-variable function models (among which, regression model is typical one). In this Study, both these models were used for testing the precision of forecast. Figure-14 shows the flow of modal split forecast.

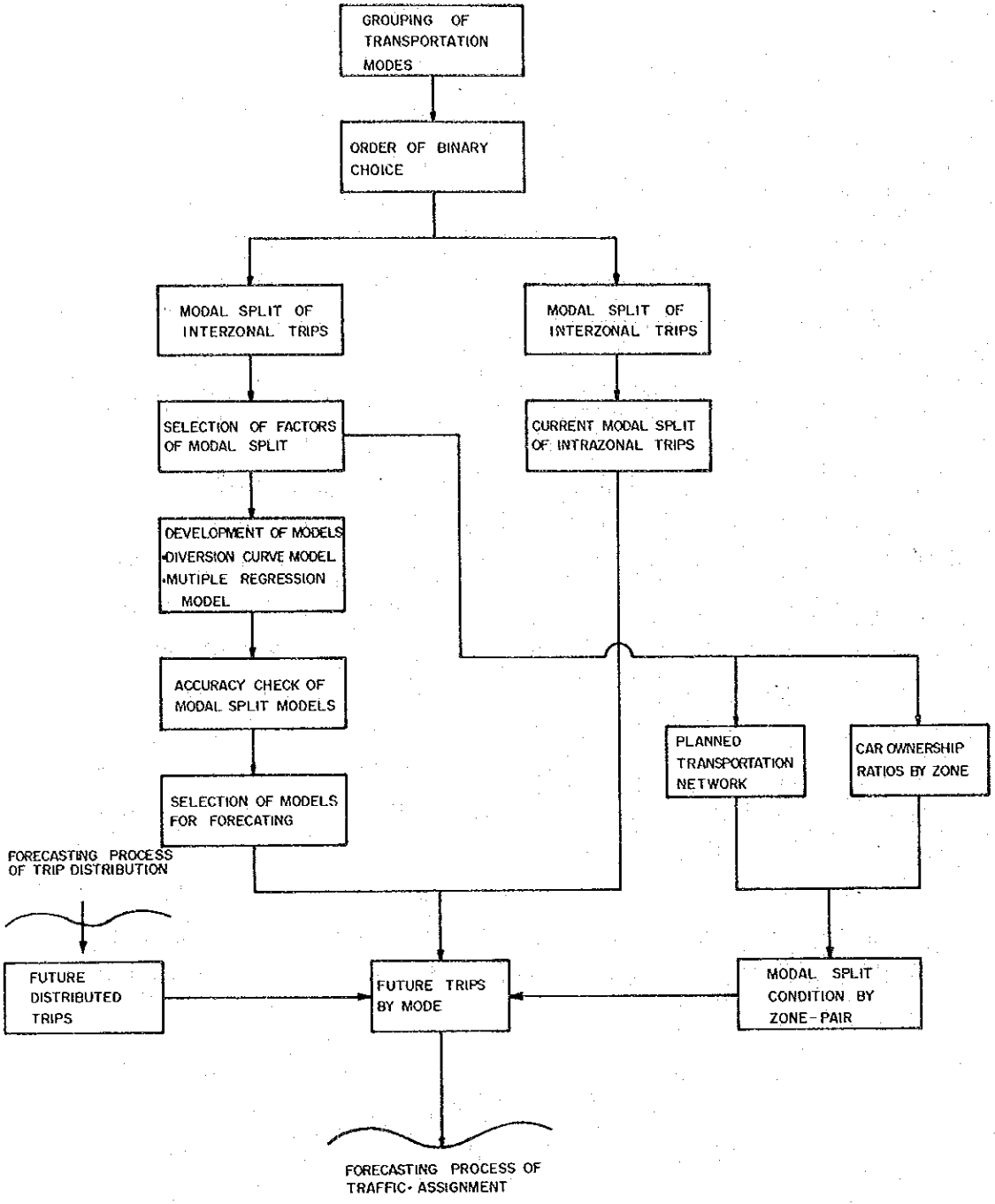


Fig. 14 PROCESS OF MODAL SPLIT FORECAST

4.2 Transport Mode Grouping and Separation Sequence

(1) Mode Grouping

The breaking down of future modal split forecast value into the same ten modes used for the 1979 Person-Trip Survey will neither be simple, nor will guarantee a high level of forecast precision. In accomplishing the thus necessary grouping of transport modes, similarities between different modes and future transportation policy measures are borne in mind. Figure-15 shows the result of similarity analysis of modes using current data: walking and bicycle and motorcycle used for short distance trips can be grouped together, while public transport modes such as the bus and the PUJ can be considered another group and the car and the truck can be considered still another group: the tricycle can be considered to stand between the walking group and the public transport group, and the PU and the taxi, between the public transport group and the private transport group. The bus, which is to be introduced as an important means of future transport, is to be treated as a separate group of its own. Except those of industrial use, trucks are not separated from cars in view of the peculiarly high rate of use of trucks for passengers and of possible future shift of passengers from trucks to cars.

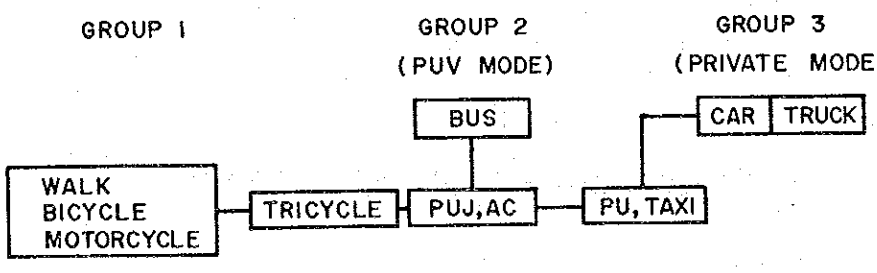


Fig: 15 GROUPING OF TRANSPORTATION MODES

(2) Separation Sequence

Modes of transport can be separated into groups either by multi-mode method, which simultaneously determines the split ratios of multiple number of modes, or by binary choice method, which determines the split ratios through a series of binary choices. The latter method, which is more precise, is used for this Study. It is known that a greater stability can be achieved by separating out the mode or modes of a shorter trip length at each step of choice. Thus, "walking (and the like)" is first separated from the total quantity of O-D trips, and from remainder "cars and trucks" is separated in the second step, and so on, as shown in Figure-16, finally breaking the total inter-zonal trips down into five modal groups.

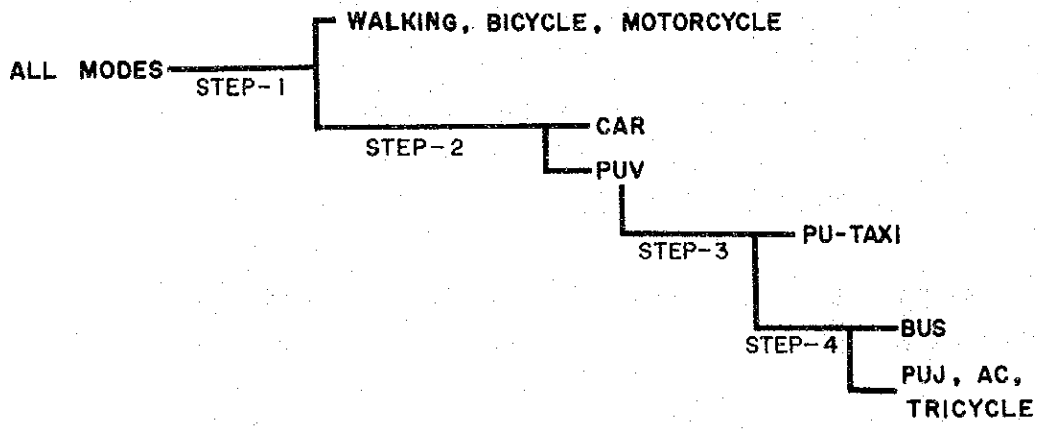


Fig: 16 BINARY CHOICE ORDERS

4.3 Modal Split Model Structure

Modal split models can be roughly classified into split ratio curve model and multi-variable function model. Multi-variable function model can further be sub-divided into multi-regression model and principal component analysis model. With regard to the first and second

steps, the precision of modal split models are compared by using the split ratio curve model and the multi-regression model which is a typical model among multi-variable function models. With certain degree of scattering by trip purpose, both showed similar levels of precision and multi-correlation coefficients of about 0.8, indicating that either of the two models may be used for a relatively high precision. Therefore, split ratio curve model, which is simpler and more popular of the two, is used for forecast.

(1) Step 1 (Walking vs. Others)

At this point, the structure of split model by split ratio curves is to be described. Here, factor analysis is done in order to obtain basic data for developing split ratio curve model, thus finding factors which substantially affect modal choice behavior. At Step 1, trip length is the strongest determinant for any trip purpose, followed by car ownership. The influence of car ownership is particularly strong on business trips and is farily strong on commuting trips, suggesting that it also affects decision to walk. For Step 1, forecast is accomplished by split ratio curves formulated by using trip length as the independent variable separately for those (who belong to a family) with car and those without. In view that trip purposes also affect modal split at Steps 1 and 2, the split ratio curves are drawn for each trip purpose for these Steps, but not for Steps 3 and 4.

(2) Step 2 (Cars vs. PUV's)

At Step 2, car ownership is the stronest factor, followed by population density and other factors, which are believed to reflect the service level of public transport in competition with cars. Trip length is only a weak factor, because cars and PUV's (particularly PUJs) are in competition with each other in a wide range of

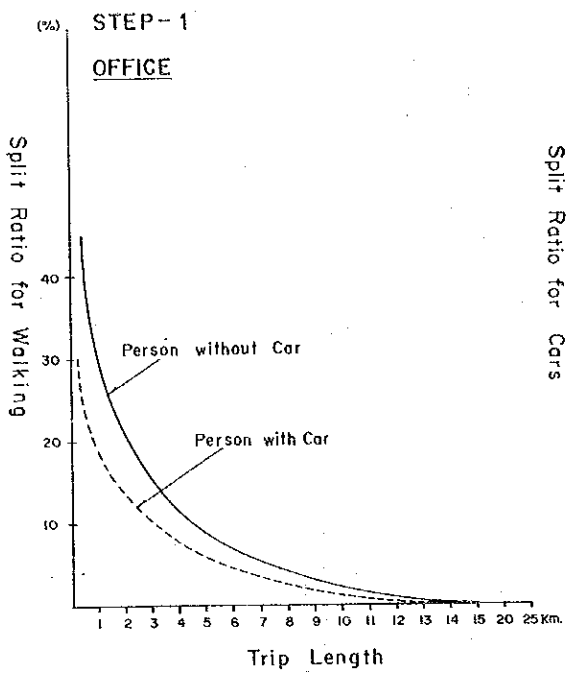
trip distances. For Step 2, split ratio curves are drawn separately for those with car and those without, with the service level of PUV's, which is explained by population density, as the independent variable.

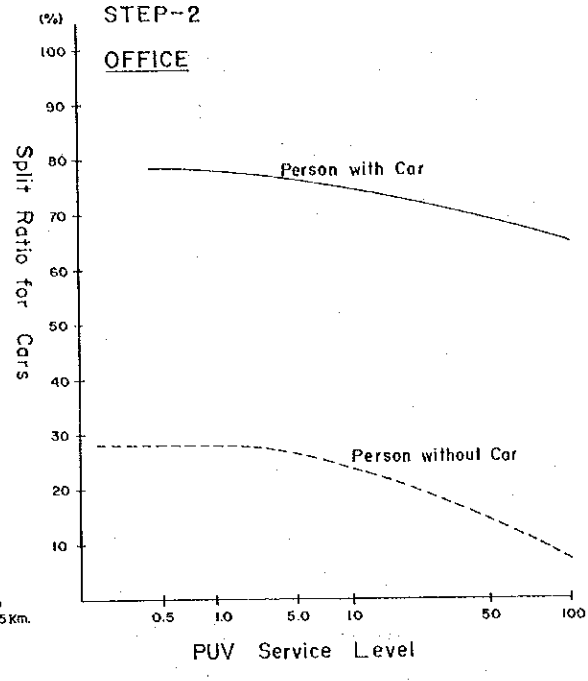
(3) Step 3 (PU·Taxi vs. other PUV's)

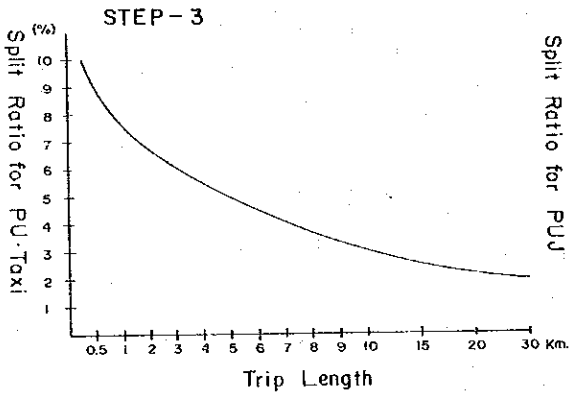
No factor analysis, in statistical sense, is done for Step 3, but split ratio curves are drawn by trip length in view that the result of current situation analysis showed trip length as a strong factor.

(4) Step 4 (Bus vs. PUJ)

Future modal split structure upon the introduction of city buses may not be predicted based on the analysis of the current situation, because the only buses now in operation are provincial buses. The structure, it is judged however, can be explained by trip length (just as for Step 3). Operation speed, waiting time, and time needed for access to and from the point of loading/unloading are assumed for the bus and for the PUJ, and calculation based on such assumed values indicates that time required for trip by the PUJ is shoter than that by the bus for short distances, and vise versa, with the break-even point at the trip length of about 10 kilometers if the bus service network is rather sparse and about 5 kilometers if the network is rather dense. As it is predicted that a fairly close (or dense) bus network will be developed by the year 2000, it is assumed that the bus and the PUJ will have equal shares (split) at the trip length of 5 kilometers, under which the PUJ will enjoy a greater share and over which the bus will enjoy a greater share. Similarly, the break-even point is assumed to be 10 kilometers in 1990, provided that a smoother PUJ-Bus modal split transition curve is assumed for 1990 than for the year 2000 as indicated (see Figure 17), because it is anticipated that modal split will still be indistinct between the two modes by 1990.







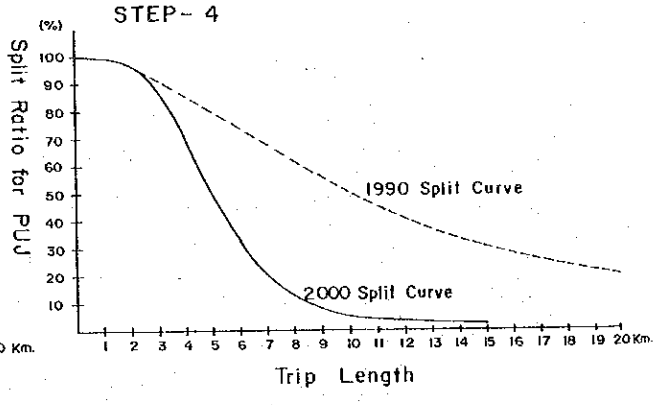


FIG. 17 SPLIT RATIO CURVES

5. Assigned Traffic Forecast

The forecast of assigned traffic is a process through which the O-D trips which have been arrived at by going through the above steps (the step of forecasting total trip generation in the Project Area to the step of forecasting modal split of trips) are assigned to the road network or the PUV network. The result of this process offers a fundamental material for the judgement as to whether or not a planned network will have sufficient capacities to accomodate the future traffic movements and will be in harmony with land use and other plans.

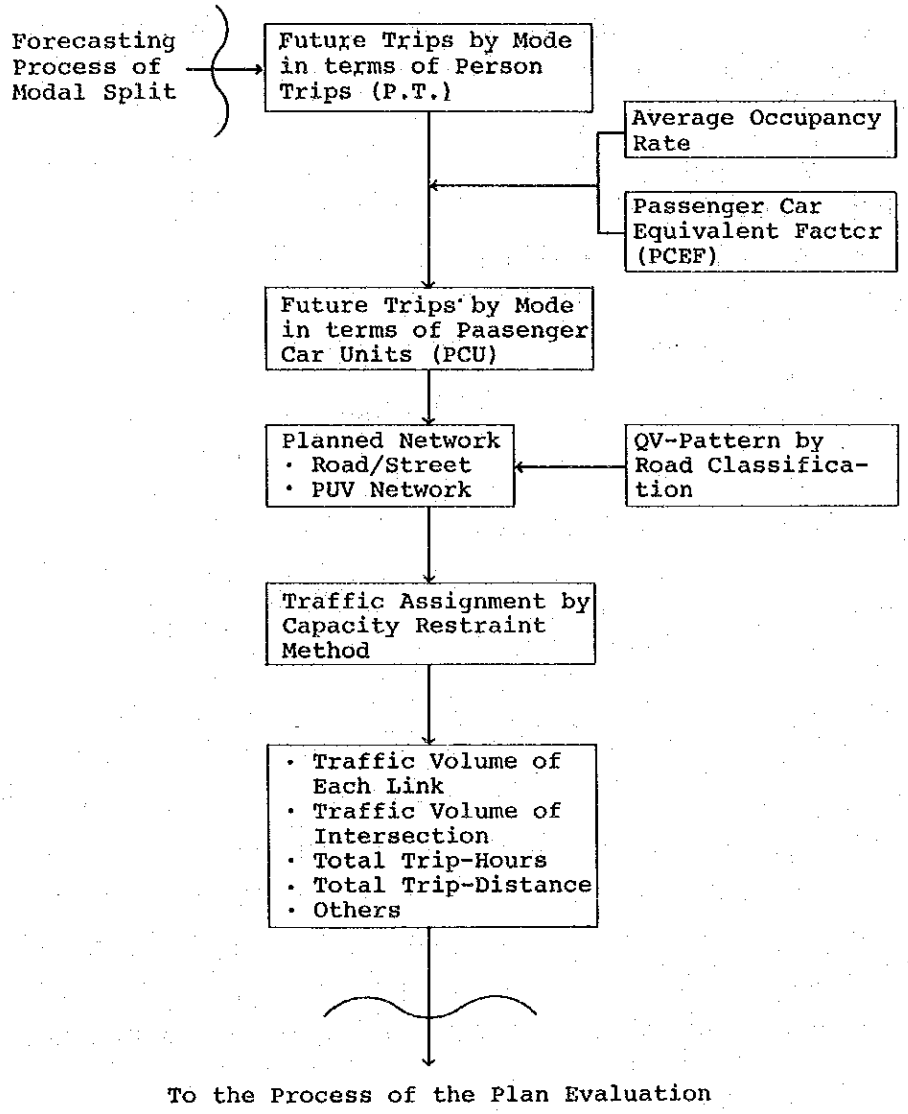


Fig. 18. PROCESS OF TRAFFIC ASSIGNMENT FORECAST

5.1 O-D Assignment Table Formulation

The formulation of the table of assigned O-D is the operation through which future transport demand estimated in terms of passenger-trip is converted into passenger car units (PCU) using average occupancy rate in terms of the number of passengers per vehicle and passenger car equivalent factor (PCEF). The Highway Planning Manual published by Planning and Project Development Office (PPDO) of the Ministry of Public Works and Highways defines the capacity of roads by PCU, and assigned traffic can be estimated conveniently in terms of PCU. The average occupancy rate is determined from the Person-Trip Survey findings. PCEF is obtained from the Volume 2 of said Mannual, provided that the following representative value(s) is used in place of PCEF defined in detail by the Manual according to the drivelane width, road shoulder width, roadside condition, gradient, the rate of large vehicles to total vehicles, and so forth, because the level of precision offered by the detained definition is neither necessary nor meaningful.

Table 12. Average Occupancy Rates and PCEF by Type of Vehicle

	Average Occupancy Rate	Passenger Car Equivalent Factor (PCEF)
Bus	22.00	2.0
PUJ	8.07	1.5
PU·Taxi	0.61 1/	1.0
Car	1.80	1.0
Truck	1.80	2.0

1/ : Running without passenger is considered.

5.2 Assigned Network

The road/street network to which traffic is to be assigned consists of thoroughfares which function as trunk roads in the Project Area and will become the base for future traffic planning. The degree of density of this network is determined in conformity with the expanse of the analysis zone. The establishment of the network is fundamentally based on the following conditions:

(1) Trunk Road Network

i) Roads which nearly compare to national roads are included in this network, as a principle.

ii) Bus routes and PUJ routes are included, as a principle

(2) Arterials

i) Roads established under the trunk road network are included

ii) Those with the width (travelled way) of 10 meters or more are included, fundamentally

iii) Bus routes and PUJ routes are included, as a principle

iv) Major city roads are selectively included

5.3 Assignment Model Structure

1) Forecast of Assigned Traffic on Road/Street Network

Traffic can be assigned to road network either by phenomenal assignment, which reflects the actual traffic flow over the network based on route selection by user preference, or by planning assignment, which reflects the way in which passengers and goods should be transported according to plans. For the purpose of this Study, phenomenal assignment will be used, provided that time distance is considered the greatest factor of route

preference by users. This assignment will be accomplished by the minimum path method which considers road capacity constraint. Road capacity constraint will be established by the equation expressing relationship between speed and traffic volume (quantity-velocity curve) by the dimension of each road, because the geometry of the road and the degree of traffic congestion are dominant restraints, even though the speed of vehicles as operated on road is known to depend on the kind and performance of the vehicle and the traits of the driver.

The method of assignment discussed above is applicable to vehicles which are not limited to any fixed route. Bus traffic and PUJ traffic are assigned prior to planned routes.

2) Assigned PUV Traffic Forecast

PUV (bus and PUJ) traffic is assigned to service network (routes), rather than to the road network and, therefore, assignment is accomplished under transport plans and program (planning assignment). Here, passengers are allocated basically in accordance with the regular travel speed (as stipulated by the service time table) of each link, assuming that passengers reach their destinations in the minimum of time (thus, no capacity constraint is considered).

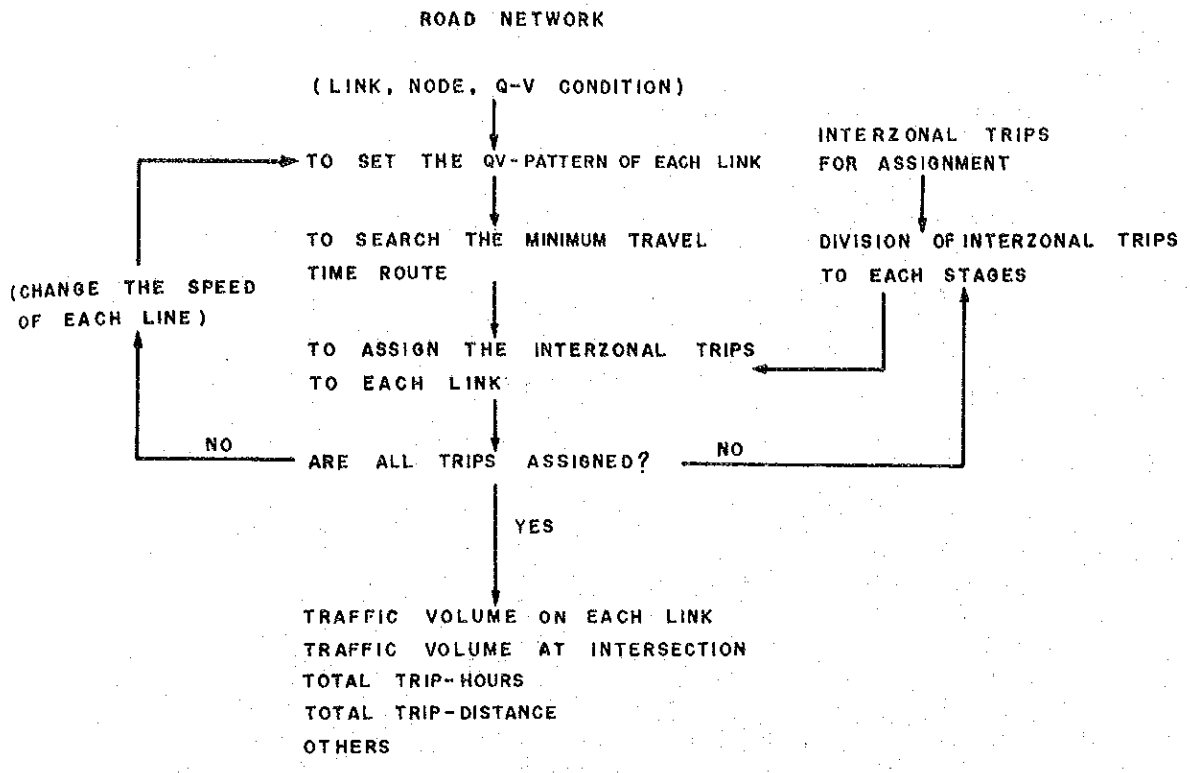
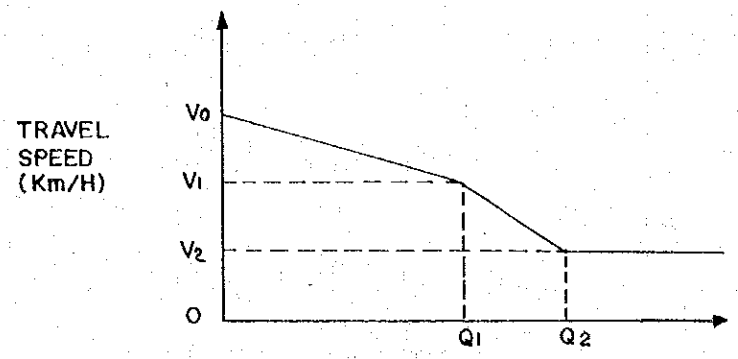


Fig: 19 TRAFFIC ASSIGNMENT PROCESS BY CAPACITY RESTRAINET TECHNIQUE



WHEREIN: V_0 = INITIAL SPEED

V_1 = TRAVEL SPEED IN ROAD CAPACITY

V_2 = CRITICAL TRAVEL SPEED

Q_1 = ROAD CAPACITY

Q_2 = CRITICAL TRAFFIC VOLUME

FIG. 20 Q-V FORMULA PATTERN

Table: 13 Q-V Formulation by Road/Street Classification

Q-V NO:		Lane	DESIGN SPEED (KM/HR)	Q-V FORMULATION					
				Vo	V1	V2	Qo	Q1	Q2
ROAD	1	4	80	80	48	24	44,000	66,000	
	2	4	60	60	36	18	36,000	54,000	
	3	2	60	60	42	18	13,000	26,000	
	4	4	50	50	30	15	32,000	48,000	
	5	2	50	50	35	15	11,000	22,000	
	6	2	40	40	28	12	11,000	22,000	
	7	2	30	30	21	9	9,000	18,000	
	8	2	20	20	14	6	9,000	18,000	
STREET	9	6	80	48	30	18	60,000	90,000	
	10	4	60	48	30	18	40,000	60,000	
	11	2	60	48	36	18	18,000	36,000	
	12	6	50	40	25	15	54,000	81,000	∝
	13	4	50	40	25	15	36,000	54,000	
	14	2	50	40	30	15	16,000	32,000	
	15	6	40	32	20	12	54,000	81,000	
	16	4	40	32	20	12	36,000	54,000	
	17	2	40	32	24	12	16,000	32,000	
	18	2	35	28	21	10	16,000	32,000	
	19	2	30	24	18	9	16,000	32,000	
	20	2	50	40	30	15	15,000	30,000	
	21	2	40	32	24	12	15,000	30,000	
	22	2	35	28	21	10	15,000	30,000	
	23	2	30	24	18	9	12,000	24,000	
	24	2	20	16	12	8	12,000	24,000