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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION (CDR)
REPUBLIC OF LEBANON

THE STUDY
OF
ENVIRONMENTAL FRIENDLY INTEGRATED TRANSPORTATION PLAN
FOR
GREATER TRIPOLI

FINAL REPORT

TECHNICAL REPORT - 1

TRAFFIC ANALYSIS AND FORECAST

DECEMBER 2001

KATAHIRA & ENGINEERS INTERNATIONAL

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REPORT COMPOSITION

The Final Report of the Study is structured to meet the requirements of each user-group. It contains an executive summary, two main reports and six technical reports as follows:

EXECUTIVE SUMMARY: is designed to address the decision-makers as ministers and politicians who do not need deep information in technical and engineering aspects. It contains brief information on all the aspects of the Study and concentrates on the input and output of each aspect. It has also a more concentrated summary for the main conclusions in two pages.

MAIN REPORT – 1 "Integrated Transport Plan": is designed for planners and directors of CDR and concerned ministries and authorities, who need more technical information on the Master Plan formulation. It contains applied planning policies, development and evaluation of alternatives, main information on the plan of each sector, evaluation results of the Master Plan and the overall implementation plan.

MAIN REPORT - 2 "Short-term Improvement Plan": integrates more detailed studies and information on the urgent projects included under the Short-term Improvement Plan. The report gives the necessity, objectives, preliminary design, cost estimate and project evaluation on the technical, environmental and economic viability of each project.

TECHNICAL REPORT - 1 "Traffic Analysis and Forecast": is basically prepared for technology transfer purposes. It addresses transport planners and contains the forecast procedures of forecasting future transport demand. The procedure starts with traffic surveys and analysis, socioeconomic framework, trip generation and attraction and the future transport demand.

TECHNICAL REPORT - 2 "Road Network Plan": is for the specialists in the road planning and network development. It includes the present road network pattern as well as the planning concept and strategies, which are the basis of the proposed network pattern. Projects of the developed plan are prioritized for implementation under each of the planning periods.

TECHNICAL REPORT - 3 "Public Transport Plan": is for the specialists in the public transport sector and schemes planned under the Master Plan. It includes the estimated future demand, proposed routes, required number of buses and cost estimation in addition to the implementation plan. It includes also plans and measures for taxi service and school buses.

TECHNICAL REPORT - 4 "Traffic Management": is for the specialists in the traffic management sector and projects included under the Master Plan. It demonstrates the problems under existing conditions and the formulated plan that includes different procedures and measures for traffic signalization, parking control as well as safety and education measures.

TECHNICAL REPORT - 5 "Environmental Assessment": gives the environmental conditions and initial environmental examination for the Study Area. Through an environmental impact study, it highlights the environmental issue in establishing the urban transport plan in order to emphasize the importance of preserving and improving the environment.

TECHNICAL REPORT - 6 "Project Management and Financing": is addressing the administrative issues that will affect the successful implementation of the planned projects. It includes the present legislation, organization and funding system of agencies that will implement the projects under the Study. For the successful implementation of the projects as scheduled, management and financing plans are presented.

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LIST OF ABBREVIATIONS

AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ADT	Average Daily Traffic
B/C	Benefit-Cost Ratio
BOT	Built, Operate and Transfer
CAS	Central Administration of Statistics
CBD	Central Business District
CDR	Council for Development and Reconstruction
CEGP	Council Executive des Grand's Projects
CNG	Compressed Natural Gas
CO	Carbon Monoxide
COM	Council of Ministers
DGHB	Directorate General of Highways and Buildings
DOR	Directorate of Road
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ERM	Environmental Resource Management
EU	European Union
FAR	Floor Area Ratio
FHWA	Federal Highway Administration
FYDP	Five Year Development Plan
GDP	Gross Domestic Products
GNP	Gross National Products
GOJ	Government of Japan
GOL	Government of Lebanon
HC	Hydrocarbon
HCM	Highway Capacity Manual
IBRD	International Bank for Reconstruction and Development
IEE	Initial Environmental Examination
ISF	Internal Security Force
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
LL	Lebanon Lira, Lebanon Pound
LOS	Level of Service
LRT	Light Railway Track
MEA	Middle East Airlines
M/P	Master Plan
MOE	Ministry of Environment
MOF	Ministry of Foreign Affairs
MOMRA	Ministry of Municipal and Ruler Affairs
MOI	Minister of Interior
MOPWT	Ministry of Public Works and Transport

MPWT	Ministry of Public Works and Transportation
NAC	Noise Abatement Criteria
NERP	National Emergency Reconstruction Program
NGOs	National Governmental Organizations
NO	Nitrogen Dioxide
NPV	Net Present Value
OD	Origin-Distention
ODA	Official Development Assistance
O & M	Operation and Management
ORRPT	Office of Rail Road & Public Transport
PCE	Passenger Car Equivalent
PCU	Passenger Car Unit
PDR	Plan Dimension Ratio
PIU	Project Implementation Unit
PMT	Project Management Team
RC	Reinforced Concrete
RER	Real Estate Registry
ROW	Right of Way
STRADA	JICA System for Traffic Demand Analysis
TCC	Technical Coordination Committee
TSP	Total Suspended Particulate
TTC	Travel Time Cost
UNICEF	United Nation Children's Fund
USEPA	United State Environmental Protection Agency
V/C	Volume-Capacity Ratio
VOC	Vehicle Operating Cost
WHO	World Health Organization
WTW	Water Treatment Works

CHAPTER 1

TRAFFIC SURVEY AND ANALYSIS

CHAPTER 1

TRAFFIC SURVEY AND ANALYSIS

1.1 PROCEDURE

To study the present traffic pattern and existing problems, and to estimate the future transport demand required for the formulation of the future urban transport plan, the following traffic surveys were conducted in the Study Area of Greater Tripoli:

1) Person-Trip Survey
2) Commodity Movement Survey
3) Cordon Line Survey
4) Screen Line Survey
5) Intersections Traffic Volumes Survey
6) Public Transport Survey
7) Travel Speed Survey
8) Parking Area Survey
9) School Trip Survey

The main objectives of the survey are to collect necessary data and information in order to comprehend the existing traffic condition and to identify related issues and planning parameters. The JICA Study Team prepared the survey forms in English and Arabic versions were prepared in Lebanon for the smooth implementation of the surveys. Different survey locations are shown in Figure 1.1-1.

The zoning system consists of 60 zones for the whole country in which the zones 1 to 46 represents the study area and 47 to 54 represents the outer area strongly connected with the Study Area. During the process of the study and for clear-presentation purposes, the 60 zones were aggregated into 25 zones as clarified in Figure 1.1-2 that includes the zoning system for both cases.

1.2 PERSON-TRIP SURVEY

1.2.1 Methodology

The survey was designed to interview a total of 2,500 households in the Study Area, which represents a rate of about 3%, as the number of dwelling units in the study area was estimated to be about 75,000 units with a population of about 350,000 inhabitants. Samples were selected based on the sampling system of the Central Administration of Statistics in Lebanon from where some basic information regarding the numbers of households and establishments were collected. To collect information on households and trips, contents of person-trip survey sheet basically included a questionnaire for household information and trip information. The specific items in the questionnaire are:

1) Household attributes
   - Household structure
   - Vehicle ownership (number & type of vehicle)
2) Personal attributes (for each of members 6 years old and above)
   - Gender & age
   - Occupation (self-employee, company executive, worker, housewife, student, etc.)
   - Sector (industry, agriculture, commerce, finance, construction, transport, etc.)
   - Address of home, office and/or school
3) Trip description (for each one-way trip)
   - Trip purpose
   - Transport mode
   - Origin / time of departure
   - Origin / time of departure
   - Destination / time of arrival
   - Parking condition for passenger vehicles

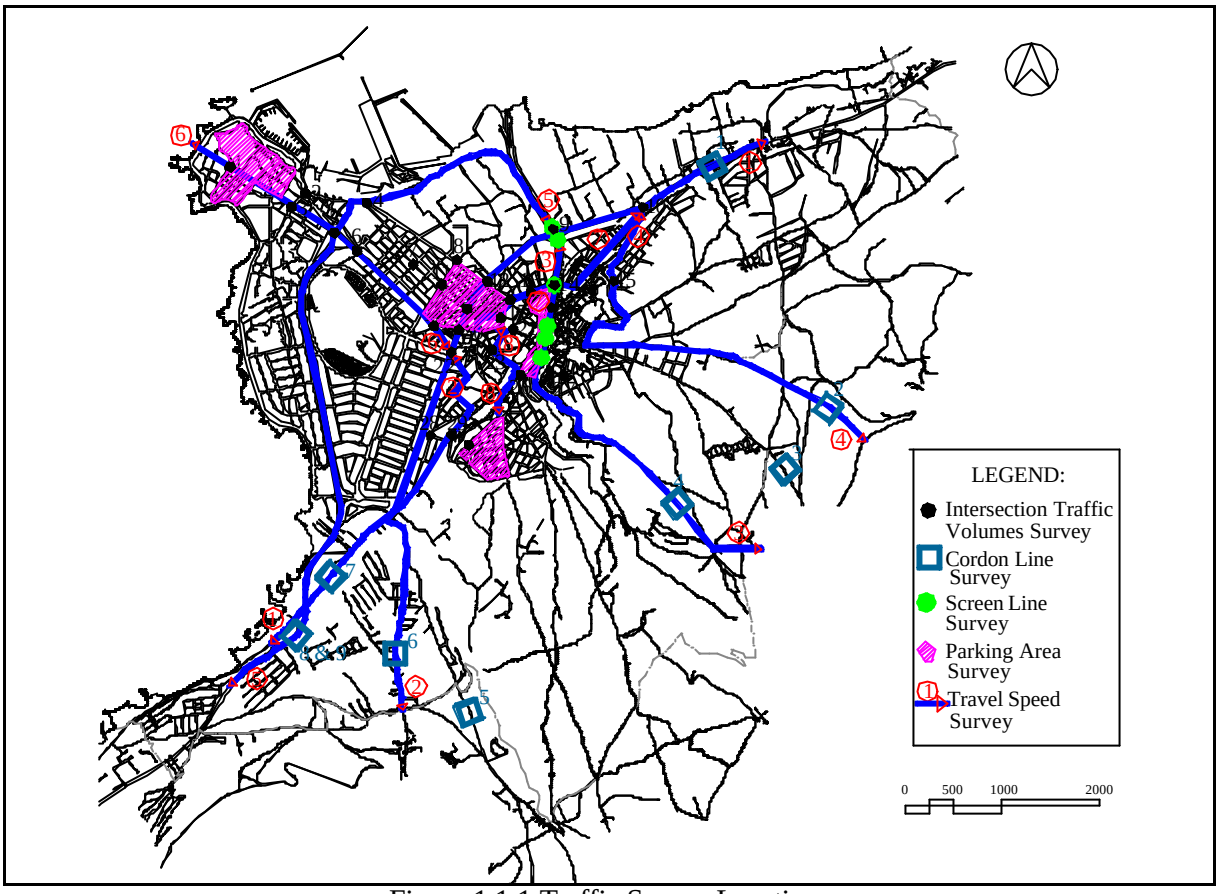


Figure 1.1-1 Traffic Survey Locations

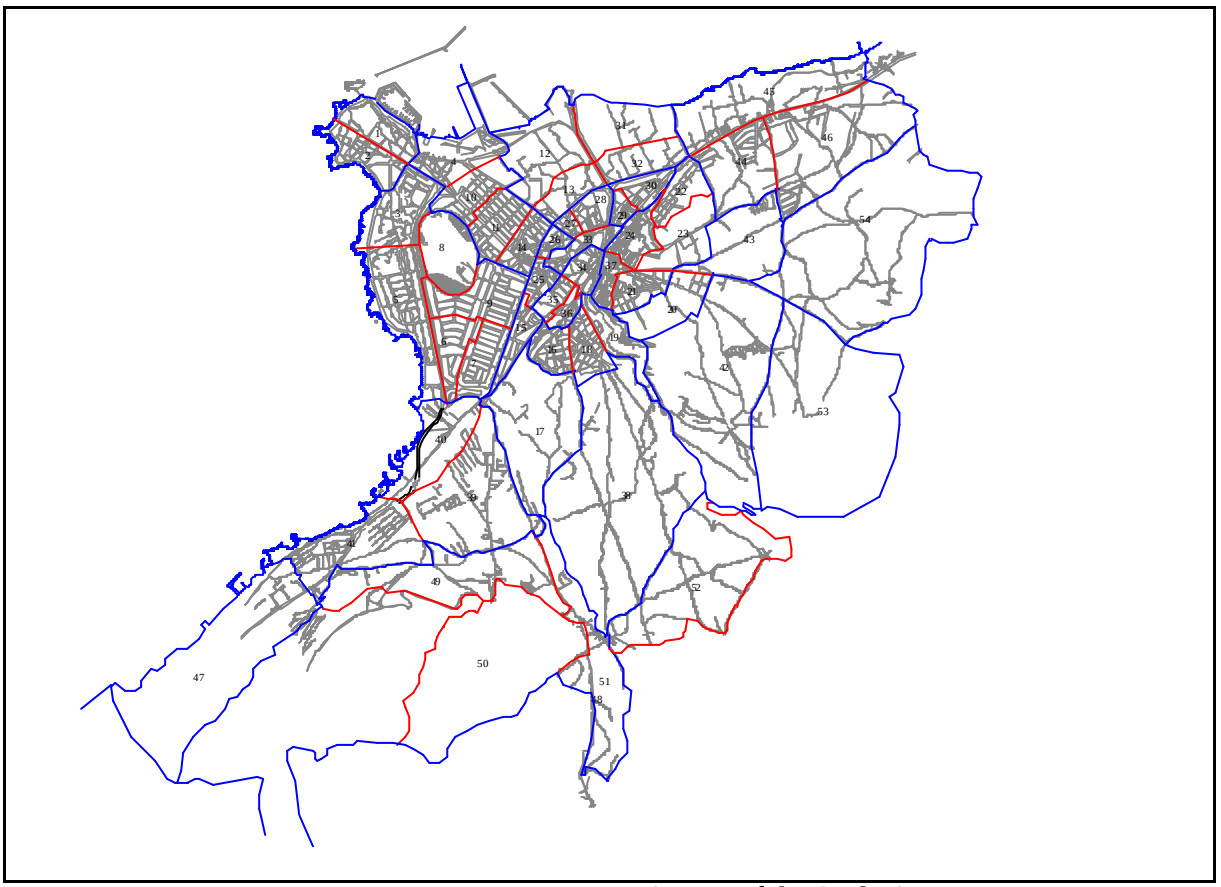


Figure 1.1-2 Zoning System of the Study Area

1.2.2 Survey Results

(1) Total Number of Trips

A random sampling-base procedure was established for application on the sub-zoning system of the Central Statistics Administration system. The sampling rate is about 3.16% that is higher than the target sample rate of 3% and is considered high enough to produce a reasonable accuracy level, and the total number of collected samples is presented in Table 1.2-1. Expansion factors were estimated based on trips per each age group in order to produce present OD tables for people movement per purpose and per transport mode. Total number of trips was 1.242 million per day and the average number of trips per person was about 4 trips per day.

Table 1.2-1 Number of Household Interviewed

Household Samples	No. of Family Members	Average Family Members	Population	Households
2,612	12,114	4.5	305,732	67,140

1.2.3 Characteristics of Person Trip

The total number of person trips per day within the Study Area is 694,423 trips and the average number of trips per person (trip rate) is 2.332.

(1) Trip Rate

The trip rate by sex and age group is presented in Figure 1.2-1. As for the trip rate by sex, the trip rate of male is higher than that of female. The former trip rate is 2.424 trips while the latter is 2.240 trips. As for that by age group, the age group of 20 – 59 years old is the highest among them.

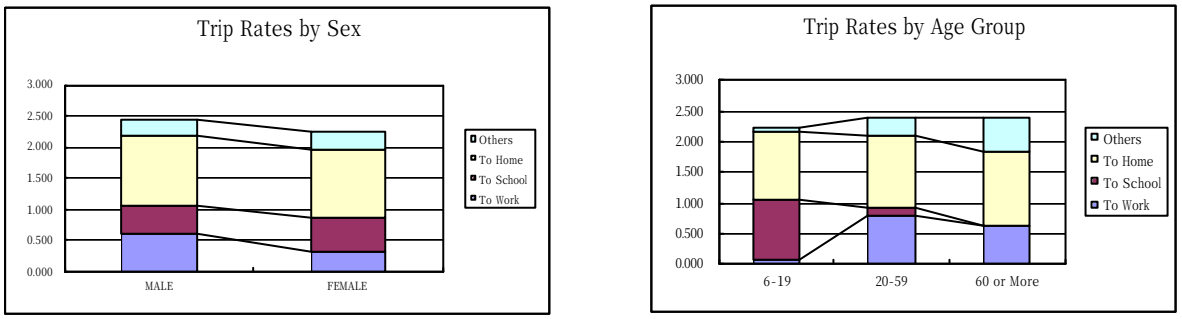


Figure 1.2-1 Trip Rate by Sex and Age Group

(2) Trip Composition by mode

Trip compositions by transport modes are presented in Figure 1.2-2. Walking trips has the highest share of 28%, while trips by vehicles are mainly by private vehicles (car and van) (33%). Buses and service taxis, which may represent the public transport share, handle about 37% of all trips. Trips by bicycles and motorcycles, which are not shown in the figures, have a share of less 0.1% each.

(3) Trip Purpose

Trip composition by purpose is presented in Figure 1.2-2, in which the "to Home" trips have a share of 48%, to school trips with a relatively high share of 21% and to work trips with a share of 20%. These three trip purposes, which are considered as daily trips.

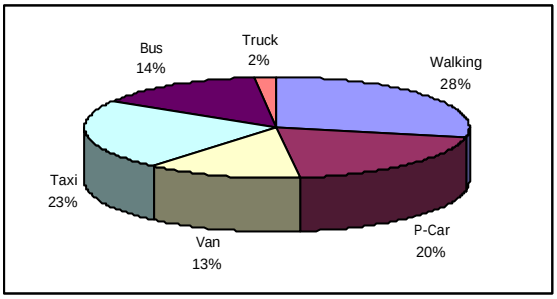


Figure 1.2-2 Trip Compositions by Transport Mode

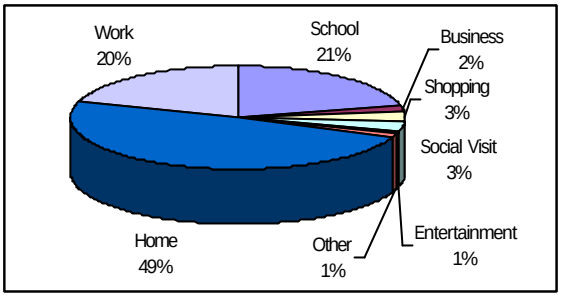


Figure1.2-3 Trip Compositions by Purpose

(4) Trip Generation and Attraction

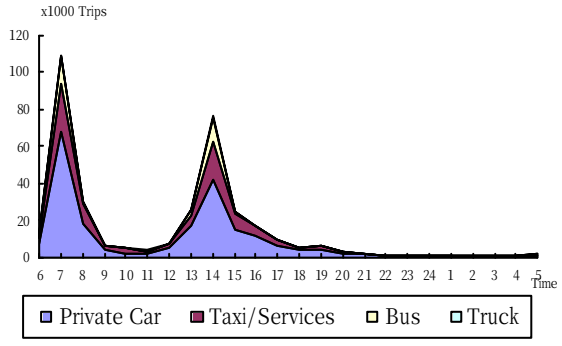
Table 1.2-2 presents the generated trips and the attracted ones. Excluding home trips, which are generally generated and attracted based on zonal population, other trip purposes have different characteristics. Work trips are generating in large scale from residential areas since their occurrences correlate with the size of the population. The volume of attraction is high in employment areas, such as the central commercial and business area (zones 10, 24 and 25) as well as in light-industrial areas (zone 40).

Table 1.2-2 Trip Distribution by Trip Purpose

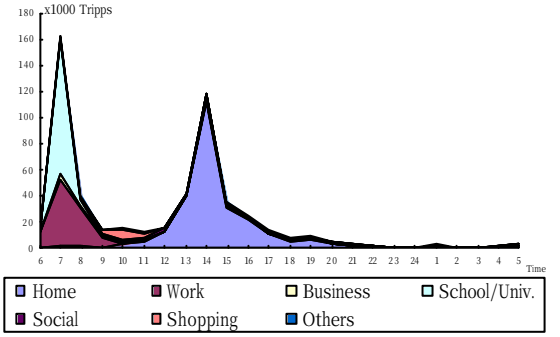
Trip	Home	Work	School	Others	Total (G)
Generation	331,205	137,169	146,949	79,100	694,423
Attraction	331,205	137,169	146,949	79,100	694,423
Total	662,410	274,338	293,989	158,200	1,388,846

(5) Hourly variation of Person Trip

The hourly variation of person trip is presented in Figure 1.2-4.



Generated Trips by Time and Mode



Generated Trips by Time and Purpose

Figure 1.2-4 Hourly Variation by Trip Purpose

(6) Trip Length

The person trip length distribution is presented in Figure 1.2-5. The average person-trip length is about 9,5 kilometer/trip as most of the trip lengths lie in the zone of 5-10 kilometers. It is followed by shorter trips while longer trips are mostly to outside zones.

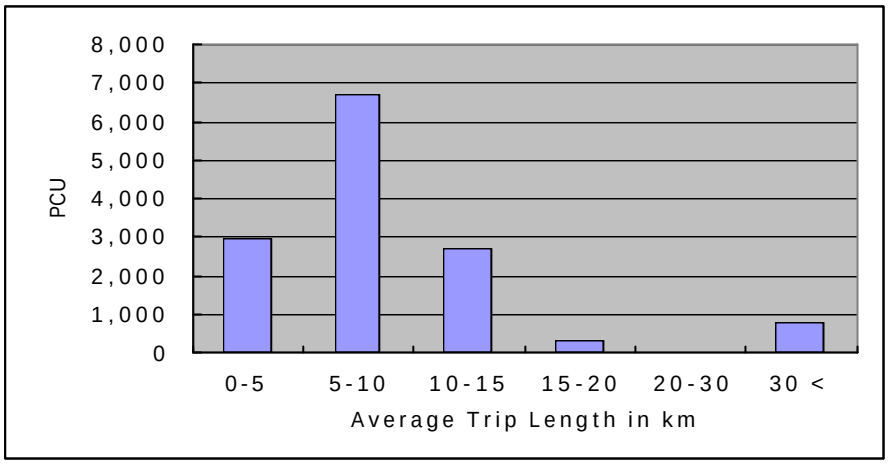


Figure 1.2-5 Trip Length Distribution

(7) Family Income and Vehicle Ownership

The relationship between family income and vehicle ownership is clarified in Table 1.2-3. In average, the ownership rate is 0.77 vehicle/household. By adding vehicles of part-time use, which are mostly those vehicles, belong to work place, the rate of vehicle/household will increase to 0.9.

Table 1.2-3 Family Incomes and Vehicle Ownership

Monthly Income (1000 LL)	No. of Households	No. of Vehicles (Full-time Use)	Vehicle per Household
No Answer	46	26	0.57
0 – 150	48	8	0.17
151 - 300	238	86	0.36
301 - 600	712	376	0.53
601 - 750	668	486	0.73
751 - 1500	596	556	0.93
1501 & Over	384	528	1.38
Total	2,612	2,066	0.77

Most of the owned vehicles, however, are considered as old vehicles. More than one half of the fleet running in the Study Area is more than 16 years old while new vehicles with less than 5 years account only about 4.6% as shown in Table 1.2-4.

Table 1.2-4 Vehicle Age

Vehicle Age	Vehicle %
Less than 5 years	4.6
6 – 10 years	10.0
11 – 15 years	26.6
More than 16 years	58.8
Total	100 %

1.3 COMMODITY MOVEMENT SURVEY

1.3.1 Methodology

The major transport companies within the Study Area were surveyed. Almost a full sample size was considered due to the limited number of big companies. Interview surveys were carried out to collect data regarding the commodity movement demand within the Study Area. The interview survey sheet includes questionnaire about the following characteristics:

1) Company Attributes:
   - Category
   - Number of employee
   - Number of truck fleet

2) Trip Information:
   - Loading item and volume
   - Origin / time of departure
   - Destination / time of arrival

The survey was carried out by sending questionnaire sheets on the characteristics of company attributes and trip information to major commodity companies. Fillings of the sheets were carried out later in the presence of company representatives to assure questionnaire understanding.

1.3.2 Survey Results

(1) Company Categories

Figure 1.3-1 shows the distribution of company categories based on the surveyed results. The categories include: 1. Agriculture, 2. Forest, 3. Marine, 4. Mineral, 5. Metal & Machine, 6. Chemical, 7. Light Industry / Electronics, 8. Miscellaneous Industry, 1. Construction and 10. Others.

(2) Trip Time

Distribution of trip time is shown in Figure 1.3-2. Average trip time was estimated around 2.33 hr. Almost all of the trip times are less than 5 hr. The light industry / electronics has the biggest share. Chemicals, metal and machines are coming in the second rank. Some categories such as agriculture, marine and mineral have no specialized company.

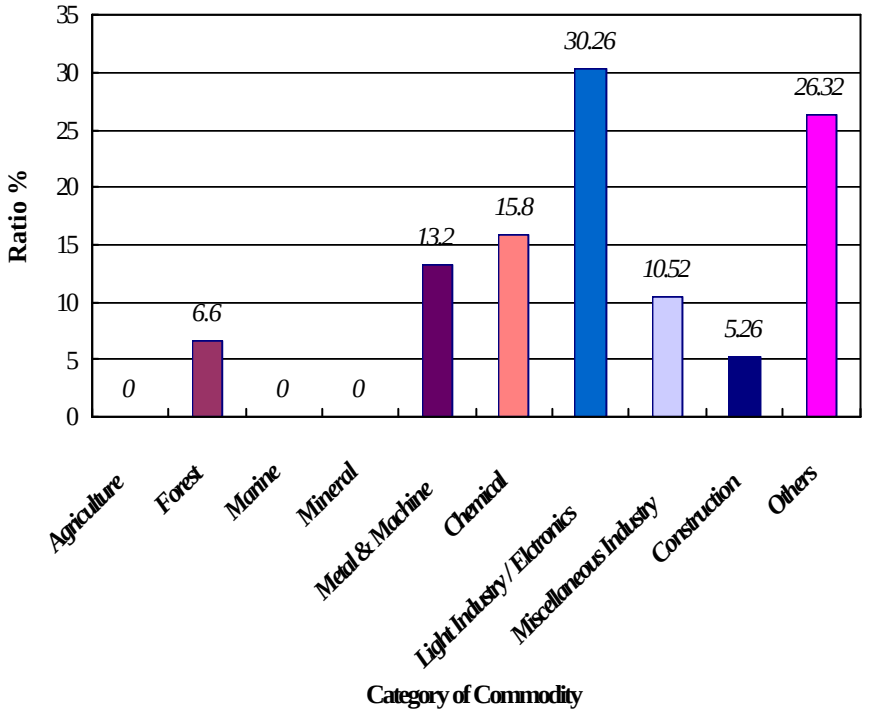


Figure 1.3-1 Distribution of Company Categories

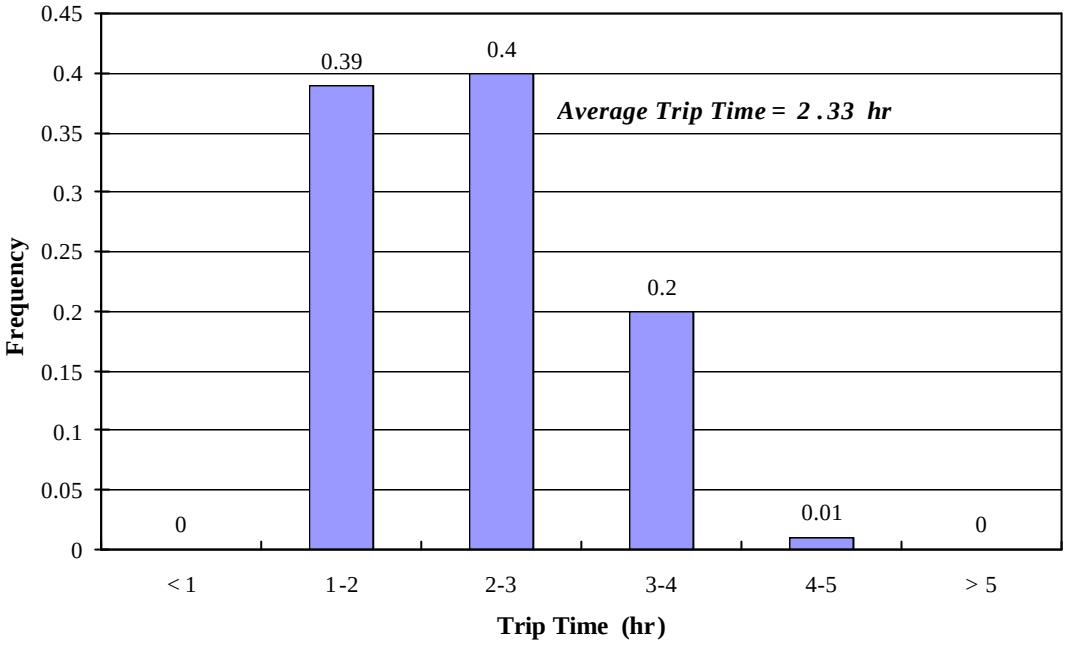


Figure 1.3-2 Distribution of Trip Time

(3) Origin and Destination

Origin and destination (OD) are presented as shown in Figures 1.3-3 and 1.3-4. Many zones can not be recognized as an origin or a destination on the subject of the commodity movements.

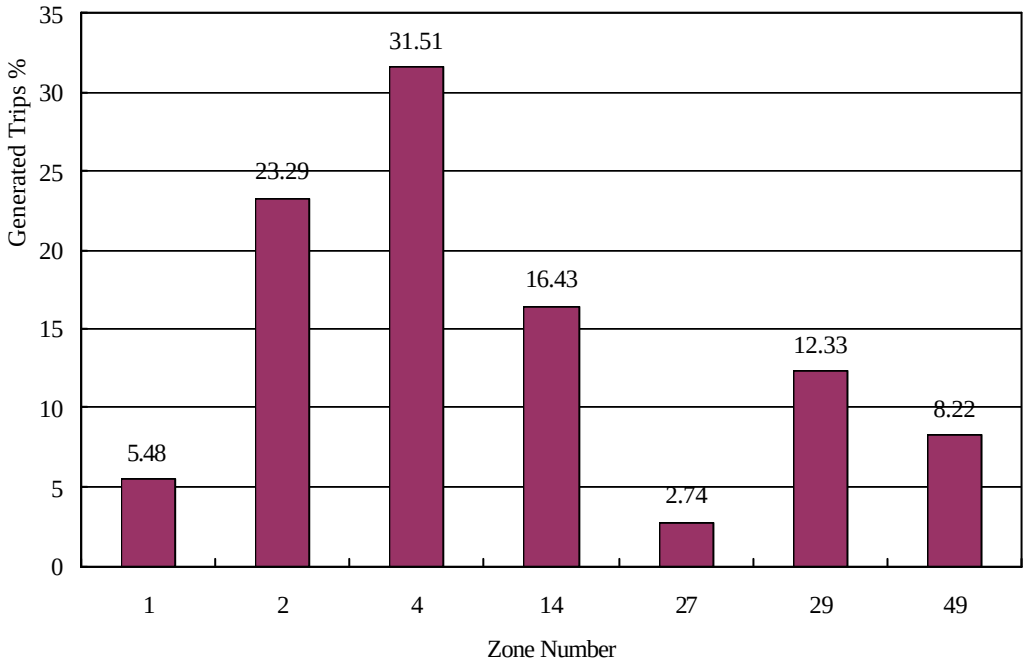


Figure 1.3-3 Origin of Commodity Trips

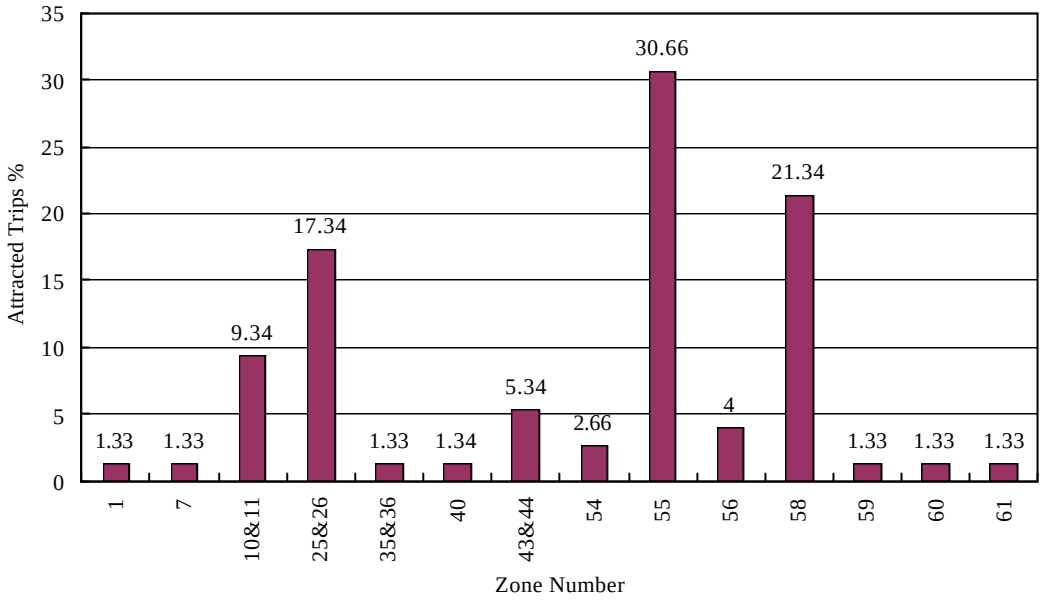


Figure 1.3-4 Destination of Commodity Trips

About 60% of the trips are generated from zone 1, 2 and 4. These zones are located in El-Mina. This ratio clarify the significant of the port area as a zone generating the biggest number of trips. The zones at and near to the downtown area are the main destination for the commodity vehicles.

1.4 CORDON LINE SURVEY

1.4.1 Methodology

The objective of this survey is to collect data on the inbound and outbound traffic volumes as well as to establish OD matrices for trips of people, commodity and vehicular movements between the study area and outside zones. The survey was conducted for classified vehicular counting and roadside OD interview at nine stations located on eight main roads used as entrances and exits at the study area borders as shown in Figure 1.1-1. With the high traffic volume and high speeds on the expressway to Beirut, the survey was divided into two locations at the two exists to the city. The survey was carried out on a typical working day during November 2000. It has two main tasks as follows:

- Classified vehicular counting: The survey was conducted for 24 hours on both traffic directions and the type of each vehicle was manually and separately counted, and then recorded for every 15-minute intervals.
- Roadside OD survey: The survey was conducted for14 hours from 6:00 to 20:00, with not less than 10% of traffic to be stopped at random, and then drivers and bus/taxi passengers were interviewed.

1.4.2 Survey Results

Figure 1.4-1 shows the hourly distribution for all vehicles in the two directions of "to Tripoli" and "from Tripoli". The morning peak hour is mostly between 07-08hr while the evening peak is 14-15hr for outbound traffic and 16-17hr for inbound traffic. While the morning peak is almost at the same time for both directions, it is clear also that the outbound peak starts earlier than inbound beak.

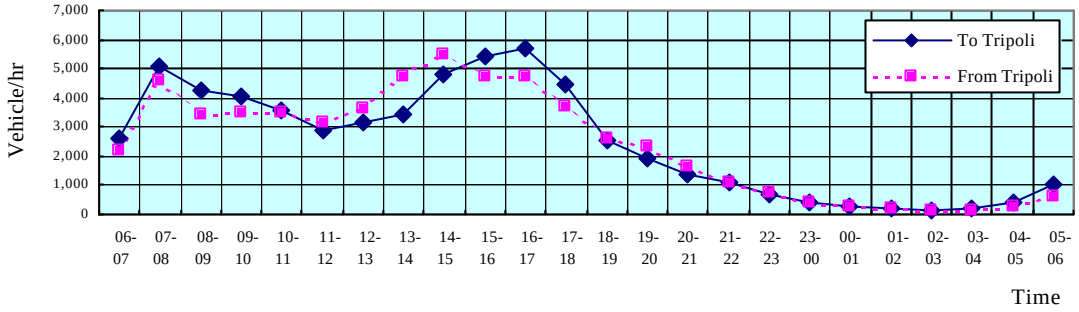


Figure 1.4-1 Hourly Traffic Volumes to/from Tripoli

Figure 1.4-2 presents the 24-hr traffic volumes at the survey stations in both directions per vehicle category. The figure shows that more than 35,000 passenger cars are composing the traffic volume, which is reaching about 60,000 vehicles in each direction.

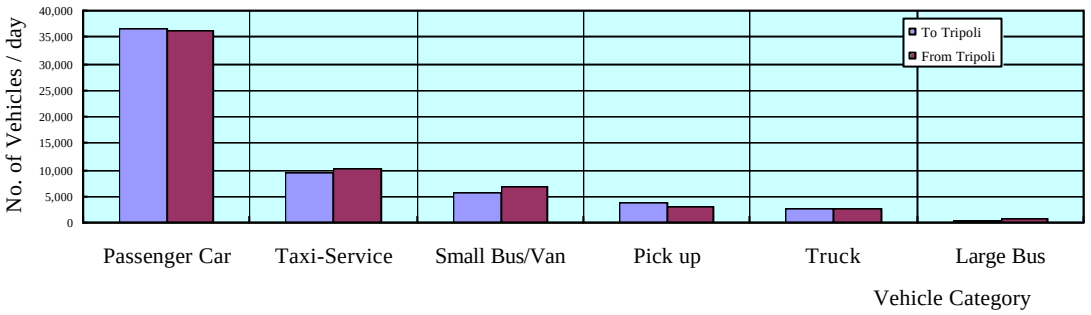


Figure 1.4-2 Total Trips to/from Tripoli

The breakdown for each survey stations is presented in Appendix 1.4-2. Figure 1.4-3 summarizes the collected data for each direction on an illustrated sketch-map. The highest traffic volumes were recorded in the south on the expressway connecting Tripoli with Beirut with about 42,000 vehicles on both directions. It is followed by the road going north to the Syrian borders with a volume of about 35,000 vehicles. Other information that was concluded from this survey includes peak hour factors, and occupancy rate for persons in each vehicle category. Table 1.4-1 presents the peak hour factors for each road, while Table 1.4-2 gives the average occupancy rate for each vehicle category.

Table 1.4-1 Peak Hour Factors

Station	To Tripoli		From Tripoli		Total	
	Peak Hour	%	Peak Hour	%	Peak Hour	%
1	16:00-17:00	14.4	14:00-15:00	1.1	15:00-16:00	11.6
2	07:00-08:00	13.2	14:00-15:00	7.12	14:00-15:00	11.0
3	14:00-15:00	15.3	14:00-15:00	11.4	14:00-15:00	13.3
4	07:00-08:00	8.5	16:00-17:00	11.3	16:00-17:00	1.8
5	14:00-15:00	11.1	16:00-17:00	10.0	14:00-15:00	10.0
6	07:00-08:00	13.0	14:00-15:00	12.7	07:00-08:00	12.2
7	16:00-17:00	8.2	07:00-08:00	1.0	07:00-08:00	8.4
8	01:00-10:00	1.1	14:00-15:00	8.2	01:00-10:00	7.1
9	14:00-15:00	1.6	07:00-08:00	13.1	07:00-08:00	10.5

Table 1.4-2 Occupancy Rates

P-Car	Taxi / Service	L. Bus / Van	Pick-up Cargo	Truck 2-axle	Truck 3-axle	Truck 4-axle	Large Bus	M-Cycle Bicycle	Others
1.818	2.117	4.204	1.856	1.771	1.312	1.317	18.616	1.146	1.000

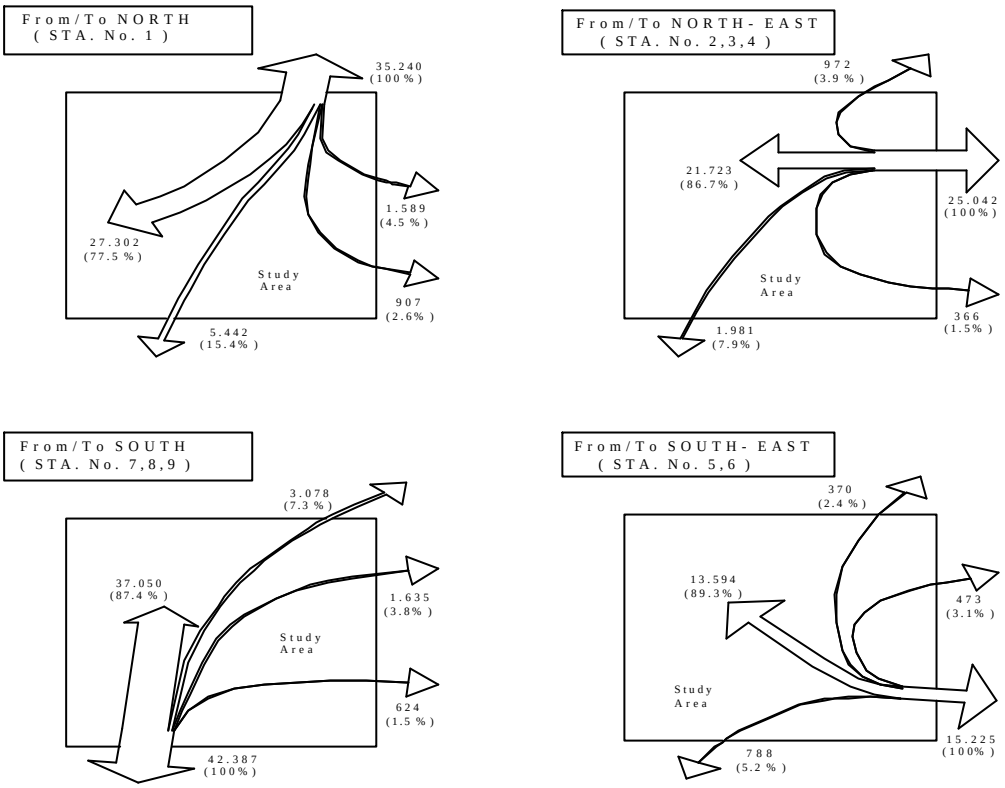


Figure 1.4-3 Characteristics of Traffic to/from Tripoli

1.5 SCREEN LINE SURVEY

1.5.1 Methodology

Survey Stations: Abu Ali River divides Tripoli city as well as the Study Area into northern and southern parts, and all the bridges for vehicular-use on the river were selected to be the stations of this screen line survey. The survey was conducted at 6 stations, which are shown in Figure 1.1-1. The survey was conducted for 24 hours on both traffic directions and the type of each vehicle was manually counted, and then recorded for every 15-minute interval.

1.5.2 Survey Results

The hourly traffic volumes of the six survey stations are presented in Appendix 1.5-1 while Figure 1.5-1 shows only the accumulated values of all the stations. The figure clarifies that there are two peaks in the direction out of the central area to the north while on the opposite direction to the city center; the demand is almost constant during the daytime hours. The traffic composition at screen line stations is presented in Figure 1.5-2.

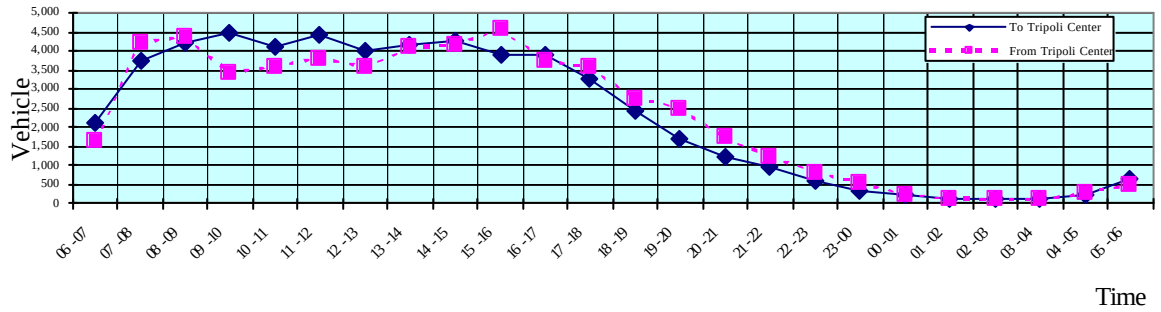


Figure 1.5-1 Hourly Distributions at Screen Line Stations

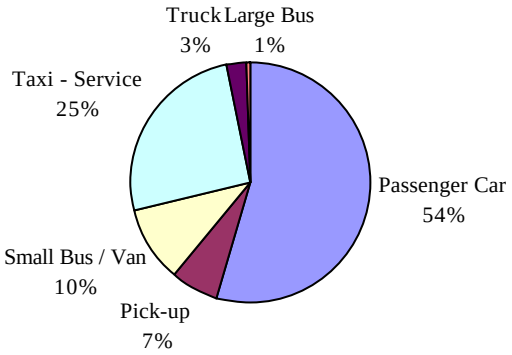


Figure 1.5-2 Traffic Composition at Screen Line Stations

1.6 INTERSECTION TRAFFIC VOLUME SURVEY

1.6.1 Methodology

There is an ongoing project managed by CDR to install traffic signals at the major intersections within Greater Tripoli. The CDR traffic signals implementation plan depends on the field observations and engineering judgment. There are no traffic volumes data at these intersections. The field observation by the Study Team shows that these intersections are characterized with the most heavy traffic volumes. Data on traffic volumes at these intersections are needed to assess the reliability of the selected traffic signal locations and for pashing plan. With this background, the methodology to carry out the survey is described hereafter.

Survey Stations: The selection of the survey locations is depended on two main items which are:

- The study carried out by CDR for installation of traffic signals at the major intersections in Greater Tripoli.
- The field observation that was carried out by the Study Team for the major intersections within the study area.

Based on the investigation of the above mentioned items, thirty locations were selected that represent all of major intersections within the Study Area, as presented in Figure 1.1-1.

Survey Criteria and Counting Duration: Classified vehicles counting was carried out for continuous 14 hours from 06:00 to 20:00 at each selected intersection. The surveys always carried out on a typical working days. The collected data includes traffic volumes by direction for ordinary intersections and entering and leaving each approach as well as for each weaving section for the roundabout type intersections. The classified vehicles counting was recorded for each 15 minutes intervals.

1.6.2 Survey Results

Figure 1.6-1 presents the result of the evaluation of the existing level of services based on the calculations of the average ratio of vehicle / capacity ratio (V/C). Intersections number 5, 1, 16, 20 and 22 are characterized with the most bad level of service. Intersection number 5 is located along El-Mina Street. The others are located along the Tripoli Boulevard. Tripoli Boulevard is the main corridor passing through the middle of the downtown area. The distribution of V/C ratio is presented in Figure 1.6-2.

About 75% of the surveyed intersections suffered from congestion. It can be noticed also that about 18% of the surveyed intersections characterized with greater than 2.5 of average V/C ratio. In this respect, it is reasonable to mentioned that the value of the calculated V/C ratio were recognizably affected due to the existing of the parked vehicles at the approach entrances of intersections. Table 1.6-1 shows the daily traffic volumes of the most congested intersection approaches.

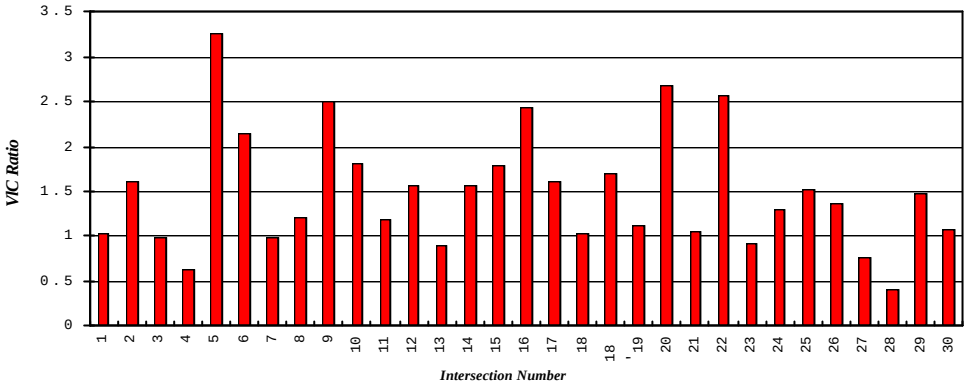


Figure 1.6-1 Existing Intersections Level of Services

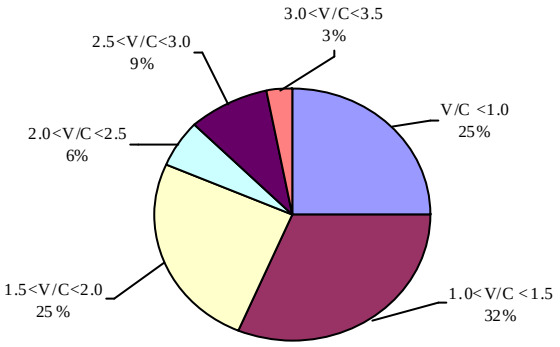


Figure 1.6-2 Distribution of Vehicle / Capacity Ratio

Table 1.6-1 Daily Traffic Volume At Congested Intersections

Intersection No.	Approach						Total Inbound Volume Veh./Day
	1	2	3	4	5	6	
5	7434	10735	8628	4333	7510		38640
1	20757	21645	1663	21645			73710
16	12101	16871	18177	1877			57834
20	17736	7087	11132	1510			53545
22	5310	14376	6082	8871	17624	8857	61208

As can be noticed from the table the maximum daily traffic volume was observed at intersection No. 1 (Abou Ali Square), then No. 22 (Abd El-Hamiad Karami Square and both of them are located along Tripoli Boulevard. For the determination of the peak hour, the distribution of traffic volumes at the different intersection approaches was analyzed. The result is presented in Figure 1.6-3.

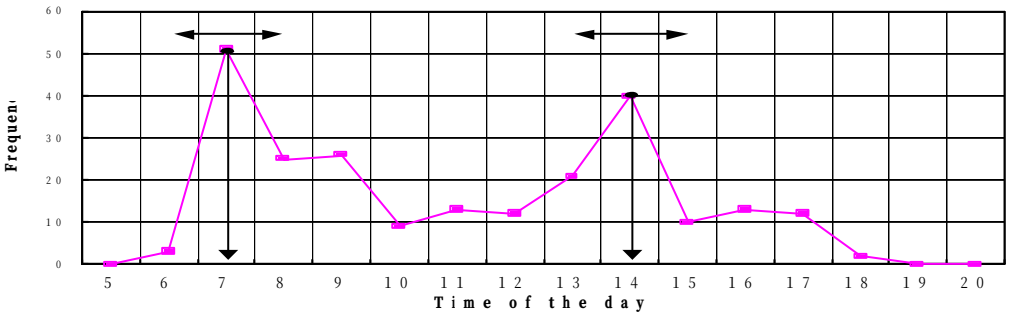


Figure 1.6-3 Peak Hour

The morning peak hour is around 7:00 AM and the evening one is around 2:00 PM. The investigation shows also that the traffic volumes during the morning peak are greater than the evening one.

1.7 PUBLIC TRANSPORT SURVEY

1.7.1 Public Transport Company Survey

(1) Number of Companies

The existing four main intercity bus companies were surveyed. All of them are private ones. There is no official public transport city or intercity company in Tripoli. Also, there is no city or intercity taxi company. The four intercity bus companies are:

- Transport / Bikaai Abr El-Shark
- Abyad Company
- Tripoli Express
- El-Ahdab

The activities of these companies are related to the intercity public transport. Inside the city, the service taxis and school bus are the only mode of public transport.

(2) Collected Data

The collected data includes:

- Number of vehicles
- Area or route of operation
- Total number of passengers
- Problems in operation and Management
- Fare
- Frequency of operation
- Management System
- Future plan

(3) Survey Method

The survey was carried out by mailing questionnaires with a letter of request (signed by governmental authorities) in advance. Interviews were carried out after collecting questionnaires.

(4) Result of the Survey

The survey results are summarized in Table 1.7-1.

Table 1.7-1 Characteristic of Public Transport Intercity Bus Services

Company	No. of Employees	No. of Buses	Route	Frequency	Fare (LL)
Transport / Bikaai Abr El- Shark	20	8 (45 seat)	Tripoli-Aleppo Tripoli-Hama Tripoli-Hums Tripoli-Hums-Damascus Tripol-Tartous-Lattakieh Tripoli-El-Rayed Tripoli-UAE (Dubai & El-Ain) Tripoli-Qatar-Bahrain	4/day 4/day 4/day 2/day 1/day 2/day 2/week 1/week	8000 6000 4500 7000 4500 /6000 80000 110000 115000
Tripoli Express	30	15 (22 seat)	Tripoli-Beirut	30/day	2000
Abyad Company	28	10 (24 seat) 6 (50 seat)	Tripoli-Beirut Tripoli-Beirut	22-25/day 10/day	1000 -1500
Al Ahdab	70	30 (40-45 seat)	Tripoli-Beirut	50/day	2000 -2500

1.7.2 Passenger Interviews

(1) Survey Locations

The survey was conducted at main terminals of city taxi, intercity taxi and at intercity bus terminals where passengers are frequently get-into and get-out from buses and taxis.

(2) Collected Data

The data were collected from the passengers and especially regarding to:

- Trip purpose
- Trip origin and destination

(3) Survey Method

Bus and taxi passengers were interviewed while they are waiting for bus or taxi and/or when they are getting off from bus or taxi.

(4) Results of the Interview Survey

Figure 1.7-1 shows the distribution of the public transport by the trip purpose.
Figure 1.7-2 and 1.7-3 show the distribution of origin and destination of public transport trips for the different traffic zones within the Study Area.

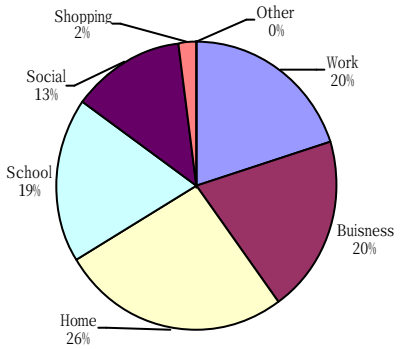


Figure 1.7-1 Trip Purpose

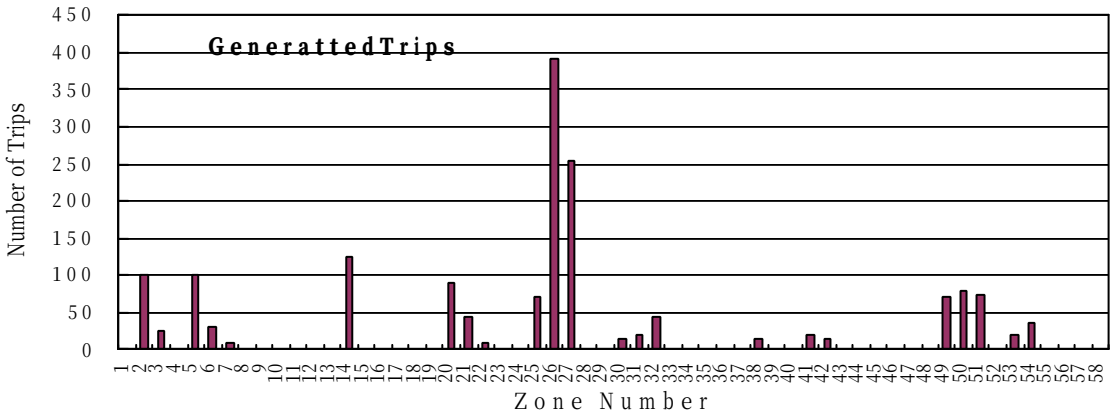


Figure 1.7-2 Trip Origin

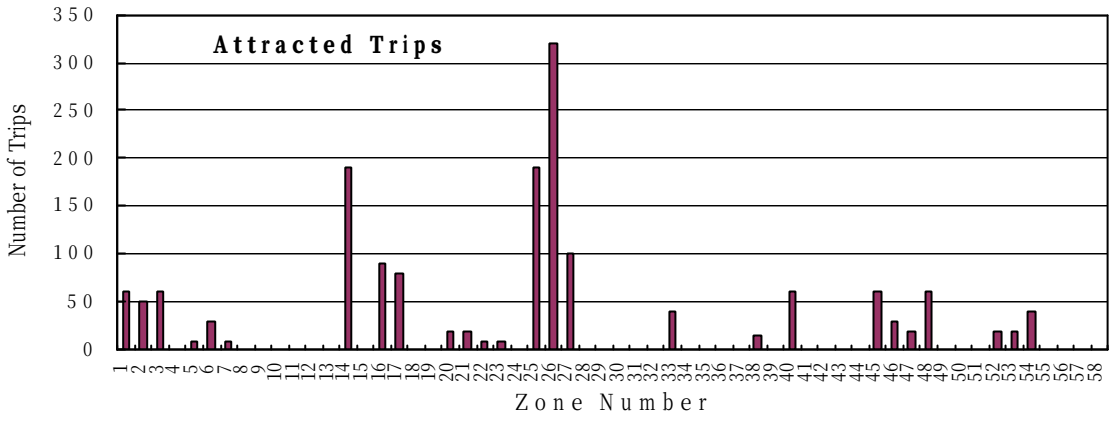


Figure 1.7-3 Trip Destination

Figure 1.7-4 shows the distribution of walking distance from origin to terminals. The maximum distance is 300m. More than 35% of the total sample is less than or equal 50m. It can be concluded also that more than 50% is less than 100m. Figure 1.7-5 shows the distribution of walking distance from terminals to destination. The maximum distance is 400m. More than 50% of the total sample is less than or equal 50m. It can be concluded also that about 90% is less than or equal 100m.

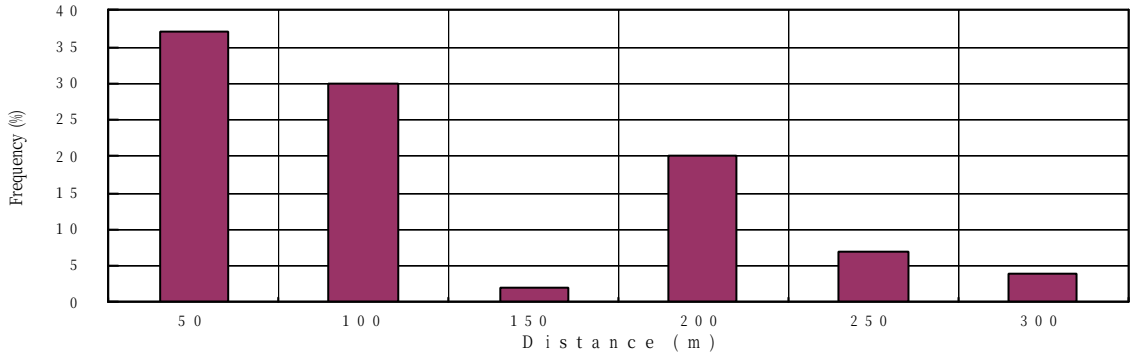


Figure 1.7-4 Distance Distribution from Origin to Terminal

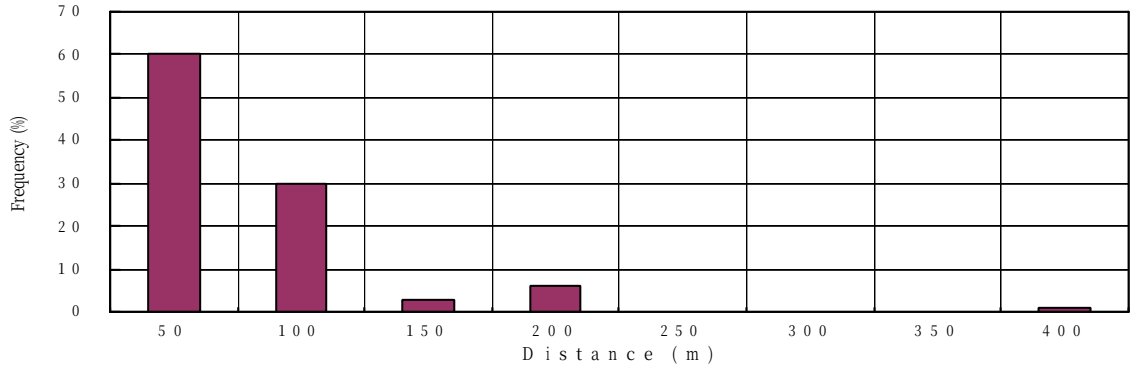


Figure 1.7-5 Distance Distribution from Terminal to Destination

The investigation of the waiting times shows that about 78% are less than or equal 5 minutes. The fare charge investigation shows that about 66% of the total sample paid 500 LL and the rest paid 1000 LL. These two values only were reported. The distribution of the travel time is shown in Figure 1.7-6. About 55% is less than 10 minutes. The ratio of travel time more than 30 minutes is only 2%. The result of waiting condition survey is presented in Figure 1.7-7. Only 15% of the sample are satisfied with the existing condition.

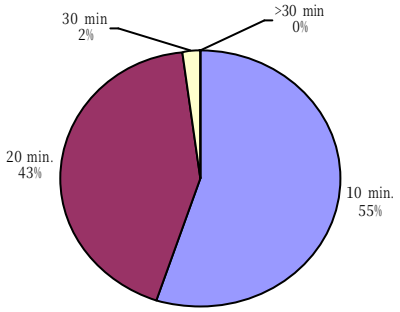


Figure 1.7-6 Distribution of Travel Time

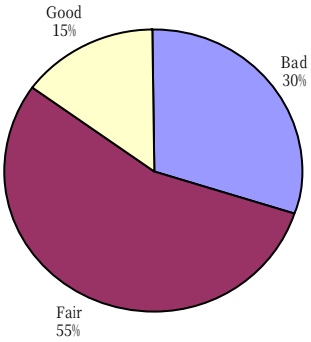


Figure 1.7-7 Distribution of Waiting Condition

1.7.3 Public Transport Policy Survey

(1) Survey Method

The Study Team carried out this survey to collect the information from official in charge for public transport in cities and municipalities. The investigation carried out by the Team through the consultation with CDR and Tripoli Municipality Officials confirmed that there are no official public transport organizations in Greater Tripoli. The only official authority is "Office of Rail Road & Public Transport" of the Ministry of Public Works and Transport. This office takes the responsibility of public transport planning all over Lebanon. Therefore, Greater Tripoli public transport aspects are coming under this office responsibility.

(2) Collected Data

The survey includes the following:

- Public transport system (business license, route permit, operating regulations, etc.)
- Existing plan (bus terminal project, bus operation project, etc.)

Under the first item, nothing was obtained because currently there is no public transport service in Greater Tripoli. However, the business license, route permit and operating regulation comes under the authority of Office of Rail Roads & Public Transport. Officials mentioned that a decision was taken in 15 of August 2000 to introduce a public transport services in Tripoli. The plan will depend on a study carried out by a French Consultant for North Lebanon. The output of the study and the proposed lines are presented in Technical Report-3. Authorities revised the plan and 5 bus routes were selected. The authority has 22 minibuses with 25 seats capacity assigned for Tripoli public transport services. Based also on the information obtained from authority, there is a plan to:

- Rebuild the railway between Jonia and Tripoli
- Build a Bus Terminal in the south of Tripoli

The results of this survey show that currently there is no governmental city or intracity public bus services within the boundary of Greater Tripoli. There is a plan to provide the Tripoli City by the city public bus services by the coming June 2001. The final implementation is not clear yet since the available number of minibuses is too limited.

1.8 TRAVEL SPEED SURVEY

1.8.1 Methodology

The survey was carried out at major eight routes as shown in Figure 1.1-1. These routes were selected depending on the inventory survey for the road network and to represent the most prevailing conditions of the road network. The survey carried out by the floating car method. Before conducting the survey, several checkpoints were selected along the routes and confirmed at the site and on location map. A pair of enumerators involved in each survey to read passage time of checkpoints and stopping time, and also to assess causes of stopping and record all information on the survey form.

1.8.2 Survey Results

Figure 1.8-1 shows the results of the travel speed investigation of the surveyed route No.1 as an example. Section length, number of lanes, intersection control, travel speed and flow characteristics defined by the level of services are described. Table 1.8-1 presents a summery evaluation of these roads conditions.

Table 1.8-1 Travel Speed Conditions

Route No.	Average Travel Speed (km/hr)		Level of Service	
	Inbound	Outbound	Highest	Lowest
1	40	38	A	F
2	25	30	B	F
3	35	40	B	E
4	30	30	B	F
5	45	50	A	D
6	20	20	C	F
7	15	15	D	F
8	20	20	B	F

In all surveyed routes, there are one or more segments can be classified under interrupted flow category of level of service E or F. Almost along the same route, the driver never can keep a reasonable steady running speed. Along the same route, the speed and consequently level of service fluctuated between the extremes; speeds fluctuated from 70 km/hr to some times less than 10 km/hr and consequently, the level of service changing from A or B to E or F. This phenomenon shows clearly the existing of many bottlenecks on the road network.

1.9 PARKING AREA SURVEY

1.9.1 Methodology

The parking survey was conducted in four locations, each with an approximate area of about 500m x 500m that were selected to represent the different land-use and parking characteristics and problems in the Study Area. Figure 1.1-1 shows the parking survey areas, which were selected to represent the center of Tripoli area as the central business district (CBD), the Old City that accommodates the historical and Abou Samra and El-Mina as a residential area.

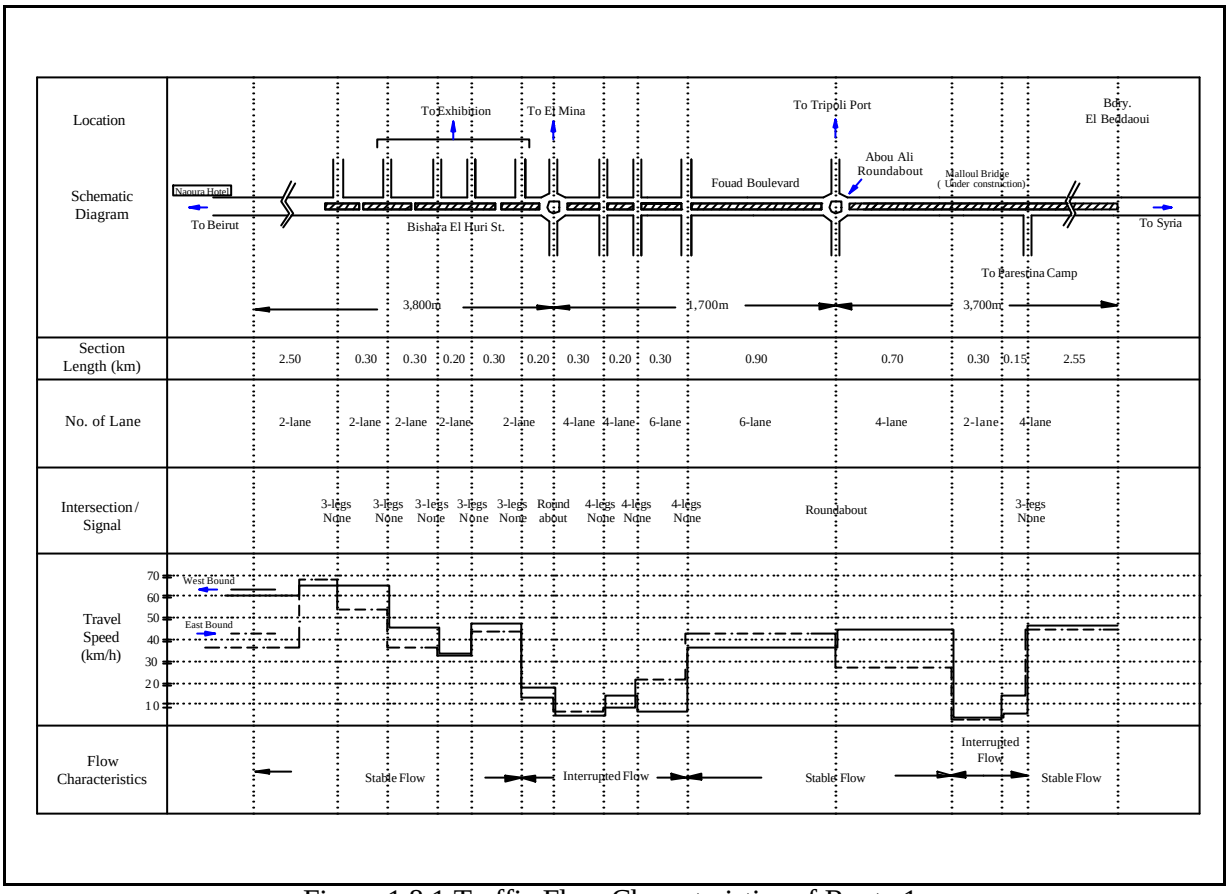


Figure 1.8-1 Traffic Flow Characteristics of Route 1

Inventory Survey

A map of the selected areas was prepared based on the existing road maps and aerial photographs to indicate the condition of on-street and off-street parking spaces. Width of streets and the area of off-street parking spaces were measured to estimate available capacities. The numbers of off-streets parked vehicles were counted along the different time of the typical working day. For on-streets parking, the numbers of parked vehicles between intersections were counted for each side of the street, for each row of vehicles, for double or treble parking, legal and illegal parking. The counting was carried twice a day during morning and afternoon peak periods. For the area related to the CBD, additional data was collected to show the duration of parking time in the central zone. The data are utilized to show the trend of long and short time parking in the central area.

Interview Survey

Data on destination, purpose, walking time, arrival time, expecting parking period and fare were collected from the drivers who are parking their cars in the selected survey areas.

1.9.2 Survey Results

(1) Parking Type

The parking type as paid and un-paid is presented in Figure 1.9-1 for the off-street parking. This type cannot be clarified for on street parking since all on-street parking follows un-paid system. From the figure, it can be noticed that the number of paid stalls is about 700 and un-paid is about 400. Some areas such as 3 and 4 only include un-paid off-street parking.

(2) Payment Method

The distribution of payment method for off-street parking shows that about 55% follows daily payment and the rest follows monthly payment.

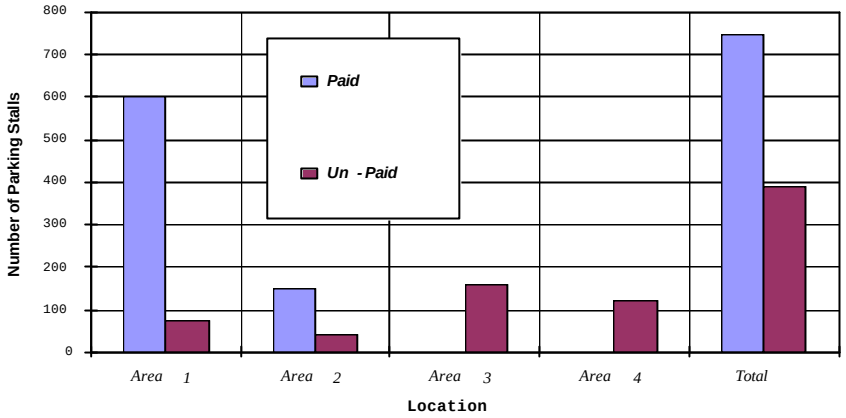


Figure 1.9-1 Parking Type

(3) Amount paid

The rate based on daily base is 1000 to 1500 LL/day.

(4) Frequency

The frequency of users for the parking areas is shown in Figure 1.9-2.

(5) Distance

The distribution of the walking distance to the users destinations is almost less than 150m. The maximum is not more than 300m.

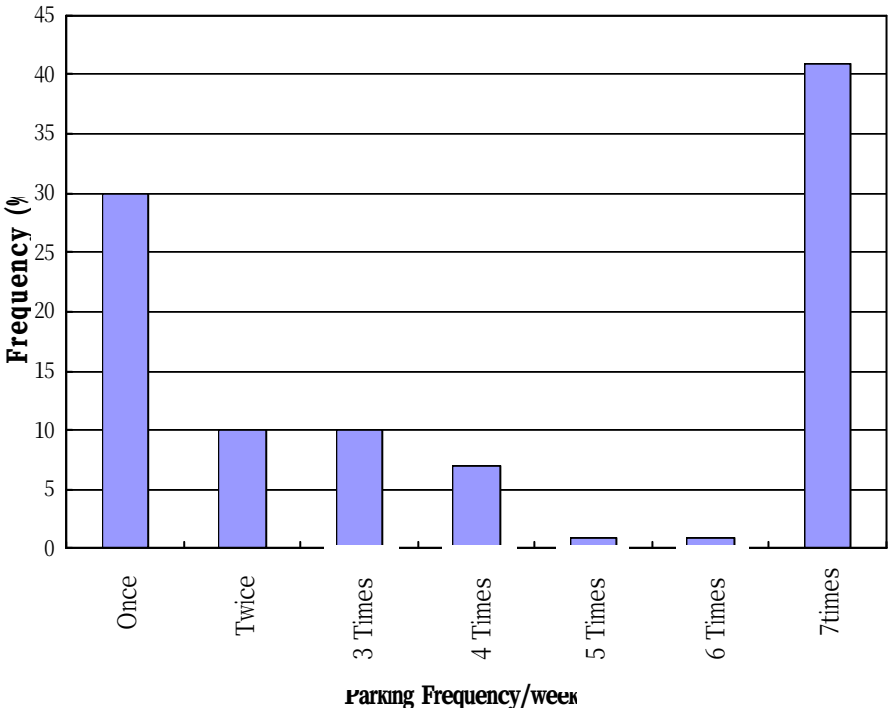


Figure 1.9-2 Parking Frequency Distribution

(6) Purpose

Figure 1.9-3 shows the distribution of the trip purposes.

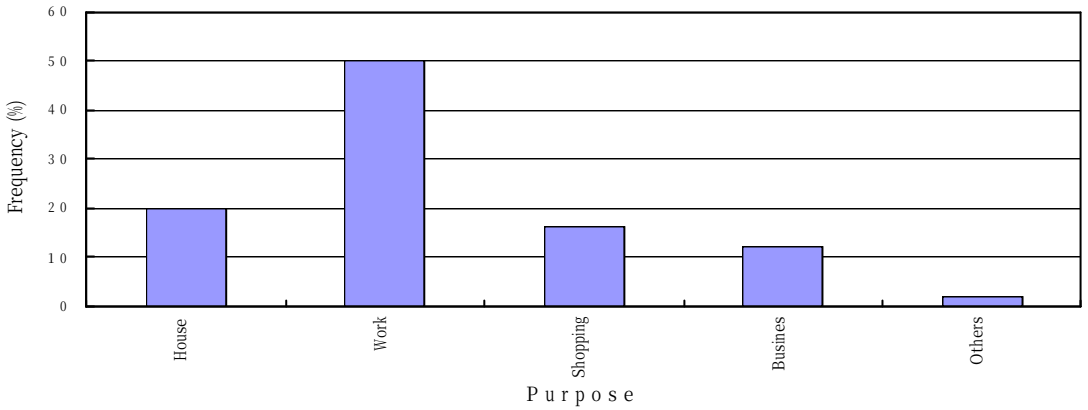


Figure 1.9-3 Trip Purpose Distribution

(7) General Analyses

Figure 1.9-4 shows the comparison between the parking demand and supply on off-street parking. The demand was estimated based on the analysis of the maximum difference of in and out parked vehicles per hour. As can be noticed from the figure and even the maximum demand was considered almost the supply is more than the demand.

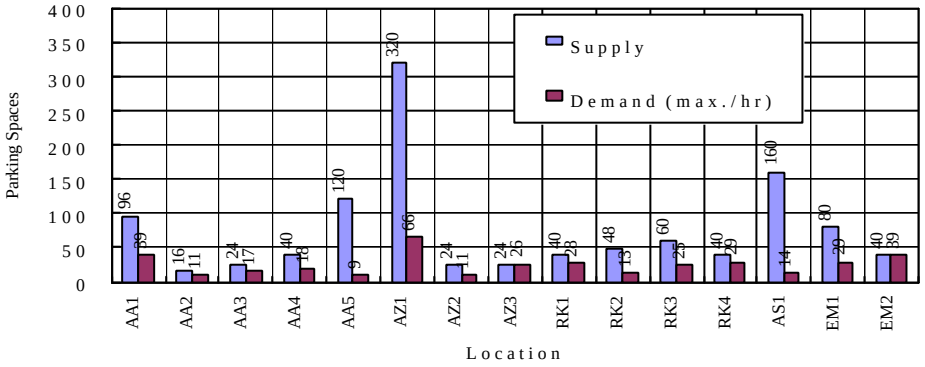
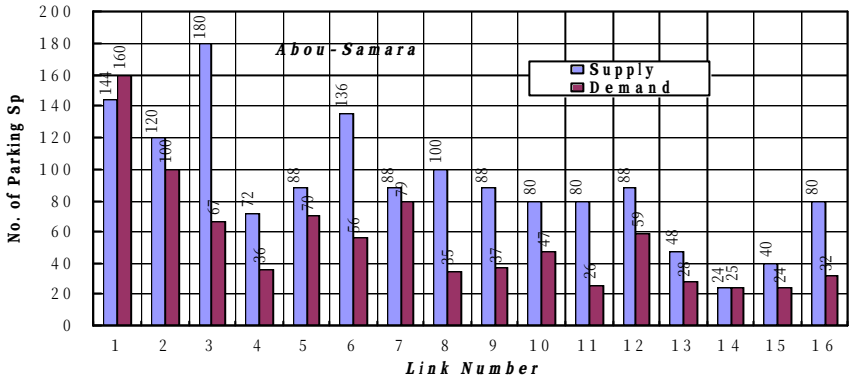
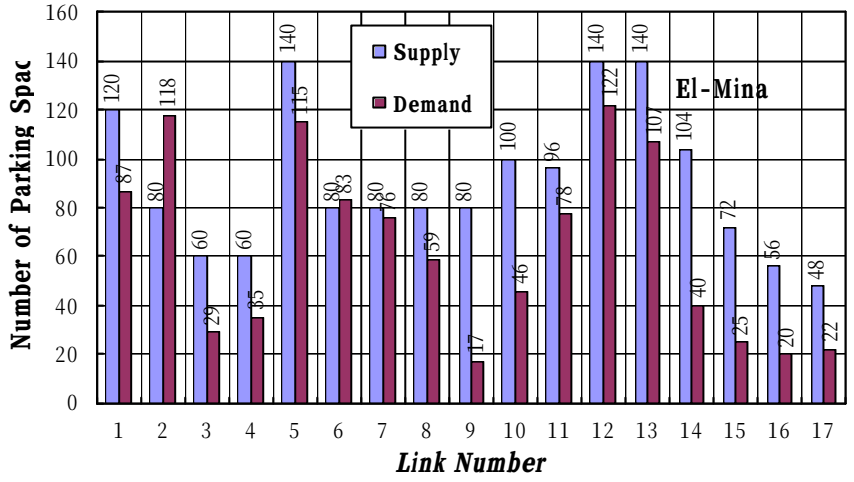
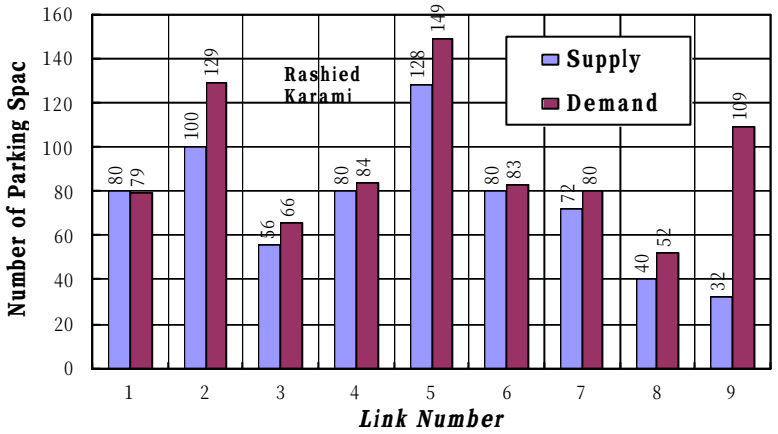


Figure 1.9-4 Off-Street Parking Supply and Max. Demand

Figures 1.9-5a, b, c, d shows the on-street demand and supply of the different corridors within the surveyed areas. Figure 1.9-6 shows the key map for corridors numbers. The supply capacity of on-street parking was analyzed based on the road length to be utilized for parking, while the demand was estimated based on the number of vehicles parking on the roads. The ratio of the on-street parking is estimated to be about 5 times of the off street parking supply.







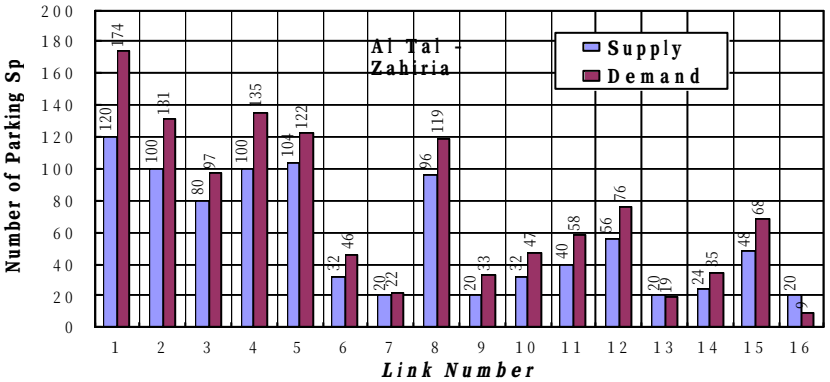


Figure 1.9-5 Demand and Supply of Main Streets

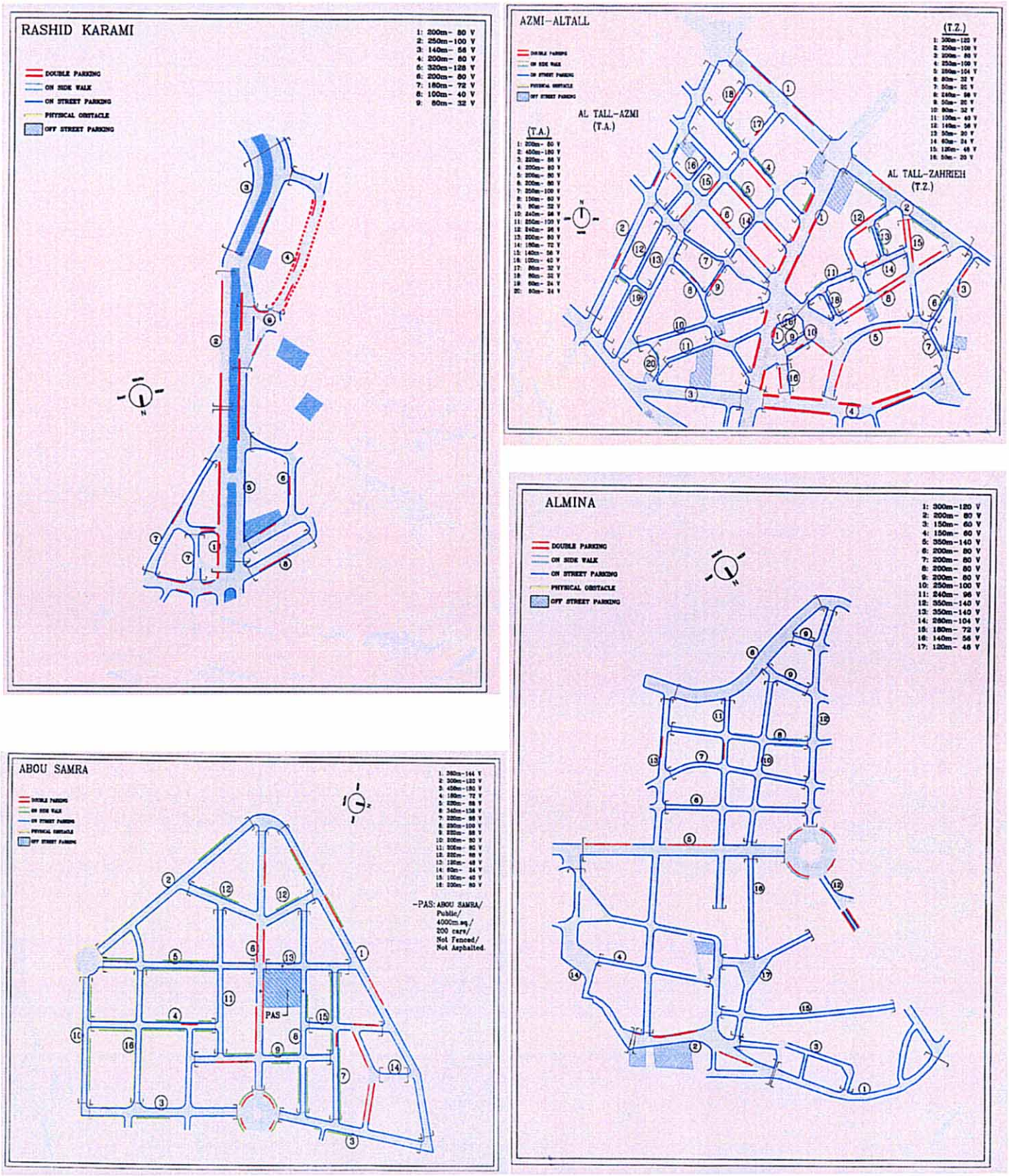


Figure 1.9-6 Key Map of Corridor Numbers

1.10 SCHOOL TRIP SURVEY

1.10.1 Collected Data

The survey was carried out at four universities and 15 schools within the Study Area. Data on the number of school buses, routes, operating hours, number of users, charge and private cars driven to-and-from schools were collected through the interview with persons in charge. Table 1.10-1 shows a list for these universities and schools and a brief description about each ones. The analysis, results and main findings from the investigation of the collected data are shown hereinafter.

1.10.2 Survey Results

Figure 1.10-1 shows the results of the assessment of the transport modes to the school locations. The assessment shows the high share of the shared (service) taxis. The capacity of a taxi is about 5 passengers. Each taxi makes two trips in the morning and another two in the afternoon. The school buses comes in the second rank. Many schools do not have the school bus services. The private cars represent the third rank.

Table 1.10-1 List and Main Characteristics of Surveyed Schools and University

Name	Category	Students	Zone	Transport Modes
Orthodox School	S. High School	511	21	Taxi, Private Car & 4 Buses (20-25 seats)
Maronite Zaitoune	Primary/Private	314	20	Taxi, Private Car & 3 Buses (15-20 seats)
Al Bayan School	Primary School	522	16	Taxi, Private Car & Buses
Al Iman Al Islami		2464	16	Taxi & Private Car
National Orthodox Collage	S. High School	2044	1	Taxi, Private Car &64 Buses (45-50 seats)
The Two Scared Hearts Collage	S. High School	1478	1	Taxi, Private Car &64 Buses (45-50 seats)
Al Nasser for Boys	Public School	790	2	Taxi & Private Car
Tripoli Hadadeen High School	Public School	456	35	Taxi & Private Car
Tripoli High School for Girls	Public School	697	11	Taxi & Private Car
Malaab Tripoli High School	Public School	665	27	Taxi & Private Car
Tripoli El-Qubba High School	Public School	647	21	Taxi & Private Car
Complementary Tabanna School	Public School	1140	30	Taxi & Private Car
Abou Feerass El-Hamadani School	Public School	711	22	Taxi & Private Car
El-Marounieh Zeitoune Branch	Private	314	20	Taxi, Private Car & 3 Buses (25-30 seats)
Lebanese University	Public		23	Taxi & Private Car
Lebanon University Engineering Branch	Public		23	Taxi & Private Car
Fine Arts Institute	Public		23	Taxi & Private Car
Lebanon University Literature & Human	Public		23	Taxi & Private Car
St. Juseph University	Private		47	Taxi & Private Car

Figure 1.10-2 shows the distribution of school trip times for the different transport modes. As can be noticed, the private cars characterized with a very short time about 15 minutes in average. Taxi average trip time is about 20 minutes. School bus average trip time is about one hour. It seems that the bus trip journey time severely affected by the repeatedly stopping and moving for boarding or un-boarding of students.

Figure 1.10-3 presents the fare of taxi charge per month. In average the taxi charge per month can be estimated about 13,000 LL (9 US$). This charge seems to be very cheap if compared with the city service taxi fare that is 500 LL/one ride from terminal and 1000 LL/one ride outside the terminal. The estimated charge if the student will makes two trips per day under 500 LL fare in a month will be about 25,000 LL. This last value is almost double the average shared taxi charge per one month.

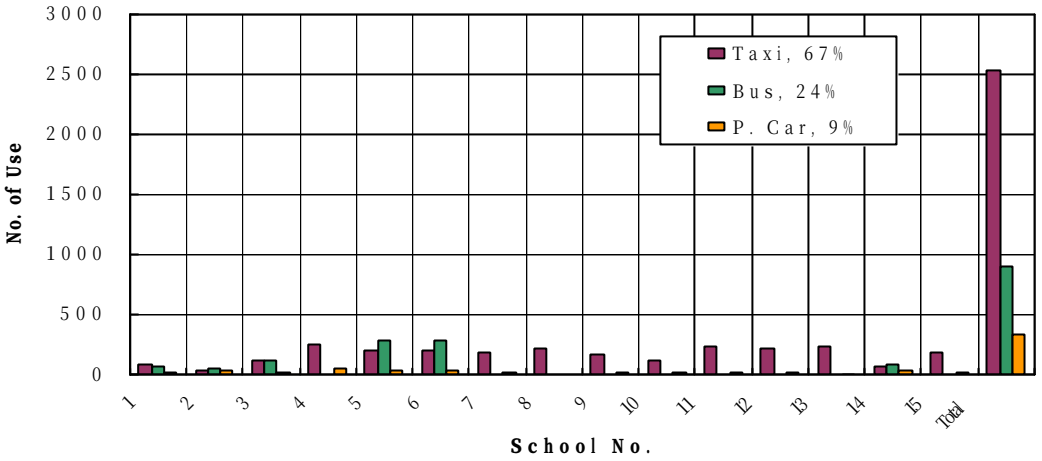


Figure 1.10-1 Distribution of Transport Modes

The assessment of bus school charges is presented in Figure 1.10-4. The average charge is about 280,000 LL (190 US$)/year. The school year includes about 8 months and that means the cost per one month in average is about 35,000 LL (23.3US$) that is higher by more than twice than the taxi charge. This figure gives an explanation why the taxi share is high. It must be recognized also that the level of schools having this facility of services is classified under the high level education institutes.

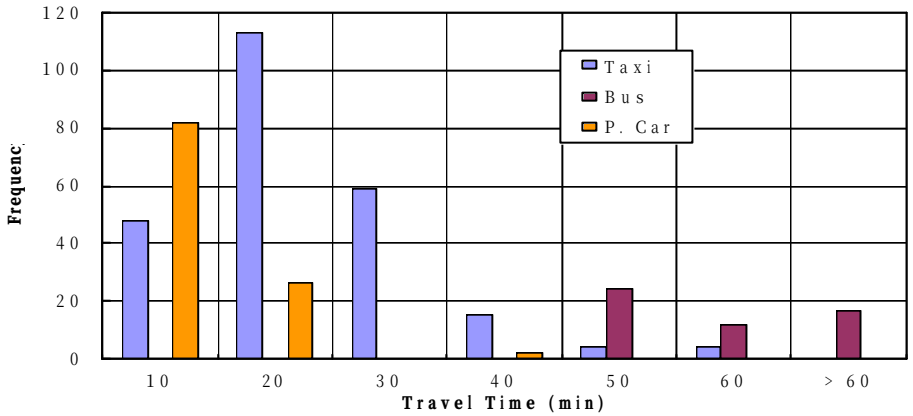


Figure 1.10-2 Trip Times of Different Transport Modes

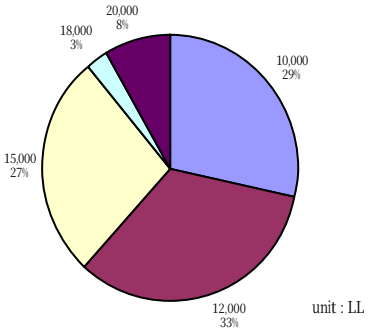


Figure 1.10-3 Shared Taxi Charge/Month

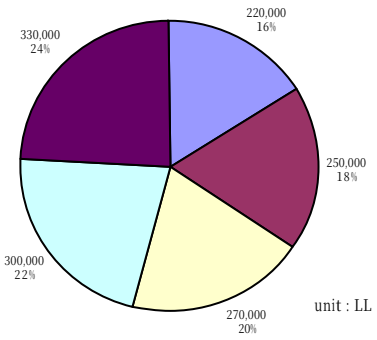


Figure 1.10-4 School Bus Charge/Year

1.11 PRESENT OD MATRICES

- Based on the traffic surveys undertaken, the present OD matrices were prepared comprising:
- Present person trip OD by trip purpose and transport mode
- Present vehicle OD by vehicle type

Present desire line is shown in Figure 1.11-1. Present OD pattern is summarized as follows:

- Downtown (zone 3 and 4), Old City (zone 6), El-Mina (zone 1) and New Tripoli (zone 2) are attracting trips from other zones.
- Trips between above mentioned zones are heavy due to concentration of economic and social facilities in these zones.
- Through traffic (between zone 22 and 25) is not so heavy yet.

1.12 PRESENT TRAFFIC VOLUME

Result of traffic assignment is shown in Figure 1.12-1. Traffic volume on major roads is as presented in Table 1.12-1.

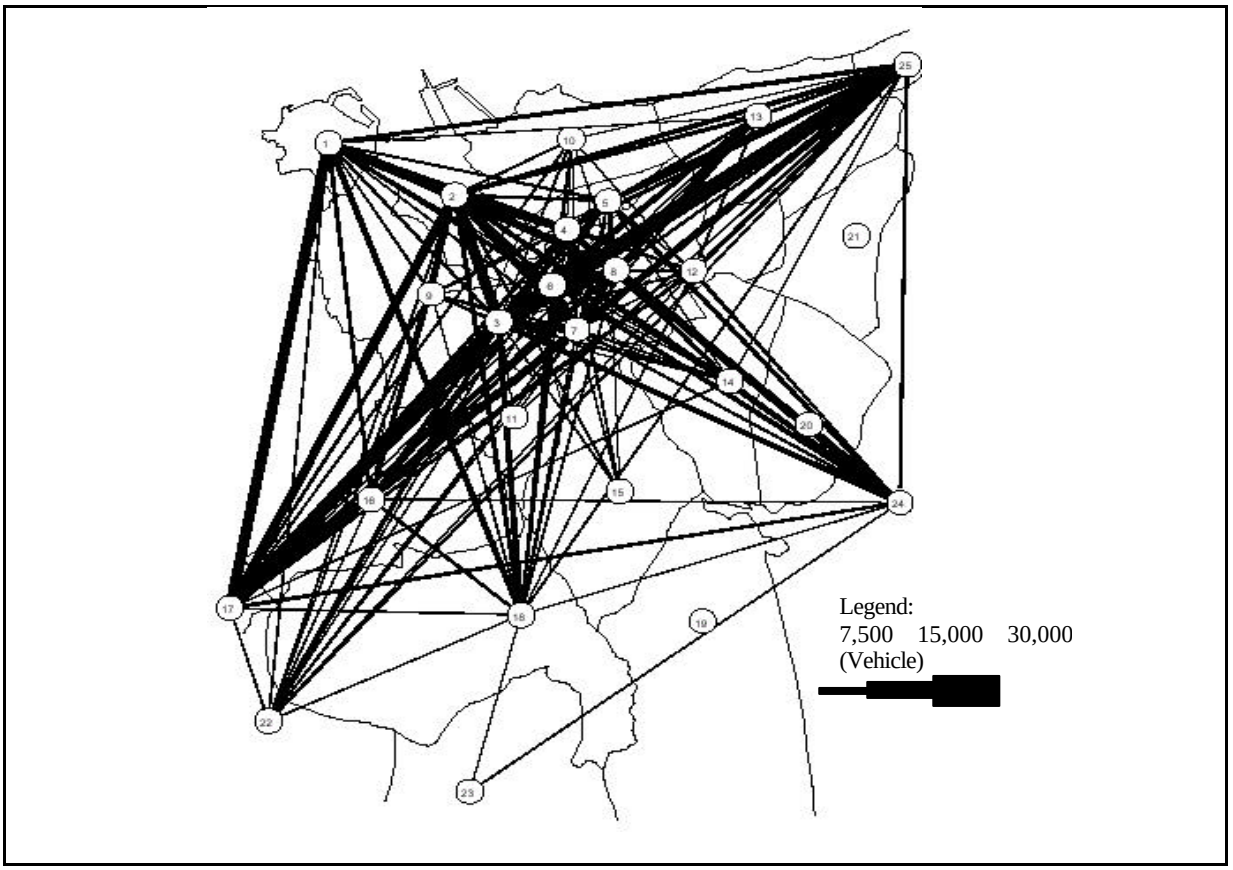


Figure 1.11-1 Present Desire Line

Table 1.12-1 Traffic Volume on Major Roads

Road Name	Traffic Volume (veh./day)
Tripoli Boulevard	35,000 – 40,000
El-Mina Street	18,000 – 24,000
Tripoli – Sir El-Danie Road	7,000
Tripoli – Ehden Road	12,000
Ras-Maska – Kousha Road	12,000
Beirut – Tripoli Motorway	30,000

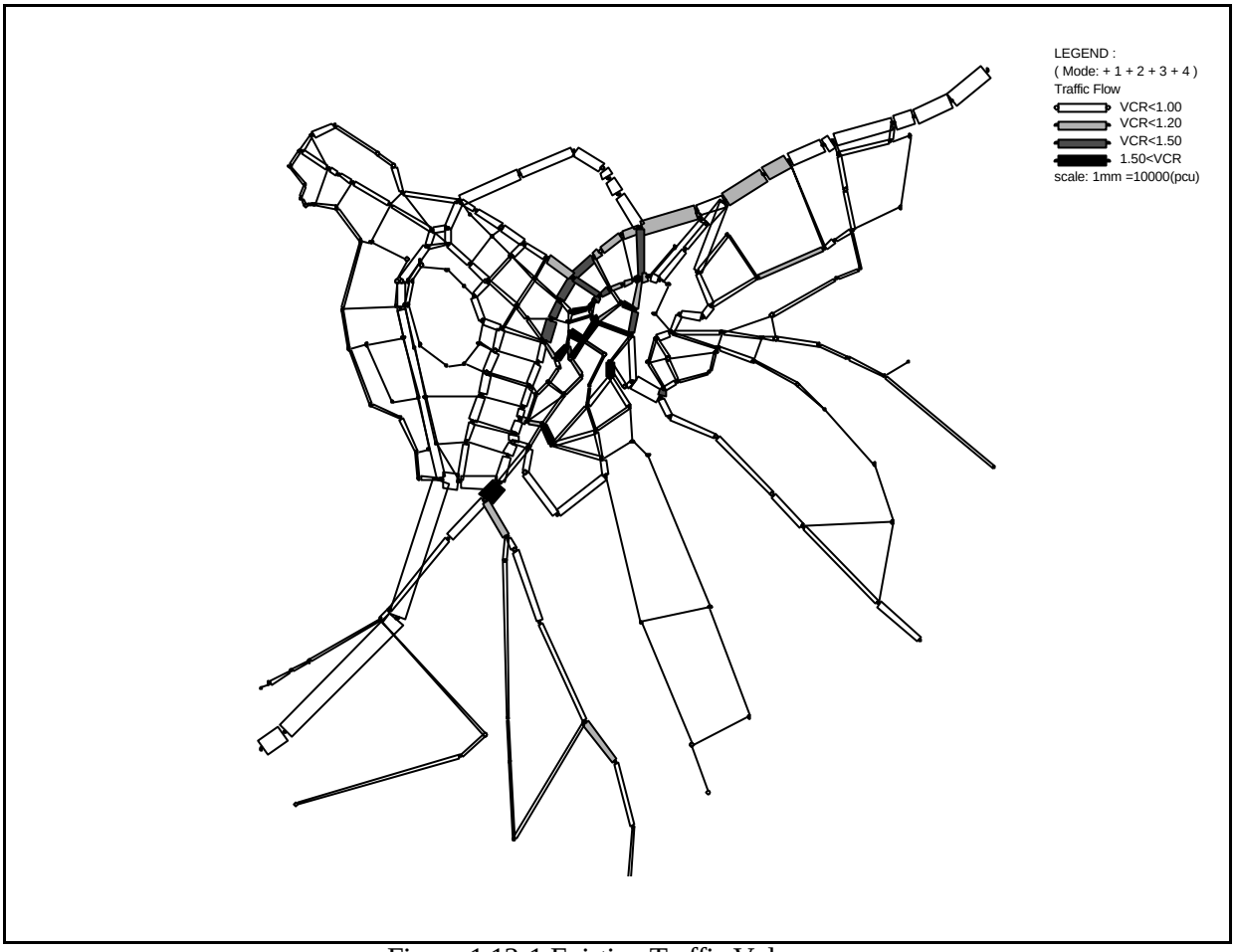


Figure 1.12-1 Existing Traffic Volume