TRAFFIC SURVEYS.

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SCHOOL OF ENGINEERING

PROJECT REPORT

AMERICAN UNIVERSITY OF BEIRUT

TRAFFIC SURVEYS

THESIS
1953

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DRS.

PREFACE

This thesis is intended to be used in making traffic surveys in main municipalities near the proposed speedway (between Beirut and Damascus) to determine the amount of traffic that would be expected from feeder boulevards; also to set a standard for traffic surveys in these municipalities and the like in the Middle East.

The assistance of the Consulting Engineers to the project--" The Beirut-Damascus Turnpike "-- is gratefully acknowledged.

I am indebted particularly to Mr. Issam Minkarah, my classmate, for his suggestions and for the help he has offered in locating some of the reference books.

Beirut, Lebanon

April 27, 1953.

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TRAFFIC ENGINEERING

As a general rule, cities with a population of 250,000 or more can support a full-time, well-staffed traffic engineering department; cities with a population of between 100,000 and 250,000 can justify the services of at least one full-time trained traffic engineer; cities with a population of less than 100,000 may find it necessary to combine traffic engineering functions with those of the city engineer, the city planner, or engineering official.

Since the traffic engineer's job is that of making the best use of existing street facilities, he is concerned with the regulation of the flow of traffic through the use of signs, signals, safety zones, pavement lane markings, segregation of passenger car and truck traffic, stop-streets, one-way streets, speed limitations, parking regulations, off-street parking facilities, driver and pedestrian education, and the enforcement of traffic regulations.

The improvements in traffic flow that can be accomplished through these devices can be obtained promptly at slight cost. Every urban community is well advised to utilize traffic engineering to secure the best possible use of its existing street system. Indeed, only after this first step in traffic improvement has been taken should the community attempt to measure the need for major improvements in its street system.

TRAFFIC SURVEYS

A traffic survey furnishes the information required by a traffic engineer as a basis for his work. Much of this information is required by the city planner, also, and can be made even more valuable if the traffic engineer and the city planner jointly develop the program for the survey. Since traffic changes are constantly taking place with each change in the street system; in the use of abutting property, in the design of motor vehicles, and so on, periodic traffic surveys are required. Periodic surveys furnish a basis for an understanding of trends in the growth and distribution of traffic which is essential to a prediction of future traffic loads on the street system.

A complete traffic survey will analyze existing state and local legislation for the regulation of traffic and enforcement methods and activities; will show the location of truck routes, parkways, stop streets, one-way streets, and the like; of traffic signals, signs, safety zones, accidents and accident hazards; the location and extent of parking facilities; the speeds, loads, and other characteristics of vehicles being operated over the streets; and, perhaps most important of all, a series of traffic counts which, properly organized, will show the extent and character of the traffic flow. The movements of different types of vehicles, rates of speed, causes and extent of delays, and origin and destinaton of traffic will be identified.

Although street traffic has hourly, daily, and seosonal variations of consequence, it is not necessary to carry on counts for twenty-four hours a day over the period of a year at all counting stations. Procedures have been developed for short traffic counts which produce findings of sufficient [illegible] accuracy for all practical purposes at a moderate cost. It is desirable that those who make traffic surveys file with their reports an outline of procedures followed to facilitate interpretation by those who may wish to use the data in future years.

From the information obtained through a traffic survey, a traffic engineer will be able to identify points of difficulty and to recommend steps that may be taken to reduce traffic delays, congestion and accidents. These recommendations may include such measures as better enforcement of existing traffic regulations, the designation of routes for the by-passing of central contested districts by through traffic, modifications in the routing of traffic through complicated intersections, improvements in the regulation of parking and of street loading and unloading,establishment of one-way streets, changes in the location or timing of street traffic signals, and the like.

<u>Purposes of Traffic Surveys</u>. The principal purposes of traffic surveys may be listed as follows:

1. Determination of priority of improvement.
2. Determination of controlling features of design.
3. Budgeting of funds for constuction, reconstruction, and maintenance.
4. Allocation of funds, particularly motor-vehicle funds, to various highway systems.
5. Scheduling of construction and maintenance operations.

Character and Amount of Information Secured.

The character and amount of information to be secured in any traffic survey will depend upon the purposes to be served and upon available funds for the work. A traffic survey may be made on one or several roads or streets only or may embrace all or part of the area of a city, metropolitan area, or county; in othor cases it may be conducted on all or a part of a definite highway system.

The basic information desired from almost every traffic survey is the number of vehicles passing a given point in a given length of time, or the density of the traffic. This information can be secured by observation of the traffic with no interference with the movement of vehicles. A traffic survey involving only observation of vehicles often is described as a taffic census. Highway vehicles generally are classified into five or six groups:

(1) private passenger cars,	(4) streetcars,
(2) trucks,	(5) motorcycles,
(3) buses, and	(6) horse drawn vehicles.

In some surveys (5) and (6) are not imcluded. Trucks frequently are subdivided into groups according to size, normal load capacity, type, or legal classification. Trailers sometimes are considered part of the vehicle to which they are attached and in other cases are listed seperately. Additional information which generally is obtained by observation includes the percentage of out-of-state vehicles in each vehicle group; sometimes the direction of travel is noted, and the proportion of local and non-local vehicles is obtained. The number of passengers may be noted, and a general classification of trucks with reference to commodities hauled may also be made.

If more detailed information is desired, it is necessary to stop vehicles and interview the drivers. If traffic is heavy, only a percentage of the vehicles is stopped. A postcard, to be filled out by the driver and mailed at destination, often is used to avoid delays to vehicles when the information sought cannot be obtained in a short space of time. This additional information may embrace numerous items related to highway transportation; among the items often secured are origin and destination, purpose of trip (business or pleasure), commodities carried, annual travel mileage, gasoline consumption, and trip time. In some cases vehicles are weighed.

Survey Stations. Survey stations are classified into two groups:

(1) primary or control stations, and

(2) secondary or limited-count stations.

Primary stations may be observation or sampling stations (including weighing stations); generally secondary stations are observation stations.

Survey stations require careful selection, and a knowledge of local conditions is essential to insure accuracy, particularly in the selection of control stations and corresponding secondary stations. Stations generally are selected at intersections because they are locations of changes in traffic and because they offer opportunities of counting traffic on sevral roads at the same time. Control stations and secondary stations should be established on the basis of the class of road (e. g., main county highways, land-service roads, street thoroughfares, residential streets) and the characteristics of the area served; the type of road frequently should be taken into consideration.

Recording Traffic Survey Data.

Traffic survey data is obtained by manual observation and by automatic countbing machines. These machines measure traffic density only; and manual observation is necessaary if any form of traffic classification is to be obtained. Automatic traffic counters are very useful in establishing traffic patterns, particularly on rural highways.

Traffic survey data obtained by manual observations are recorded usually on printed forms assigned to show the information desired. Figure 1 shows a simple form used for recording traffic density on a county highway system by hourly periods for 16-hour daily traffic counts. Figure 2 shows a more elaborate form for recoding traffic density on a statewide highway traffic survey. Vehicles usually are recorded by means of a mark for each unit, but hand-operated counting devices sometimes are necessary for heavy traffic. Studies of origin, destination, andownership of vehicles, nature of commodities hauled, trip and annual mileages, and other data are recorded on interview forms and on forms distributed to motorists for completion and mailing.

Duration and Frequency of Observations.

The continuous observation of traffic for each hour of the day is a costly procedure (I won't do it myself for 30 L.L. a day, after I tried it for few hours during the vacation.)and is unnecessary for the determination of reasonably accurate results. The continuous observation of traffic at some control stations by means of automatic recording machines may be desirable, but manual observations are made for short periods of time at regular intervals.

The "key station plan" developed by the U.S. Public Roads Administration for state-wide traffic studies conducted in the period from 1929 to 1935 is described by H.E.Cunningham as follows:*

" The key station schedule was designed to determine the amount of total traffic flow expressed as average daily 24-hour traffic. The plan required seven 8-hour coutsfrom 6 A.M. to 2 P.M.,seven 8-hour counts from 2 P.M. to 10 P.M., and from three to four 8-hour counts from 10 P.M. to 6 A.M. The total of 17 or 18 counts made in this manner were spaced systematically thoughout a year period so as to produce balanced data with respect to hourly, daily, and seasonal variations and to furnish a complete brakdown by vehicle types. A typical arrangement of a key station schedule is given in the following table.

Table 1.

Typical "key Station" Schedule for Highway Traffic Counts (According to H.E.Cunningham, Highway Engineer Economist, U.S. Public Roads Administration, Proceedings, Highway Research board, Vol.25, P.329 (1945))

Between the Hours of 6 A.M. to 2 P.M.		Between the Hours of 2 P.M. to 10 P.M.	
Date	Day	Date	Day
Jan. 10	Wed.	Feb. 5	Mon.
Mar. 3	Sat.	Mar. 29	Thurs.
Apr. 24	Tues.	May 20	Sun.
June 15	Fri.	July 11	Wed.
Aug. 6	Mon.	Sept. 1	Sat.
Sept. 27	Thurs.	Oct. 23	Tues.
Nov. 18	Sun.	Dec. 14	Fri.

*Abstracted from Proceedings, Highway Research Board, Vol. 25, pp. 329-342 (1945).

This schedule maintains a systemtic spacing of 26 daysbetween counts, and all days of the week are represented in both the morning and after noon periods. Bet ween successive couts on the same day of the week there is an exact 6-month spacing, thus providing a seasonal balancing of the data, Average daily 16-hour traffic is first computed by adding the figures for the 14 counts and dividing the total by 7. The night counts are then included, after making any adjustment that may be necessary for missing days, and average daily 24-hour traffic computed from the combined data.

The accuracy of the key station schedule in estimating average daily 24-hour traffic has been found to be within about 2.8 per cent of the true mean. Experience with the schedule has also proved its adaptability to ordinary working hours and travel conditions."

Studies of short count methods in a number of locations have demonstrated their feasibility, especially for Secondary stations.

Compilation of Data. The data obtained from a traffic survey are compiled by means of various summaries and visual charts.

Traffic flow diagrams show visually the density of traffic on a highway or street system. Figure 3 shows traffic flow diagram for a street intersecton in which traffic volumes are plotted asbands whose widths are proportional to the amount of traffic.

Traffic distribution diagrams are useful in studying average and maximum traffic volumes at various times and for various periods of time. Thse diagrams are useful in studying average and maximum traffic volumes and are frequently called traffic patterns and may illustrate numerous traffic conditions. They are particularly useful in the design of highways, in the selection of type of wearing surface, in planning maintenance operation, and in the control of traffic. Figures 4 and 5 illustrate hourly and daily traffic patterns.

Capacity of Roads.

(1) Theoretical. The width of a single traffic lane on a straight road has been standardized at 10 feet, or three meters. A normal road consists of two or more such lanes. The theoretical capacity of each lane is worked out in terms of the number of vehicles that can pass a given point upon it within one hour.

A thouroughfare uninterrupted by cross-roads has a very high traffic capacity —a capacity which reaches its maximum when there is a uniform flow of vehicles at a certain uniform speed. Tests made indicate that some speed between 17 and 27 m.p.h. (probably about 23) is the most favorable, being the highest at which vehicles can conveniently and safly run in close succession. At higher speeds the intervals must be increased (for reasons of safety), and the number of vehicles passing the point of enumeration is thus reduced, It is computed in fact that, at double the most favorable speed, the number of vehicles is reduced by thirty per cent . At slower speeds, the lessening of the distance between succeeding vehicles does not offset the reduction due to a smaller number of vehicles passing the point in a given time.

A rough idea of the number of vehicles which theoratically, given perfect conditions, could pass a given point in one hour is shown in the table that follows. This number must obviously vary according to the distance between the vehicles which can only be given as an approximation.

Speed of Vehicles in miles per hour (m.p.h.).	Distance Apart in yards.	Number of Vehicles passed in 1 hour.
5	1	1,467
10	2	2,514
12	3	2,640
15	4	2,933
20	4	3,911
25	5	4,400
30	8	4,061
35	12	3,624

Given ideal conditions, therefore, it can be computed that each traffic lane on a road could accomodate over 4,000 vehicles per hour. In practice, of course, ideal conditions do not obtain; vehicles do not run at uniform speeds, performance and braking efficiency vary, the capabilities of drivers differ, and all urban areas there very considerableinterruption by reason of cross-roads, junctions, standing vehicles, horse-drawn or slow moving traffic, pedestrians, etc. Account, therefore, must be taken of thesefactors.

Where intersections are frequent, the capacity of the road is governedby the capacity of the intersections. Take for example a straight road in some modern city where the layout is rectangular. Let us assume that each lane in the road (having regard to the disparity of vehicle-speeds, etc.) has a maximum accommodation of 2,500 vehicles per lane per hour, of that the times of stoppage at each cross-road are standardised by means of traffic signals at each intersection which allow the following periods:

For the main streets	35 seconds
For the cross-streets	25 seconds
A period of 3 seconds of amber at each change, viz.	6 seconds/cycle
	66 seconds

In such circumstances the traffic, in the main streets, is running only 35 seconds out of every 66 seconds; the traffic capacity is thereby reduced by 47 per cent, and it is usual to allow a further 10 per cent for the loss of speed incurred through stopping and starting. On that basis the total reduction works out at 57 per cent, thus yielding a reputed capacity of approximately 1,075 vehicles per lane per hour - a capacity which applies only, of course, to lanes unencumbered by standing vehicles. If there are standing vehicles, a still further reduction will occur. In a six-lane main street which has a continuous row of standing vehicles on each side, the average capacity of each lane of the street as a whole must be reduced theoratically by 33 per cent, but in practice the reduction is much greater on account of the delays due to the weaving of three streams of traffic into two. In addition, if vehicles are delayed through promiscuous crossing on the part of pedestrians, the capacity is reduced still further. The ultimate figure might therefore be brought down very much lower, even indeed to the neighbourhood of 400 vehicles per lane per hour.

(2) Actual Volumes Recorded. Densities of between 650 and 800 vehicles (exclusive of pedal cycles) per lane per hour are of daily occurrence in some of the really busy streets in towns. In Inner London, the volume seldom exceeds 600 vehicles per lane per hour which is also true about Beirut. Under exceptional circumstances, high figures can be reached; densities of over 1,170 vehicles per lane per hour were recorded (exclusive of pedal cycles).

Preparation and Presentation of Statistics.

When figures are about to be assembled, three points are of essential importance: (1) That a sufficiently large number of cases shall be taken to make the statistics representative. (2) That the mthods used for collecting the figures shall be on a uniform basis. (3) That all parties concerned in obtaining or preparing the figures shall have been fully instructed.

Statistics as to Circulation. The number of vehicles registered can always be ascertained from the registration authorities, but knowledge as to the extent to which vehicles are actually on the road can only be obtained by means of a traffic census. The main objects of such an enumeration are:

(a) to provide Highway Authorities with reliable data for their improvement schemes;

(b) to register the points of congestion;

(c) to ascertain the increase or diminution of traffic at various points in order to arrange - where necessary for alternative routeing, imposition of regulations, etc.

General Census. A census in its simplest form merely serves the purpose of determining the number of vehicles, classified under various heads, which pass certain recording stations (See Fig. 1). Little preperation is needed: instructions are issued to the enumerators as to the precise positions which they are to occupy, and mill-boards and spring clips are supplied to hold the forms.

The best method of enumeration is generally found to be on the "gate" principle, i.e. four vehicles are indicated by downward strokes (working from left to right), and the fifth vehicle by a diagonal stroke across the preceding four strokes. In this way I̸III I̸III II indicates that twelve vehicles have been counted. A record of the weather is kept hour by hour, e.g. fine, dull, showery, rain, etc.

Use has been made in America of automatic traffic counters to obtain accurate checks of traffic volume on highways. The machine prints the day, the hour and the cumulative total of passing vehicles. It operates on the photo-electric cell principle. The defect, of course, is that the apparatus cannot differentiate between the seperate classes of vehicles.

Transportation Survey. Transportation serveys, as taken in the United States of America, are of a very elaborate character and include even such details as the place of ownership of vehicles, the total distance of travel, the number of passengers, the commodities transported, the place of origin and destination, weight, size of tyres, etc. From earlier transportation surveys it was deduced that the larger part of the total traffic was local. The through traffic was as low as 2 per cent in some areas, though it was as high as 46 per cent in certain resort areas. Two-thirds of the passenger car journeys were found to be less than 60 miles and three-fourths of the goods vehicles journeys were less than 30 miles.

Origin and Destination Surveys. This type of survey is carried out by several methods:

(1) By issue of printed pre-paid post-cards to drivers passing certain points. Drivers are asked to insert the name of the place to which they are going and to post the card. Exact results are clearly not possible by this method, but approximate information of a useful character can be obtained.

(2) By the " license-plate " method. This is only practicable in simple road systems: the license plate numbers are taken by observers at various points in the system and records are compared.

(3) The " car-interview " method. This is carried out by stopping a percentage of vehicles in the outskirts of the town and obtaining details. Survey of this kind in the United States of America has indicated (as might be expected) that the proportion of traffic in the vicinity of a town, and intending to enter that town, is likely to increase with the size of the town. In other words, the traffic approaching a small town is predominantly through traffic, but the traffic approaching a really large town is almost entirely bound for that town. The proportion of town-bound to **through-traffic** varies with the population of the town.

(4) By the "house to house " method. As practised in the United States of America the city concerned is first divided into zones and enquiries are made of a certain proportion of the householders and residents and also of the registered lorry drivers and taxi-cab drivers. The person interviewed is asked to give details of all the journeys made on the previous day and also of the routes taken, the times, stops and reasons for any delays.

Use of Statistics. Measures for increasing public safety or for the improvement of traffic circulation must as faras possible be based upon ascertained fact. Facts in turn can often be established by means of intelligent and correct deductions from statistics. At the same time, the ease with which statistics can be misread is proverbial. Not only must correct deductions be drawn from the statistics but correct use must be made of them, no individual deduction being artificially separated from others that may be equally relevant.

Special care is required when dealing with figures in regard to traffic circulation. In deciding, for example, whether a particular junction is busier than another junction and stands consequently in greater need of improvement, it is not sufficient to compare the total number of vehicles passing through the respective junctions during 24 hours. The peak hour traffic is the most relevant, and even this should, of course, be considered in relation to the number of traffic lanes at each junction. The types of traffic using the junction should also be taken into account, for a preponderance of slow-moving vehicles will considerably reduce the rate of flow. Seperate account of pedal cyclists must be taken in all cases, as the cycles occupies so verymuch less space than a car or lorry.

In the reading of all comparative statistics, particular care is required to ensure that like is compared with like, and that full allowance is made for all variables.

Misuse of Statistics. Statistics, however impartially compiled, can notoriously be twisted to suit the ends of the theorist. Even more common is the placing of misconstructions upon good statistics by means of careless inference. An example of rash assumption has reference to women drivers. Statistics showed that 4 per cent of the drivers involved in fatal accidents in 1933 were women, while the number of women holding driving lecendes was 12 per cent of the total. From these two statistical facts the Press almost with one voice deduced the conclusion that women were better drivers than men. In point of fact no basis for accurate comparison had been afforded, that basis obviously being the number of road hours or road miles performed respectively by women and men. It is no use to compare a woman who drives a few hours weekly with a commercial motor or omnibus driver who drives all day every day and often in the most difficult and accident producing areas. Examples of misuse of statistics could be indefinitely mutltiplied.

Sound statistics are a presentation of impartial fact. If deliberately assembled to support any particular theory they are suspect at once. The task of the statistician has thus been described: "His job is to keep his mind clear of preconceived ideas, to treat his data scientifically and impartially and to exclude nothing relevant, to minimise nothing and to magnify nothing".

OUTLINE FOR A COMPREHENSIVE GENERAL TRAFFIC SURVEY

I. Legal Phases

a. Statutes

b. State traffic code

c. Local ordinances

(1) City

(2) Coordination with regulations in neighboring local political units.

II. Traffic Regulatory Methods and Devices

a. Maps showing

(1) arterials

(2) one-way streets

(3) boulevards

(4) truck routes

(5) transit lines

(6) et cetera

b. Signals, signs, safety zones, etc.

(1) maps showing types, locations, etc.

c. Traffic enforcement methods and activities

d. Speed, signal, and sign observance by vehicles and by pedestrians

III. Traffic Flow

a. Pedestrian counts in congested districts

b. Vehicular counts

(1) passenger cars

(2) trucks, truck trailers

(3) motor buses

(4) trolley-buses

(5) street cars

(6) turning movements by each type of vehicle at each important intersection

c. Traffic flow data, charts, and maps

d. Hourly, daily, and seasonal variations

e. Examination of data from previous surveys and analysis of changes

IV. Safety Studies

a. Devices to promote safety

b. Accident areas

(1) accident spot maps

(2) railroad crossings

(3) heavy pedestrian crossings

(4) school crossing

(5) "worst intersection" studies--condition and collision diagrams

c. Types of traffic accidents

d. Analysis of accident causes

V. Capacity Studies in Congested Areas

a. Volume carried in each lane

b. Causes and extent of delays

(1) due to interference by cross traffic

(i) vehicles on cross streets

(ii) pedestrians crossing against traffic

(iii) pedestrians crossing with traffic

(2) due to marginal interference

(i) parking

(ii) loading and unloading at curb

(iii) vehicles entering parking lots, etc.

(3) due to internal interferences

(i) weaving from lane to lane

(ii) Lanes too narrow

(iii) rough pavement, steep grades, etc.

(iv) slow moving vehicles

(v) obstuctions such as loading platforms, safety islands, elevated railway pillars.

(vi) cars moving in opposite directions

(4) due to regulatory system

c. Effects of one-way streets.

d. Effects of street system features

(1) bridges, tunnels, viaducts, etc.

(2) dead-end-streets

(3) roadway and sidewalk widths

(4) curb radii

(5) variation in block lengths

(6) irregular intersections

VI. Parking survey -- street and off-street parking facilities and their use

VII. Transit Studies

VIII. Characteristics of Vehicles of Different Types

a. Speeds

(1) average, minimum, maximum

(2) acceleration anddeceleration

b. Sizes of vehicles and loads

c. Load characteristics

d. Methods of operation

IX. Source and Destination Surveys

a. Through traffic in congested areas

b. Foreign traffic

c. Homes to places of employment

d. Factory trucking

e. Residence of owners of parked cars in congested area -- traced from license numbers.

Station No. | Traffic Density | Date
Location

Hours	Passenger Cars	Buses	Trucks	Total Vehic.
A.M. 6-7				
7-8				
8-9				
9-10				
10-11				
11-12				
P.M. 12-1				
1-2				
2-3				
3-4				
4-5				
5-6				
6-7				
7-8				
8-9				
9-10				
Totals				

Remarks
Weather

Observers

Fig. 1. Simple form for recording traffic density; when used at intersections, one form may be used for each approach; foreign traffic may be recorded on separate forms or by means of colored pencils or a different symbol.

Traffic Survey
Density Report
Primary Stations

Station No. Weather Date 195 Day County
Route No. To Direction From Station Hours 6 A.M. To 2 P.M.

Hours	Pedestrians or Bicycles	Local Vehicles: Passenger Cars	Trucks: Light	Medium	Heavy	Tractor-Tr.	Truck-Trailer	Buses: School	Other	Foreign Vehicles: Pass. Cars	Trucks: Light	Medium	Heavy	Tractors	Trucks with Trailers	Buses	Total
6-7																	
7-8																	
8-9																	
9-10																	
10-11																	
11-12																	
12-1																	
1-2																	
Totals																	
Route No.		To						Direction From Station									
P.M. 2-3																	
3-4																	
4-5																	
5-6																	
6-7																	
7-8																	
8-9																	
9-10																	
Totals																	

Truck classification — Light, $1\frac{1}{2}$ ton or less; Medium $>1\frac{1}{2}<5$ tons; Heavy, >5 tons.

Visit by Supervisor
or Manager Name Hour of Visit Signed

Fig. 2. Form used for recording traffic density on a state highway system.

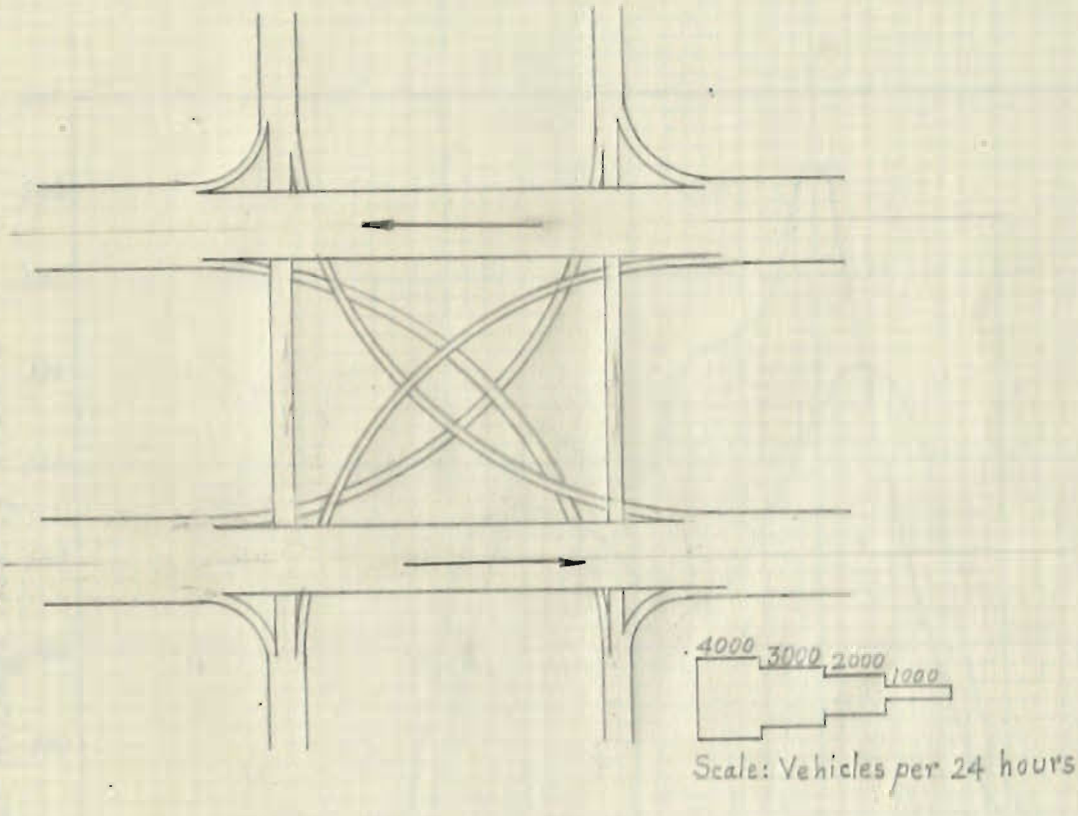

Fig. 3. Traffic flowdiagram for a city street intersection.

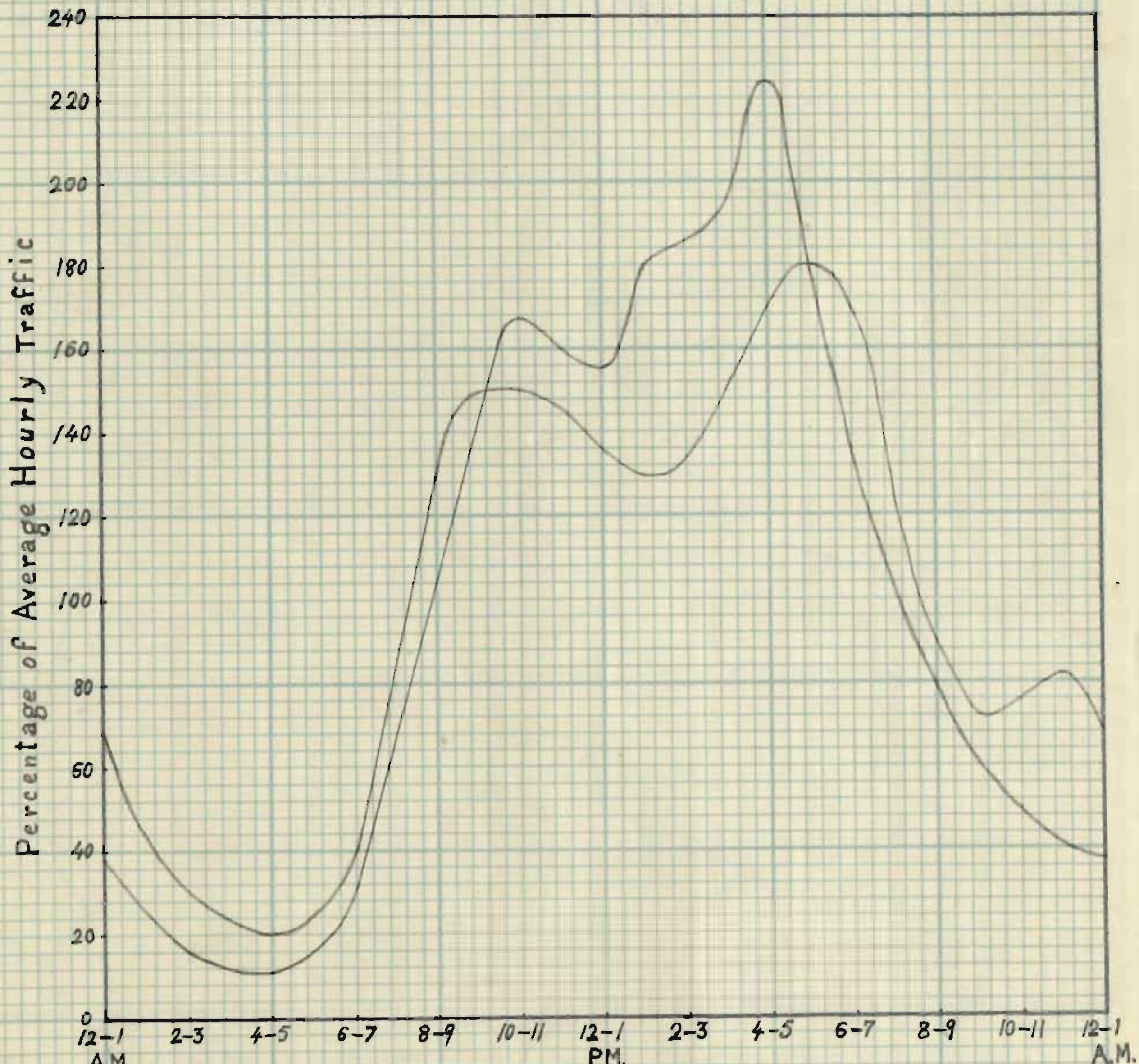

Fig. 4. Diagram illustrating hourly variation in highway traffic.

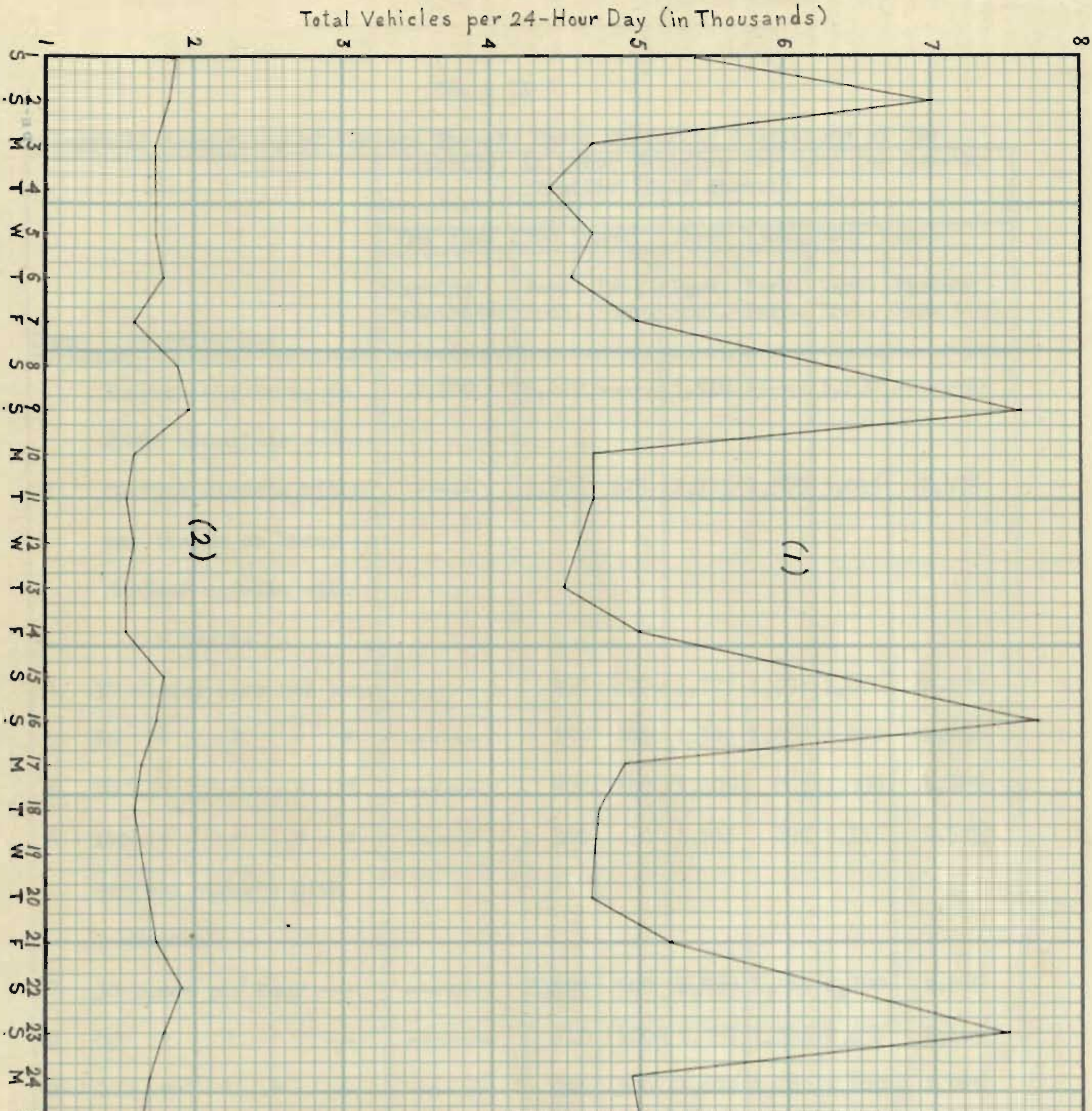

Fig. 5. Daily traffic on two primary highways.

Table II

Automobile Capacities of Various Streets Under Differing Conditions of Use

Item	Descriptions	Capacity, in Motor Vehicles Per Hour for One-Way Traffic (Half Street)						
		One lane	Two lanes		Three lanes		Four lanes	
		Parking Prohibited	Park. Proh.	Park. Perm.	Park. Proh.	Park. Perm.	Park. Proh.	Parking Permitted
1	Express highways, no grade crossings ------	1,500	2,670	-----	3,510	-----	3,900	--------
2	Surface streets, without car tracks or buses --	-----	1,215	675	2,115	1,575	3,015	2,475
	Surface streets with car tacks:							
3	30 street cars per hour	------	940	420*	1,775	1,235	2,670	2,135
4	60 " " " "	------	755	280	1,590	1,050	2,490	1,950
5	90 " " " "	------	570	140	1,405	865	2,305	1,765
6	120 " " " "	------	380	0	1,215	675	2,115	1,575
	Surface streets with buses:							
7	30 buses per hour ---	------	1,025	500	1,890	1,365	2,790	2,265
8	60 " " " ---	-------	910	400*	1,755	1,245	2,655	2,145
9	90 " " " ---	------	795	300	1,620	1,125	2,520	2,025
10	120 " " " ---	------	680	200	1,485	1,005	2,385	1,905
11	150 " " " ---	------	565	100	1,350	885	2,250	1,785
12	180 " " " ---	------	380	0	1,215	720	2,115	1,620

*True in Beirut, after few hours-counts taken by me during Eastern vacation.

Source: Hawly S. Simpson, "Use and Capacity of City Streets," Transactions of the American Society of Civil Engineers, 1934, p. 1025.

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