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16. Abstract

The objective of this project is to identify unique causal factors controlling accidents experienced on crosswalks of intersections on oneway street networks. Identification of these causal factors will help local traffic engineers and policy makers to accomodate these unique characteristics in planning, controlling or redesigning oneway street networks. However, if the causal factors are only vehicle related, specific proposals for vehicle modifications will be made to the National Highway Traffic Safety Administration (NHTSA) or other appropriate agencies for possible action.

The pedestrian-vehicle incidences addressed by this project is "Why left-turning vehicles are at least twice as probable to strike a pedestrian in a crosswalk than right-turning vehicles". The New York City Police accident file was used in the analysis to determine these appropriate causal factors.

The report provides analysis which indicates the various causal factors; the primary factor is driver visibility. This visibility is primarily associated with: vehicle design and configuration, and lighting. The report presents detailed guidelines for further investigation.

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Unclassified	Unclassified	62	

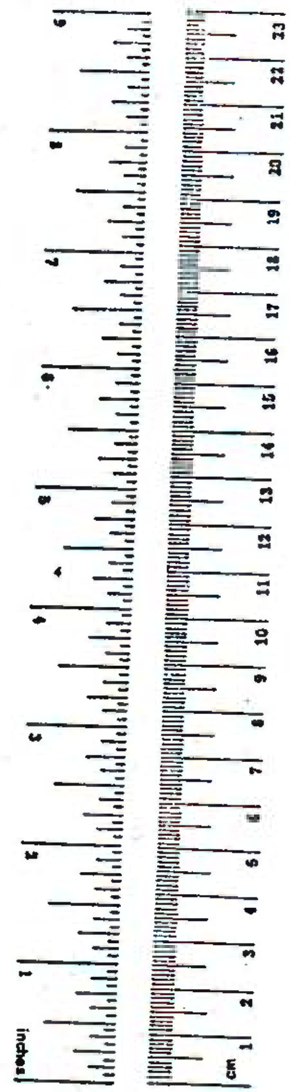
Form DOT F 1700.7 (8-72)

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

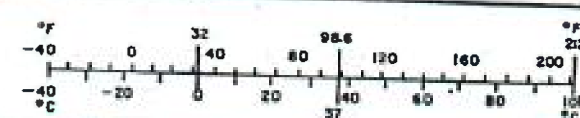
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in ≡ 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



EXECUTIVE SUMMARY

The aspect of pedestrian safety that this project addresses is: on a one-way system, preliminary evidence indicates that pedestrians in crosswalks are hit about twice as often by vehicles making left-turns than vehicles making right-turns. That is, pedestrian accident experience in the crosswalk where pedestrians share the green with left-turning vehicles is significantly higher than in the crosswalk where the pedestrians share the green with right-turning vehicles.

In England, where the driver's seat is located on the right, the crosswalk where pedestrians share the green with the right-turning traffic has an accident experience twice that of the crosswalk where the pedestrians share the green with left-turning vehicles. The question "why should a left-turning vehicle be twice (at least) as probable to strike a pedestrian in a crosswalk than a right-turning vehicle?" will be addressed in this study.

The objective of this research is to identify the unique causal factors controlling accidents experienced on different crosswalks of intersections on one-way street networks. Identifying these causal factors will help local traffic engineers and policy makers accommodate these unique characteristics in planning, controlling or redesigning one-way street networks.

RESEARCH TECHNIQUE

A basic component of our approach to this research involved the establishing and collection of data at a set of intersections for which a complete set of accident records were available. Test intersections of the same operation and geometric characteristics were selected. In addition, one long section of arterial,(20 or more blocks)was also evaluated. Geometric characteristics, parking regulations, pedestrian and traffic movements, crosswalk orientation with respect to the sun, and other intersection attributes were documented for each test intersection. All intersections were located in Manhattan, selected for its large one-way street network.

The pedestrian-accident experience on the conflict crosswalks was collected for each test intersection for a period of a little more than four years (1972-early 1976). The time of accidents, the characteristics of the pedestrian (e.g., age, etc.), the model of the vehicle, the cause of the accident -- such as the pedestrian and/or the driver (vehicle) actions and other pertinent information that contributed to pedestrian accidents at street intersections -- were extracted from the accident files. The study also employed manual tallies of pedestrian and vehicle movements at test intersections. A moving-car experiment at intersections that have the highest accident frequency was conducted with the aid of a movie camera.

Information on traffic accidents was acquired from the New York City Police Department. Other sources were the New York City Traffic Department and from the project study team that did the pedestrian and traffic movement tallies. The following table summarizes the data used.

STRUCTURE OF GENERAL DATA BASE

Precinct Number
Accident Number
Date
Time (military)
Day of the Week
Number Killed
Number Injured
Primary Street Code
Intersecting Street Code
Weather and Road Condition
Action of Pedestrian
Age Group of Pedestrian
Apparent Cause - Vehicle #1
Apparent Cause - Vehicle #2
Primary Street - Alphabetic Name
Intersecting Street - Alphabetic Name
Direction - Vehicle
Direction - Pedestrian
Action of Vehicle #1
Action of Vehicle #2

ADDITIONAL DATA FOR TEST INTERSECTIONS

Vehicle Year (last 2 digits)
Vehicle Model
Vehicle Body Type
Sex of Driver
Sex of Pedestrian
Residency of Driver
Residency of Pedestrian
Light Condition
Seat Belts
Type of Injury
Type of Physical Complaint
Traffic Volumes *
Pedestrian Volumes *
Parking Regulations *

* Field Inventory Data

ANALYSIS AND RECOMMENDATIONS

The basic analysis procedure was to compare attributes of left-turning accidents and from right-turning accidents. Where differences could be identified for a particular attribute, measures were put forward that attempt to remedy the situation, either through implementation or future research. The following are some of the findings.

Non-Contributing Factors

The following is a listing of factors that do not contribute to explaining the difference between left and right-turning accidents

- Pedestrian Age
- Day of Week and Month of Day
- Curbside Parking Regulations
- Length of Crosswalk
- Pedestrian Actions

Contributing Factors

The following is a listing of factors that explain some of the differences between left and right-turning accidents.

- Lighting
- A-Pillar Visibility Limitations
- Driver Habits
- Signal Placement

Recommended Countermeasures

The following outlines the proposed recommended countermeasures that address the above mentioned contributing factors.

(1) Extensive driver education to improve awareness of hazardous left-turning maneuvers.

(2) Redesign of vehicle to improve sight angles. Optimum condition is design where left-turning sight angles are the same as right-turning sight angles. Also recommended is an elimination of vent-window design and increased windshield wiper area.

(3) Additional traffic signal should be placed above the turning crosswalk at the far side of the intersection in order to improve driver's target detection and to increase eye contact.

(4) Improved lighting; a clear sidewalk 50 feet upstream of intersection; a 12 to 15 foot parking lane; and a 3 foot indentation (into the block) of the turning crosswalk are all recommended environmental changes.

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CHAPTER I

PROJECT REVIEW AND OBJECTIVES

The aspect of pedestrian safety that this project addresses is: on a one-way system, preliminary evidence indicates that pedestrians in crosswalks are hit about twice as often by vehicles making left-turns than vehicles making right-turns.(1,3) That is, pedestrian accident experience in the crosswalk where pedestrians share the green with left-turning vehicles is significantly higher than in the crosswalk where the pedestrians share the green with right-turning vehicles (see Figure 1).

In England, where the driver's seat is located on the right, the crosswalk where pedestrians share the green with the right-turning traffic has an accident experience twice that of the crosswalk where the pedestrians share the green with left-turning vehicles (2) (also see Appendix 1). The question "why should a left-turning vehicle be twice (at least) as probable to strike a pedestrian in a crosswalk than a right-turning vehicle?" will be addressed in this study.

The objective of this research is to identify the unique causal factors controlling accidents experienced on different crosswalks of intersections on one-way street networks. Identifying these causal factors will help local traffic engineers and policy makers accommodate these unique characteristics in planning, controlling or redesigning one-way street networks. Should the causal factors only be vehicle-related, specific proposals will be made to the National Highway Traffic Safety Administration (NHTSA) or other appropriate agencies.

Identifying the causal factor(s) will identify the actions to be taken:

- Develop preliminary design to improve a causal condition.
- All "design" work will depend on the identification of the causal factor(s).
- Develop a usable plan that can be applied to urban areas in short-term future.
- It may be necessary to design an education program to be inputted into drivers education courses and State Motor Vehicle manuals to make new drivers aware of the problem.
- Identify further research needs based on project findings.

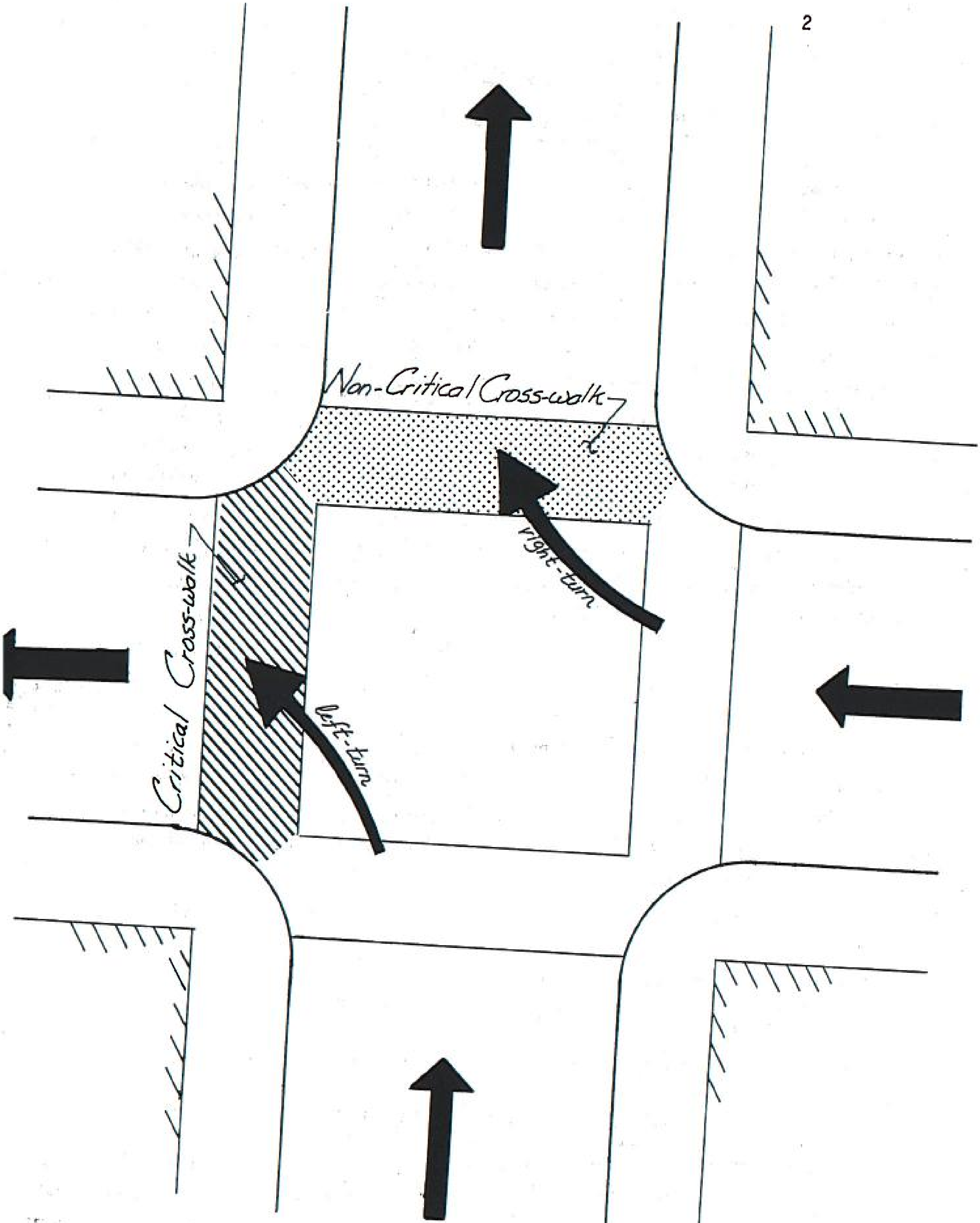


FIGURE 1. ONE-WAY INTERSECTION LAYOUT

RESEARCH TECHNIQUE

A basic component of our approach to this research involved the establishment and collection of data at a set of intersections for which a complete set of accident records were available. Test intersections of the same operation and geometric characteristics were selected. In addition one long section of arterial, 20 or more blocks was also evaluated. Geometric characteristics, parking regulations, pedestrian and traffic movements, crosswalk orientation with respect to sun, and other intersection attributes were documented for each test intersection. All intersections were located in Manhattan, selected for its large one-way street network.

The pedestrian-accident experience on the conflict crosswalks was collected for each test intersection for a period a little more than four years (1972-early 1976). The time of accidents, the characteristics of the pedestrian (e.g., age, etc.), the model of the vehicle, the cause of the accident--such as the pedestrian and/or the drivers (vehicle) actions and other pertinent information that contributed to pedestrian accidents at street intersections-were extracted from the accident files.

The study also employed manual tallies of pedestrian and vehicle movements at test intersections. A moving-car experiment at intersections that have the highest accident frequency was conducted with the aid of movie cameras.

The data collected was evaluated in an attempt to identify one or more of the following as the causal factors of pedestrian-vehicle incidences at intersections:

- Roof-support impedance to visibility.
- Approach speed of turning vehicle.
- Parking regulations.
- Illumination of intersection.
- Climatic conditions.
- Intersection geometrics.
- Intersection control.
- Others.

Information on traffic accidents was acquired from the New York City Police Department. Other sources were the New York City Traffic Department and from the project study team that did the pedestrian and traffic movement tallies.

REPORT ORGANIZATION

The remainder of this report is organized into three components. Chapter 2 presents the actual data collected and analysis of accidents of a large data set and their subsequent causal factors. Chapter 3 presents analyses of the data at the selected intersections and shows comparison between the accidents involving left-turning vehicles, through and right-turning traffic. Chapter 4 deals with conclusions and recommendations.

CHAPTER 2

DATA INVENTORY

The approach to this work task in regard to the problem addressed by this study necessitated obtaining pedestrian accident data for a period of at least three years. The following data elements were desired to help accomplish the investigation requirements:

- The time and cause of accidents and other related information as extracted from accident reports, insurance claims and/or hospital records.
- Geometric characteristics, parking regulations, pedestrian and traffic counts, crosswalk orientation with respect to the sun and other intersection attributes with documentation for each test intersection;
- The make-model and model year of vehicle involved, roof support identification, i.e., the driver's obscured field of view; and
- The characteristics of the pedestrians involved in the accident, i.e., age, sex, physical condition, etc.

Information on pedestrian-vehicle accidents for the period 1972 to early 1976 was supplied by the New York City Police Department. Manhattan, New York City was selected for this pedestrian safety study because it is one of the most densely populated cities in the United States and has a grid pattern of street systems, most of which is one-way.

The NYCPD provided data for all accidents in Manhattan over the 1972 early 1976 period. From this data, pedestrian accidents at signalized intersections were extracted to form a subset. A review of this subset indicated that there were selected precincts primarily in the midtown and downtown areas, where the one-way grid street system was dominant. Thus a project study area was derived.

SELECTION OF STUDY AREA

The project study area is located in Mid-Manhattan bordered by 110th Street on the North, Franklin D. Roosevelt Drive (FDR) on the East, Houston Street on the South, and the West-Side Highway from Houston Street to 59th Street and Eighth Avenue from 50th Street to 110th Street on the West. This area also includes Manhattan Police Precincts 4, 6, 9, 10, 13, 14, 17, 18, 19 and 23 (see Figure 2). There were 2217 pedestrian accidents of interest at approximately 730 intersections in this project study area.

PRELIMINARY SELECTION OF ARTERIALS AND INTERSECTIONS

A representative north-south arterial within the project study area was also selected and analyzed with regard to traffic flow characteristics and pedestrian accident history. Accident data at each intersection along this arterial was aggregated to represent an overall view of pedestrian-vehicle accident occurrence over a length of the arterial. This evaluation supplemented the analyses at selected intersections. The selection of the arterial was based on:

- Frequency of left-turn pedestrian-vehicle accidents.
- Mileage of arterial which passes through residential and commercial district
- Number of sensitive locations bordering the arterial; e.g., school, hospitals, etc.

First and Second Avenues have the highest occurrence of left-turn pedestrian-vehicle accidents. In addition, these two avenues traverse similar land use - high density residential and commercial - and both are bordered by several schools and hospitals.

The selection of Second Avenue between 34th Street and 58th Street as a representative arterial was made because of its highest frequency of left-turn pedestrian-vehicle accidents. This section is bordered by seven schools and one hospital.

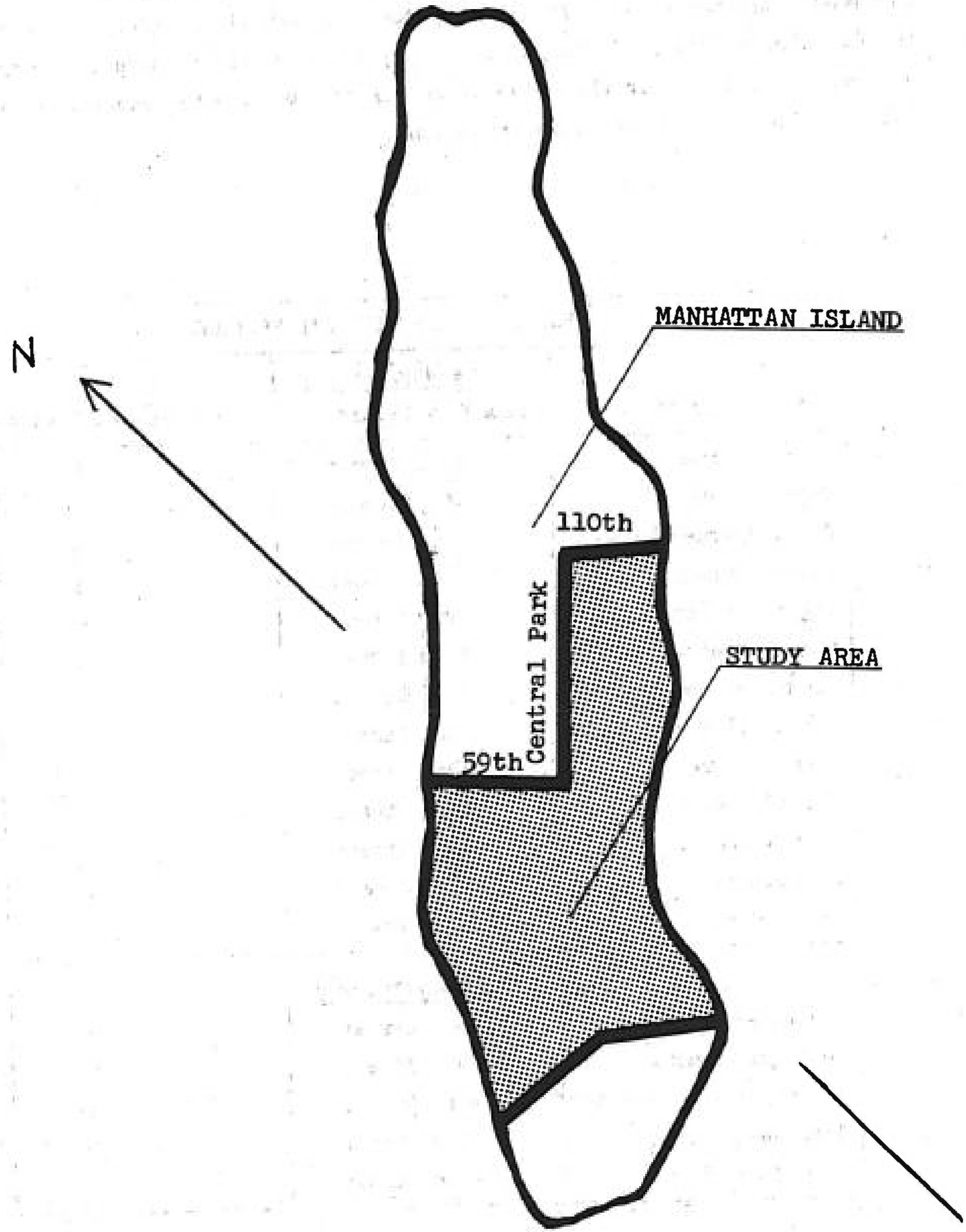


FIGURE 2. PROJECT STUDY AREA

In addition to the arterial section, eighteen intersections were selected for study throughout the project area. These eighteen intersections involved a minimum of four left-turn pedestrian-vehicle accidents throughout the duration of the analysis period. They included 13 in which both streets are one-way and five in which one street is one-way and the other two-way. Table 1 identifies these 18 intersections.

TABLE 1 -- SELECTED INTERSECTIONS

Primary Street	One-Way/One-Way Secondary Street	Left-Turn Accidents
First Avenue	59th Street	7
Eighth Avenue	49th Street	7
First Avenue	4th Street	5
Second Avenue	49th Street	5
Eighth Avenue	40th Street	5
Eighth Avenue	55th Street	5
Avenue of the Americas	21st Street	4
Avenue of the Americas	51st Street	4
First Avenue	12th Street	4
Second Avenue	14th Street	4
Second Avenue	58th Street	4
Second Avenue	59th Street	4
Fifth Avenue	60th Street	4
	One-Way/Two-Way	
Second Avenue	86th Street	9
Lexington Avenue	34th Street	4
Avenue of the Americas	42nd Street	4
Broadway	57th Street	4
Second Avenue	42nd Street	4

DATA ELEMENTS

The accident data used in this project was taken exclusively from the standard NYCPD accident forms (See Figure 3). Three data sets were developed for the analysis procedure. These are defined below:

Study Area Data Set - All intersection pedestrian accidents in the study area as shown in Figure 2 during the analyses period - 2217 accidents.

Test Data Set - All intersection pedestrian accidents at the 43 test intersections, 225 accidents.

Combined Data Set - All intersection pedestrian accidents at the 43 test intersections plus all other right-turn pedestrian accidents from the study area data base - 455 accidents.

The basic information provided on computer tapes by the New York City Department of Traffic in the study area data set did not include some important variables. Therefore, after selecting the test intersections, hard copies of the accident report forms were retrieved and additional information appended to the information already on the study area data set. A test data set was thereby developed. Table 2 shows the elements comprising each data set.

The need for the combined data set was to have more right-turn accident samples, due to their relative scarcity in the test data set. It was assumed that there are no differences between the characteristics of the right-turn accidents of the study area and of the test intersections. The combined data set was used where the number of right-turn accidents from the test data base was too small to provide meaningful comparisons with left-turn accidents in specific analyses.

Table 3 is a segregation of the data elements for the pedestrian/vehicle accident system. It should be noted again that all accidents occured at signalized intersections.

PEDESTRIAN LOCATION (1)
1. Pedestrian at Intersection
2. Pedestrian Not at Intersection

PEDESTRIAN ACTION (2)
1. Crossing, With Signal
2. Crossing, Against Signal
3. Crossing, No Signal, Marked Crosswalk
4. Crossing, No Signal or Crosswalk
5. Walking Along Highway With Traffic
6. Walking Along Highway Against Traffic
7. Emerging from in Front of/Behind Parked Vehicle
8. Child Getting On/Off School Bus
9. Getting On/Off Vehicle Other Than School Bus
10. Pushing/Working On Car
11. Working in Roadway
12. Playing in Roadway
13. Other Actions in Roadway*
14. Not in Roadway (Indicate)*

TRAFFIC CONTROL (3)
1. None
2. Traffic Signal
3. Stop Sign
4. Flashing Light
5. Yield Sign
6. Officer/Flagman/Guard
7. No Passing Zone
8. RR Crossing Sign
9. RR Crossing Flashing Light
10. RR Crossing Gates
20. Other*

APPARENT CONTRIBUTING FACTORS
1. None

HUMAN
2. Alcohol Involvement
3. Backing Unsafely
4. Driver Inattention (Indicate)*
5. Driver Inexperience (Indicate)*
6. Drugs (Illegal)
7. Failure to Yield Right-of-Way
8. Fell Asleep
9. Following Too Closely
10. Illness
11. Lost Consciousness
12. Passenger Distraction
13. Passing or Lane Usage Improper
14. Pedestrian's Error/Confusion
15. Physical Disability
16. Prescription Medication
17. Traffic Control Device Disregarded
18. Turning Improperly
19. Unsafe Speed
40. Other*

VEHICULAR
41. Accelerator Defective
42. Brakes Defective
43. Headlights Defective
44. Other Lighting Defects
45. Oversized Vehicle
46. Steering Failure
47. Tire Failure/Inadequate
48. Tow Hitch Defective
49. Windshield Inadequate
60. Other*

ENVIRONMENTAL
61. Animal's Action
62. Glare
63. Lane Marking Improper/ Inadequate
64. Obstruction/Debris
65. Pavement Defective
66. Pavement Slippery
67. Shoulders Defective/Improper
68. Traffic Control Device Improper/Non-Working
69. View Obstructed/Limited
80. Other*

Vehicle 1 (19) — Vehicle 1 (20) — Vehicle 2 (21) — Vehicle 2 (22)

LAND USAGE OF ACCIDENT LOCALITY (4)
1. School/Playground
   If No School/Playground Select One Below
2. One/Two Family Residential
3. Apartment Residential
4. Business/Shopping
5. Industrial/Manufacturing
6. Agricultural/Undeveloped
7. Recreational/Park/Camping

State of New York
Department of Motor Vehicles

POLICE ACCIDENT REPORT (N.Y.C.)

MV-104AN (1/74)

* EXPLAIN IN ACCIDENT DESCRIPTION

IF A QUESTION DOES NOT APPLY, ENTER A DASH (—).

IF AN ANSWER IS UNKNOWN, ENTER AN "X"

DIRECTION OF TRAVEL

N, E, S, W — 1, 2, 3, 4, 5, 6, 7, 8

Vehicle 1 (23) — Vehicle 2 (24)

ROADWAY CHARACTER (5)
1. Straight and Level
2. Straight and Grade
3. Straight at Hillcrest
4. Curve and Level
5. Curve and Grade
6. Curve at Hillcrest

ROADWAY SURFACE CONDITION (6)
1. Dry
2. Wet
3. Muddy
4. Snow/Ice
5. Slush
10. Other*

WEATHER (7)
1. Clear
2. Cloudy
3. Rain
4. Snow
5. Sleet/Hail/Freezing Rain
6. Fog/Smog/Smoke
10. Other*

LOCATION OF MOST SEVERE PHYSICAL COMPLAINT
1. Head
2. Face
3. Eye
4. Neck
5. Chest
6. Back
7. Shoulder-Upper Arm
8. Elbow-Lower Arm-Hand
9. Abdomen - Pelvis
10. Hip-Upper Leg
11. Knee-Lower Leg-Foot
12. Entire Body

PRE-ACCIDENT VEHICLE ACTION
1. Going Straight Ahead
2. Making Right Turn
3. Making Left Turn
4. Making U Turn
5. Starting from Parking
6. Starting in Traffic
7. Slowing or Stopping
8. Stopped in Traffic
9. Entering Parked Position
10. Parked
11. Avoiding Object in Roadway
12. Changing Lanes
13. Overtaking
14. Merging
15. Backing
20. Other*

Vehicle 1 (25) — Vehicle 2 (26)

LOCATION OF FIRST EVENT (27)
1. On Roadway
2. Off Roadway

WHICH VEHICLE OCCUPIED
1. Vehicle No. 1
2. Vehicle No. 2
B. Bicyclist
P. Pedestrian
O. Other*

POSITION IN/ON VEHICLE
1. Driver
2–7. Passengers
8. Riding/Hanging On Outside

1 2 3 / 4 5 6 / 7 / 8

SAFETY EQUIPMENT USED
1. No Restraint Used
2. Lap Belt
3. Harness
4. Lap Belt and Harness
5. Child Restraint
10. Other*

EJECTION FROM VEHICLE
1. Not Ejected
2. Partially Ejected
3. Ejected

TYPE OF PHYSICAL COMPLAINT
1. Amputation
2. Concussion
3. Internal
4. Minor Bleeding
5. Severe Bleeding
6. Minor Burn
7. Moderate Burn
8. Severe Burn
9. Fracture - Dislocation
10. Contusion - Bruise
11. Abrasion
12. Complaint of Pain
13. None Visible

VICTIM'S PHYSICAL AND EMOTIONAL STATUS
1. Apparent Death
2. Unconscious
3. Semiconscious
4. Incoherent
5. Shock
6. Conscious

TYPE OF ACCIDENT

COLLISION WITH
1. Other Motor Vehicle
2. Pedestrian
3. Bicyclist
4. Animal
5. Railroad Train
10. Other Object (Not Fixed)*

COLLISION WITH FIXED OBJECT
11. Light Support/Utility Pole
12. Guide Rail
13. Crash Cushion
14. Sign Post
15. Tree
16. Building/Wall
17. Curbing
18. Fence
19. Bridge Structure
20. Culvert/Head Wall
21. Median/Barrier
22. Snow Embankment
23. Earth Embankment/Rock Cut/Ditch
24. Fire Hydrant
30. Other Fixed Object*

NON-COLLISION
31. Overturned
32. Fire/Explosion
33. Submersion
34. Ran Off Roadway Only
40. Other*

First Event (28)

SECOND EVENT — Vehicle 1 (29) — Vehicle 2 (30)

8 — 9 — 10 — 11 — AGE 12 — SEX 13 — 14 — 15 — 16

INJURED TAKEN: 17 BY — TO 18

FIGURE 3. ACCIDENT REPORT FORM 1 OF 2

MV-104AN 1/74 Page _____ of _____ Pages

State of New York – Department of Motor Vehicles

POLICE ACCIDENT REPORT (N.Y.C.)

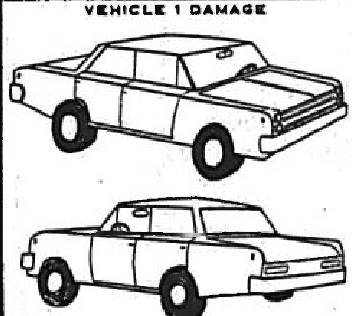
PRECINCT

ACCIDENT NO.

ACCIDENT DATE MO / DA / YR	DAY OF WEEK	TIME (MILITARY)	NUMBER OF VEHICLES	NO. INJURED	NO. KILLED	NON-HIGHWAY ☐	NOT INVESTIGATED AT SCENE ☐	LEFT SCENE ☐	POLICE PHOTOS YES ☐ NO ☐

VEHICLE 1	VEHICLE 2
LAST NAME DRIVER 1 / FIRST NAME / MIDDLE INITIAL	LAST NAME DRIVER 2 / FIRST NAME / MIDDLE INITIAL
NUMBER AND STREET	NUMBER AND STREET
CITY / STATE / ZIP CODE	CITY / STATE / ZIP CODE
DATE OF BIRTH MO / DA / YR / SEX / UNLICENSED ☐ / NUMBER OF OCCUPANTS / PUBLIC PROPERTY DAMAGED ☐ / DMV USE	DATE OF BIRTH MO / DA / YR / SEX / UNLICENSED ☐ / NUMBER OF OCCUPANTS / PUBLIC PROPERTY DAMAGED ☐ / DMV USE
LAST NAME OWNER 1 / FIRST NAME / MIDDLE INITIAL	LAST NAME OWNER 2 / FIRST NAME / MIDDLE INITIAL
NUMBER AND STREET	NUMBER AND STREET
CITY / STATE / ZIP CODE	CITY / STATE / ZIP CODE
PLATE NUMBER / YEAR & VEHICLE MAKE / VEHICLE TYPE / INS. CODE	PLATE NUMBER / YEAR & VEHICLE MAKE / VEHICLE TYPE / INS. CODE

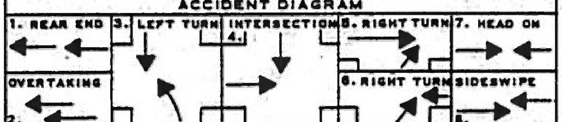
VEHICLE 1 DAMAGE



NO DAMAGE ☐ UNDERCARRIAGE ☐

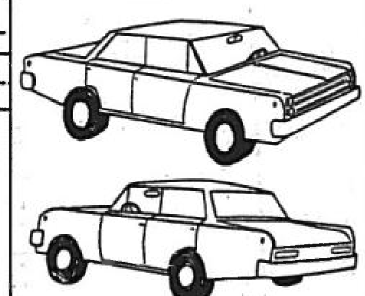
VEHICLE TOWED BY TO

ACCIDENT DIAGRAM



9.

VEHICLE 2 DAMAGE



NO DAMAGE ☐ UNDERCARRIAGE ☐

VEHICLE TOWED BY TO

REFERENCE MARKER | LOCATION CODE | COUNTY | ADDRESS/LANDMARKS AT SCENE

ROUTE NO. OR STREET NAME ON _____ ☐ MILES ☐ FEET ☐ N ☐ S ☐ E ☐ W OF ☐ AT INTERSECTION WITH ROUTE NO. OR STREET NAME

TICKET/ARREST OPR 1 ☐ OPR 2 ☐ PEDESTRIAN ☐ OTHER ☐ | TICKET/ARREST NUMBER(S) | VIOLATION SECTION(S) | COMPLAINT NO.

ACCIDENT DESCRIPTION

ALL INVOLVED	8	9	10	11	12	13	14	15	16	17	18	NAMES OF INJURED — IF DECEASED ALSO INCLUDE DATE OF DEATH
A												
B												
C												
D												
E												
F												
G												

SIGN HERE — OFFICER'S RANK AND NAME	BADGE NO.	DEPARTMENT	PRECINCT/TROOP/ZONE	STATION/POST/BEAT/SECTOR	REVIEWING OFFICER	DATE/TIME REVIEWED
		03030				

TABLE 2 - STRUCTURE OF DATA BASE

Test Data Set

Study Area Data Set

Combined Data Set

DATA ELEMENTS
Precinct Number
Accident Number
Date
Time (military)
Day of the Week
Number Killed
Number Injured
Primary Street Code
Intersecting Street Code
Weather and Road Conditions
Action of Pedestrian
Age Group of Pedestrian
Apparent Cause - Vehicle
Apparent Cause - Pedestrian
Primary Street - Alphabetic Name
Intersecting Street - Alphabetic Name
Direction - Vehicle
Direction - Pedestrian
Action of Vehicle #1
Action of Vehicle #2
Vehicle Year
Vehicle Model
Vehicle Body Type
Sex of Driver
Sex of Pedestrian
Residency of Driver
Residency of Pedestrian
Light Condition
Seat Belts
Type of Injury
Type of Physical Complaint

TABLE 3 - PEDESTRIAN/VEHICLE ACCIDENT SYSTEM

Pedestrian	Vehicle
Action of Pedestrian	Apparent Cause - Vehicle
Age Group of Pedestrian	Direction - Vehicle
Apparent Cause-Pedestrian	Action of Vehicle
Direction of Pedestrian	Vehicle Year *
Sex of Pedestrian *	Vehicle Model *
Residency of Pedestrian *	Vehicle Body Type *
Type of Injury	
Type of Physical Complaint *	
Number Killed	
Number Injured	
Driver	**Environment**
Sex of Driver *	Precinct Number
Residency of Driver *	Date
Seat Belts *	Time
	Day of Week
	Primary Street Code/Name
	Intersecting Street Code/Name
	Weather and Road Conditions
	Light Conditions *

* Appended data for test intersections

It should be noted that, especially for the appended data elements shown in Table 3, reporting on the accident forms was not always done, thereby further reducing data elements for specific analyses.

GENERAL DESCRIPTION OF DATA BASE

The following section provides selected summaries of the 2217 records for the project area. These are presented to assist in a general description of the utilized data. All tables present below do not distinguish between the various turning accidents. This is addressed in detail in Chapter 3.

The annual number of pedestrian accidents within the study area for the period 1972 to early part of 1976 is summarized in Table 4. Table 5 indicates the trend in accidents by months . There is a significant rise from September through November leading to a peak during the Christmas shopping month of December. On the whole this period through the winter is the season of highest accidents.

Tables 6 and 7 relates the number of accidents to the time of day and day of week. They illustrate that the highest incidence occurs during the evening rush-hour. The day of week data coincides with the standard daily traffic volume distribution.

In terms of weather conditions, most accidents occurred in clear dry weather. Rain and clear wet conditions followed far behind with other conditions scarcely represented (see Table 8).

based on pedestrian-vehicle volume as determined by exposure rate method, shows that the frequency of accident involvemnt of left-turning vehicles is not influenced by different exposure as the sum of all left-turn exposure rates is almost the same as the sum of all right-turn exposure rates Thus, the accident problem being evaluated does not stem from an imbalance of pedestrian and vehicle movements at intersections in the study area.

In addition to these counts super 8 mm movies were taken while driving in the study area. Filming offered a valuable supplement to the statistical data collected. Time lapse photography (at 0.5 sec. and 1.0 sec. intervals) as well as continuous filming was used to try to simulate driver perception under normal driving conditions (Figure 3A) Time lapse photography helped illustrate how crossing pedestrians can go unnoticed to the driver, or be within the driver's blocked arc of vision (primarily blocked by roof support) while taking his eyes off the road for a half-second or one second (simulates the driver glancing at a traffic signal or other distractions).

SUMMARY

The combined accident record data, field inventory counts and limited filming provided the research team with the quantitative elements to procede with the conduct of the study. Chapter 3 presents all evaluations of these data elements.

TABLE 4 -- YEAR OF ACCIDENT		
Category Label	Absolute Frequency	Relative Frequency (percent)
1972	638	28.8
1973	549	24.8
1974	487	21.9
1975	539	24.3
1976	4	0.2
TOTAL	2,217	100.0

TABLE 5 -- DATE OF ACCIDENT		
Category Label	Absolute Frequency	Relative Frequency (percent)
January	191	8.6
February	214	9.7
March	223	10.1
April	198	8.9
May	194	8.8
June	159	7.2
July	129	5.8
August	131	5.9
September	163	7.4
October	184	8.3
November	200	9.0
December	231	10.4
TOTAL	2,217	100.0

TABLE 6 -- (MILITARY) TIME OF ACCIDENT		
Category Label	Absolute Frequency	Relative Frequency (percent)
12:00 Midnight	58	2.6
1:00 A.M.	42	1.9
2:00 A.M.	28	1.3
3:00 A.M.	21	0.9
4:00 A.M.	18	0.8
5:00 A.M.	7	0.3
6:00 A.M.	11	0.5
7:00 A.M.	33	1.5
8:00 A.M.	96	4.3
9:00 A.M.	111	5.0
10:00 A.M.	95	4.3
11:00 A.M.	120	5.4
12:00 Noon	169	7.6
1:00 P.M.	138	6.2
2:00 P.M.	134	6.0
3:00 P.M.	169	7.6
4:00 P.M.	164	7.4
5:00 P.M.	182	8.2
6:00 P.M.	138	6.2
7:00 P.M.	127	5.7
8:00 P.M.	107	4.8
9:00 P.M.	88	4.0
10:00 P.M.	88	4.0
11:00 P.M.	72	3.2
12:00 Midnight	1	0.0
Total	2,217	100.0

TABLE 7 -- DAY OF WEEK ACCIDENT OCCURRED

Category Label	Absolute Frequency	Relative Frequency (percent)
Sunday	177	8.0
Monday	342	15.4
Tuesday	336	15.2
Wednesday	351	15.8
Thursday	356	16.1
Friday	383	17.3
Saturday	272	12.3
Total	2,217	100.0

TABLE 8 -- WEATHER AND ROAD CONDITIONS

Category Label	Absolute Frequency	Relative Frequency (percent)
Clear-Dry	1,608	72.5
Clear-Wet	115	5.2
Clear-Ice/Snow	21	0.9
Rain-Wet	409	18.4
Rain-Ice/Snow	7	0.3
Snow-Wet	23	1.0
Snow-Ice/Snow	15	0.7
Fog-Wet	6	0.3
Muddy	1	0.0
Freezing Rain-Ice/Snow	5	0.2
Other	7	0.3
Total	2217	100.0

Table 9 provides a description of the "situation" preceeding the accident. Most pedestrian accidents at the intersections occur when pedestrians cross with signal, implying that they are turning accidents. This is a surprisingly large percentage.

For several reasons pedestrian initiated actions, as determined by the traffic police, were a "contributing circumstance" in a majority of pedestrian-vehicle accidents (Table 10). The pedestrian "failure to yield to vehicle" when combined with other "pedestrian's Action" provides a category that exceeds all others for reported data. On the vehicular side, the driver's judgement, rather than mechanical failure, is indicated by the data as being the major contributing circumstance (see Tables 9 and 10).

The action of vehicles prior to accident clearly shows that vehicles making a left turn at an intersection are more prone to incidence with a pedestrian in the crosswalk as compared to a vehicle making a right turn. Table 11 shows that vehicles making a left turn at intersections are involved in accidents approximately twice as frequently as those making a right turn.

Table 12 illustrates the breakdown of pedestrian-vehicle accident by age. Approximately 22% of pedestrian accidents within the project area and period of study involved adults between 21 years and 30 years of age, 25% involved adults between 31 years and 60 years, 26% involved elderly between 61 years and 80 years, while about 8% involved very old people above 80 years and youths less than 15 years old.

TABLE 9 -- ACTION OF PEDESTRIAN PRIOR TO ACCIDENT		
Category Label	Absolute Frequency	Relative Frequency (percent)
Crossing With Signal	1,237	57.6
Crossing Against Signal	533	24.8
Crossing: No Signal	23	1.1
Crossing: No Signal or Crosswalk	15	0.7
Coming from Behind Parked Vehicle	38	1.8
Playing in Roadway	10	0.5
Crossing Road Not at Intersection	30	1.4
Getting On/Off Bus or Other Vehicle	20	0.9
Working in Roadway	25	1.2
Working in Road With/ Against Traffic	13	0.6
Not in Road	23	1.1
Other	182	8.5
Total	2149	100.0

TABLE 10-- APPARENT CONTRIBUTING CIRCUMSTANCES		
Category Label	Absolute Frequency	Relative Frequency (percent)
Speed Too Fast for Conditions	29	1.3
Failing to Keep Right	7	0.3
Failing to Yield Right of Way to Vehicle	235	10.8
Failing to Yield Right of Way to Pedestrian	388	17.8
Following Too Closely	5	0.2
Backing Unsafely	77	3.5
Reckless Driving	8	0.4
Driving While Intoxicated	15	0.7
Driving While Ability is Impaired	2	0.1
Improper Passing	2	0.1
Improper Turning	15	0.7
Unattended: Rolling Downhill	1	0.0
Failing to Obey Signal	31	1.4
Wrong Way: One-Way Thoroughfare	1	0.0
Defective Brakes	5	0.2
Improper Parking	1	0.0
Pedestrian's Actions	222	10.2
Defective Equipment	4	0.2
Missing	1132	52.0
Missing Data		
Total	2,180	100.0

TABLE 11 -- ACTION OF VEHICLE PRIOR TO ACCIDENT

Category Label	Absolute Frequency	Relative Frequency (percent)
Straight	1,021	51.4
Passing	3	0.2
Right Turn	260	13.1
Left Turn	492	24.8
U-Turn	1	0.1
Backing	94	4.7
Start in Traffic	34	1.7
Stopped in Traffic	28	1.4
Start from Park	10	0.5
Slowing	11	0.6
Skidding	4	0.2
Parked	9	0.5
Other	20	1.0
Out of Range	179	Missing
Total	2166	100.00

TABLE 12 -- AGE GROUP OF PEDESTRIAN		
Category Label	Absolute Frequency	Relative Frequency (percent)
Under 5 years	16	0.7
5 to 10 years	62	2.9
11 to 15 years	60	2.8
16 to 20 years	108	5.0
21 to 30 years	506	23.6
31 to 40 years	301	14.0
41 to 50 years	253	11.8
51 to 60 years	223	10.4
61 to 70 years	282	13.1
71 to 80 years	293	13.7
Over 80 years	42	2.0
Total	2,146	100.0

The distribution of accidents within the study area (see Figure 2) by police precinct is illustrated in Table 13.

TABLE 13 -- NUMBER OF PRECINCT			
Category Label	Precinct Number	Absolute Frequency	Relative Frequency (percent)
	4	19	0.9
	6	96	4.3
	9	130	5.9
	10	101	4.6
	13	189	8.5
Midtown North	14	482	21.7
	17	236	10.6
Midtown South	18	393	17.7
	19	341	15.4
	23	230	10.4
	Total	2,217	100.0

Tables 14 and 15 show accident fatalities and injury. Due to their nature, almost all pedestrian accidents are either fatal or injury accidents.

TABLE 14 -- NUMBER OF PERSONS KILLED IN ACCIDENT		
Number Killed	Absolute Frequency	Relative Frequency (percent)
0.	2,193	98.9
1.	24	1.1
Total	2,217	100.0

TABLE 15 -- NUMBER OF PERSONS INJURED IN ACCIDENT		
	Absolute Frequency	Relative Frequency (percent)
0.	67	3.0
1.	2,047	92.3
2.	86	3.9
3.	11	0.5
4.	3	0.1
5.	2	0.1
8.	1	0.0
Total	2,217	100.0

FIELD DATA COLLECTED

Ten hour directional traffic and pedestrian volumes were counted for each selected intersection during the third week of February. In addition parking regulations were recorded for each approach leg (by direction) of each test intersection. The purpose of these counts was to provide quantitative description of the pedestrian/vehicle conflicts at the test intersections. An exposure rate for each crosswalk was calculated based on traffic/pedestrian volumes. This exposure rate, E, was defined as a ratio of the product of pedestrian and traffic volume to their sum:

$$E = (PV/P+V)$$

Where E = Exposure Rate

P = Pedestrian Volume

V = Vehicle Volume

Table 16 presents the exposure rates for each crosswalk for turning vehicle/pedestrian conflicts. Data was not completely available for two test intersections. It should also be noted that, due to severe snow conditions in the Winter of '78, this field counting program was delayed for several weeks. A general assessment of pedestrian vehicle incidence,

TABLE 16 -- EXPOSURE RATES AT INTERSECTIONS				
Intersection	Left-Turn		Right-Turn	
	Major Street	Minor Street	Major Street	Minor Street
First Avenue & 4th Street	540	----	----	450
Eighth Avenue & 55th Street	---	847	1,120	---
Second Avenue & 40th Street	1,920	---	-----	1,601
Second Avenue & 49th Street	781	---	-----	1,391
Eighth Avenue & 49th Street	-----	662	880	-----
Sixth Avenue & 21st Street	-----	992	1,007	-----
Sixth Avenue & 51st Street	-----	2,473	3,443	-----
First Avenue & 12th Street	619	-----	-----	339
Second Avenue & 14th Street	-----	789	1,365	-----
Lexington Avenue & 34th Street	2,539	1,182	1,668	906
Sixth Avenue & 42nd Street	453	549	2,236	639
Broadway & 57th Street	940	1,986	4,089	686
Second Avenue & 42nd Street	1,629	2,283	2,116	1,427
Second Avenue & 58th Street	-----	1,356	1,252	-----
Eighth Avenue & 40th Street	2,128	-----	1,631	-----
Second Avenue & 86th Street	-----	844	-----	674
Total	11,549	13,963	20,807	8,113
	25,512		28,920	

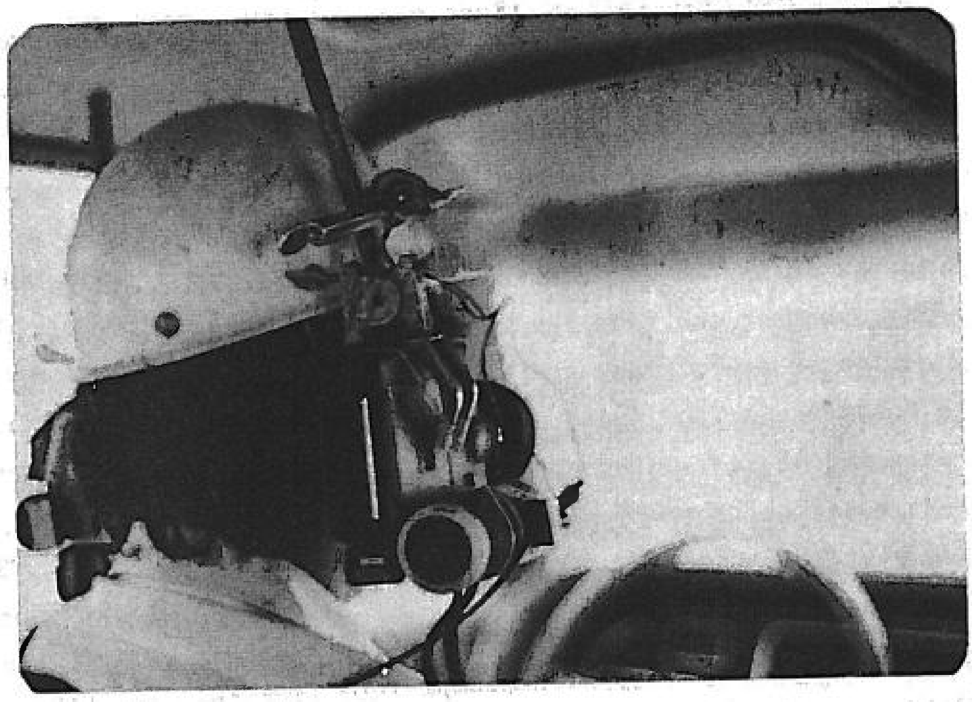


FIGURE 3A

HEADSET APPARATUS FOR FILMING

CHAPTER 3

ANALYSIS OF DATA

A combined data base of right-turn accidents from the project area data base, left-turn and through accidents from the data set of selected intersections and arterial section is used for the analyses in this chapter. This data base is comprised of 455 accident records: 110 left-turn, 260 right-turn, and 85 through accident and is used to compare the percentage frequency of left-turn, right-turn, and through vehicle-pedestrian accidents in regard to accident location, time of accident, accident severity, weather and road conditions, age distribution of ped-estrians and, action of pedestrians and vehicles prior to the accidents. In addition to frequency comparisons, cross-tabulation analysis was used only for the data set of test intersections and selected arterial, which comprised of 225 accident records: 110 left-turn, 30 right-turn, 85 through accidents. These crosstabulations depict vehicular movement with regard to time of accident, vehicle make, vehicle year, vehicle body type, accident severity, type of physical complaint, lighting conditions, parking regulations, and minor/major street analysis of cross-walk incidences. It should be pointed out that, because of the small overall size of data basis, statistical validity to a high degree of confidence can only be inferred as the analysis is presented.

The following paragraphs present various analysis performed in this study. The first section outline the non-contributing factors and the second section identifies factors with seemingly direct bearing on ex-plaining the differences between left and right-turning accidents.

NON-CONTRIBUTING FACTORS

General Comparisons

Table 17 presents the frequencies of accidents by month of the year and by day of the week for the data base being used. Comparison of right-turn and left-turn frequencies does not show any definable pattern.

Table 18 presents frequency by time of day. On the surface, there does not seem to be appreciable differences between day and night accidents. However, the period from 6 to 8 PM shows a 14.6% to 5.4% left-turn versus right turn rates. This period does have fairly high pedestrian activity and, during one-half of the year it is a period of darkness

TABLE 17 -FREQUENCY DISTRIBUTION BY MONTH OF YEAR AND DAY OF WEEK

MONTH	Through	Right-Turn	Left-Turn
January	4.7	6.9	7.3
February	3.5	10.0	9.1
March	14.1	8.8	11.8
April	9.4	10.4	10.0
May	5.9	6.9	8.2
June	5.9	6.2	10.9
July	10.6	5.8	2.7
August	5.9	4.6	4.5
September	12.9	7.3	7.3
October	7.1	11.5	7.3
November	5.9	12.3	10.9
December	14.1	9.2	10.0
	100%	100%	100%
DAY			
Sunday	9.2	3.8	7.3
Monday	17.6	22.7	16.4
Tuesday	16.5	17.3	16.4
Wednesday	15.3	17.3	18.2
Thursday	15.3	15.8	16.4
Friday	15.3	13.5	15.5
Saturday	10.6	9.6	10.0
	100%	100%	100%

darkness/twilight conditions does point out the likelihood that improved illumination of these critical crosswalks will reduce some left-turn accidents.

TABLE 18 -FREQUENCY DISTRIBUTION BY HOUR OF DAY

TIME	Through	Right-Turn	Left-Turn
6 AM - 7 AM	5.9	5.0	3.6
7 AM - 8 AM	5.9	7.7	4.5
8 AM - 9 AM	4.7	4.6	2.7
9 AM - 10 AM	3.5	6.2	1.8
10 AM - 11 AM	9.4	8.1	5.5
11 AM - Noon	4.7	8.5	6.4
Noon - 1 PM	4.7	6.2	3.6
1 PM - 2 PM	2.4	9.6	10.0
2 PM - 3 PM	7.1	9.6	6.4
3 PM - 4 PM	5.9	7.3	10.9
4 PM - 5 PM	2.4	3.5	6.4
5 PM - 6 PM	3.5	5.0	10.0
6 PM - 7 PM	7.1	2.7	8.2
7 PM - 8 PM	2.4	2.7	6.4
8 PM - 6 AM	30.7	13.6	13.5
	100.0%	100.0%	100.0%

Table 19 presents a comparison of severity of accidents. Though not by a large amount, left-turn accidents, do seem on the average to be more serious than right-turn accidents, implying a higher contact speed. This seemingly higher average contact speed would logically translate into either a shorter average reation time for the driver during left-turns or some physiological characteristics of the driver that causes a higher left-turn speed , all other things being equal.

TABLE 19 - SEVERITY OF ACCIDENTS			
FATALITIES	Through	Right-Turn	Left-Turn
0	97.6	99.2	99.1
1	2.4	0.8	0.9
	100.0%	100.0%	100.0%
INJURIES			
0	1.2	4.6	0.9
1	95.2	90.8	93.6
2	2.4	3.8	5.5
3	1.2	0.8	0.0
	100.0%	100.0%	100.0%

Table 20 presents frequences for accident types related to weather and road conditions. In comparing left and right-turn accidents, rain does seem to accentuate the problem. Previous studies in traffic operations do show that drivers will, all other things being equal, drive slower during rain. Therefore, higher left-turn accidents during rain is caused by visibility limitations rather than short reaction time. These differences in visibility restrictions could be general environmental visibility limitations or, more likely, from rain drops accumulated on the windshield in the vicinity of the A-pillar (not removed by wiper) that results in a general decline in left-turn visibility when taken in conjunction with the A-pillar itself. The actual quantitative effect of this factor is very small in explaining turning movement accident differences.

TABLE 20 - WEATHER/ROAD CONDITIONS			
WEATHER & ROAD CONDITIONS	Through	Right-Turn	Left-Turn
Clear - day	73.8	75.8	69.1
Clear - wet	4.8	3.8	5.5
Clear - Ice/Snow	2.4	1.5	0.9
Rain - wet	16.7	15.0	22.7
Snow - wet	0	1.9	0
Snow - Ice/Snow	1.2	1.5	1.8
Fog - wet	0	0.4	0
	100 %	100 %	100 %

Table 21 shows the frequency distribution of pedestrian involvement by age. No specific inferences can be drawn from this comparison. It would not be accurate to compare the age distributions with general population distributions due to the marked differences in trip making (and hence exposure) among these age groups.

TABLE 21 - PEDESTRIAN AGE

PEDESTRIAN AGE	Through	Right-Turn	Left-Turn
Less than 5	1.2	0.8	0
5 - 10	2.4	1.6	0
11 - 15	4.9	1.6	0
16 - 20	4.9	4.0	1.9
21 - 30	22.0	21.0	24.3
31 - 40	12.2	17.1	11.2
41 - 50	15.9	10.9	16.8
51 - 60	8.5	7.9	15.9
61 -70	14.6	17.1	20.6
71 - 80	12.2	15.1	8.4
Greater than 80	1.2	3.2	0.9
	100.0%	100.0%	100.0%

Table 22 provides some in-sight into the activity of the pedestrian leading up to the accident.As shown, crossing with the signal is dominant for right and left turns. The data does not show any peculiar attribute of the pedestrian that can be identified as a causal factor when company right and left turning accidents. The'crossing against signal' population represents those pedestriants stuck in the 'through'crosswalk by turning vehicles. These accidents occurred close to the sidewalk and are included because the turning vehicle accidents characteristics are under study and not individual crosswalk accident experiences. These accidents are primarily 'dart out' accidents at the intersection, hence there are no identifiable differences between turning maneuvers.

Table 23 presents the police departments view of the cause of the accident. It should be noted that only about one-half of the records contained this information. The table does show one item of interest. For right turning accidents, the pedestrian and the vehicle share, almost equally, the blame(24.6% to 23.4%), however, for left-turning accidents, the vehicle was to blame for 62% (30.9% to 19.1%). Although the data is limited, this additional evidence identifies the driver/vehicle (as opposed to the pedestrian) as the prime source to be addressed in explaining the differences between left-turn and right-turn accidents.

TABLE 22- ACTION PRIOR TO ACCIDENT

PEDESTRIAN ACTION	THROUGH	RIGHT-TURN	LEFT-TURN
Crossing with signal	37.5	84.9	87.2
Crossing against signal	36.3	7.6	5.5
Crossing:no signal	3.8	0.4	0.9
Crossing:no signal or cross-walk	1.3	0.4	0.9
Coming from behind parked car	2.5	0.4	1.8
Playing in roadway	0.0	0.0	0.9
Crossing road not at intersection	5.0	0.4	0.0
Getting off/on bus	1.3	0.0	0.0
Working in roadway	2.5	0.8	0.9
Not in road	1.3	0.8	0.0
Other	7.5	4.4	1.8
	100.0%	100.0%	100.0%

TABLE 23-APPARENT CAUSE OF ACCIDENT			
CAUSE	THROUGH	RIGHT-TURN	LEFT-TURN
Speed too fast	1.2	0.4	0.9
Failing to keep right	0.0	0.4	0.0
Failing to yield ROW to vehicle	3.7	24.6	19.1
Failing to yield ROW to pedes'n	9.9	23.4	30.9
Pedestrian's action	14.8	2.7	2.7
Other	6.2	3.6	1.8
Missing	64.2	44.6	44.6
	100.0%	100.0%	100.0%

Types of Physical Complaint and Injury

Most pedestrians involved in accidents complained of necks, hip - upper leg or pelvis, knee, and in some cases, their entire body. Overall, nine persons hit by left-turns were rendered unconcious, compared to four for right-turns. As expected, the lower body was hit in almost all accidents. The results presented in Table 14 do indicate that only 1% of these accidents results in a fatality, which translates into a generally low speed impact. The analysis does not point out explicit methods of further reducing impact speed.

Parking

Data on parking regulation for each approach leg of each test intersection was collected to evaluate its effect on turning accidents. These regulations were classified into four types: bus stop, hydrant,parking meter and no-parking/no-standing. Table 23A summarizes the accident frequences for left-turns and right-turns for each regulation type. Although the data is limited, there does not appear to be any appreciable difference in percentage frequencies.

TABLE 23A-ACCIDENTS BY PARKING REGULATIONS					
PARKING REGULATIONS		LEFT-TURNS		RIGHT-TURNS	
		NUMBER	FREQUENCY	NUMBER	FREQUENCY
Bus Stop		18	18	4	15
Hydrant		18	18	5	19
Parking Meter		5	5	0	0
No parking/standing		57	59	17	66
	samples	98	100%	samples 26	100%

It should be noted that, most intersections had no legal parking but, there were usually vehicle standing or load/unloading goods. Given evidence of a general low speed maneuver(5 to 10 mph) and the above data, it is probably safe to conclude that parking is not a causal factor to be addressible by recommended changes.

Accident Location - Major or Minor Street

The project data base was analysed to determine whether left-turn versus right-turn accident ratios varied with street width. The major streets in the project area have three or four travel lanes plus parking lanes. The minor streets have two travel lanes and parking lanes. Table 24 presents the findings for the project area data base.

TABLE 24-MAJOR/MINOR STREET ACCIDENT ANALYSIS		
ACCIDENT TYPE	NUMBER MAJOR STREET	NUMBER MINOR STREET
Left-turn	205	243
Right-turn	107	122
Ratio left-turn/right-turn	1.9	2.0

Table 24 indicates that the 2 to 1 relationship of left-turns to right turns exists for both major and minor streets. This implies that cross-walk length does not appear to be a causal factor affecting the difference between left-turn and right-turn accidents.

CONTRIBUTING FACTORS

Lighting

In addition to the analysis of time of day accidents in this chapter, further study was conducted to determine whether left-turn accidents were influenced by daylight, night-time or artificial lighting conditions. Daylight hours were assumed to be 6 A.M. to 7 P.M., while night-time was defined as 7 P.M. to 6 A.M. Table 25 presents the analysis.

TABLE 25 - DAY/NIGHT ANALYSIS

ACCIDENT TYPE	DAY (6 A.M.- 7 P.M.)	NIGHT (7 P.M. - 6 A.M.)
Left-turns	395	97
Right-turns	224	36
Ratio Left-turns/Right-turns	1.8	2.7

Table 25 shows a difference in the left/right-turn ratios for the defined conditions and further substantiates the recommendation for increased lighting at these critical crosswalks. This finding if rectified, would account for 10-15% of the difference between left and right turning accident frequencies.

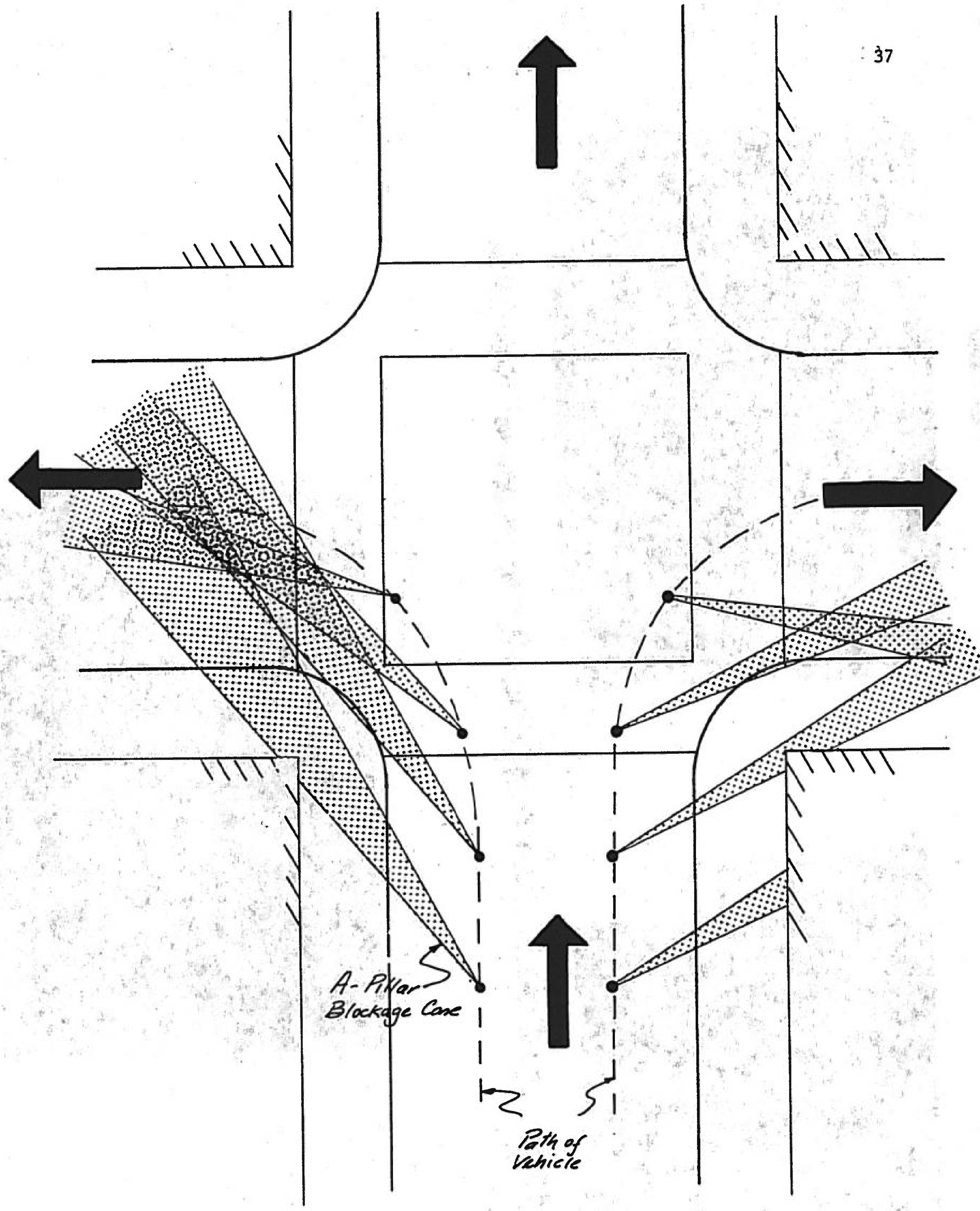


FIGURE 4. AVERAGE ROOF SUPPORT BLOCKAGE CONES

LEFT-TURN

RIGHT-TURN

COMPARISON OF VISIBILITY DIFFERENCE BETWEEN LEFT AND RIGHT TURNS APPROACHING INTERSECTION.

LEFT-TURN VISIBILITY AT INTERSECTION.

FIGURE 5 - DRIVER'S VIEW

<u>Driver's Visibility & Vehicle Characteristics</u>

Figure 4 sketches the visibility blockage resulting from the A-pillar roof supports for a typical driver and vehicle for intersection turning maneuvers. Figure 5 shows photographes taken from inside a standard size American car. The transition of the blockage cone as the vehicle approaches the intersection is different for left and right turns. For left turning the A-pillar blocks the near half of the crosswalk as the vehicle approaches. For right-turns, the blockage cone rarely, if ever, traverses the crosswalk.

Presumably, the transition of the blockage cone as the left-turn maneuver is being made could result in pedestrians, that are walking parallel to the vehicle, not being seen by the driver. Analyses of accidents by pedestrian walking direction is shown in Figure 6 (pedestrian walking direction was not reported in about 80% of the study area data set).

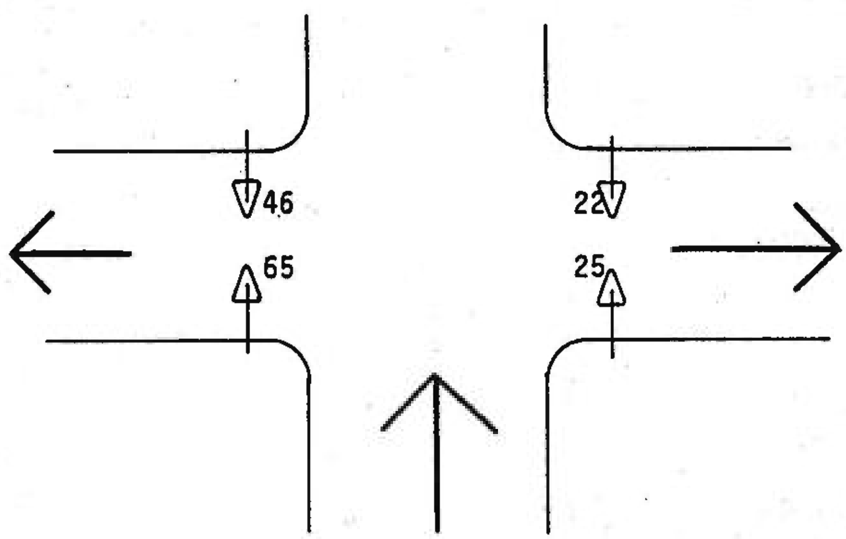


Figure 6. Pedestrian Walking Direction

The available data on pedestrian walking direction supports the hypothesis that there are critical visibility differences between left and right turns which increases accident potential. This hazard may be accentuated by pedestrians proceeding to the crosswalk from the cross street.

TABLE 26 - VEHICLE CHARACTERISTICS

Make	Through	Right-turn	Left-turn
Dodge	13	7	22
Checker	4	1	7
Chevrolet	9	2	9
Pontiac	3	1	1
Mercedes Benz	0	0	2
Ford	7	3	13
Plymouth	1	0	5
Oldsmobile	1	2	2
Opel	0	0	2
Volkswagen	2	0	4
Buick	2	1	2
Honda	1	0	1
Saab	1	0	0
Others	15	6	7
Totals	59	23	77

A surprising aspect of Figure 6 relates to the relatively high number of on-coming pedestrians that are struck by left-turning vehicles. It is assumed, and previous studies have suggested, that eye contact between pedestrians and drivers assist in reducing potential conflicts. Therefore, there should be other factors that address this problem. These are presented in 'Task Intensity' in the following section.

Figure 4 presented average conditions with respect to the A-pillar blockage cone. However, the closer the drivers eye is to the A-pillar (as in smaller cars) and the further to the left the driver sits (also in smaller cars), the farther into the crosswalk the A-pillar blockage cone will be projected possibly to the opposite side of the cross-walk. Therefore an analysis of vehicle model involved in accidents was conducted for the test data set. Table 26 shows the results. As the test data set is biased towards left-turns, and figures should be viewed in that context. However, the following findings can be made:

1) Automobile makes (1975 and older) that are dominated by vent-window design (Volkswagen, Opel, Mercedes and the American built Checker) have 13 left-turning accidents to one right-turn accidents. This is another implication that driver visibility is the prime causal factor for such accidents and that improving visibility by elimination of vent-windows will have a positive safety benefit for this type of accident.

2) As most taxis are Dodges in New York City; the high 22 left-turning accident. statistic would be 'normal'for the sample set.

3) Although the accident data did not provide the model of each make (such as Ford "Pinto", Dodge"Polara"), it is not possible to identify the small cars among the American built samples. However, the known small car sample have 7 left-turns to no right-turning accidents, a very small sample on which to draw conclusions and additional data on this should provide more revealing results.

Task Intensity

To date, no studies have been conducted that specifically address task differences (and this effects) between left and right turning maneuvers at intersections. In its simplest sense, the left-turning task should be no more difficult than the right-turning task at one-way signalized intersections. If, in fact, the left-turning task is more complicated, does that mean that it is more hazardous? Teicher's stress theory (4) contradicts Hebb's arousal theory (5) in this regard. More recent work by Bartz (6) supports Hebb's theory that, as the central task complexity goes up (e.g., left-turning maneuver), reaction time goes down for peripheral detection (eg., seeing and reacting to hazardous situations). Might we then conclude based on Bartz' and Hebb's works the possibility exists that drivers consider the left-turn maneuver to be <u>easier</u> than the right-turn maneuver. Previous research on human factors do not provide the basis for a definite statement.

Apart from all the general driver task requirements as the vehicle traverses a street system, there is a specific task that occurs for vehicles involved in turning maneuvers. The driver must shift attention from the traffic signal to the crosswalk and back to the signal several times before actually turning. Figure 7 depicts the process for left-turning vehicles. As the driver gets closer to the intersection, the angle 'α' becomes larger, and thus the time between successive observations of the crosswalk increases. A previous study (7) has shown that performance is more sensitive to the <u>inter-field</u> internal (time between observations) than display duration (time target is being viewed). As the interfield interval goes up, performance goes down. The research team considers this driver task as a contributing factor to the high number of head on (see Figure 6) accidents with pedestrian in the turning crosswalks (both left and right-turns). Combining this task with the visual handicaps of the left-turning maneuver accentuates the left-turning accident problem. The objective then would be to reduce, through environmental changes, the inter-field interval where possible (Chapter 4 discusses the means).

Driver's Eye Movements

The research team was not able to collect data on eye movements while turning maneuvers were made. The only research conducted on this subject was recently completed (8) and the results bear mentioning in this report. The study was not done for intersection maneuvers, but for highway curve negotiation in normal driving. The findings were that, on horizontal curves, driver search pattern on the right and on the left are <u>not</u> symmetrical. Visual excrusion to the right was <u>far greater</u> than to the left on curve negotiation. During right curve negotiation, 55% of the time the drivers eye was fixed to the right of 'head on'. During left curve negotiations, only 38% of the time was the drivers eye fixed to the left of 'head on'. The mean fixation on the right was 3.6° during right-curve negotiation, compared to only 0.5° to the left during left curve negotiation. Why this imbalance occurs is not stipulated, but is probably from driving habits developed by experience. One hypothesis could be that this habit was developed because drivers consider the left turn maneuver to be 'easier', therefore requiring less attention. Surely, during intersection maneuvers, the driver is'closer to the action' for the left-turn. Might it be, as evidenced from the above curve negotiation findings, that drivers concentrate less, look less, have shorter target fixation when negotiating left-turning maneuvers at one-way intersections because they consider it easier.

Appendix 1 shows some summary statistics gathered from English accident experience. Bearing in mind that the English drive on different sides of the road, the statistics seem remarkably consistent with the U.S. experience, except, right-turning accidents are the problems. This English experience eliminates two potential causal factors from considerations: (1) that pedestrians look over different shoulders differently while crossing and therefore contribute to the problem and (2) there is a basic human characteristic (not habit) that controls these types of accidents. What the English data does lead the research team to conclude is that identification and solution of the U.S. problem will also reduce the incidence of English accidents as well.

SUMMARY

It can be satisfactorally concluded that there is no single contributing factor that explains the incidence difference between left and right turning accidents at intersections. However, target detection and driver concentration show up in the analysis as being the area that would provide the highest payoff if remedial actions are made. These include improved driver visibilty, reduced inter field interval and driver education. These items, and other potential solutions are presented in Chapter 4.

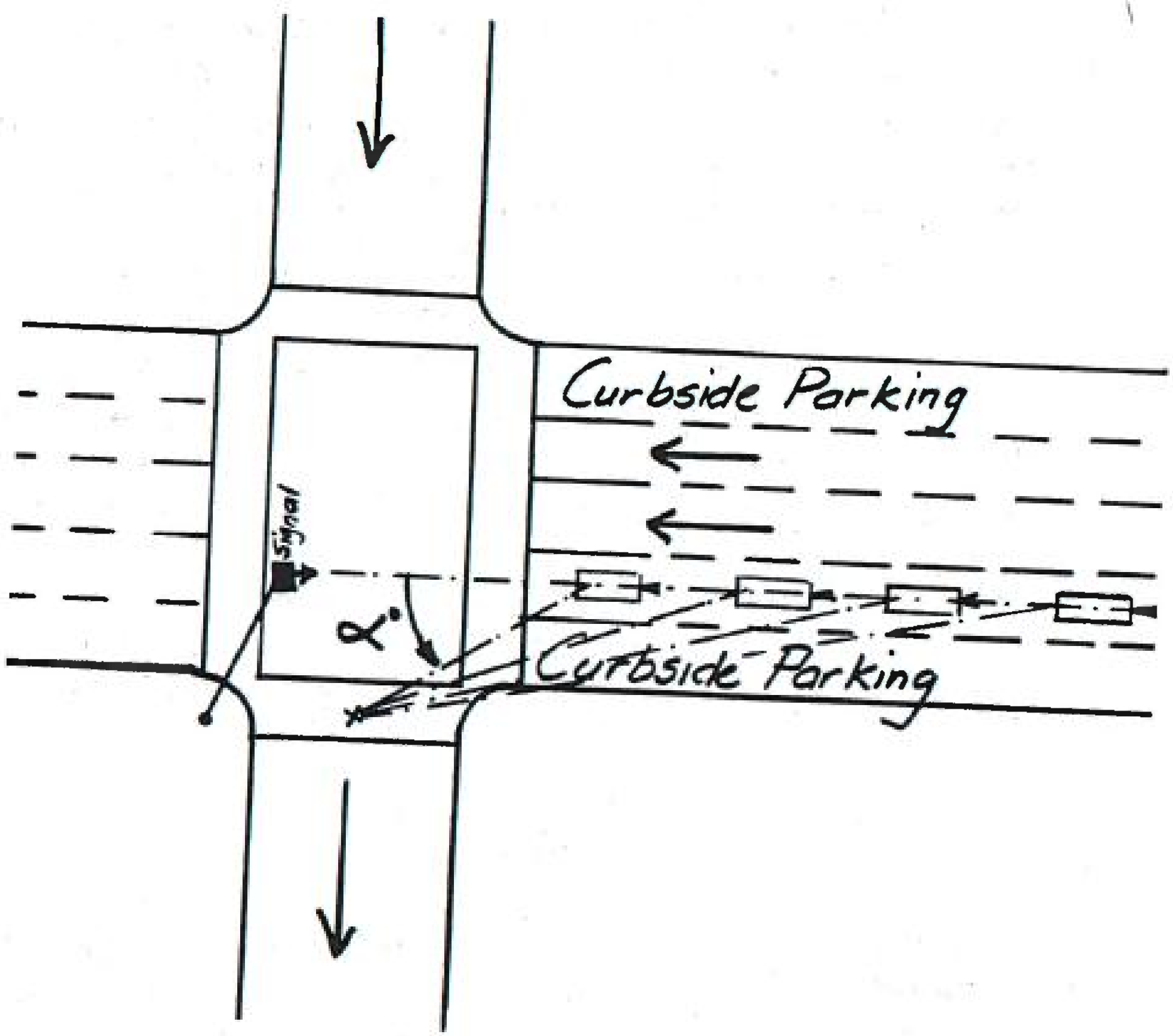


FIGURE 7. EYE MOVEMENT ANGLE FOR TURNING MANEUVER

CHAPTER 4

SUMMARY AND RECOMMENDATIONS

The purpose of this study is to explore causal factors that explain why left-turn vehicles pedestrian accidents are twice as frequent as right-turn accidents on one-way street networks. This research is also intended to provide direction for needed future research in this area.

The project data base was quite limited for various reasons: (1) low number of accidents per intersection, (2) incompleteness of recorded information on accident reports, and (3) missing information on key variables, i.e. those related to the vehicle, driver and pedestrian. However, the data base verified the 2:1 relationship left-turn vs. right-turn in accident frequency. The left-turn vehicle pedestrian accident is a major problem on one-way street networks and should be fully addressed.

Chapter 3 developed various causal theories relating to driver visibility and concentration. It is certainly desirable to acquire additional data related to these specific items, however, this report makes its recommendations on the basis of the present data and its analysis.

The recommendations presented below relate to changes in the various system components that define this problem:

- The driver
- The pedestrian
- The vehicle
- The environment

Several of these recommendations are implementable in the short-term and others are long term objectives including research needs.

The Driver

The involvement of the driver and related contributing circumstances can only be addressed and corrected through increased awareness of the potential hazards. Interpretation of the English experiences with high right-turning accidents makes the research team conclude that improving driver awareness, and therefore driver habits, would provide a meaningful reduction in these types of accidents.

Therefore, state driver instruction manuals should immediately present a definition of the problem and countermeasures to reduce involvement. These countermeasures include:

- driver awareness of vehicle sight line deficiences
- driver needs to 'look around' roof support (this also increases concentration)
- slower turning speeds

Driver education programs should also address the left-turn problem in detail, with photographs of interior visibility restrictions and the resultant need to exercise additional caution during turning maneuvers.

Potential future research with respect to the driver should be coordinated with angle of sight research to improve visibility. This would include testing fixation angles during intersection maneuvers to coordinate this with vehicle design modifications.

The Pedestrian

The role of the pedestrian in explaining differences in left and right turning accidents has not been identified. This research has no recommendation that can be forwarded that would change (improve) pedestrian performance to reduce accidents. Potential remedies to the pedestrian system are presented in the 'Environment' section of this chapter.

The Vehicle

Changing vehicle design would be the most direct but most difficult to accomplish. The ideal improvement in visibility would be to design left-turn sight angles to be identical to right-turn angles shown on Figure 4 . This can be accomplished by a combination of improvements: moving the driver's seat closer to the center of the car, increasing the size of the windshield, reducing the thickness of the A-pillar, increasing the distance from the drivers eye to the A-pillar, better design of windshield wiper to reduce water (and dust) building up near the A-pillar,elimination of vent-window design. Specific design study(s) should be conducted to fix the various desired standards related to the above improvements and coordinate these features with driver eye movements. However, the angle from the head-on view to the beginning of the blockage cone should ideally be increased from the current average of about 30° to 60°- 65° in order to achieve the desired safety benefits.

The Environment

There are several implementable strategies that can change the pedestrian-vehicle accident system. These include primarily traffic engineering techniques. Some are listed below.

Signal Location. It is recommended that an additional signal be mounted on the left far side on the sidewalk (see Figure 8) in order that transition of driver eye from signal to crosswalk will be minimized before and during the turning maneuver and therefore increase the probability of seeing the pedestrian in the driver's vision periphery, increase the probability of correctly judging walking speed of the pedestrian, and increase the opportunity for eye contact with on-coming pedestrians. The signal location shown achieves these objectives for both right and left turns.

Crosswalks: It is a subjective assumption that crosswalk design would affect frequencies of accidents. In most cases the driver cannot really distinguish the driver cannot really distinguish the turning crosswalk until he has begun the maneuver (about 40-50' away). Studies done on crosswalk design (zebra, stripe, etc.) addressed the 'through'crosswalk and even the findings of these studies contradict each other. Helms' (9) study shows more accidents

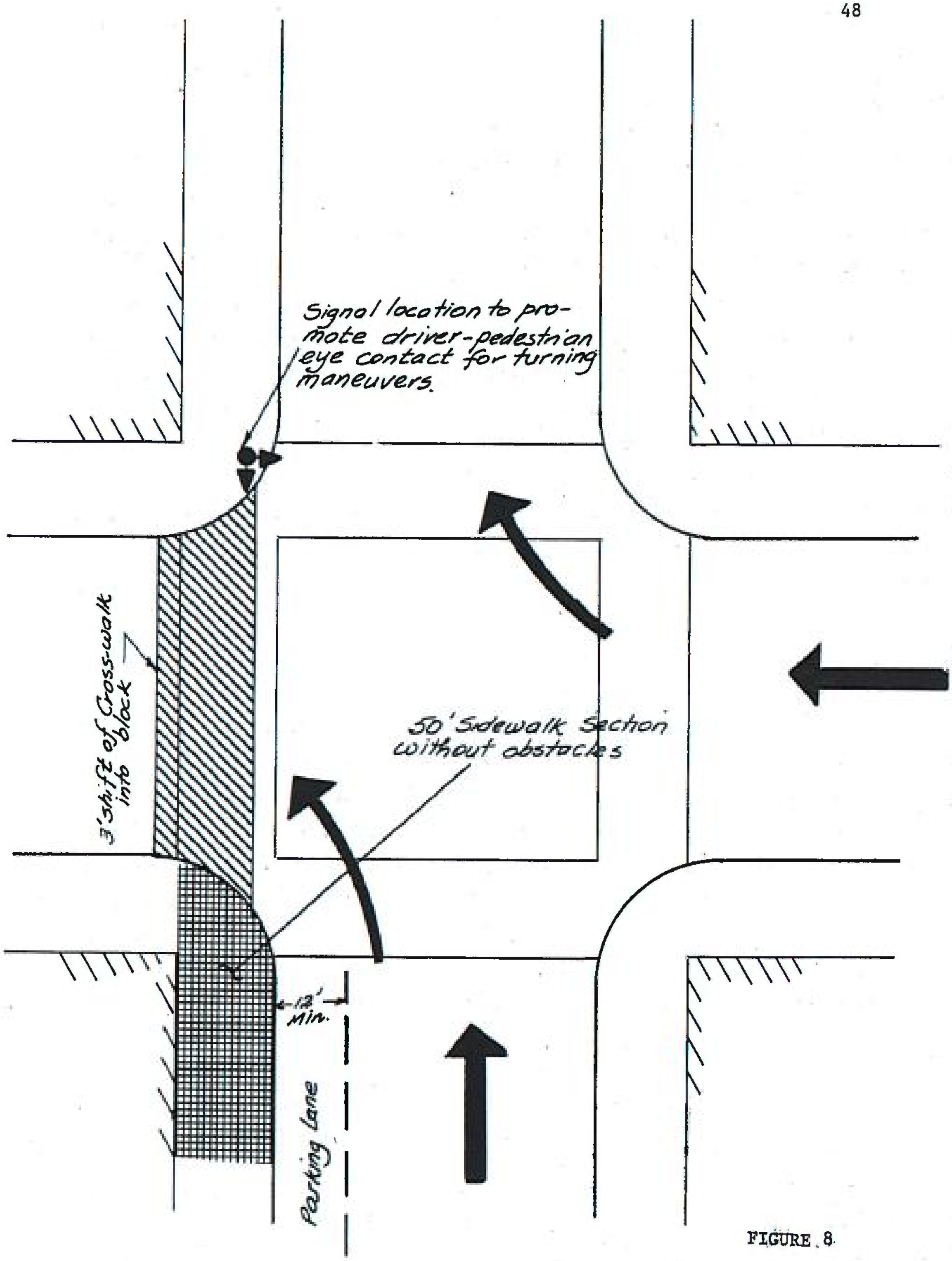


FIGURE 8

Intersection Improvements

in painted crosswalks, but a very detailed Israeli study (10) showed that vehicles slowed down or stopped more frequently for crossing pedestrians when the crossing task place in a marked crosswalk.

The farther out into the roadway the vehicle begins the turning maneuver, the earlier will potential 'lost'pedestrians reappear. This implies striping the left-most travel lane 12 to 15 feet from curbside and in addition, moving the left-turn cross-walk about 3' into the block will also afford some additional reaction time (see Figure 8.) At these slow turning speeds, small dimensional changes can be translated into realizable benefits.

Sidewalk Visibility - The fifty foot sidewalk sections upstream of the left-turn crosswalk must be well illuminated. In addition a minimum number of objects such as light stantions, signs, trees, etc. should be located in these sections. Parking regulations need not be affected (see Figure 8).

RESEARCH NEEDS

This study on turning movement accident experience has shown visibility and attention of the driver to be the key areas for countermeasure improvements. However, vehicle design modifications and driver training do not provide results in the 2-3 year period. Several of the environmental recommendations are implementable in the short-term.

Small scale demonstration projects with 'before and after' analysis should be conducted to assess the quantitative effects of the environmental countermeasures.

A more basic research need relates to traffic engineering improvements and their effects on pedestrian safety. Signal location, signal progression speeds, bicycle lanes, reversible lanes, bus stop locations, all of the basic strategies are carried out with little or no regard to the related pedestrian accident experience. Even the nationally implemented right-turn-on-red program was not adequately analyzed for quantitative effects. The relationship between traffic engineering strategies and pedestrian safety are in need of quantification.

As a result of this study, efforts should be made to develop standards for minimum and desirable lines of sight for turning movements at intersections. Vehicle modifications to improve visibility should have the largest long-term beneficial effects. Research projects defined to achieve their objectives should be pursued.

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APPENDIX

1. S. Older's Letter to J. Fruin
2. Traffic Count Sheet
3. Pedestrian Count Sheet
4. Typical Intersection Count Finished Sheet
5. Traffic Volume Count
6. Pedestrian Volume Count

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Department of the Environment Crowthorne Berks RG11 6AU

Telex 84272 Telephone Crowthorne 3131 Ext 2443

John J Fruin PhD
Research Engineer
Port of New York Authority
111 EighthAvenue - at 15th Street
New York
NY 10011 USA

Please reply to Director
Your reference

Our reference
TB/417/450/01
Date
12 July 1972

Dear Mr Fruin

1. Many thanks for your letter of June 19. As you surmise it has been noted that more right turning vehicles than left turning vehicles are involved in accidents with pedestrians at intersections in this country. The following figure give the number of such accidents involving fatal or serious injury in urban areas in 1968 at the two most common junction layouts.

Layout	Vehicle manoeuvre	Signal Controlled	Non signal controlled
T or Y	Turning right	22 (8.5%)	273 (3.3%)
	Turning left	13 (5.0%)	131 (1.6%)
Crossroads	Turning right	75 (6.3%)	58 (3.1%)
	Turning left	49 (4.1%)	34 (1.8%)

You will see that the average ratio of right to left turning vehicles is just less than 2 : 1. The percentage in brackets are of all fatal or serious accidents involving a pedestrian at the junction, showing that turning vehicles are not the major problem to pedestrians at intersections.

2. I have some doubt that the preponderance of the right turning vehicle over the left turning one can be explained solely on the grounds of obscuration by the righ hand windscreen pillar as you suggest. My own opinion is that the right turn driver has more conflicting traffic movements to attend to than the left turner and that this is more likely to distract him from observing possible pedestrian movement. At a signal controlled junction for example the left turner has to consider as possible hazards only the crossing pedestrians; without signal control he usually has in addition to merge with only one stream of vehicles.

3. It may also be true, although I can quote no evidence, that the pedestrian is less likely to scan for the right turn vehicle, which at the conflict point may be travelling faster than the left turn vehicle.

APPENDIX 1.

John J Fruin PhD

Our reference TB/417/450/01

Date July 1972

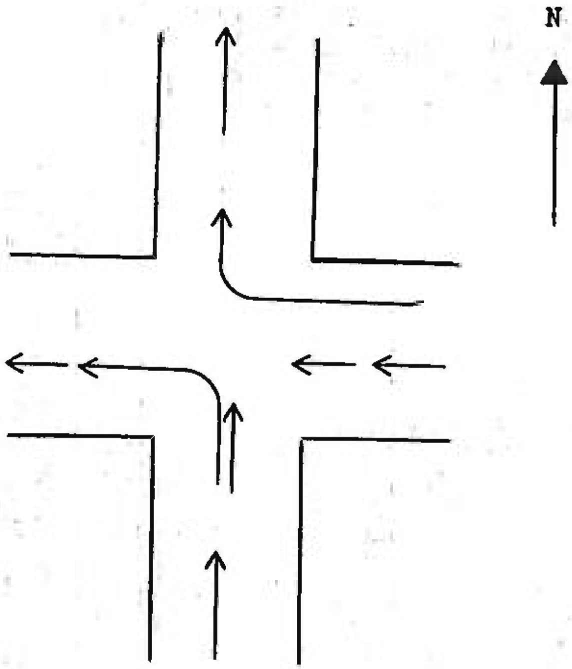
4. In short I would consider differences in the complexity of the manoeuvres to be more important explanatory variables than obscuration due to the windscreen pillar.

5. In concluding may I say that we find your book "Pedestrian planning and design" very useful, informative and interesting to read and hope that it achieves a wide readership.

Yours sincerely

S J Older

S J OLDER



55TH STREET

Time	L	R	Time	T	R
7·45-8:00	37	40	3:15-3:30	58	53
8:00-8:15	53	29	3:30-3:45	43	58
8:15-8:30	47	31	3:45-4:00	40	47
8:30-8:45	44	34	4:00-4:15	36	59
8:45-9:00	43	34	4:15-4:30	39	58
9:00-9:15	47	53	4:30-4:45	23	53
9:15-9:30	65	43	4:45-5:00	26	41
3:00-3:15	58	49	5:00-5:15	20	23

EIGHTH AVENUE

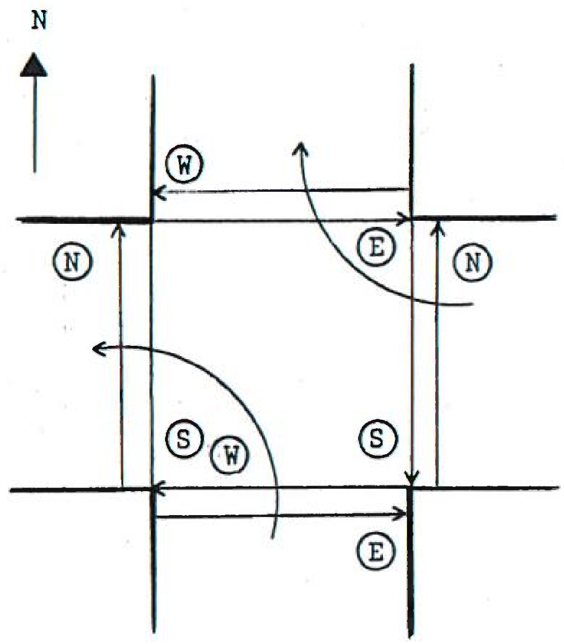
Time	L	T	Time	L	T
7:45-8:00	10	198	3:15-3:30	26	317
8:00-8:15	22	263	3:30-3:45	19	386
8:15-8:30	19	297	3:45-4:00	21	328
8:30-8:45	32	312	4:00-4:15	18	320
8:45-9:00	27	370	4:15-4:30	20	396
9:00-9:15	24	456	4:30-4:45	22	402
9:15-9:30	25	353	4:45-5 00	17	211
3:00-3:15	23	267	5:00-5·15	23	127

ONE-WAY/ONE-WAY VEHICLE COUNTS

APPENDIX 2.

Time	W	E	Time	W	E
7·45-8:00	40	73	9:00- 9:15	65	64
8:00-8:15	46	85	9:15- 9:30	44	70
8:15-8·30	52	94	10·30-10·45		
8·30-8:45	54	112	10·45-11 00		
8:45-9:00	46	70	11:00-11:15		

Time	N	S	Time	N	S
3:00-3:15	68	72	4:30-4:45	87	65
3:15-3 30	84	59	4:45-5·00	92	104
3:30-3·45	71	63	5:00-5:15	73	92
4:00-4 15	98	79			
4·15-4:30	92	78			



55TH STREET

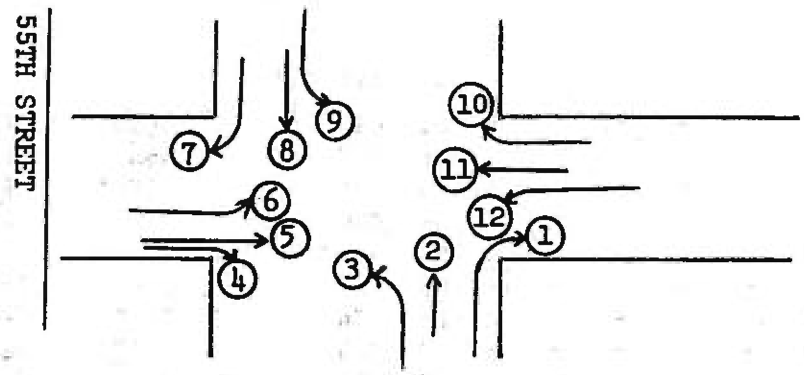
Time	N	S	Time	N	S
7:45-8 00	80	92	9:00-9:15	139	89
8·00-8:15	92	106	9·15-9:30	129	142
8:15-8:30	100	118			
8:30-8:45	106	124			
8:45-9·00	100	84			

EIGHTH AVENUE

Time	W	E	Time	W	E
3:00-3:15	52	69	4:15-4·30	126	114
3·15-3:30	57	72	4:30-4:45	115	98
3:30-3:45	59	67	4:45-5 00	118	109
3:45-4:00	110	92	5:00-5:15	115	87
4:00-4:15	120	107			

APPENDIX 3.

TRAFFIC
COUNT



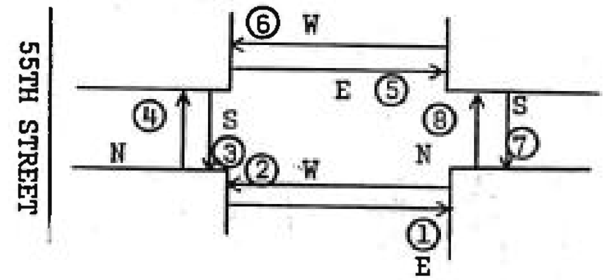
EIGHTH AVENUE

Time Interval	12 min. Count	Adjusted 15 min. Count	% of 10 hour Interval	1	.75 2	.06 3	4	5	6	7	8	9	.08 10	.11 11	12
7:30- 7·45	285	357	.0204	-	248	13	-	-	-	-	-	-	46	50	-
7:45- 8:00	285	357	.0204	-	248	13	-	-	-	-	-	-	46	50	-
8:00- 8:15	367	459	.0290	-	329	28	-	-	-	-	-	-	36	66	-
8:15- 8:30	394	493	.0313	-	371	24	-	-	-	-	-	-	39	59	-
8:30- 8:45	422	528	.0315	-	390	40	-	-	-	-	-	-	43	55	-
8:45- 9:00	474	594	.0365	-	463	34	-	-	-	-	-	-	43	54	-
9:00- 9:15	580	725	.0305	-	570	30	-	-	-	-	-	-	66	59	-
9:15- 9:30	486	607	.0333	-	441	31	-	-	-	-	-	-	54	81	-
9:30- 9:45	448	561	.0294	-	420	34	-	-	-	-	-	-	45	62	-
9:45-10:00	390	488	.0256	-	365	29	-	-	-	-	-	-	39	54	-
10:00-10:15	412	515	.0270	-	386	31	-	-	-	-	-	-	41	57	-
10:15-10:30	362	453	.0238	-	340	27	-	-	-	-	-	-	36	50	-
10:30-19:45	316	394	.0207	-	272	24	-	-	-	-	-	-	32	43	-
10:45-11:00	316	394	.0207	-	296	24	-	-	-	-	-	-	32	43	-
11:00-11:15	332	415	.0218	-	311	25	-	-	-	-	-	-	33	47	-
11:15-11:30	308	385	.0202	-	289	23	-	-	-	-	-	-	31	42	-
11:30-11·45	369	461	.0242	-	346	28	-	-	-	-	-	-	37	51	-
11:45-12:00	362	453	.0238	-	340	27	-	-	-	-	-	-	36	50	-
12:00-12:15	433	541	.0284	-	406	32	-	-	-	-	-	-	43	60	-
12:15-12:30	406	507	.0266	-	380	30	-	-	-	-	-	-	41	56	-

EIGHTH AVENUE

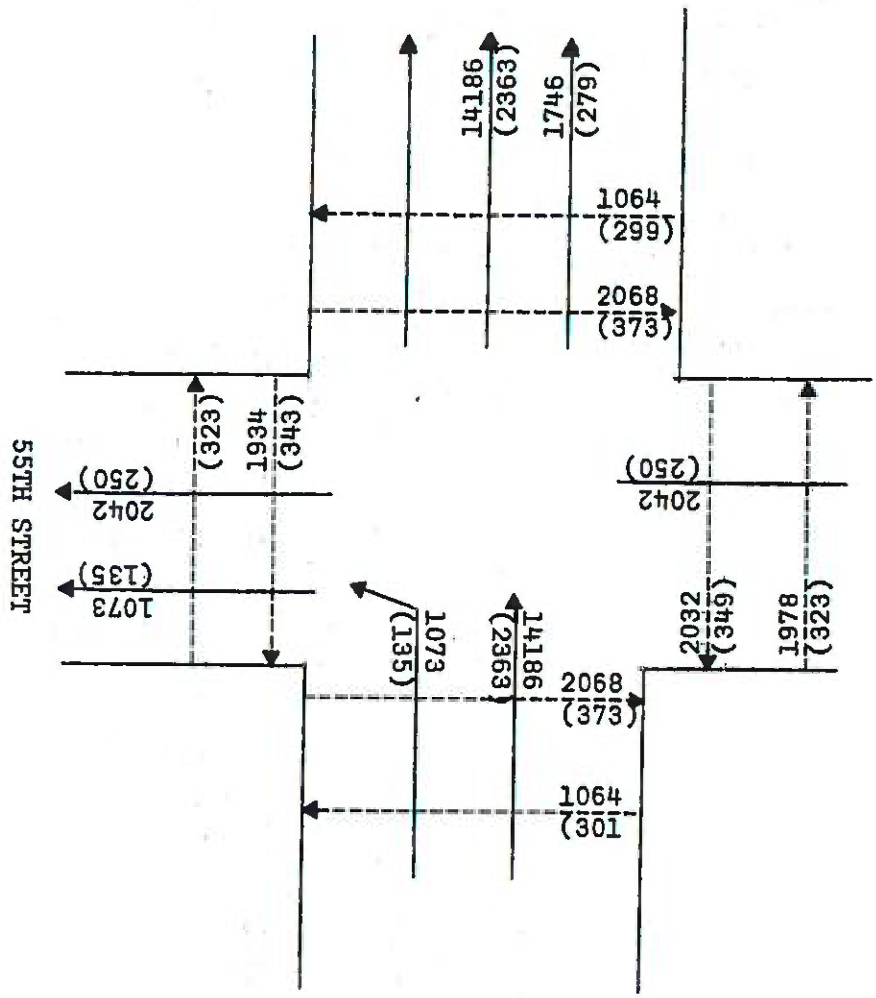
Time Interval	12 min. Count	Adjusted 15 min. Count	% of 10 hour Interval	1	.75 2	.06 3	4	5	6	7	8	9	.08 10	.11 11	12
12:30-12:45	349	436	.022(	-	327	26	-	-	-	-	-	-	34	38	-
12:45- 1:00	349	436	.0229	-	327	26	-	-	-	-	-	-	35	48	-
1:00- 1:15	338	423	.0222	-	317	25	-	-	-	-	-	-	34	47	-
1:15- 1:30	303	379	.0199	-	284	23	-	-	-	-	-	-	30	42	-
1:30- 1:45	387	484	.0254	-	363	29	-	-	-	-	-	-	39	53	-
1:45- 2:00	300	375	.0197	-	281	23	-	-	-	-	-	-	30	41	-
2:00- 2:15	382	478	.0251	-	359	29	-	-	-	-	-	-	38	53	-
2:15- 2·30	323	404	.0212	-	303	24	-	-	-	-	-	-	32	44	-
2:30- 2:45	379	474	.0249	-	356	28	-	-	-	-	-	-	38	52	-
2:45- 3:00	352	440	.0231	-	330	26	-	-	-	-	-	-	35	48	-
3:00- 3:15	497	622	.0213	-	459	29	-	-	-	-	-	-	61	73	-
3:15- 3:30	454	568	.0226	-	396	33	-	-	-	-	-	-	66	73	-
3:30- 3:45	506	634	.0244	-	483	24	-	-	-	-	-	-	73	54	-
3:45- 4:00	436	545	.0218	-	410	26	-	-	-	-	-	-	59	50	-
4:00- 4:15	433	542	.0204	-	400	23	-	-	-	-	-	-	74	45	-
4:15- 4:30	513	642	.0258	-	495	25	-	-	-	-	-	-	73	49	-
4:30- 4:45	500	626	.0260	-	503	28	-	-	-	-	-	-	66	29	-
4:45- 5:00	295	369	.0265	-	264	21	-	-	-	-	-	-	51	33	-
5:00- 5:15	193	242	.0294	-	159	29	-	-	-	-	-	-	29	25	-
5:15- 5:30	193	242	.0294	-	159	29	-	-	-	-	-	-	29	25	-
					14,186	1073							1746	2042	

PEDESTRIAN COUNTS



EIGHTH AVENUE

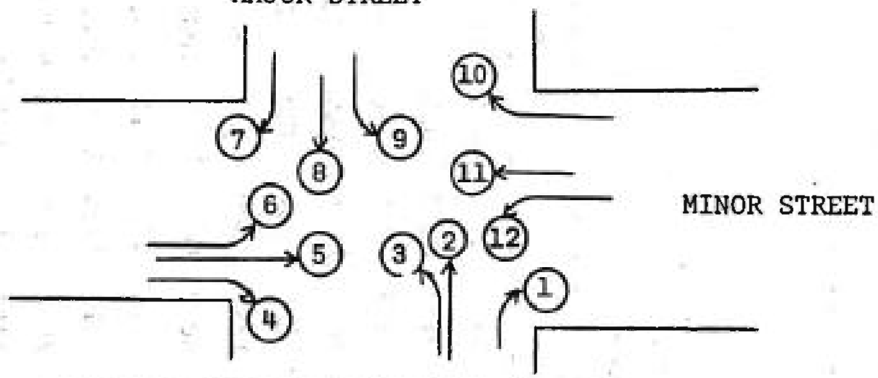
Time Interval	12 min. Count	Adjusted 15 min. Count	% of 10 hour Interval	.15 1 E	.07 2 W	.13 3 N	.14 4 S	5 E	6 W	7 S	8 N
7:30- 7·45		318		46	25	43	45	46	25	45	43
7:45- 8:00		318		46	25	43	45	46	25	45	43
8:00- 8:15		343		54	29	53	36	54	29	35	53
8:15- 8:30		472		74	33	63	74	58	33	74	63
8:30- 8:45		496		70	34	66	78	70	34	78	66
8:45- 9:00		378		44	29	63	53	44	29	53	63
9:00- 9:15		447		40	41	86	56	40	41	55	88
9:15- 9:30		483		44	28	81	89	44	28	89	80
9:30- 9:45		486		73	34	63	68	73	34	63	68
9:45-10:00		460		69	32	69	64	69	32	69	64
10:00-10:15		404		61	28	53	57	61	27	53	57
10:15-10:30		353		52	25	46	49	52	25	46	49
10:30-19:45		202		30	14	26	28	30	14	26	28
10:45-11:00		167		25	12	33	23	25	12	22	23
11:00-11:15		217		33	15	28	30	33	15	28	30
11:15-11:30		222		33	16	29	31	33	16	29	31
11:30-11:45		226		34	16	29	32	34	16	29	32
11:45-12·00		236		35	17	31	33	35	17	31	33
12:00-12:15		523		78	37	68	73	78	37	68	73
12:15-12:30		596		89	42	77	83	89	42	77	83
12:30-12:45		733		110	51	95	103	110	51	103	95
12:45- 1:00		568		87	40	75	81	87	40	81	75
1:00- 1:15		583		87	41	76	82	87	41	82	76
1:15- 1 30		470		71	33	61	66	71	33	66	61
1:30- 1:45		575		86	40	75	81	86	40	81	75
1:45- 2:00		460		69	32	60	64	60	32	64	60
2·00- 2 15		423		63	30	55	59	63	30	59	55
2:15- 2:30		384		58	27	50	54	58	27	54	50
2:30- 2·45		392		59	27	51	55	59	27	55	51
2:45- 3:00		401		60	28	52	56	60	28	56	52
3:00- 3:15		329		44	33	43	45	43	33	45	43
3:15- 3:30		341		45	36	53	48	45	35	36	53
3·30- 3:45		326		43	37	45	40	41	37	39	43
3:45- 4:00		473		58	69	59	51	57	69	50	59
4:00- 4:15		504		68	75	61	50	66	75	48	61
4:15- 4:30		512		71	79	58	48	71	79	48	58
4:30- 4:45		449		61	73	55	54	41	71	41	56
4:45- 5:00		521		69	74	58	58	65	74	65	58
5:00- 5:15		453		55	73	46	46	58	71	58	46
5:15- 5:30		453		55	73	46	46	58	71	58	46



EIGHTH AVENUE

APPENDIX 4.

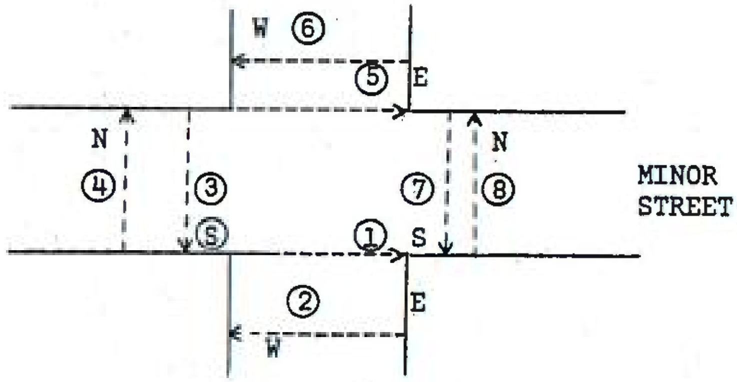
TRAFFIC COUNT



TRAFFIC COUNT BY DIRECTION

Streets Intersection	1	2	3	4	5	6	7	8	9	10	11	12	Total
2nd Ave. & 42nd St.				3214	7314		1866	21308	3652		3818	2212	
2nd Ave. & 58th St.				1731	3462			21928	1731				
1st Ave. & 12th St.	371	9887			865	1123							
Lexington & 34th St.				1944	15552		972	11988	1296		15552	3240	
1st Ave. & 4th St.	631	9097			576	835							
2nd Ave. & 14th St.				2546	7354		958	11309	1389				
6th Ave. & 42nd St.	667	24254	570		12258	351				2711	12258		
Broadway & 57th Street				5266	11646		719	11725	2293		17013	`990	
8th Ave. & 49th St.		20182	1009							1766	2270		
8th Ave. & 40th St.	1891	16311			3309	2128				1746	2042		
8th Ave. & 55th St.		14186	1073										
1st Ave. & 59th St.	223	2193	3146		8984	576				942	7468		
6th Ave. & 21st St.		7901	1075							1507	1297		
2nd Ave. & 86th St.					4690	6744					5058	844	
6th Ave. & 51st St.		16916	2566							3770	6528		
2nd Ave. & 49th St.							2161	28087			4681	1080	

APPENDIX 5.



PEDESTRIAN COUNT BY DIRECTION

Street Intersection	1	2	3	4	5	6	7	8
2nd Ave. & 42nd St.	2456	3736	2648	3424	2456	3736	3442	2648
2nd Ave. & 58th St.	2156	2372	2802	3450	2156	2372	2802	3450
1st Ave. & 12th St.	636	742	2330	1588	636	742	2330	1588
Lexington & 34th St.	1038	10706	5354	8030	1038	10706	5354	8030
1st Ave. & 4th St.	298	292	756	776	292	294	748	776
2nd Ave. & 14th St.	1338	1562	900	900	1338	1562	900	900
6th Ave. & 42nd St.	6072	6684	7086	8107	6078	6684	8170	7086
Broadway & 57th St.	9722	8754	7912	6932	9772	8754	7912	6932
8th Ave. & 49th St.	702	526	964	964	614	1190	1404	2458
8th Ave. & 40th St.	13066	1306	14374	6534	7640	1960	3920	6534
8th Ave. & 55th St.	2068	1064	1934	2094	2060	1064	2032	1978
1st Ave. & 59th St.	1296	1592	2175	2134	1296	1592	2185	2134
6th Ave. & 21st St.	1612	1476	3670	2804	1612	1476	3670	2804
2nd Ave. & 86th St,	2724	8170	2452	818	2724	5174	3268	1906
6th Ave. & 51st St.	19718	20044	31480	36614	19718	20044	31480	36614
2nd Ave. & 49th St.	1345	1480	1749	2152	1345	1480	1748	2152

APPENDIX 6.

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☐	☐	Would you be interested in receiving further reports in this area of research? If so, fill out form on other side.

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