FM 19-21

FIELD MANUAL

TRAFFIC CONTROL STUDIES

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HEADQUARTERS, DEPARTMENT OF THE ARMY
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DEPARTMENT OF THE ARMY
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TRAFFIC CONTROL STUDIES

*This manual supersedes TM 19-251, 6 June 1966.

CHAPTER 1
GENERAL

1-1. Purpose and Scope

a. This manual is intended as a guide to personnel who supervise or conduct traffic control studies. Normally, the traffic section of the installation provost marshal's office will plan and supervise the various traffic control studies conducted on the installation. Personnel used to gather the information for the studies will be provided from local resources.

b. This manual provides the basis for conducting various types of traffic control studies. It outlines minimum information needed for each study and the means to collect this information. The results and the possible application of each study, as well as followup activities indicated by these studies, are outlined in broad terms. Additional information is available in publications listed in appendix A.

1-2. User Comments

Users of this publication are encouraged to submit recommended changes and comments to improve the publication. Comments should be keyed to the specific page, paragraph, and line of text in which the change is recommended. Reasons will be provided for each comment to insure understanding and complete evaluation. Comments should be prepared using DA Form 2028 (Recommended Changes to Publications) and forwarded to Commandant, United States Army Military Police School, ATTN: ATSMP-CTD-DT-DTL, Fort Gordon, Georgia 30905.

1-3. Training

a. General. Personnel assigned to traffic study duties must be trained prior to performing these duties. Utilization of untrained personnel may result in input of questionable data into the study.

b. Supervisory personnel, to include traffic officers and traffic noncommissioned officers, should be school trained in the conduct and analysis of traffic studies. This formal training should be supplemented by attendance at seminars, special courses at civilian institutions, and participation in extension course programs. Additional experience and training may be attained by close liaison with the State and local agencies that also supervise and conduct traffic studies.

c. Personnel who conduct traffic studies need job-related training prior to performing these functions. Minimum classroom instruction is necessary. Usually, a brief orientation on the entire study, to include its importance to the installation, will serve as a basis. The remainder of the training should take the form of practical exercises. The time required for these exercises will vary according to the responsiveness of the personnel and their mastery of the task to be performed.

1-4. Use of ADPS

A reduction in the number of information gathering activities may occur when adequate information has been programed into the installation automatic data processing system. As noted in the various sections that follow, ADPS is expected to reduce cost as well as increase the validity of the study. However, it is necessary that the traffic section provide adequate and valid data for input into the installation ADPS. ADPS, as it relates to traffic accident analysis, is discussed in chapter 14.

1-5. Pitfalls of Traffic Studies Analyses

Because studies and statistical presentations often provide ready and apparent answers to problems, the provost marshal, traffic officer, or traffic noncommissioned officer can be misled into oversimplifying results when he identifies trends or establishes cause and effect relationships. He must constantly be on guard against accepting the quick and easy answer or the obvious solution to a problem. Some of the pitfalls are—

a. Failure to explore or evaluate all the data at his disposal. All angles or approaches to a problem must be explored. Halfway measures encourage false conclusions.

b. Failure to recognize the effects of four

Type	Purpose	Requirement for study	Personnel and equipment
Traffic Control Device Studies	To inventory, locate, classify, and evaluate traffic control devices; and increase adequacy of these devices.	One initial study of all devices which is updated by periodic studies of specific areas on a routine basis.	Special two-man teams. Normal patrol equipment, and stopwatch, tape measure (100 ft), Manual on Uniform Traffic Control Devices, field forms or notebook.
Vehicle Registration Study	To determine peak loads of traffic and adequacy of parking. May be used to adjust or update origin and destination study, or be used in lieu of this study.	As required to measure peak traffic in relation to existing roadways, and duty hour schedules.	Study is conducted by extraction and processing of information with ADPS. Traffic section personnel obtain input data, and ADP section processes data as required.
Origin—Destination Study	To develop data on origins and destinations of military and civilian personnel entering, leaving, or traveling within a military installation on a typical working day.	As required to support long-range planning, to anticipate major changes in strengths and functions, to support traffic construction requirements, and to assign traffic properly.	Varies with type and scope of study. See section IV.
Speed Study	To determine if prevailing speeds are proper; to determine proper speed for new or improved roadways; to serve as a warrant for, and guide in, the placement and operation of traffic control devices, and to assist in accident research and enforcement.	Conducted for specific roadways as a result of observation, enforcement activity, and accident experience. Also required for new or renovated roadways.	Personnel may consist of one-man or two-man teams depending on the method and type of study. Equipment may consist of patrol vehicle, mirror box, stopwatch, field sheets, radar (with or without graphic recorder) and electric timer. Normally, MP gear and marked vehicles are not used.
Speed-Delay Study	To determine variation in speed along a route; indicate amount, location, course, frequency and duration of delays, and provide overall speed and travel time along a route.	Conducted on specific routes as problems develop of congestion, delay and insufficient capacity. Also conducted when necessary to assign route priority, to consider use of alternate routes, to evaluate speed limits, and to check effectiveness of control devices.	Personnel will consist of a two-man team without distinctive MP gear. Unmarked sedan or ¼-ton truck, standard watch and stopwatch, and field sheets as required.
Motor Vehicle Volume Study	To obtain an accurate record of the number, directional movements, and variation in volume of motor vehicles passing through intersec-	Conducted as required to determine street adequacy, to appraise effectiveness of traffic control measures, and to establish priorities	Two military policemen are required to observe and record at a normal two-way intersection. If traffic exceeds 1500 vehicles per hour enter-

	tions or using major routes; and to provide data for use in construction of a traffic flow map.	and designs for traffic and/or road improvements and for new streets.	ing the intersection, one military policeman may be required for each of the four approaches. Ordinary watches, field sheets, summary sheets, and (if used) manual counters are needed.
Roadway Capacity Studies	To determine the practical capacities of roadways as an adjunct to other studies; and to provide basic information required to update traffic regulations, to establish priorities for street improvements, and to aid in traffic planning.	Conducted as required to relieve congestion through appropriate corrective action in those areas where traffic volumes exceed traffic capacities.	Varies wtih scope of study. Normally, as a minimum, requires a two-man team equipped with tape measure, stopwatch post or engineer maps, sketch pads, and odometer (optional).
Vehicle Occupancy Study	To determine the number of occupants per motor vehicle.	As required to examine parking difficulties and congestion; to assist in planning for future traffic and parking facilities, and to evaluate the adequacy of transit services.	Either one-man or two-man teams with normal MP gear depending on traffic volume. Equipment required includes ordinary watch, field sheets, and summary sheets.
Pedestrian Study	To determine the amount of pedestrian traffic at intersections and/or midblock crossing points.	As required to evaluate pedestrian-vehicle conflicts, and assist in planning control, physical protection, and enforcement measures.	Locally designed field sheets or notebooks. Either one-man or two-man teams depending on the pedestrian volume. Military police gear is not worn.
Observance of Stop Sign Study	To determine the degree of driver obedience.	As required to study the relation of driver obedience to accidents at high accident frequency locations, and to assist in taking measures to increase driver obedience.	One person can normally make this study. He should not wear distinctive military police equipment, and should have a watch and field sheets.
Observance of Traffic Signals Study.	To determine voluntary observance of intersection traffic control signals.	As required at intersections where congestion and high accident rates prevail.	Two military policemen without distinctive MP gear are normally required. On multiple approaches with heavy traffic, four or six military policemen may be required. Equipment consists of an ordinary watch, field sheets, and summary sheets.

Figure 1–1. Guide to traffic control studies.

Type	Purpose	Requirement for study	Personnel and equipment
Parking Studies	To determine the adequacy, use, and location of existing parking facilities; and to provide guidance in the placement and design of parking areas for future use.	A comprehensive, installation survey is normally required only in conjunction with long-range planning for major changes in the installation. Surveys are conducted at specific areas as parking problems become evident, or in anticipation of the development of parking problems.	Field sheets, summary sheets, post map, aerial photos, and questionnaires are used as required for the specific study or survey being conducted. Personnel requirements and use of military police gear depend on the type and scope of the study.
Accident Records Study	To improve enforcement, engineering, and education programs.	As needed to identify and treat high accident locations, to assist in evaluating highway design factors, to establish priorities of action, and to measure effectiveness of remedial action.	ADP equipment and trained personnel for automatic data processing. Normally, two military police perform observations for condition and collision diagrams.

Figure 1–1. Guide to traffic control studies.—Continued

types of fluctuations in data, which occur commonly, and which are often misinterpreted.

(1) A long-term trend which is not affected by short-term fluctuations or chance variations. It is brought about largely by changes in the basic factors contributing to the problem.

(2) A long-term trend which fluctuates above and below the trend line which is influenced by economic cycles and a number of short-lived influences.

(3) A seasonal fluctuation, or trend, which is produced by the time of day, time of week, time of year, etc., in which volume, speed, or incidents increase or decrease periodically according to the clock or the calendar.

(4) A chance variation, or the spatter effect of data which has no real significance. When data are accumulated over a long period of time, chance variations tend to offset one another and form a definite pattern, but their concentration in short periods of time can be misleading. In determining real changes, the study must be sufficient in time span to identify and take into account the effects of cycles, seasons, and chance variations.

c. Faulty reasoning or interpretation in one or more of the following forms:

(1) *Unjustified assumption of cause and effect.* If one event always follows another, it is convenient, but incorrect, to assume that the former causes the latter.

(2) *Generalizing on the basis of an average.* Various averages, arithmetical mean, median, and mode, are useful for identifying typical or representative cases, but they have limited use in making analyses. For example, icy roads may be involved in an average of one accident per 1000, yet icy roads attain major importance on the 1 or 2 days a year when the roads are dangerously icy.

(3) *Generalization from a specific instance.* For example, the reduction in traffic loads brought about by staggering work hours among two major elements of an installation does not mean that a staggering of work hours among all elements of the installation will further reduce traffic loads. The converse may be true since such action may reduce the number of car pools and thus increase the number of vehicles using the installation roads.

(4) *Spurious accuracy.* If two or more figures are combined in a computation and one of the figures is a guess or an approximation, the result cannot be accepted as a precise mathematical calculation. The result will be only an approximation.

1–6. Planning Traffic Studies

a. The traffic section of the installation provost marshal's office, through a traffic branch, normally maintains a continuing program of traffic studies. The objective of this program is to insure that the installation traffic control plan is adequate, and to provide for the safe and efficient movement of traffic. In addition, this program provides a continuing flow of information to the installation provost marshal, the traffic council, the installation master planning board, and the engineer, as justification for various road and related projects. Figure 1–1 reflects a guide to the various type studies with related information. Data on the guide will require adjustment for each installation.

b. It is necessary to include traffic movement in the master plan of the installation. Prior to a major revision of the installation master plan, appropriate traffic control studies will provide important information needed by the commander and his planners to provide roads and facilities to support their objectives. Failure to include traffic as a consideration will result in major control problems as well as reduce the efficiency of the installation. The requirement for considering the traffic area when developing the master plan is prescribed in AR 210–20. Planning should be coordinated with the post engineer, transportation officer and safety officer.

c. Traffic studies are required when a change of conditions occurs. This change of conditions may be major and affect the entire installation, such as a change in mission, relocation of units, a substantial increase in the number of vehicles, or a major change in the direction of movement of vehicles. The change of conditions may also be restricted to a small segment of the installation or even a short secondary road. It may be only a new building, an enlarged parking area, rebuilt road shoulders, or the removal of trees or power poles from the shoulders of the road. The type of change will determine the nature and scope of the studies to be conducted.

d. In estimating time required for the preparation and conduct of studies, required training for personnel not previously involved in traffic studies should be considered. Time requirements for computation of data and study analysis will depend on the extent to which automatic data processing (ADP) is used.

e. Road users must understand the need for studies if they are to support them. Close cooperation must be maintained with the installation information officer to insure all available media are used in any public relations effort. In addition, commanders' conferences, daily bulletins, and poster campaigns are other means of insuring that the public is aware of the conduct of the study and its purpose.

f. Requirements for personnel as shown in figure 1–1 are based on one operating station. Supervisors should be provided on the basis of one supervisor for every two to eight operating stations, however, the supervisor must be able to observe each operating station a minimum of 5 minutes in each operating hour. Such a restriction may limit the number of operating stations under one supervisor. A coordinating supervisor, normally an officer or senior noncommissioned officer, is appointed from the traffic section for the entire study from initial planning to analysis of the results.

g. Each operating station should have two-way communications capability which will enable the operating station to notify the traffic section of emergencies or problems. If installation telephones are not available, field telephones should be used rather than radios to maintain communications between operating stations. Supervisors should be provided with radio equipped vehicles that net with the installation military police net. Planned communication will permit direction and control of all study related activity from and through the traffic section.

h. Aerial photos, still photos, and motion pictures are valuable tools in resolving traffic problems. These techniques are of particular use in "before and after" views of critical intersections, in parking lot studies, and in the training of new personnel.

CHAPTER 2

STUDIES OF TRAFFIC CONTROL DEVICES

2–1. General

Traffic control studies usually measure the adequacy of traffic control devices. These studies are normally performed only once at an installation and are updated on a programed basis by regular military police patrol activity. For example, through periodic (daily or weekly) studies of specific areas, the entire installation may be surveyed on a semiannual or annual basis. The initial traffic control device study is programed to insure that all of the installation roads are studied. This study will provide information as shown in paragraph 2–3 below. Subsequent studies will then update the data. An index file may be established to record areas studied and dates studies were conducted. Observance studies which evaluate the effectiveness of these devices are contained in chapters 11 and 12. Portable signals and devices should not be included in these studies. The three different types of studies, discussed in the following paragraph, may be conducted independently or in any desired combination depending upon the purpose of the study.

2–2. Types of Traffic Control Devices Studies

a. Signs. A traffic control device study (signs) inventories, evaluates the condition of, locates placement of, and classifies all devices mounted on a fixed support that conveys a specific message by means of words or symbols. These devices are officially erected for the purpose of regulating, warning, or guiding traffic.

b. Signals. A traffic control device study (signal) with inventory, evaluates the condition, locates the placement, and classifies the power-operated devices which regulate or warn traffic, or which direct traffic to take some specific action.

c. Pavement Markings. A traffic control device study (markings) will inventory; evaluate the condition; locate the placement; and classify all lines, patterns, words, colors, or other devices, except signs, set into the surface of, applied upon, or attached to the pavement or curbing, or to objects within or adjacent to the roadway. These markings are officially placed for the purpose of regulating, warning, or guiding traffic.

2–3. Conduct of Traffic Control Device Studies

a. Signs. Information of a physical nature pertaining to the signs is obtained and recorded. Depending on the extent of the study, all or any part of the following items would be included:

(1) The type and classification of the sign such as stop, one-way, school, right curve, etc.

(2) The size and shape.

(3) The color.

(4) Whether the sign is reflectorized and if so, what type.

(5) The location of the sign in terms of streets, height, distance from pavement or curb, and distance from intersection or other identifiable object.

(6) The legibility as a result of location, size, or manner of lettering, and state of maintenance.

b. Signals. The following information about these devices is obtained and recorded:

(1) The type of each signal controller such as fixed time, full traffic actuated, flashing, etc.

(2) A sketch of the phasing of each signal and the timing of each phase in terms of green, red, and yellow time.

(3) The geographic location of each signal and its position at the location.

(4) Data of a physical nature about the signal system, such as number and size of heads, state of maintenance, etc.

c. Pavement Markings. Pertinent information is obtained and recorded on the following:

(1) The type of legend, such as left turn only, railroad crossing warning, double center line, etc., and the type of material.

(2) The size of each marking in terms of overall measurements, line widths, and letter heights; or for center and lane lines, the width and length of each section.

(3) The condition of each marking and

DATE 5 June SHEET 1 of 10

STREET 1st FROM Provost Ave. TO Marshal Ave. LENGTH 600′ WIDTH 30′

Side of Street	Type or Legend	Size & Shape	Color	Type of Reflectorization	Position			Remarks
					Height	Distance from Highway	Distance from Corner	
North	Stop	30″	RED	Sheeting	7′-0″	6′-0″	10′-0″	
North	Curve	24″ x 24″	YELLOW	Sheeting	6′-8″	4′-8″	300′	

Figure 2–1. Sign inventory-field sheet.

whether it is reflective. Reflective marking paint contains small glass beads that may be visible under close scrutiny or may be detected by touch. When viewed at night from an automobile with the headlights on, reflective paint will stand out to a much greater degree than ordinary paint.

2–4. Personnel and Equipment

Special teams, normally consisting of two men, are established to perform the initial study. If previous studies have been conducted, printouts or cards of these are taken with the team. In addition to normal patrol equipment, the following special equipment should be provided:

a. Manual on Uniform Traffic Control Devices.

b. Stopwatch.

c. Tape Measure—100 Feet.

2–5. Obtaining Data and Posting Results

a. Information is collected by field observation. The normal procedure is a two-man team traveling by automobile. If there is a concentration of control devices in an area, it is advisable to travel on foot. A combined inventory of all three classes of control devices may be made in one routing.

(1) *Signs.* In conducting an inventory of traffic signs, the observer must devise a plan or pattern to be followed in the field inspection. This plan, which outlines an orderly system of travel, must insure that all signs may be inventoried in a minimum of time. While conducting the field inspection, the required information should be recorded on a field sheet such as shown in figure 2–1.

This suggested field sheet includes all the information that would normally be required in any sign inventory. In a particular study where all of this information is not required, the columns that are not applicable may be so marked. If the observer has a thorough knowledge of the standards outlined in the *Manual on Uniform Traffic Control Devices for Streets and Highways*, he may merely mark "standard" in the remarks column when the sign conforms to such standards. If the observer does not have the knowledge or in a particular situation is not sure, he should record all the information. The remarks column is used to record condition, size and manner of lettering, or any unusual legend or feature. On long stretches of highway the sign location can be identified by noting in the remarks column the odometer reading with respect to a known point such as lightpoles or buildings. The other columns are self-explanatory. In many cases, it may be convenient to inventory an individual intersection by marking a diagram of it showing the various signs and their locations.

(2) *Signals.* An inventory of traffic signals requires observation of the signal through several complete cycles. A stopwatch is used to time each action of the signal. An inspection of the control box reveals the type of controller and the time intervals that have been set on the dials for each phase. If the signal is traffic actuated, the type and location of all detectors can be obtained by physical inspection. It is advisable to sketch the phasing of the signal while at the site. This information for each location can be recorded in any orderly, easily understood manner, such as is shown in figure 2–2.

(3) *Pavement markings.* A pavement marking inventory should be conducted following a plan such as discussed in (1) above. In most instances the same routing plan used in (1) above will suffice. The required data may be recorded on a field sheet, such as is shown in figure 2–3. On long stretches of highway, pavement markings can be located by odometer readings similar to that described in (1) above. As in the sign inventory, it is advantageous for the observer to have a thorough knowledge of the *Manual on Uniform Traffic Devices for Streets and Highways* prior to accomplishment of field observations.

b. Data obtained by the study team may be recorded and posted for either manual or machine processing. A card file or looseleaf notebook system is normally established and maintained in the traffic section for traffic control devices in a manual operation. A machine card system is established and maintained in an ADPS operation.

c. Teams gathering the data in an initial study must locate and record information (para 2–3) on all devices. For subsequent studies, previous data is carried by the team and updated for that particular portion of the installation which is being surveyed. This previous data, as noted above, may be in the form of cards or looseleaf notebook for manual operations, or a printout from machine cards for machine operations.

d. As noted above, local forms may be used by the field observers to record information on the initial study. The data may then be transferred to the card or notebook file, or to the punchcard by the traffic section. Observer personnel on subsequent studies may use the appropriate

SIGNAL INVENTORY

FIELD SHEET

DATE ______ SHEET ______ OF ______ SHEETS

LOCATION ______

CONTROLLER TYPE ______

DIAL SETTINGS ______

ACTUATED TIMING ______

NO & SIZE OF HEADS ______

NO & TYPE OF DETECTORS ______

REMARKS ______

______

______

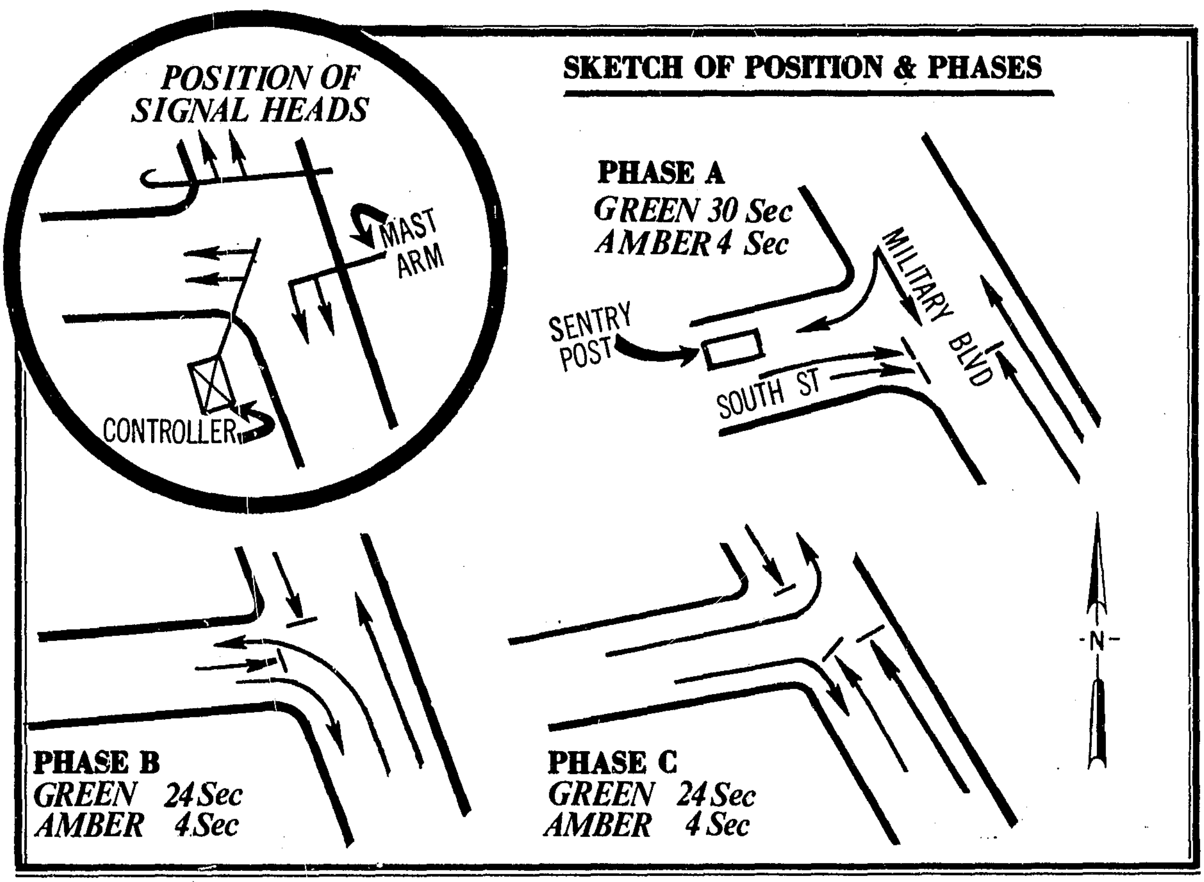

Figure 2–2. Signal inventory field sheet.

DATE 5 JUNE

SHEET 2 of 12 SHEETS

LINES					LEGENDS & SYMBOLS			
LOCATION	TYPE	LENGTH	WIDTH	MATERIAL	LOCATION	DESCRIPTION	MATERIAL	DIMENSION OF LETTERS
Provost Ave. to Marshal Ave.	Centerline	600′	4″	White paint	Provost Ave., west of 1st St.	Crosswalk	White paint	

Figure 2–3. Pavement marking inventory field sheet.

portions of the card file or printout and update the material.

e. In a machine operation, standard 80-column punchcards are used. Locations may be coded by streets (using abbreviations) or by use of 8-digit military group coordinates. Other data required is also coded on the punchcard using the information collected by the field observers.

f. The traffic section of the installation provost marshal's office should maintain a map or maps of the installation which portray by overlays, markings, or pins the location of various traffic control devices. The map or maps are updated after each study. They provide a rapid visual review of the installation traffic control device situation. By use of special markings or colors, attention may be directed to those devices requiring action.

g. Standards for the design and usage of traffic control devices are defined in detail in the *Manual on Uniform Traffic Control Devices for Streets and Highways*, a US Department of Transportation publication, dated 1971. The manual was prepared by the National Joint Committee on Uniform Traffic Control Devices.

2-6. Supervisory Review

When evaluation by the military police indicates deficiencies such as the need for sign repairs, repainting of markings, or standardizing of signal devices, the patrol or traffic supervisor will confirm the findings by a physical inspection of the devices in question. The appropriate information is then placed into the records system. Military police patrols, as part of their normal duty, should observe and report on traffic control devices on a continuing basis.

2-7. Common Applications of Information Developed by Traffic Studies

a. They provide a list (printouts) of traffic control devices that do not meet the standards of the *Manual on Uniform Traffic Control Devices.*

b. The studies list (printout) corrective action to insure adequate maintenance information is provided the installation engineer.

c. Input data is provided for a condition diagram study of a high frequency accident location.

d. Information is provided about control devices which must be changed because of new or revised law, ordinance, or regulation.

e. They provide guidance in conjunction with other studies such as traffic volume or street capacity studies to insure maximum safe flow of traffic.

f. They provide data on which to determine the proper location and placement of a traffic control device.

g. They provide backup information on road reconnaissance and classification (FM 5-36) which is normally performed on all installation roads as a part of the military police mission of the post.

CHAPTER 3

VEHICLE REGISTRATION STUDY

3-1. Purpose

The vehicle registration study supplies data used to adjust duty hours to reduce peak loads of traffic, and also serves in the design planning of adequate parking lots. The data developed as a part of this study may be used in lieu of an origin-destination study, or may be used to adjust or update an origin-destination study (chap 4).

3-2. Method of Study

Note. This study method is based on the use of EAM or ADP equipment.

a. Information recorded on the Vehicle Registration and Driver Record (DA Form 3626) is used to provide input into the machine equipment. Information must be complete. Item 5 on the form, Organization, *must include place of work.* The unit assignment of an individual may not be the same as his actual place of duty. For example, a person assigned to a headquarters company may work in a staff section. The home addresses may be coded by 2-letter codes given to the various major areas within the community. The machine equipment can then be used to determine the amount of traffic from the major areas and from each of the specific offices on the installation. When this information is developed, logical traffic patterns can be drawn using the normal routes taken on the major roads in the community. The extent and use of car pools should be considered in determining traffic volume. A correction factor based on car pools must be used to estimate volume properly.

b. After the traffic volume and normal route patterns are determined, the data may be presented graphically on a map which reflects the installation road net and all gates. Large installations which have numerous gates may require a series of maps. The map or maps will show the approximate volume of road use at peak hours.

c. A schedule of duty hours for installation activities and offices is obtained and reviewed. Through a comparison of the vehicle registration study and the duty hour schedules, the questions of when and where people are going or which routes are probably used may be answered. These estimates may present information required for more specific analysis.

d. If available, results of a speed-delay study may be utilized to tie in on-post movement rates on the various routes.

e. The information developed may then be analyzed as it applies to a specific length of roadway. Results are then recorded on a route volume graph (fig 3-1) which will show the approximate volume of road use at peak hours.

f. If the traffic volume is within the practical capacity (chap 8) of the roads used and a review of accident statistics does not disclose any problems, no action need be taken.

g. When a deficiency exists or problem is apparent, consideration should be given to adjusting duty hours. Prior to any adjustment, a letter interview should be conducted. A sample interview questionnaire is shown in figure 3-2. This questionnaire may be altered to fit local requirements. These interviews should be sent through normal command channels to all personnel who have a DA Form 3626 on file. The interview sheet should be analyzed to insure that any adjustment in hours does not adversely affect car pools or their operation. It may be necessary to sample commercial traffic if such traffic exerts a major influence. The proposal to adjust duty hours should be considered in light of the mission of the elements of the installation and public transportation schedules. If it is considered necessary to change duty hours, a recommendation should be submitted to the installation traffic council. The council's action must be restricted to acceptance or rejection of the proposal. Changes must be supported by the study, not personal opinions.

3-3. Other Uses of Data Developed

The data developed in this study and the other information reported on the Vehicle Registration and Driver Record, DA Form 3626, support

EQUIVALENT PEAK HOUR TRAFFIC FLOW

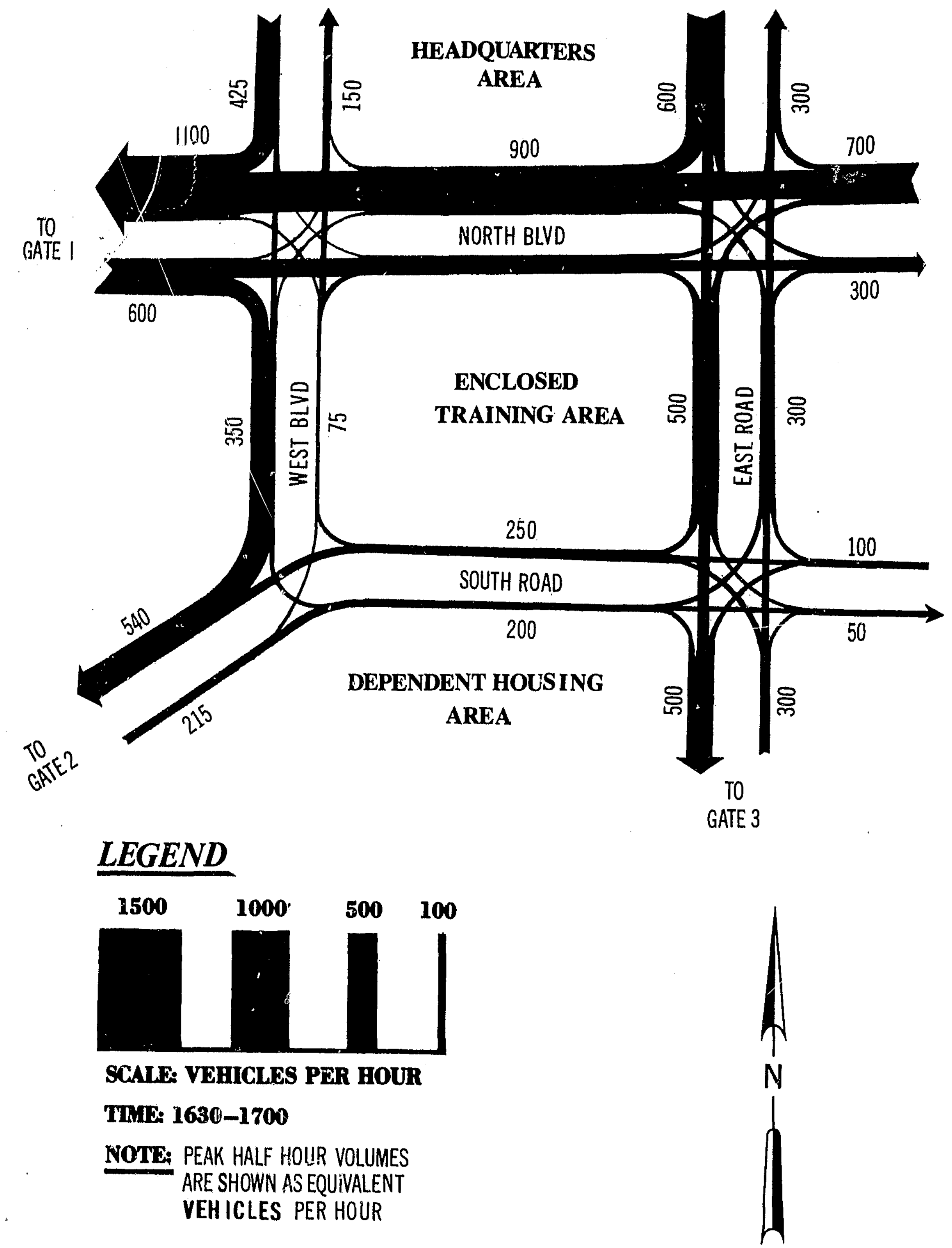

Figure 3–1. Route volume graph.

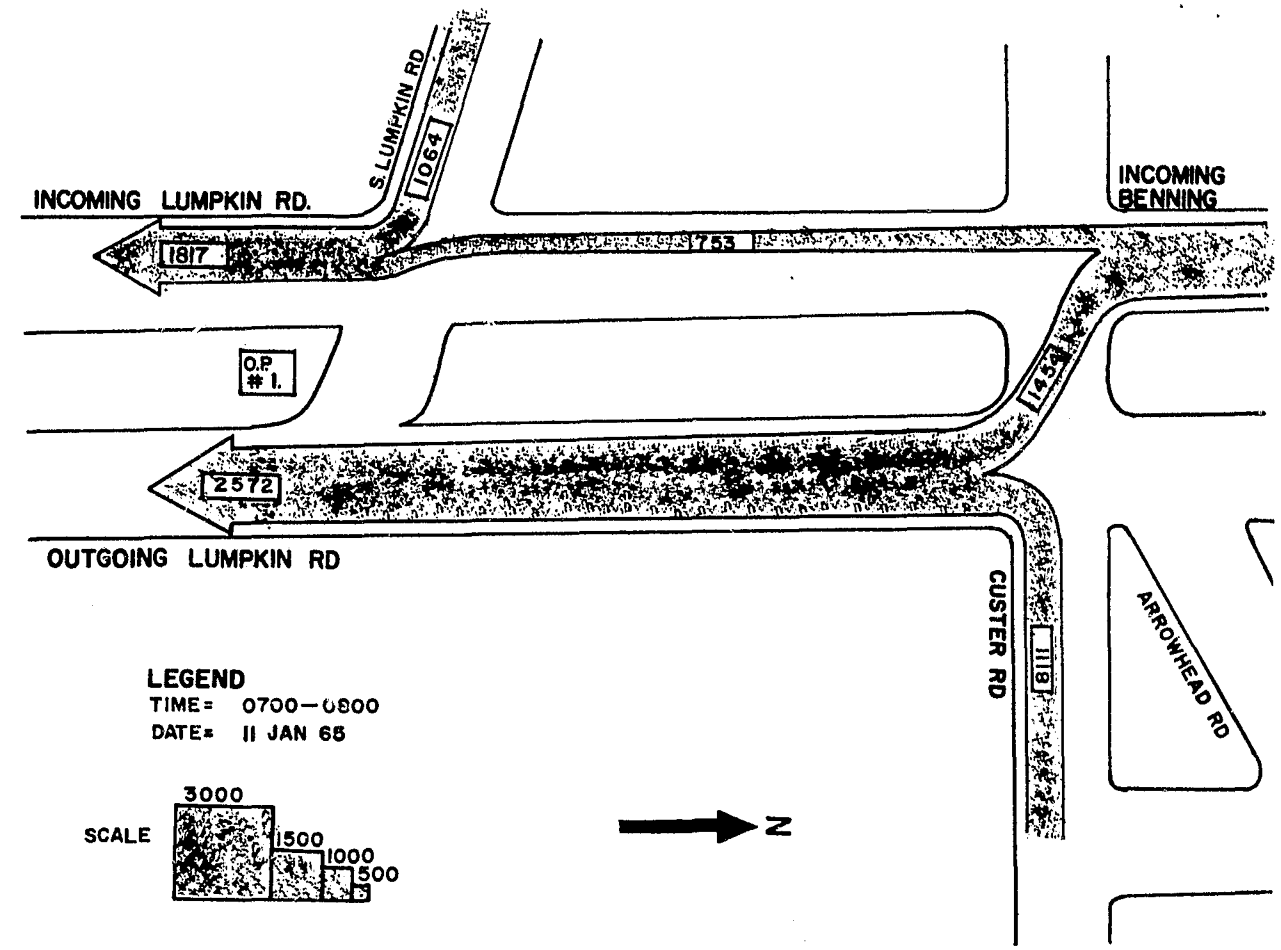

Figure 5. Route volume graph.

1. How do you normally travel to and from your place of duty?
   - Drive car
   - Passenger in car
   - Public transit
   - Walk
2. If you drive a car please answer the following:
   - a. How many people are in the car (include self)?
     One Two Three Four Five Six
   - b. Where does your trip originate?
     Street Address:
     City:
   - c. Through which gate do you enter the Post?
     Main Gate West Gate Sixth St. Gate
   - d. Where do you park your car during duty hours?
     Give parking lot number, nearby building number, or nearest intersection:
   - e. What is your place of duty? ______________________
   - f. If in car pool, what is on-post destination of other members of car pool?

____

____

Figure 3–2. Origin-destination study.

police selective enforcement activities. Some area of possible use are—

a. Identification of vehicles stolen, abandoned, recovered, etc.

b. Control to insure compliance with insurance regulations.

c. Identification of vehicles by year, model, make, state, etc., when investigating an incident.

d. Maintenance of driver records as provided in AR 190-5.

e. Determination of vehicle ownership.

CHAPTER 4

ORIGIN-DESTINATION STUDY

4-1. Purpose

The origin-destination study develops data on origins and destinations of military and civilian personnel entering, leaving, or traveling within a military installation on a typical working day. Studies of travel patterns normally are conducted as an integral part of long-range traffic planning. A particular study is also indicated when substantial changes are anticipated in the strength of the installation or in land uses on the installation and in surrounding areas. Origin-destination studies must be augmented with analyses of present land use, growth trends, and proposed route improvements to provide a complete basis for future planning. (A modified origin-destination study is accomplished by the vehicle registration study, chap 3.)

4-2. Scope

An origin-destination study will—

a. Develop the number of trips into, within, and/or through the installation.

b. Aid in evaluating the general road plan, and in developing designs and locations of new road facilities.

c. Show the time of day that trips are made, the modes of travel used, and the average number of occupants per vehicle.

d. Depict present travel patterns on the installation and in surrounding areas.

e. Show which areas on an installation and in surrounding areas generate the most traffic.

f. Afford a basis for determining future travel patterns and rerouting traffic into new or other existing routes.

g. Aid in determining the nature of present and future transportation deficiencies.

h. Permit evaluation of the potential traffic pattern and relief that may be afforded by new or alternate routes.

i. Relate travel patterns to efficient use of traffic lanes.

j. Provide a basis for the design and location of new streets and parking areas.

4-3. Planning an Origin-Destination Study

a. An origin-destination study is usually conducted by interviewing a sample of the total number of persons who make trips in an area. The travel habits of the persons interviewed should be representative of the total population. The results of the interviews then merely have to be multiplied by appropriate factors to represent the total. Thus, the accuracy of such a study depends upon the number of persons interviewed in relation to the total population; therefore care must be taken in selecting a representative sample, and in recording the data. The size of the sample to be taken will depend on the size of zones into which the study area will be divided for analysis, the minumum number of trips (trip interchange) between zones, and the size of the population.

b. Every one-way movement between a place of origin and a destination is classed as a trip, and three categories of trips (internal, external, and through) are recognized. Placement into category is based upon the location of origin and destination within the particular area under study.

4-4. Methods of Conducting an Origin-Destination Study

The various methods by which an origin-destination study may be undertaken and their comparative merits are listed in figure 4-1. On some installations combinations of these methods may be used. The precise study method to be used will depend upon the specific installation and the degree of information required. Following are specific types of origin-destination studies:

a. Registration Questionnaire. Vehicle registration data are analyzed and an address list is extracted. This list will consist of military and civilian personnel from those installation areas and activities which generate the most traffic. The analysis is then extended by distributing questionnaires to those on the list at their place of duty or employment. The information re-

No.	Item	Type of Survey				
		a	b	c	d	e
		Address lists or questionnaire	External post card	Roadside interview	License plate or tag-on-car	Home interview
1	Applicability	On most installations. When work trips dominate traffic.	When through trips are significant and internal trips are not significant.	Supplement to on-post questionnaire. When through trips are significant and internal trips are not significant.	Determining proportions and patterns of through traffic. For specific movements in dense area. Determining potential bypass traffic.	Only in conjunction with Bureau of Public Roads and State highway department.
2	Method and place of interview.	Distribute questionnaire at place of work or duty.	Distribute post cards on roadway at or near entrance gates.	Interview on roadways at or near entrance gates.	Mark cars and/or check license plates at or near entrance gates.	Sample interviews in selected dwelling units.
3	Size of Sample	Variable	25–50% return desirable.	20% of total two-way traffic approximate minimum (more on low volume roads).	Variable	Minimum of 5% to 20% depending on size of adjacent urban areas.
4	Means of sample control.	Relate interview or responses to total population in each area interviewed.	Relate returns to total traffic at each location.	Relate returns to total traffic at each location by hours of the day.	Relate cars tagged to cars counted at each location.	Preselect size or sample; "screenline" check of data.
5	Accuracy	Approx. 75–95% (estimated).	80–90% Less uniform distribution of returns.	80–90% Good distribution of returns.	Good for through trips	85–100% Uniform distribution of returns.
6	Method of data processing.	Machine or manual	Machine	Machine	Manual	Machine
7	Costs	Minimum	Substantial	Substantial	Minimum	Maximum
8	Advantages	Minimum cost Large sample No interference to traffic.	Minimum interference to traffic. Adaptable to peak hours. Done in 1 day	Control of sample Accuracy of trip distribution.	Low cost Provides simple answer to specific problem.	Accuracy Completeness
9	Disadvantages	May not fully reflect nonwork travel. Does not detect through trips.	Does not fully reflect internal trips. Incomplete control of response.	Interferes with traffic in peak hours. Does not fully reflect internal trips.	Limited to specific problems only. Difficult to match vehicles (accuracy).	Greater cost, time, complexity.

Figure 4–1. Guide to origin-destination studies.

ceived is then transferred to ADP or EAM punchcards for tabulation.

b. Post Card. A prepaid post card with return address and questionnaire to be filled in by the vehicle driver may be distributed to personnel entering the installation at each of the entry points. The cards should be distributed between 0600 and 1800 hours, with distribution being extended to 18 to 24 hours under special conditions. The questions on the card should be simple and should be limited to the basic information desired. Traffic volume counts will be taken at each of the roadside survey stations to permit expansion of the post card returns to 24 hours. The information may be transferred to punchcards to assist in computation.

c. Roadside Interview. Roadside interviews require advance publicity, with an explanation of their purpose. A roadside interview may be conducted at each of the entry gates, or other control points. Military police conducting the interview should be in uniform. Additional military policemen should be available for traffic control. As a minimum, a 50-percent sample should be obtained of all vehicles entering the post during off-peak hours. A minimum sample of 25-percent should be obtained during peak hours. The sample percentage should be increased for low-volume road (less than 1000 vehicles per day).

(1) It is not essential to operate interview stations simultaneously; the interviews may be extended throughout several days of the week. A simple strip of bumper tape (or other system) may be used to avoid reinterview of the same drivers.

(2) A manual count of traffic by hours, direction, and classification of vehicles should be undertaken simultaneously with interviewing to permit expansion of interviews to a 24-hour period (para 4–3*a*).

(3) One interview takes about 40 seconds. Five interviewers in one file (one lane of traffic) can interview about 300 drivers per hour. There should never be more than six interviewers in one file. If the width of the roadway permits, additional files may be established.

(4) A predetermined, recognizable interview procedure permits efficient operation of interview stations and produces statistically sound results. In laying out stations, it is important to provide ample sight distance for approaching traffic, width for bypassing, and proper signing.

d. Tag on Car. At locations where an installation is completely encompassed by built-up areas, and/or where it is desired to know the travel patterns and proportions of through traffic traversing the installation, a modified station-to-station origin-destination survey may be made. The number of vehicles entering the installation will be counted, and a colored tape or tag (a different color for each station) will be placed on the front bumper of each car entering the installation. Drivers should be requested to leave the tape or tag on the car for the duration of the survey. The number and type of taped vehicles leaving the post will be counted, thereby permitting vehicle paths to be traced. This limited study could be done during typical peak, off-peak, and midday hours.

e. Comprehensive home interview. This comprehensive study, which samples the total transportation demand for an area, will not usually be warranted on a military installation. Some installations are, however, so located with respect to cities that the patterns of travel to, from, and through them are depicted in comprehensive origin-destination studies conducted by state highway departments in conjunction with the US Bureau of Public Roads. If such a study has been made, or is in process, it will likely provide all information needed on travel patterns or travel desires.

4–5. Associated Studies

An origin-destination study may be augmented by the following studies:

a. Land Use Study. Land use maps and related information on land uses will be compiled for both the installation and the surrounding areas. Residential, industrial, commercial, and recreational land uses will be ascertained for surrounding areas. Basic information maps of the installation will furnish much data, such as locations of buildings, cantonment areas, hospitals, warehouses, magazine areas, range areas, airfields, and other fixed uses of land (AR 210–20).

b. Growth Trends. Trends in population, land use, and highway travel on the installation and in its environs, including the surrounding urban areas, will be investigated (AR 210–20). The population to be used for traffic planning should be based upon the strength authorized for the permanent mission of the installation. It will be considered by category, i.e., military personnel, civilian office employees, civilian maintenance and service personnel, visitors, contractors' personnel, hospital personnel, and summer training reserves. Trends for the areas surrounding the installation should be determined through conference with planning agencies, utility companies, and highway officials.

c. Off-Post Route Improvements. Plans of cities, counties, and states for major new routes and for extensive reconstruction of existing routes in the vicinity of an installation should be investigated. Information should be obtained on the locations, alignment, design, capacities, access points, and staging of new highway facilities that are being planned or constructed by these agencies. This information may be available from the records of the provost marshal's office or the installation engineer.

4–6. Analysis

Origin-destination and related data should be thoroughly analyzed to permit development of current and anticipated vehicular travel patterns and demands for the installation. When pertinent, the patterns will also reflect the future demands on surrounding roads.

a. Present Travel Patterns. Present travel patterns should be shown as follows:

(1) The origin-destination data will be coded to previously established zones which will be overlaid on the general site map (AR 210–20). The data should be expanded to reflect a typical 24-hour weekday period. Where home interviews are made, the persons interviewed will be related to the total population. When post cards are issued along a roadway or roadside interviews are made, a table should be prepared showing the percentage of total traffic interviewed by location. This table may be similar to that shown in sample (fig 4–2). The conversion to 24-hour periods is normally accomplished in the processing of data by ADP systems.

by ADP system.

Line	a Station	b Location	c Total traffic	d Number interviewed (*)	e Percentage interviewed
1	A	Main gate ___	9,000	1,800	20%
2	B	Pershing road gate _______	5,000	1,100	22%
3	C	Lincoln blvd gate _______	3,000	900	30%
4	D	Lee blvd gate _	3,000	800	27%
5	Total	_____________	20,000	4,600	23%

(*) Or post card returns.

Figure 4–2. Origin-destination survey coverage of drivers interviewed at a hypothetical military installation.

(2) Desire-line maps may be prepared to indicate travel to and from the installation, through the installation, and between major functional areas on the installation. For this purpose average weekday traffic may be represented by bands of relative width which are superimposed on the general site map of the installation as shown in figure 4–3.

(3) A detailed triangular table may be prepared, similar to the sample (fig 4–4), indicating movements between the various zones.

(4) A map may be prepared indicating the major traffic generators on the installation and the relative magnitude of traffic which they generate.

b. Future Travel Patterns. Future travel patterns may be estimated on the basis of conditions projected ahead for 5, 10, or 20 years, as required. Particular attention should be paid to the probable effect of projected permanent facilities that are shown on the general site plan for future development and listed in the installation construction program. Analyses will include the following:

(1) Anticipated changes in population and vehicle registration as compared to the present strength and registration, as illustrated in sample (fig 4–5) for each projected year.

(2) Changes in travel on the post resulting from shifts of activities to new locations, construction of new buildings, and development of other functional units, and use areas. For example, a new research center employing 1500 persons may be developed in a vacant area on the installation. This potential traffic generator must be studied in detail since the traffic volume and traffic patterns cannot be predetermined from a uniform percentage projection. The distribution of trips to off-post areas will be related to the regional plan and particularly to the location and capacity of new residential housing areas.

(3) Future desire-line maps may be prepared, corresponding to the maps showing present travel desires, for each projected year. For this purpose, anticipated average weekday traffic can be shown by bands of relative width superimposed as overlays on the general site plan of the installation.

(4) Future parking requirements can be determined by evaluating the anticipated daytime population of each major functional area and by preparing a tabulation similar to the

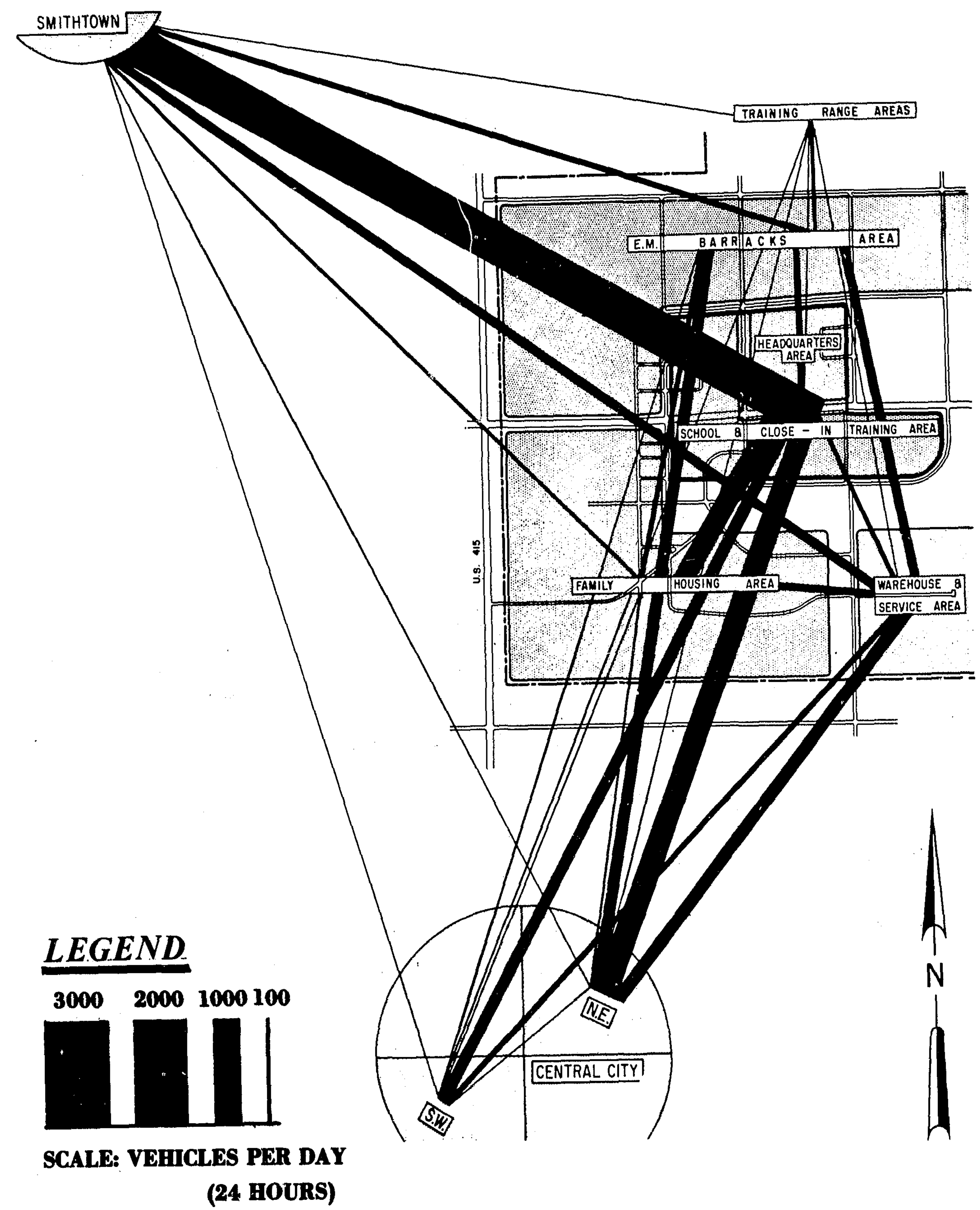

Figure 4–3. Present travel desires at a hypothetical military installation.

Zones and description	Zones within installation				Zones outside installation				
	1	2	3	4	5	11	12	13	21
1—Headquarters area	(*)	200	1000	200	50	2000	1000	500	50
2—Service area		(*)	300	350	30	400	500	200	10
3—Family housing area			(*)	200	40	150	100	50	20
4—E. M. barracks area				(*)	100	200	500	20	50
5—Range area					(*)	10	5	5	0
11—Smithtown						(*)	20	10	0
12—Central City NE							(*)	15	0
13—Central City SW								(*)	10
21—Other									(*)
(*) Intrazone trips will not usually be included.									

Figure 4–4. Origin-destination triangular table showing number of interzone trips for a hypothetical military installation.

sample shown in figure 4–6. For additional information on parking data, see chapter 13.

(5) An economic vehicle ownership study may also be considered. Figures obtainable from the Department of Labor showing the relationship between economic status and vehicle ownership may be used in projecting anticipated trends in vehicle registration.

	Present 1973				Future 1978		
Line	a	b	c	d	e	f	g
	Personnel category	Personnel strength	Vehicles registered	Persons per vehicle	Personnel strength	Vehicles registered	Persons per vehicle (estimate)
1	Officers - - -	2,730	2,100	1.3	3,100	2,580	1.2
2	Enlisted - - -	13,550	5,410	2.5	15,000	7,900	1.9
3	Civilian - - -	8,140	5,430	1.5	8,000	6,150	1.3
4	Retired - - -	360	310	1.2	500	420	1.2
5	Temporary - -	120	110	1.1	120	120	1.0
6	Others - - - (visitors, contractors, etc.)	100	90	1.1	120	120	1.0
7	Total - - - -	25,000	13,450	1.9	26,840	17,290	1.6
8	Percent change -	- - - - - - -	- - - - - - -	- - - - - - -	+7%	-16%	+28%

Figure 4–5. Anticipated changes in population and vehicle registration at a hypothetical installation.

Line	a	b	c	d	e	f	g	h
	Location	Available Spaces			Effective spaces (*)		Needs	
		On-street	Off-street	Total		Demand	Surplus	Deficiency
1.	A	50	200	250	237	150	+87	
2.	B	20	280	300	285	400		-115
3.	C	0	400	400	380	300	+80	
	Etc.							
60.	Total	900	2400	3300	3135	2800	+1400	-1065
	Net Surplus (or Deficiency)						+335	

(*) Assumed as 95 percent of total spaces - May be less in certain cases.

Figure 4-6. Parking space surplus and deficiency for a hypothetical military installation.

CHAPTER 5

SPEED STUDY

5–1. Description and Use

This study is composed of a series of observations of speeds at which vehicles are traveling past a given point. The time intervals are measured between two points and subsequently converted into speeds, or electronic equipment is employed to record speeds. The study is generally used—

a. To help determine whether prevailing speeds are too fast or too slow for conditions.

b. To help determine the proper speed for new or improved roadways.

c. To serve as a warrant for, and guide in, the placement and operation of traffic control devices.

d. To aid in studying the relationship between speed and accidents.

e. To measure the effect of speed control measures or to change the enforcement program.

5–2. Time and Length of Study

The basic study is divided into three parts and performed for 1 hour on not less than fifty motor vehicles during 3 periods at each location. Normally, periods should be between: 0900–1200, 1500–1800, and 2000–2200 hours. A speed study should be made in good weather and under normal conditions. Bad weather observations are made only when information is desired to show motor vehicle speeds under unfavorable road and weather conditions.

5–3. Locations To Be Studied

Speed studies are usually made at the following locations:

a. Roadways which may require an evaluation of a minimum/maximum speed limit or a change in existing speed limits.

b. At points where installations of traffic signals and stop or yield signs are contemplated.

c. On all major thoroughfares.

d. At all high accident frequency intersections and locations.

e. At all other representative locations chosen to provide basic data as part of an overall installation traffic study.

5–4. Principles for Conducting a Speed Study

The following principles should be followed when conducting a speed study:

a. To secure results which reflect normal behavior, personnel conducting the study and their equipment should be inconspicuously located. Distinctive military police equipment and markings must not be used during the study. Military police patrols should be instructed to avoid the area being studied.

b. To determine minimum and maximum speeds the study should be made away from intersections or other points which may cause a local reduction in typical speeds (except on approaches to those indicated in para 5–3*d* above).

c. Speeds should be recorded on a controlled sampling basis. For example, every vehicle, every third vehicle, or every fourth vehicle speed should be recorded.

d. No study of an area should be undertaken immediately after a controlled effort on speed enforcement.

5–5. Recording Techniques

a. Following are techniques which may be used in recording data during a speed study.

b. The use of a mirror box, stopwatch, and a military policeman on a measured course provides an accurate means of determining vehicle speeds. The speed field data sheet is used in lieu of the tally sheet described in FM 19–25. This sheet provides an easy method of interpreting the data recorded.

c. Radar devices not equipped with graphic recording devices may be used with the field data sheet. When using radar devices with graphic recorder, notations should be made next to each vehicle speed to reflect direction and type of vehicle. Radar devices must be placed inconspicuously or drivers will see the devices and slow down. These devices may be used successfully day or night.

DATE 11 APRIL 1973 LOCATION Provost & 4th DIRECTION South on 4th TIME 1500-1600
WEATHER CLEAR ROAD DRY WIDTH 40 ft CONDITION Good TYPE PAVEMENT Concrete
RECORDER J.E. Jones

Seconds	MPH 88'	X MPH 176'	Civilian			Military			Cum total	Cum %
			Passenger type	Tr & Bus	Total	Passenger type	Trucks	Total		
1	60.0	120.0								
1 1/5	50.0	100.0								
1 2/5	42.8	85.7								
1 3/5	37.5	75.5								
1 4/5	33.3	66.6	/		1				1	
2	30.0	60.0	//		2				3	
2 1/5	27.2	54.5	//		2				5	
2 2/5	25.0	50.0	////		4				9	
2 3/5	23.0	46.1	卌		5				14	
2 4/5	21.4	42.8	卌 卌	///	13				27	
3	20.0	40.0	卌 卌 卌 ////		19				46	
3 1/5	18.7	37.5	卌 卌 卌 卌		20				66	
3 2/5	17.6	35.2	卌 ///		8		/	1	76	
3 3/5	16.6	33.3	卌 卌 ///		13				88	
3 4/5	15.7	31.5	卌 卌		10		//	2	100	
4	15.0	30.0	卌 //		7		/	1	108	
4 1/5	14.2	28.9	卌 卌		10		//	2	120	
4 2/5	13.6	27.2	卌		5		/	1	126	
4 3/5	13.0	26.1	///		3	/	//	3	132	
4 4/5	12.5	25.0	卌		5		//	2	139	
5	12.0	24.0	卌		5		/	1	145	
5 1/5	11.5	23.0	////		4				149	
5 2/5	11.1	22.2	卌		5		/	1	155	
5 3/5	10.7	21.4	//		2				157	
5 4/5	10.3	20.6	//		2				159	
6	10.0	20.0	///		3		/	1	163	
6 1/5	9.6	19.3	///		3				166	
6 2/5	9.3	18.7	/		1		/	1	168	
6 3/5	9.0	18.1	///		3				171	

Figure 5-1. Speed field data sheet.

6 4/5	8.7	17.6	HHT		5		11	2	178	
7	8.5	17.1								
7 1/5	8.3	16.6					1	1	179	
7 2/5	8.1	16.2								
7 3/5	7.8	15.7					1	1	180	
7 4/5	7.6	15.3								
8	7.5	15.0								
8 1/2	7.0	14.1								
9	6.6	13.3								
9 1/2	6.3	12.6								
10	6.0	12.0								
11	5.4	10.9								
12	5.0	10.0								
TOTAL	- - - - -	- - - - -	157	3	160	1	19	20	180	

Figure 5-1—Continued.

d. Electric timers may be used. These consist of electric stopwatches which are actuated and stopped by the action of vehicle tires on air tubes. Detailed instructions for their use are provided by the manufacturers.

e. The speedometer or pace method is the most unreliable means of measuring speed. It requires a proportionally larger expenditure of manpower and equipment with fewer data obtained. Unmarked vehicles manned by personnel without distinctive equipment are used in lieu of patrol vehicles. The vehicle traverses the area being studied. It maintains the speed of the first vehicle in front of it throughout the area, recording the speed twice while in the area. The study area should be $^2/_{10}$ of 1 mile in length. The speed field data sheet (fig 5-1) may be used to record the speed. The speed recorded is rounded to the nearest 5 miles. If this method is used, it is recommended that the speedometer of the pace car be calibrated to increase the accuracy of the study.

5-6. Interpreting Field Data

a. The speed field data sheet provides useful information. One sheet is used for each direction of travel. Average and mean speeds have little meaning in determining actions necessary to insure the safe, efficient movement of traffic. The most meaningful figure is the 85 percentile, and on high speed roads, an additional figure of importance is the 15 percentile. It is common practice to accept the 85 percentile speed as the optimum safe speed and the 15 percentile speed on high speed roads as the minimum speed under normal conditions. On the field sheet, the 85 percentile speed may be determined by simply counting down from the top of the column titled "Cumulative total" to that number of vehicles that equals 15 percent of the total in that column. Thus, of the 180 vehicles as recorded on the sample field sheet (fig 5-1), 15 percent or 27 vehicles were traveling at 42.8 miles per hour. Therefore, 42.8 miles per hour is the 85 percentile in this particular case. This is then marked on the field sheet in the 85 percentile by circling the "MPH" for the appropriate foot distance. To determine the 15 percentile and minimum speed, simply count down to the number of vehicles which equals 85 percent of the cumulative total. Of the 180 vehicles used to illustrate above, this number would be 153. The speed of the vehicle opposite the closest figure (155) is 22.2. This would then be circled as a minimum speed.

b. When radar or electric timers with graphic

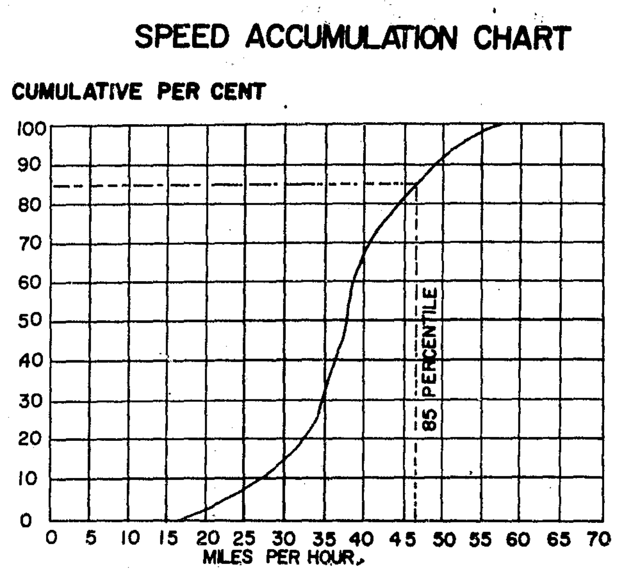

Figure 5-2. Speed accumulation chart.

recorders are used, the data is normally transferred to field data sheets to summarize the information.

c. When field actions have been completed, a speed accumulation curve may be constructed (fig 5-2). This curve shows the total percentage of vehicles which are traveling at or below various consecutive speeds reflected in 5-mile per hour intervals. This curve assists in interpreting voluminous field data.

5-7. Applications

There are numerous applications of the speed study. The most important include—

a. To determine whether or not prevailing speeds are too fast for conditions.

b. To determine a reasonable speed limit (the 85 percentile) on a particular street or in a particular zone and to aid in planning an enforcement program.

c. To determine a reasonable minimum speed on a particular highway (15 percentile speed).

d. To assist in timing traffic signals. The length of the proper clearance (yellow) period depends upon the speed of approaching traffic. The length of this period should equal the time needed for traffic to travel a distance equal to the driver stopping distance plus the distance between opposite curbs at the intersection. At offset intersections, extremely wide or complicated intersections, and on grades, it will be necessary to add 1 or 2 seconds to the clearance period determined for normal intersections. However, at no time will the speed limit be increased to correspond to the timing of the signal.

e. To aid in determining the type of traffic control signs (regulatory or warning) necessary, on the basis of safe approach speeds to intersections.

f. To lower the posted speed limit when the study shows that drivers do not follow it, and consider it excessive or unsafe for conditions.

g. To establish whether or not complaints about speeding are justified.

h. To prepare a traffic speed map for one street or for an entire post. This map shows congestion resulting from slow speeds and is useful in public relations and general traffic planning. It also serves as an aid in selecting through streets.

i. To raise speed limits where drivers consistently exceed the speed limit, and where accident experience is minimal.

CHAPTER 6

SPEED-DELAY STUDY

6-1. Purpose of the Study

A speed-delay, also referred to as travel time and traffic delay study, shows the variation in speed along a route; indicates the amount, location, cause, frequency, and duration of delays; and provides the overall speed and travel time along a route. The floater car is normally used to accomplish this study.

6-2. Equipment

a. An unmarked sedan per team used for the floater car. A 1/4 ton truck may be substituted for roads with speed limits of less than 40 mph. The odometer and mileage indicator must be calibrated.

b. A standard watch is used to reflect local time and a stopwatch to measure time lapses.

c. A field data sheet similar to the one shown in figure 6-1, locally reproduced, may be used to record the information developed during the study. Any satisfactory means of recording data may be substituted for the field sheet.

6-3. Personnel

A driver and a recorder are needed for each team conducting a speed-delay study. These military policemen will not wear distinctive military police equipment during the study, thus eliminating a factor which may invalidate the study.

6-4. Planning

a. Routes to be studied must be identified. The total length of the route and location of key landmarks should be accurately posted on the field data sheet prior to the study. The normal peak traffic hours both morning and afternoon must be determined prior to the study.

b. The number of teams used on a given route is determined by the length of the route and the duration of normal peak traffic. The study should be conducted during each of the four normal peak traffic periods on the same day. This requirement may be increased if the variation between runs is great or if some unusual event occurs, such as a major accident in an area with a low accident frequency. One team would suffice on a route 1 mile long, with a peak traffic period lasting 1 1/2 hours. If the route is 6 miles long and the normal peak traffic period lasts for 30 minutes, three teams may be required.

6-5. Method of Conducting the Speed-Delay Study

The teams in the floater cars enter the routes at 5 to 15 minute intervals. The starting time and mileage is recorded on the field sheet (fig 6-1). The time and odometer reading when passing each landmark preposted on the sheet is recorded. The location, nature, and length of time of each delay (timed by the stopwatch) is also recorded. Delays may result from signals, left turns, stop signs, parking maneuvers, parking, pedestrians, congestion, passenger loading and unloading, etc. The floater cars travel with the main stream of traffic. A rule of thumb is that each time a car passes a floater car, a car is passed *by* the floater car. The time and mileage when the route is completed is recorded on the field sheet.

6-6. Study Results

The speed-delay study will indicate the following as required: Overall speeds and running speeds by locations; distribution of total running and delay time by location; and distribution of delays by cause, frequency, and duration. This information may be summarized as follows:

a. Results may be presented for each of the routes studied for peak and off-peak periods. This will include the length of route; the posted speed limits; travel time, both running and stopped; the average speeds, and the relation between peak and off-peak speeds. This tabulation may be prepared as in sample (fig 6-2).

b. A flow map may be prepared graphically depicting the peak and off-peak speeds on the

ROUTE________ DIRECTION________ TRIP NO.________

TRIP STARTED________ A.M. P.M. at ________ (Location) ________ (Mileage)

TRIP ENDED________ A.M. P.M. at ________ (Location) ________ (Mileage)

Continuous time reading (Minutes seconds)	Check block for begin and end of Stop	Odometer reading (miles & tenths)	Location or landmark	Cause for stop or slow

DATE________ WEATHER________ DISTANCE________

OVERALL TIME________ STOPPED TIME________

Figure 6–1. Field sheet, speed-delay study.

street system. Speeds should be proportional to the width of the flow bands.

c. A table or chart may be prepared showing the distribution of delay by type and time.

6–7. Application

Data obtained in the speed-delay study may be used to—

a. Define points of congestion, delay, and insufficient capacity.

b. Evaluate the use of traffic control measures.

c. Determine the adequacy of posted speed limits and the need for a speed study (chap 5).

d. Develop priorities for traffic control programs and programed road construction.

Line	a Route and description	b Route "A" Wilson Ave and Lee Blvd Pershing Rd to North Gate	c Route "B" Washington Blvd Lincoln Blvd to Main Gate
1.	Length (miles)	1.7	0.8
2.	Posted speed limit (mph)	25	30
	Off-Peak Hours		
3.	Travel Time (min–sec)	3–27	3–10
4.	Time Stopped min–sec)	0–01	0–30
5.	Average Speed (mph)	32.5	16.0
6.	Running Speed (mph)	32.6	19.2
	Peak Hours		
7.	Travel Time (min–sec)	3–32	4–49
8.	Time Stopped (min–sec)	0–22	2–20
9.	Average Speed (mph)	31.7	10.0
10.	Running Speed (mph)	35.4	18.2
11.	Average Peak Hour Speed as Percentage of Average Off-Peak Speed (line 9 ÷ 4)	97.5%	62.5%

Figure 6–2. Speed-delay characteristics of principal streets on a hypothetical military installation.

CHAPTER 7

MOTOR VEHICLE VOLUME STUDY

7-1. Description and Use

This study is designed to obtain an accurate record of the number, directional movements, and variation in volume of motor vehicles passing through intersections or using major routes. When made on an extensive scale, it provides a traffic flow map for an entire area.

7-2. Location of Study

a. Isolated counts are made at any problem location.

b. For area-wide surveys, counts should be made at the following locations in order to obtain a complete picture of the traffic flow on the installation:

(1) The high accident frequency intersections.

(2) All intersections leading into and from the installation (a cordon count study).

(3) The important intersections on all arterial routes immediately outside the installation (optional).

(4) All signalized intersections.

(5) On limited access roads which run on or through the installation and connect with major thoroughfares at the boundary of the installation.

(6) At various midblock points as needed to provide a complete volume flow map.

(7) On streets and roads which lead to major headquarters and business areas of the installation.

7-3. Personnel and Equipment

a. In most cases two military policemen can satisfactorily observe and record traffic at a normal two-way intersection, provided the entering volume does not exceed 1500 vehicles per hour. If traffic volume is so heavy that more than two military policemen are required to check it, the usual practice is to assign one military policeman to each of the four approaches. In exceptional cases, two or three checkers may be needed for each approach, one to check each entering traffic lane. When in doubt, have several military policemen make a trial count for an hour at one of the heaviest traveled intersections and base manpower requirements on the results. One military policeman can observe and record 1000 vehicles per hour between intersections. Personnel other than military police may assist in counts if properly trained and supervised. Ordinary watches, field sheets, and summary sheets will be needed.

b. Manually operated counters may be employed advantageously in most instances instead of the tally method. It may be feasible to employ the manual counters for heaviest movements, recording the lighter movements by the tally method. Manual counters usually require direct readings by military policemen to determine counts by time periods. Manual counters usually do not separate cars and trucks.

c. Some new and more sophisticated automatic traffic counters will graphically record by time, and may count vehicles by the number of axles and length. Because of the variations in this type of equipment, specific instructions have been omitted. Users should rely on the manufacturer's detailed instructions for the guidance necessary to operate a given counter.

7-4. Time and Length of Study

Noncontinuous or short-time vehicle counts should be made in good weather unless there is a specific reason for making them in bad weather. Counts on days from Monday through Friday produce a more normal vehicle flow than on Saturday or Sunday. A count is generally made to cover 10, 12, or 24 hours. A count may require continuous counting for the indicated period, or if a short count technique is used for a number of locations, counts may be made for shorter durations and then expanded to give estimated 10-, 12-, or 24-hour totals as described under recording techniques (para 7-5 below). The time period should begin a minimum of one-half hour before and end one-half hour after the peak periods of traffic flow. Use of other periods, as may be required, can best be determined by the experienced analyst or the

VEHICLE VOLUME

FIELD SHEET

DATE ____________ LOCATION ____________________

WEATHER ____________ ROAD SURFACE CONDITIONS ____________ TIME FROM ____________ TO ____________

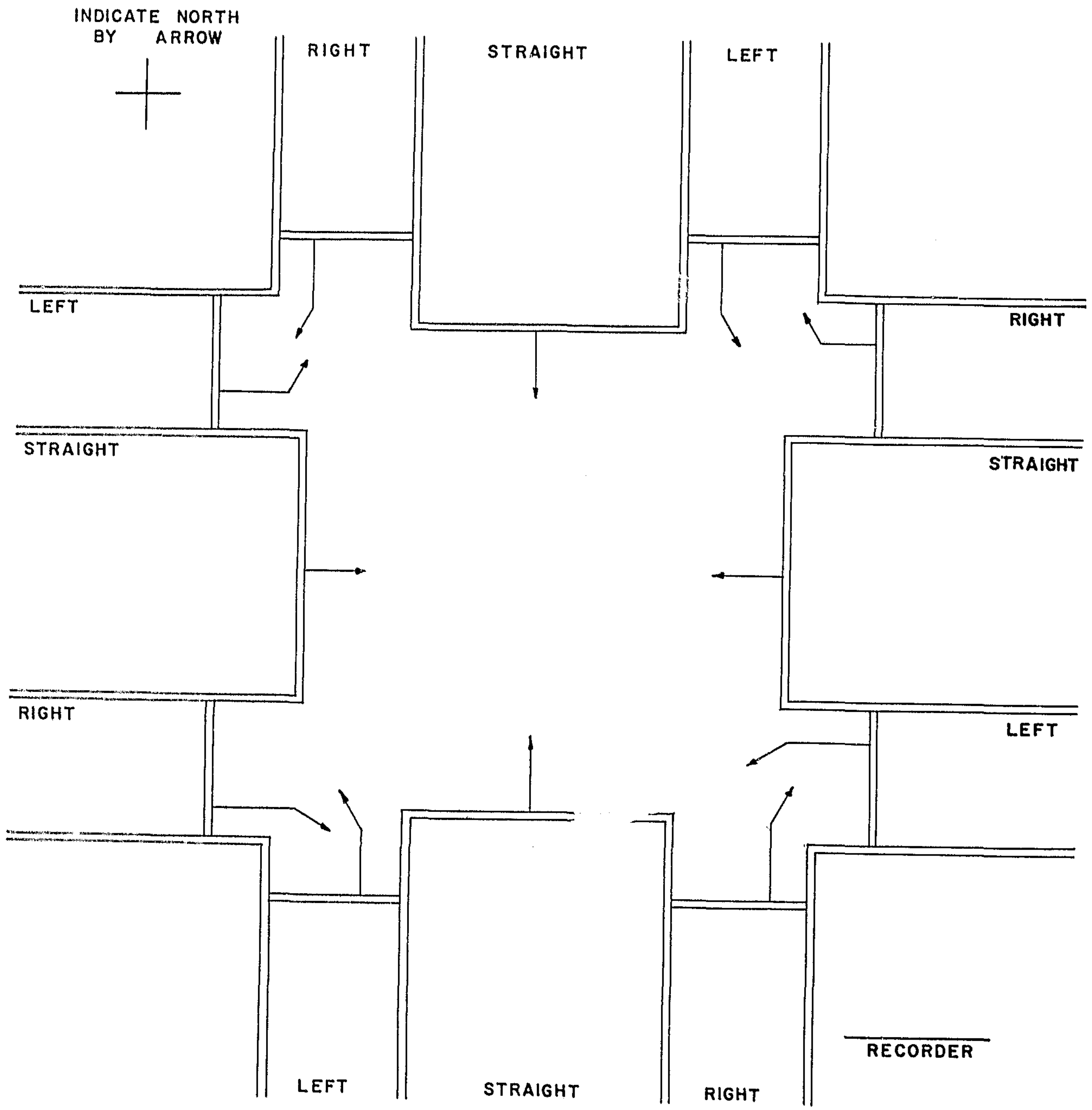

Figure 7–1. Vehicle volume field sheet.

LOCATION ____________________ DATE ____________

WEATHER ____________________ ROAD SURFACE CONDITION ____________

Time starts M	From north on ______St.			From south on ______St.			From west on ______St.			From east on ______St.			Half hour total
	L	S	R	L	S	R	L	S	R	L	S	R	
0700–0730													
0730–0800													
0800–0830													
0830–0900													
0900–0930													
0930–1000													
1000–1030													
1030–1100													
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1930–2000													
2000–2030													
2030–2100													
2100–2130													
2130–2200													
2200–2230													
2230–2300													
2300–2330													
2330–2400													
Total													
Total													

Compiled by ____________________

R—Right turn.
L—Left turn.
S—Straight ahead.

Figure 7–2. Vehicle volume summary sheet.

traffic officer. When traffic volume is consistently heavy day and night, an 18-hour count may be useful to produce records on the amounts and other characteristics of evening traffic. Such a count would normally be made in the period 0620 to 0020 hours. If traffic flow fluctuates significantly during the day, counts should be made during peak hours to assist in planning a selective enforcement program.

7-5. Recording Techniques

Supervisors should arrive at the location in sufficient time to familiarize personnel with the site before the count is scheduled to start. If one military policeman is to make the count, he should be positioned so that he will have an unobstructed view of all traffic on the road or entering the intersection. When two military policemen are used, they should stand on diagonally opposite corners of the intersection, or on opposite sides of the street or road if a midblock count is to be made. When two military policemen are used at an intersection, each man counts traffic entering the intersection from two directions. In conducting this type of study, the following forms are required:

a. Field Sheet. This form (fig 7-1) is used in the actual counting at the location. A new sheet should be started every hour or each half hour, depending on the amount of traffic and the purpose of the count. Traffic may be so heavy that a new sheet is needed every 15 minutes to provide sufficient space for all tallies. If manual counters that do not record by time period are used, the totals will be recorded at the end of each 15-minute period on the proper place in the field sheet. Each sheet will show the time or period that the particular data covers.

b. Summary Sheet. This form is designed to summarize a specific period. It is used by the traffic officer and traffic noncommissioned officer for compilation of the figures (data) listed on the field sheets as to the exact times and directional flow of traffic (fig 7-2).

c. Graphic Summary Sheets. This form is helpful in determining corrective measures that may be required at a particular intersectional location. The data needed to complete the graphic summary is obtained from the summary sheet. The graphic summary sheet presents a clear picture of volume of traffic through the intersection and direction of traffic for an average hour, peak hour, full period of the study, or an average weekday (fig 7-3).

7-6. Applications

There are numerous specific applications of motor vehicle volume studies. The most important are—

a. To justify the existence or installation of fixed-time and traffic-actuated signals, and to provide information for proper timing of traffic signals. (*Manual on Uniform Traffic Control Devices for Streets and Highways).*

b. To indicate the need for stop signs and their locations. (*Manual on Uniform Traffic Control Devices for Streets and Highways).*

c. To aid in studying the relation of turning movements to accidents and congestion. Generally, special controls are required if 300 out of 1000 vehicles entering an intersection make a left turn. The addition of green directional arrows to traffic signals; the painting of lines and arrows on the pavement; and construction of grade separation, cloverleafs, traffic circles, and modifications thereof, and restrictions on turns during peak hours are possible solutions to heavy turning requirements at a busy intersection.

d. To evaluate accident data. For example, corners A and B have the same number of accidents. Corner A carried 1000 vehicles per hour and corner B, 2000 vehicles per hour. The accident rate for corner A is greater than for corner B. Corner A should be given prior attention.

e. To determine the relationship of day and night accidents to day and night traffic volume. This relation may be used in considering street lighting requirements, hours of operation of traffic signals, etc.

f. To assist in the assignment of military police personnel to intersection duty during certain periods.

g. To help determine location and geometric design of throughways and bridges.

h, To assist in evaluating the advisability of through streets.

i. To develop a speed zoning program.

j. To help plan for pavement markings.

k. To plan priorities for a program of street and highway improvement.

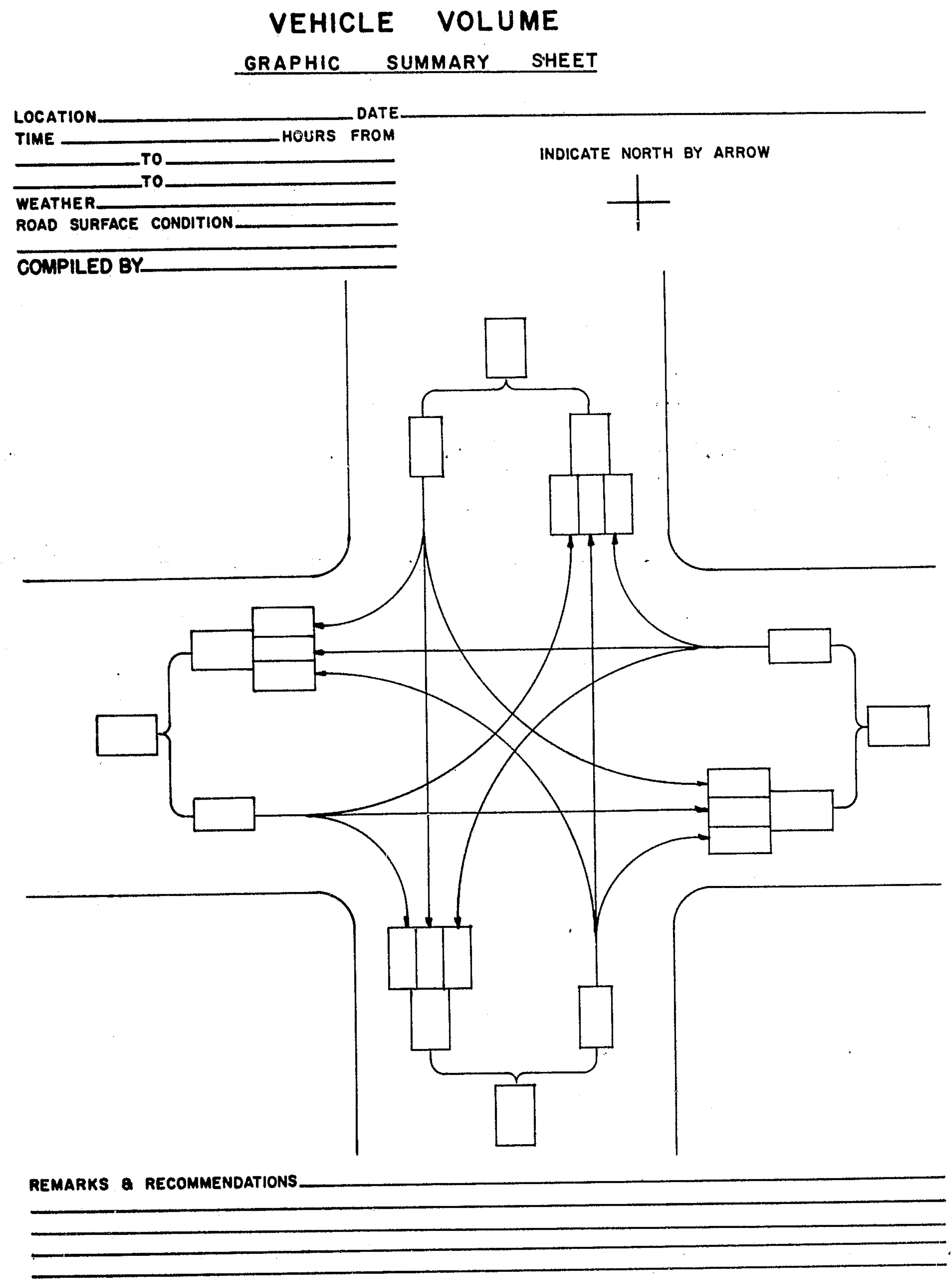

Figure 7-3. Vehicle volume—graphic summary sheet.

CHAPTER 8

ROADWAY CAPACITY STUDIES

8-1. General

The *traffic density* on a road is expressed in terms of the number of vehicles per hour which pass any selected point on that road, or in terms of the number of vehicles per mile on any given portion of that road. The *traffic density* of a road is the *maximum* traffic density which that road can accommodate at a given speed without appreciable delay. If the volume of traffic using the roads exceeds this maximum in numbers, the result is the condition commonly referred to as "congestion." Neither traffic capacity nor traffic density should be confused with the term *traffic volume*, which is used to define the number of vehicles per day which a road of satisfactory construction standards can accommodate.

8-2. Purpose of the Study

This study is necessary to estimate the practical capacity of roads and streets as an adjunct to other studies and to provide a basis for changes in traffic regulations, establishment of priorities for street improvements, and as an aid in future planning.

8-3. Factors Affecting Capacity

a. The traffic capacity of a road is influenced by the physical characteristics of the road, by the character of the traffic using the road, and by the control exercised over the traffic using the road. The physical characteristics of a road which affect the traffic capacity of that road include the number of traffic lanes (width of traveled way), type and width of shoulder, the location of off-road obstacles, the type and condition of the surface, the sharpness of curves, the steepness of grades, and the traffic signal timing. Road characteristics which tend to reduce safe speeds tend to reduce the capacity ratio or figure.

b. The characteristics of traffic using the road which affect traffic capacity include the size of the vehicles using the road, the number of trucks, the number and frequency of vehicle stop-starts, and the general use made of the road.

c. Control exercised over traffic which affects capacity include speed (maximum and minimum), lane restrictions, parking, turning requirements, and control devices. Traffic capacity can be increased by improving the traffic circulation pattern and by exercising efficient traffic control.

8-4. Determining Capacity

a. To estimate the actual capacity of a given road, a calculation of that road's theoretical capacity is made and then modified to allow for existing conditions. The theoretical traffic capacity of a road assumes an ideal road of excellent surface, zero grade, and no curvature. The theoretical figure also is based on an ideal traffic pattern where no intersectional, merging, marginal, internal, or medial conflicts of any degree exist. These types of interferences or conflicts are defined as follows:

(1) Cross or intersectional conflict occurs when two streams of traffic cross each other at the same level.

(2) Merging conflict occurs when one stream of traffic joins another at the same level.

(3) Marginal conflict occurs between moving or parked vehicles and objects or people along the outer edge of the roadway.

(4) Internal interference or conflict occurs between vehicles moving in the same direction.

(5) Medial conflict occurs at the middle of the road between vehicles moving in opposite directions.

b. In reality there are no ideal roads or traffic patterns and actual traffic capacity is much less than the theoretical capacity. Both the actual and theoretical capacities vary directly with speed up to about 25 miles per hour, but at higher speeds the capacity figures tend to remain fairly constant as a result of the increased intervehicular leads necessary at higher speeds. In the absence of any other suitable indication of how much less the actual capacity of a road is than the theoretical capacity, it is a good average rule to reduce the theoretical capacity by 25 percent to arrive at an approximate actual traffic capacity. Of course, the amount of this reduction depends upon how well the roadway is designed and built and other conditions affecting traffic. Theoretical capacities for single-lane movements are indicated in figure 8-1, and can be calculated by the following formula:

Speed (miles per hour)	Intervehicular lead (yards)	Traffic density vehicles per mile)	Traffic flow (vehicles per hour)
5	17	103	518
10	22	80	800
15	28	63	941
20	36	49	976
25	44	40	1,000
30	53	33	995
35	62	28	994
40	70	25	1,006
45	79	22	1,003

Figure 8-1. Theoretical traffic capacities for single-lane movements.

$$N = \frac{1760V}{I}$$

N—Theoretical traffic capacity, expressed in vehicles per hour.

V—Constant vehicular speed, expressed in miles per hour.

I—Intervehicular lead, expressed in yards. (Intervehicular lead is defined as the distance from the front of one vehicle to the front of the next vehicle in the traffic column.)

c. A substantial number of trucks with trailers on the roadway reduces the normal traffic volumes by one-half to two-thirds because of the need for greater intervehicular leads. A good rule to remember for rapid actual road capacity estimation is that a 22-foot traveled way, with gradients not exceeding two percent and with curves having a minimum radius of 250 feet, can handle a total of 1500 vehicles per hour in the two opposite moving lanes of traffic at a speed of 25 miles per hour. This figure presumes adequate shoulders and bridges with no appreciable turning movements other than those ordinarily encountered in two such traffic lanes. This also presumes no cross traffic or merging traffic interference. Under similar circumstances, a single lane of one-way traffic could move on such a road at a rate of about 75 percent of the two-lane capacity.

8-5. Basic Information

The practical capacity of streets between intersections or uninterrupted traffic flow differs from the practical capacity of intersections or streets approaching intersections. For this reason, these two conditions are presented separately in this section.

a. For roads with uninterrupted flow, the following physical conditions must be determined:

(1) Street width (number of lanes and width of each lane).

(2) Divided or undivided street.

(3) One-way or two-way street.

(4) Distance from edge of pavements to obstructions (e.g., bridge rails, parked vehicles, retaining walls, light poles, curbs, trees, etc.).

(5) Obstructions on one side or both sides of roadway.

(6) Width of shoulders and road surface conditions.

(7) Percentage of trucks or other heavy vehicles which are normally in the traffic stream.

(8) Percentage of total length of road on which sight distance is limited to less than 1500 feet (two- or three-lane roads only).

(9) Percent of grade and length of grade (usually required for two- or three-lane roads).

b. For intersections or approaches to intersections, the following information must be determined:

(1) Street widths.

(2) One-way or two-way streets.

(3) Two-way streets with separate turning lanes:

(*a*) Width of through lanes.

(*b*) Length of right turn lane.

(*c*) Length of left turn lane.

(4) Intersections controlled by traffic signals:

(*a*) Length of green time allotted to each movement during a cycle (amber time not included).

(*b*) Cycle time.

(*c*) Number of signal cycles per hour.

(5) For intersections with manual traffic control:

The average length of "go" time allotted to each movement during a complete sequence of traffic movements.

(6) Type of area:

(*a*) Central area of installation (near center of major activities).

(*b*) Intermediate (between major areas of installation).

(*c*) Outlying (separated from major activities).

(7) Parking permitted or bus stops located on any of the streets:

(*a*) On one side.

(*b*) On both sides.

(8) Present traffic volumes:

(*a*) Percentage of trucks or other heavy vehicles.

(*b*) Percentage of left turns.

(*c*) Percentage of right turns.

(*d*) Number of pedestrians.

8-6. Methods of Collecting Information

a. A field inventory is conducted to obtain the data outlined in paragraph 8-5 above. This information may be supplemented by reference to engineer maps of the installation or construction plans for specific locations. This information should be listed for each location being studied to assist in later calculations. Exact measurements should be made of street widths, shoulder widths, and location of obstructions.

b. Traffic factors should be obtained by actual inspection. The location and extent of parking, whether or not a street is divided, and one-way or two-way operations are found quickly through observation. Traffic signal cycles must be timed by stopwatch and recorded in terms of total seconds of green, amber, and red time. Traffic volume is obtained as explained in chapter 7.

c. Sight distances and grades may be found through field inspections and construction plans (FM 19-25).

d. The type of area being considered must be determined by actual observation of the streets, adjacent land use, and general character of the area.

e. Calculation of capacities should be made under prevailing weather conditions. Severe weather affects the actual capacity of a road if it reduces sight distance or speed, or if it causes slippery or hazardous driving conditions.

8-7. Analysis of Information

a. For roads with uninterrupted flow the basic and practical capacities (for ideal conditions) are obtained from figure 8-2.

b. The basic capacity is generally theoretical in nature and a flow equal to it could occur only on roads free of intersections and grades. The practical capacities in figure 8-2 must be modified by all of those factors which cause a reduction in the actual capacity of the road.

(1) Lane widths of less than 12 feet and obstructions less than 6 feet from the edge of the pavement cause a reduction in the practical capacity. Figure 8-3 and figure 8-4 show the

Type of road	Basic capacity*	Practical capacity	
		Central area**	Outlying area***
1 Two-lane, two-way road (total for both lanes).	2,000	1,500	900
2 Three-lane, two-way road (total for all lanes).	4,000	2,000	1,500
3 Multilane road (average per lane in direction of heavier flow).	2,000	1,500	1,000

* In passenger cars per hour.
** Assumes operating speeds less than 40 mph.
*** Assumes operating speeds over 40 mph.

Figure 8-2. Basic and practical capacities (adapted from highway capacity manual).

Distance from pavement edge to obstruction	Obstruction—One side				Obstruction—Both sides			
	12-ft lanes	11-ft lanes	10-ft lanes	9-ft lanes	12-ft lanes	11-ft lanes	10-ft lanes	9-ft lanes
6 feet	100	86	77	70	100	86	77	70
4 feet	96	83	74	68	92	79	71	65
2 feet	91	78	70	64	91	70	63	57
0 (at edge of pavement)	85	73	65	60	70	60	54	49

Figure 8-3. Effective practical capacity of two-lane highway (as percentage of capacity of 12-foot lanes with no obstructions (adapted from highway capacity manual).

Distance from pavement edge to obstruction	Obstruction—One side				Obstruction—Both sides			
	12-ft lanes	11-ft lanes	10-ft lanes	9-ft lanes	12-ft lanes	11-ft lanes	10-ft lanes	9-ft lanes
6 feet	100	97	91	81	100	97	91	81
4 feet	99	96	90	80	98	95	89	79
2 feet	97	94	88	79	94	91	86	76
0 (at edge of pavement)	90	87	82	73	84	79	74	66

Figure 8-4. Effective practical capacity for divided highways (for one direction of travel, expressed as a percentage of capacity of 12-foot lanes with no obstructions) (adapted from highway capacity manual).

combined effect of these two factors expressed as a percentage of the capacity of 12-foot lanes.

(2) Trucks or other heavy vehicles which occupy more road space and travel at lower speeds than passenger vehicles cause a serious reduction in practical capacity if they comprise more than 10 percent of the total volume of traffic. For rough estimates of the effect of these vehicles, one truck can be considered as equal to two passenger cars on level roads, to four passenger cars on rolling roads, and to eight passenger cars on mountain roads. Figure 8-5 gives the effect of these heavy vehicles in terms of the percentage of passenger car capacity. For purposes of this study, the term, passenger car, includes light reconnaissance vehicles, pickup trucks, and similar vehicles.

(3) The adverse effects of poor alignment or severe grades are most important in rural highways or in mountainous terrain. These conditions have little effect on vehicles of the passenger car class. In most cases, their effect is not significant on military installations.

(4) The capacity of a two-lane road in an outlying area without intersections, on level terrain, pavement width of 20 feet, retaining wall 4 feet from one edge of pavement and 11-foot shoulder on opposite side, heavy vehicles equal to 20 percent of total peak hour volume and no restrictions to sight distance, may be computed as follows:

Practical capacity for outlying area under ideal conditions—900 vehicles per hour in both directions (from figure 8-2).

Effect of lane width and lateral clearance (from figure 8-3) 74%

Effect of heavy vehicles (from figure 8-5) 79%

Combined effect .... .74 × .79 = .5846

Practical capacity for existing conditions:

0.585 × 900 = 527 vehicles per hour in both directions.

(5) The capacity of a street in the central area of an installation will be affected by the capacity of the intersections on it. As a rule of thumb, 400 vehicles per hour for each lane of traffic in the direction of heavier flow may be used for making rough estimates of such streets. To determine practical capacities for specific situations, the following method should be used:

(*a*) From figure 8-2 or 8-3 determine the capacity under average conditions. For purposes of this estimate consider traffic signal and manual traffic control to be equally efficient in movement of traffic. This capacity under average conditions must be adjusted because of the presence of parking, right and left turns, large number of heavy vehicles, and extra lanes for turning movement in the direction being studied. If bus stops are located in the area being considered, it should be treated as an area in which parking is permitted.

(*b*) Add 1 percent for each 1 percent that heavy vehicles are less than 10 percent of total volume on the approach, or subtract 1 percent for each 1 percent that they exceed 10 percent of the total volume. For example, heavy vehicles account for 8 percent of the total volume. Accordingly, add 2 percent to the total.

(*c*) Subtract 1/2 percent for each 1 percent of right turns which exceed 10 percent of the total traffic, or add 1/2 percent for each 1 percent of right turns which total less than 10 percent. For example, right turns are made by 16 percent of the drivers. Accordingly, subtract 3 percent from the total.

Heavy Vehicles (percent of total volume per hour)	Effective practical capacity			
	Two-lane road		Multilane road	
	Level	Rolling	Level	Rolling
None	100	100	100	100
10	89	71	91	77
20	79	54	83	63
30	70	48	76	56

Figure 8-5. Effect of heavy vehicles on capacity (adapted from highway capacity manual).

(*d*) Subtract 1 percent for each 1 percent when left turns exceed 10 percent of the total, or add 1 percent for each 1 percent when they are less than 10 percent. For example, left turns are made by six percent of the drivers. Accordingly, add 4 percent to the total.

(*e*) Do not exceed a total deduction of 20 percent.

(*f*) On one-way streets, total percentage of turning movements are less than those for two-way streets. In this case, subtract 1/2 percent for each 1 percent that the combined right and left turns exceed 20 percent of the total traffic, or add the same amount for each 1 percent of the turns which total less than 20 percent.

(*g*) On two-way streets with separate turning lanes use the width of the through lanes as one-half of the street width in figure 8-3, and add 5 percent for a left turn lane. Add the number of left turns to the capacity under average conditions from figure 8-3. For right turn lanes add $N\frac{(D-20)}{20}$ vehicles per hour. (D = length of turning lane in feet, and N = number of signal cycles per hour.) Next, make the adjustments required for heavy vehicles.

(*h*) On one-way streets, with added turning lanes, use the normal street width to obtain the capacity under average conditions from figure 8-3. Add 5 percent for an added right or left turn lane.

8-8. Application of Study

The practical capacity of a street is compared to the existing or expected peak volume for the purpose of determining locations which must be improved in order to accommodate that volume (fig 8-6). Practical capacity can be increased by—

a. Elimination of curb parking.
b. Elimination of left or right turns.
c. Widening street or adding turning lanes.
d. Proper delineation of lanes.
e. Relocation of bus stops.
f. Relocation of objects near the edge of pavement.
g. Conversion of angle parking to parallel parking where on-street parking is essential.

Line	a	b	c	d	e	f	g
	Name of facility	Effective lanes in flow direction	Vehicles per hour	Peak directional flow 30-min. peak in equiv. vehicles per hour	Possible cap. Veh. per hour	Practical cap. Veh. per hour	Volume to capacity ratio ((d÷f) x 100)
1	Washington Blvd.	2	1000	1200	2000	1600	75%
2	Grant Rd.	1	750	900	900	725	124%
3	Sheridan Rd.	1	600	700	750	600	116%
4	Lee Blvd.	2	900	1100	1400	1120	98%
5	Lincoln Blvd., Etc.	1	350	440	500	400	110%

Figure 8-6. Illustrative volume-capacity analysis for a hypothetical military installation.

CHAPTER 9

VEHICLE OCCUPANCY STUDY

9-1. Description

This is a study to determine the number of occupants per motor vehicle. It may involve an area-wide check of vehicles entering and leaving a military installation, or a check of vehicles entering and leaving a particular military traffic artery.

9-2. Personnel and Equipment Required

One field checker will be needed at each location. If traffic is very heavy and every vehicle is to be checked, one checker per lane of traffic is required at each location. An ordinary watch, field sheets, and summary sheets will be needed for each field observer. Personnel should be in the uniform prescribed for military police duty.

9-3. Time and Length of Study

To measure occupancy of an installation a count of civilian and military vehicles should begin approximately 60 minutes prior to the first working shift and continue until 15 minutes after the last shift has reported for duty. If a study is made of a particular area within the installation, periods should be chosen to represent basically different types of movement, such as the early morning peak flow, forenoon off-peak, afternoon off-peak flow, and the evening peak flow.

9-4. Method of Study

The study should include all the vehicles entering or leaving during the period studied, and a minimum of 500 vehicles (preferably 1000 vehicles) for each average occupancy ratio desired. It is desirable to classify the vehicles as passenger cars, trucks, military vehicles, and public transit vehicles. Counts should be made of only the passenger cars and trucks, and military vehicles transporting personnel to duty. Figures for public transit vehicles are easily obtained from the operators of the transit system. The checker at each location should be instructed to mark a tally in the proper box of the field sheet (fig 9-1), for each vehicle that passes. Thus for a vehicle with driver and three passengers, the recorder would place a tally under the vertical volume, according to the direction of traffic, and in the horizontal row opposite the "4." If a vehicle passes with more than eight persons in it, the number can be noted in the "8" row, with a circle around the number to distinguish it from the regular tally marks. Vehicle occupancy data may be summarized as shown in figure 9-2.

9-5. Applications

Applications of this study are as follows:

a. In traffic control transportation planning studies, it is often desirable to estimate actual number and maximum possible number of persons who may be transported along a given route, or the number entering and leaving a particular area.

b. If parking space or congestion offers problems at a military installation or other place where employees go to and from work via private passenger vehicles, an occupancy check can be used to determine the maximum reduction possible in the number of cars coming to the plant or installation that could be brought about by inauguration of a car pool plan. If a car pool plan is inaugurated, a followup study should be conducted to measure the success of the plan.

c. In planning for future traffic and parking facilities in conjunction with new construction, average occupancy ratios are helpful in estimating the probable number of vehicles to be accommodated. A ratio of 3.0 or more persons per passenger type vehicle indicates an excellent car pooling program. The estimated number of persons using vehicles divided by occupancy ratio gives estimated number of vehicles.

d. If public transit facilities are involved, the study can assist in planning for future public transit needs.

Location: 38th + Provost
Date: 5 Nov 73 Time: Start: 1000 Stop: 1200
Type of Traffic: Passenger + Light Truck Recorder: Smith

Persons per vehicle	Direction of traffic	Totals	Direction of traffic	Totals
1 (Driver only)	||||| ||||| ||||| ||	Veh. 17 Per. 17	||||| ||||| |	Veh. 11 Per. 11
2	||||| |||||	Veh. 10 Per. 20	||||| ||	Veh. 7 Per. 14
3	|||||	Veh. 5 Per. 15	|||||	Veh. 5 Per. 15
4	|||	Veh. 3 Per. 12	|||	Veh. 3 Per. 12
5	|	Veh. 1 Per. 5	0	Veh. 0 Per. 0
6	0	Veh. 0 Per. 0		Veh. 0 Per. 0
7	0	Veh. 0 Per. 0		Veh. 0 Per. 0
8 or more		Veh. 0 Per. 0		Veh. 0 Per. 0

Total Vehicles: 36
Total Occupants: 70
Total Persons per vehicle: 1.9

Total Vehicles: 26
Total Occupants: 52
Total persons per vehicle: 2.0

Figure 9-1. Field sheet for motor vehicle occupancy.

Figure 9–1. Field sheet for motor vehicle occupancy.

Location ______________________ Date ______________________

Time ______________________ Type of Traffic ______________________

Persons per vehicle	Direction of traffic ____			Direction of traffic ____			All traffic		
	No. of vehs.	Percent of total	No. of Persons	No. of vehs.	Percent of total	No. of Persons	No. of vehs.	Percent of total	No. of Persons
Driver only									
2									
3									
4									
5									
6									
7									
8 or more.									
Total________		100%			100%			100%	

Total vehicles ________ Total vehicles ________ Total vehicles ________
Total occupants ________ Total occupants ________ Total occupants ________
Ratio—persons ________ Ratio—persons ________ Ratio—persons ________
Per vehicle ________ Per vehicle ________ Per vehicle ________

Figure 9–2. Summary sheet for motor vehicle occupancy.

CHAPTER 10

PEDESTRIAN STUDY

10-1. Description

This study is a count of pedestrian traffic at street intersections and/or midblock crossing points. This type of study is normally required only at installations where a substantial number of pedestrian-vehicle conflicts develop. Pedestrians should be counted where special conditions exist as at a school or troop crossing or along a road used for periodic movement of troops on foot, or where pedestrian movements are a factor in accidents or congestion as in headquarters or commercial areas.

10-2. Method and Locations of Study

If the peak hour pedestrian volume rate does not exceed 2000 per hour in two directions, only one observer is necessary. Where volume flow exceeds 2000 per hour, two observers will be needed. Pedestrians may be counted either by hand tally or by counters. Simple field sheets designed to meet local requirements may be used to record results. Counts should be tabulated by 15-minute or 30-minute periods so that pedestrian movements can be related to vehicle traffic for corresponding periods. Pedestrians may have to be classified by type such as school children or uniformed personnel at certain public locations. Where service facilities (post exchange, commissary, etc.) are concentrated in a single general area, counts may be required on days of heavy use, such as paydays. Personnel conducting the study should not be in military police duty uniform.

10-3. Time and Length of Study

The counts should extend throughout the periods in which problems occur. Generally, pedestrians should be counted between 0600 and 1800 hours. The hours 0900 to 1100, and 1400 to 1600 are normally the most desirable periods for undertaking short or sample counts.

10-4. Applications

Pedestrian volume data may be applied as follows:

a. To determine the need for traffic signals. (See current *Manual of Uniform Traffic Control Devices for Streets and Highways.*)

b. To indicate the need for special pedestrian protection when considering traffic signals or timing of traffic signals.

c. To determine the extent of jaywalking at an intersection. If more than 5 percent of the pedestrians jaywalk when crossing the intersection, remedial action is needed. The action may initially be educational in nature, followed by restudy. Only after restudy should controls or enforcement be altered.

d. To decide whether pedestrian traffic interferes with motor vehicle turning movements.

e. To determine whether additional pedestrian protection is warranted, such as fences, islands, or barriers.

f. To determine if need exists for school safety patrols.

g. To determine the need for crosswalks.

h. To aid in determining sidewalk needs.

CHAPTER 11

OBSERVANCE OF STOP SIGNS STUDY

11-1. Description and Use

This is a study of driver observance of stop signs. It is used to determine the need for retaining or removing stop signs; or replacing them with yield signs to indicate what steps (such as selective enforcement, education, relocation of signs, addition of painted pavement stop markings, reflectors, illuminators, or fresh painting) might be taken to increase the obedience factor of motorists; and to study the relation of driver nonobservance to accidents at high accident frequency locations.

11-2. Location of Study

Stop sign observance studies should be made at the following locations:

a. All high accident frequency intersections and other problem intersections having stop signs.

b. At 25 or more additional intersections (having stop signs) throughout the installation, to develop an overall average for comparison with the experience at the individual problem area or location.

11-3. Personnel and Equipment

One person normally can conduct this type of study. Two individuals are required if two signs are observed simultaneously. Personnel gathering the data should not be in the military police duty uniform, and should locate themselves inconspicuously. Personnel are equipped with a watch and field sheets (fig 11-1). Military police patrols should be instructed to avoid the intersection being studied.

11-4. Time and Length of Study

This study should cover a period of at least 1 hour, and at least 50 vehicles should be checked at each approach to an intersection. If a study is made at a high accident frequency intersection, it should be made at the time of day, and day of the week when accidents occur most frequently.

11-5. Recording Techniques

a. In the actual recording of the data, a field sheet (fig 11-1) is used. There are spaces for two approaches with stop signs to be checked. In recording the data, the observer records each vehicle as it enters the intersection from the stop street, indicating to what degree the driver observed the stop sign (voluntary full stop, stopped by traffic, etc.), and the direction the vehicle takes upon leaving the intersection (right, straight, or left). If traffic is too heavy to permit a check of every vehicle, an attempt should be made to include every third, fourth, or fifth vehicle. In this way, a random sample will be obtained to assure maximum accuracy of the results. A brief trial period may be needed to ascertain if every third, fourth, or fifth vehicle can be recorded. Once this is decided, the observer must strictly adhere to the interval selected.

b. When the field observance studies are completed, the data contained in the field sheets can be transposed onto the summary sheets (fig 11-2) for analysis. When drawing conclusions from the summaries, it may be assumed that if 75 percent of all motorists make a full stop before entering the intersection, the observance rating is excellent. If 50 to 74 percent make a full stop, the rating is good. If under 50 percent make a full stop, nonobservance is an important factor in whatever control problem exists at the intersection.

11-6. Applications and Analysis

There are many ways in which a stop sign observance study may be applied; the more important include the following:

a. To improve generally the effectiveness of the stop sign as a traffic control device at the location studied:

(1) The data in the summary sheet may indicate that a special enforcement program is necessary. The data will also provide facts with which to demonstrate this need to the public.

DRIVER OBSERVANCE OF STOP SIGNS

FIELD SHEET

LOCATION ____________________

TIME __________ TO __________ WEATHER __________

N/S/E/W/on __________

	ENTERED FAST OVER 15 M.P.H.	
	ENTERED SLOW-4-15 M.P.H.	
	PRACTICALLY STOPPED-0-3 M.P.H.	
	STOPPED BY TRAFFIC	
	VOLUNTARY FULL STOP	
RIGHT	STRAIGHT	LEFT

LEFT	STRAIGHT	RIGHT
	VOLUNTARY FULL STOP	
	STOPPED BY TRAFFIC	
	PRACTICALLY STOPPED-0-3 M.P.H.	
	ENTERED SLOW-4-15 M.P.H.	
	ENTERED FAST OVER 15 M.P.H.	

N/S/E/W/on __________

DATE __________ RECORDER __________

Figure 11-1. Driver observance of stop signs, field sheet.

Sign on __________ Date __________ Weather __________

Location __________ Street Sign on __________ Street

Type of vehicle	Made a full stop: Voluntary		Made a full stop: Stopped by traffic		Made a full stop: Total		Practically stopped 0:3 M.P.H.		Entered slow 4:15 M.P.H.		Entered fast over 15 M.P.H.		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
MORNING ____ TIME ____														
Passenger														
Commercial														
Total														
AFTERNOON ____ TIME ____														
Passenger														
Commercial														
Total														
EVENING ____ TIME ____														
Passenger														
Commercial														
Total														
TOTAL														
Passenger														
Commercial														
Total														

Compiled by __________

Figure 11-2. Driver observance of stop signs, summary sheet.

(2) A high percentage of nonobservance may mean that the stop sign is not clearly visible because it is improperly designated or improperly placed. If the sign is not a standard reflectorized or illuminated type, or if it is placed too far from the curb, its usefulness at night is questionable.

(3) Seasonal or hourly variations in the quality of observance may point to obstructions to visibility such as shrubs, trees, or parked vehicles.

(4) Nonobservance by motorists turning left may occur where streets are wide. Lack of visibility may be a factor. The installation of an additional stop sign on the left side (near side or far side) of the street, or the installation of an overhead flashing red beacon may help to correct the situation (*Manual on Uniform*

Traffic Control Devices for Streets and Highways).

(5) Nonobservance by motorists turning right may occur at corners where curbs have been generously cut back. A stop line painted on the pavement or a suspended flashing red beacon to augment the stop sign plus special enforcement may help to correct the situation.

b. To warrant the removal of signs at intersections where a combination of the following factors exists:

(1) View at the corners is unobstructed.

(2) Right-angle vehicular conflicts are not a problem.

(3) The average full-stop observance is 50 percent or less.

(4) The accident rate for the particular location is not a factor.

CHAPTER 12

OBSERVANCE OF TRAFFIC SIGNALS STUDY

12-1. Description and Use

This study is a field check of the degree of driver observance of intersection traffic control signals. It is used to show the voluntary observance at one or more traffic signals, and to indicate what steps (such as selective enforcement, education, retiming, or physical changes in signals) should be taken to increase voluntary observance.

12-2. Location of Study

This study should be made at the following locations:

a. All high accident frequency intersections having traffic signals.

b. Signalized intersections experiencing considerable congestion.

c. Several other intersections on the installation to obtain an overall average for comparison purposes with the problem areas.

12-3. Personnel and Equipment

Two military policemen are normally required to make this type of study. If there is a multiple approach to an intersection with a high volume of traffic, the team should be increased to four or six military policemen. An ordinary watch, field sheets, and summary sheets are needed to conduct this study. Personnel should not be in military police duty uniform.

12-4. Time and Length of Study

This study should include individual periods of at least 1 hour per location, and at least 50 vehicles should be checked on each approach to the intersection. The length of the entire study at a location is a minimum of 3 hours—1 hour each in the morning, afternoon, and evening. If the study is being made at a high accident frequency intersection, it should also be conducted during the hours when accidents occur most frequently as shown by accident data.

12-5. Recording Techniques

The observer stands on a corner facing toward the center of the intersection, alternately recording vehicles entering from the approach to his left and the intersecting street approach to his right. Since these two movements take place alternately with the signal control, one military policeman can observe and record both movements. The second observer stands on the corner diagonally across the intersection from the first observer and checks the other two approaches. On multiple approaches, it may require an observer for each lane of traffic, particularly if significant differences between lanes are found. The observers should stand where they can see approaching vehicles clearly, but at the same time where they will be inconspicuous. To insure valid figures, military police vehicles and personnel must avoid the area being studied. In actually recording the data for this type of study, the following forms and recording procedures are used:

a. Field Sheet (fig 12-1). This form is divided into four quadrants, one for each intersection approach. There is space for a complete, regular, four-way intersection study on one sheet. In each quadrant there is one space for tallying vehicles entering the intersection on the green, one for vehicles entering on yellow after green, and one for entering on red. An additional space may be added to each quadrant for vehicles which "jump" the red light (waiting vehicles which start into the intersection just before the red changes to green). The military policeman gathering data for the study places a mark in the appropriate space for each vehicle passing his section of the intersection. Vehicles that completely disregard the signal will be recorded on a separate sheet of paper, by registration number and time.

b. Summary Sheet (fig 12-2). When the study is completed, the data is transposed onto the summary sheet. This sheet reflects a statistical compilation of all observations on one intersection approach for one period. When analyzing the data contained on the summary sheet, it may be assumed that if 99 percent of all motorists enter a signalized intersection on the green

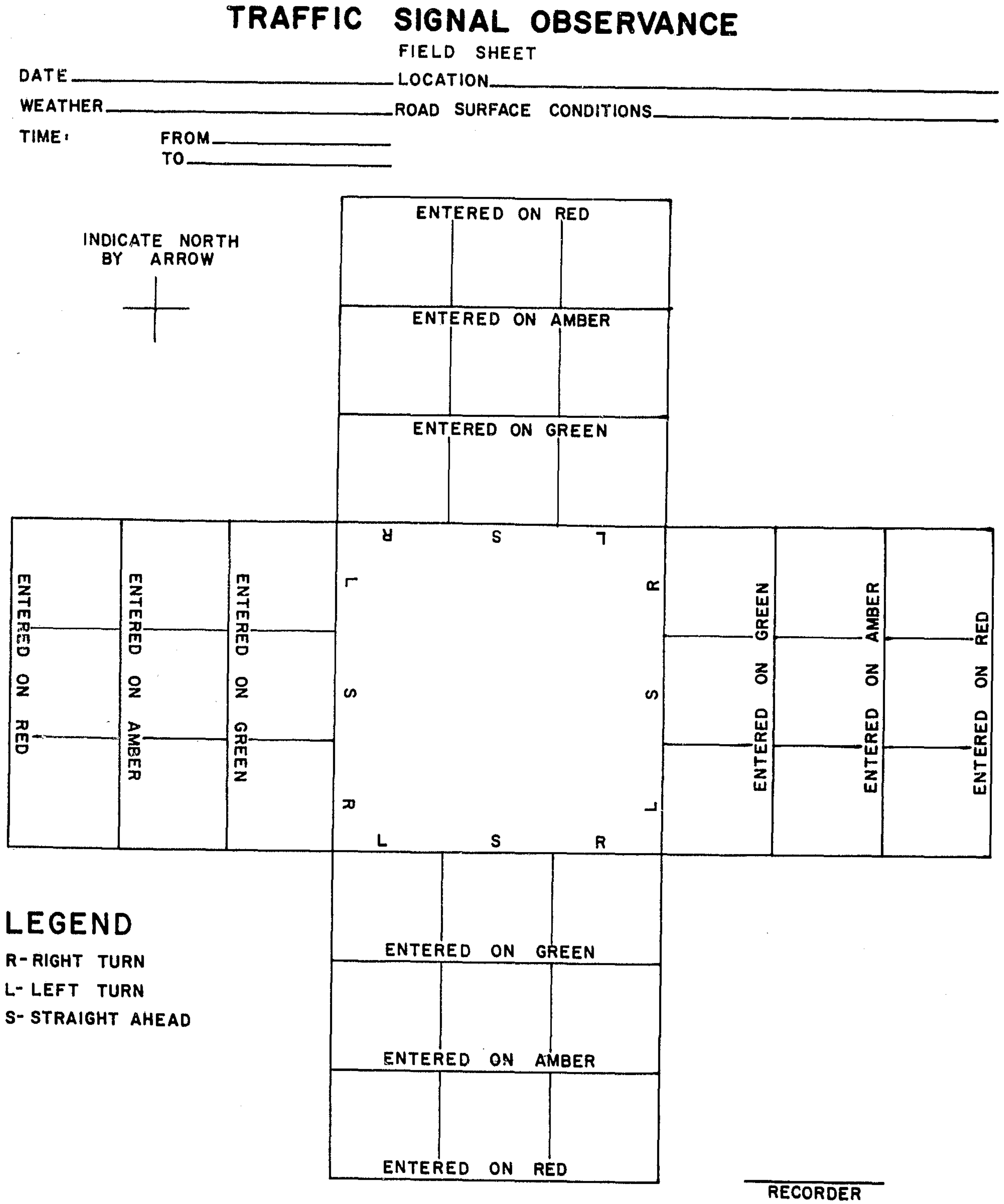

Figure 12-1. Traffic signal observance, field sheet.

signal, the observance rating is excellent. If only 97 percent enter on the green signal, the rating is good. Any lower rating indicates that nonobservance is probably a factor in whatever problem exists at the intersection, and remedial steps should be taken to improve driver observance. If 5 percent of the vehicles disobey the signal, the observance is poor.

Location ________ Date ________ Weather ________

Morning Hours ________ Afternoon Hour ________ Evening Hour ________

Entering on		Passenger vehicles				Commercial vehicles				Total vehicles			
		Left	Straight	Right	Sub-total	Left	Straight	Right	Sub-total	Left	Straight	Right	Total
Green	No.												
	%												
Yellow after green	No.												
	%												
Red	No.												
	%												
Jumped light	No.												
	%												
Total	No.												
	%												

Compiled by ________

Figure 12-2. Driver observance of traffic signals, summary sheet.

12-6. Analysis and Applications

There are many ways in which the results of a traffic signal observance study may be applied. The most important may be summarized as follows:

a. The data in the summary sheets may indicate that a special enforcement program is necessary and may provide material for demonstrating this need to the public.

b. A large percentage of nonobservance may mean that the position of the traffic signal(s) at the intersection is improper.

c. Seasonal or hourly variations in observance may often be traced to visibility. For instance, signals may be obscured by foliage or glare due to the sun's low position in the sky which may necessitate the installation of hoods and louvres on the signals. At night, illuminated advertising signs—especially those of red or green color—may interfere seriously with the effectiveness of traffic signals, particularly, if such signs are near the signals. These signs may be found on civilian-military common boundary routes.

d. Marked nonobservance may indicate faulty signal timing. If the study shows that a large number of vehicles enter the intersection on the red, the yellow or amber period may be too short for the prevailing speed. If a large number of vehicles enter on the yellow, the green period may be too short to meet the traffic demand.

e. Where the study shows that vehicles are consistently jumping the red signal, one of two engineering errors may exist: the yellow period may be too long for the cross street, or the signals on the cross street may be exposed to the view of motorists waiting for the green signal. Proper hoods and louvres on the signal will help to eliminate the latter defect.

f. Nonobservance by drivers making left or right turns may indicate the need for establishing turning lanes and stop lines, providing special turning movement signal intervals, or the addition of another signal face for better visibility. (See *Manual on Uniform Traffic Control Devices for Streets and Highways.*)

g. Nonobservance at complex intersections is often the result of driver confusion due to improper location of signals. The study may indicate a need to relocate signals.

CHAPTER 13

PARKING STUDIES

13–1. General

These studies provide data concerning the adequacy, use, and location of existing parking facilities. In addition, they provide guidance in the placement and design of parking areas for future use. Normally, the overall parking area in military installations is—unlike an urban civilian community—sufficient to accommodate all vehicles. Thus, the most critical aspect of the parking problem is the proper location, use, and preparation of the existing parking facilities. In most cases, a comprehensive parking survey of all installation parking areas need not be conducted except in conjunction with long-range future development planning for major changes in the installation. Normally, studies will be concerned with specific problem areas to improve efficiency and safety through logical parking arrangements consistent with traffic safety objectives. Parking studies often may be used in connection with, or as a part of, origin-destination studies (chap 4). The origin-destination study will provide overall parking demand, and also reflect parking desires by area.

13–2. Types of Parking

Within the military, military police are concerned with permanent and temporary parking.

a. *Permanent Parking*.

(1) *Principles*. These facilities are developed as an integral part of the whole traffic and building plan of the installation. Military police gather and supply information so that the plan will have a sound basis. The studies outlined in subsequent paragraphs will provide the data necessary for planning and improving permanent parking facilities. The military police must consistently be alert for and report problems which arise in regard to permanent parking. These problems may be reflected by—

(*a*) Excessive, illegal, and overtime parking.

(*b*) Excessive cruising to find parking spaces.

(*c*) Extensive congestion in the traffic flow caused by cars attempting to park.

(*d*) Parking in excess of 400 feet from the destination of the occupants of the vehicle.

(2) *On-street*.

(*a*) Ideally no vehicles should park on roadways. Roadways are intended for traffic movement and parking should be provided off the street. This principle applies especially to the primary traffic streets and to the streets within the headquarters area. The extent to which curb parking should be permitted is controlled by the traffic circulation plan, the volume of traffic, and width of the pavement.

(*b*) The parking of cars on the street at an angle to the curb should not be permitted except on lightly traveled streets. The accident experience of drivers backing from these angle parking stalls precludes their use on primary streets. Minimum pavement widths required for parallel parking on roadways carrying appreciable volumes of traffic are shown in figure 13–1. Minimum pavement widths on which 45° angle parking is practical (secondary streets only) are shown in figure 13–2.

(*c*) By prohibiting on-street parking near intersections, the accident hazard can be reduced and traffic capacity can be greatly increased. Parking should be prohibited for a minimum distance of 50 feet each way from a crosswalk. On the approach to a stop sign the prohibition should extend for at least 30 feet from the signs. If 15 percent of the vehicles are turning at a busy intersection, curb parking should not be permitted closer than 150 feet from the intersection. The extra width of pavement made available by the parking restriction will tend to accommodate the turning movement.

(*d*) In a headquarters area where there may be numerous visitors during the day, or near a PX, bank, or other points of community interest, the use of curb parking space should be regulated. If curb space at such locations is monopolized by employees or personnel on duty in nearby buildings, no parking space will remain for business purposes. To obtain a turnover in the use of such important curb parking

Two-way traffic	One-way traffic	Regulation
Less than 28 feet wide - - - - - - -	Less than 22 feet wide - - - - - - -	No parking either side.
29-35 feet wide - - - - - - - - - - -	23-30 feet wide - - - - - - - - - - -	Parking one side only.
36 or more (secondary street) - - -	32 or more (secondary street) - - -	Parking two sides.
40 feet or more (on primary street) -	38 feet or more (on primary street) -	Parking two sides.

Figure 13-1. Minimum pavement widths for parallel parking on roadways carrying appreciable volume of traffic.

Two-way traffic	One-way traffic	Regulation
40 to 46 feet - - - - - - - - - - -	32 to 39 feet - - - - - - - - - - -	Angle parking one side. No parking other side.
47 to 57 feet - - - - - - - - - - -	36 to 47 feet - - - - - - - - - - -	Angle parking one side. Parallel parking other side.
58 feet or more - - - - - - - - - -	48 feet or more - - - - - - - - - -	Angle parking both sides.

Figure 13-2. Minimum pavement widths for 45° angle parking (secondary streets only).

space, a limitation should be placed on the length of time that a vehicle is authorized to remain. At points of community interest, a 1-hour limit normally is sufficient. Near headquarters office buildings, a limit of 1 to 3 hours may be appropriate depending upon the demand for turnover and the spaces available.

(3) *Off-street.*

(*a*) The need for off-street facilities at any location is determined by the number of persons employed or on duty in the nearby area and military and commercial traffic requiring parking spaces in the affected area. The following formula may be used for a preliminary determination of parking space requirements at a specific location:

Parking deficit = number of spaces required

— Number of existing spaces

$$= \frac{\text{Number of personnel} \times \text{automobile factor}}{\text{Average vehicle occupancy} \times \text{efficiency factor}}$$

− Number of existing spaces

1. The value for "number of personnel" should be the number of personnel concentrated within a radius of 400 feet of the parking area, on the maximum working shift plus normal military and commercial visitors.

2. "Automobile factor" refers to the percentage of personnel normally arriving in this vicinity by private automobile. For example, if 85 percent of the personnel normally arrives by private automobile, the automobile factor is .85.

3. "Average vehicle occupancy" is based on the number of persons normally arriving in each vehicle at that particular location. This value will normally range from 1.2 to 2.0.

4. The value to be used for "existing parking spaces" is the number of stalls now available within the 400-foot radius circle which may be utilized for long-time parking by employees or personnel on duty. If a certain amount of turnover space is required for visitors or other short-time users, this amount of space should not be included in "existing parking spaces."

5. The parking "efficiency factor" provides a parking reservoir for motorists looking for a parking space upon arrival at the parking lot. If drivers are required to wait for a space to become vacant, parking aisles become congested and accident potential increases. A utilization factor of 0.95 for long time parking lots and 0.85 for short time lots will provide for the extra spaces needed to accommodate internal travel.

(*b*) There are several fundamental principles to be followed in locating and planning off-street parking facilities.

1. Parking lots should have a minimum number of clearly designated entrances and exits. Inefficient traffic movement on abutting streets will result if each of the parking rows opens onto the street.

2. Parking facilities entrances and exits should not be located near important intersections. If there is a choice between placing the entrances or exits on a primary route or a secondary route, the entrances and exits should be on the secondary route.

3. In planning parking lots, care should be taken to segregate the movement of automobiles from the movement of the pedestrians who are moving to or from their parked cars. For this purpose a desirable parking system is one in which the parking aisles are at right angles to the buildings to which the pedestrians are destined, and in which the cars are parked at 90° to the axis of the aisles. With this design the automobiles may enter and leave via the outer entrance to the parking aisles while the pedestrians enter and leave via the end nearest the buildings. Figures 13–3 and 13–4 reflect parking circulation plans for lots serving one and two buildings.

4. Angle parking is more convenient for the driver. This type parking, however, does require one-way aisles with adequate signs and signals. Good circulation with angle parking means the area must be *marked well.* Angle parking also requires traffic to pass through the major concentration of people.

5. Right angle or 90° parking operates itself with little control required. A larger lot is required for right angle than for diagonal parking.

6. An adequate reservoir space inside the entrance is a most critical element. If all vehicles arrive at approximately the same time, congestion will create a problem at the entrance. There should be a space of 30 to 40 feet or more immediately inside the entrance in which no parking is permitted.

(*c*) Figure 13–5 reflects dimensions for parking stalls for the various types of parking. Figures 13–6 and 13–7 depict typical designs and minimum dimensions for use in planning parking lots. Figure 13–8 reflects typical parking stall layout for interior lots of various frontages (9.0 feet stall width and drive-in parking assumed). The measurements listed below provide adequate space for parking and maneu-

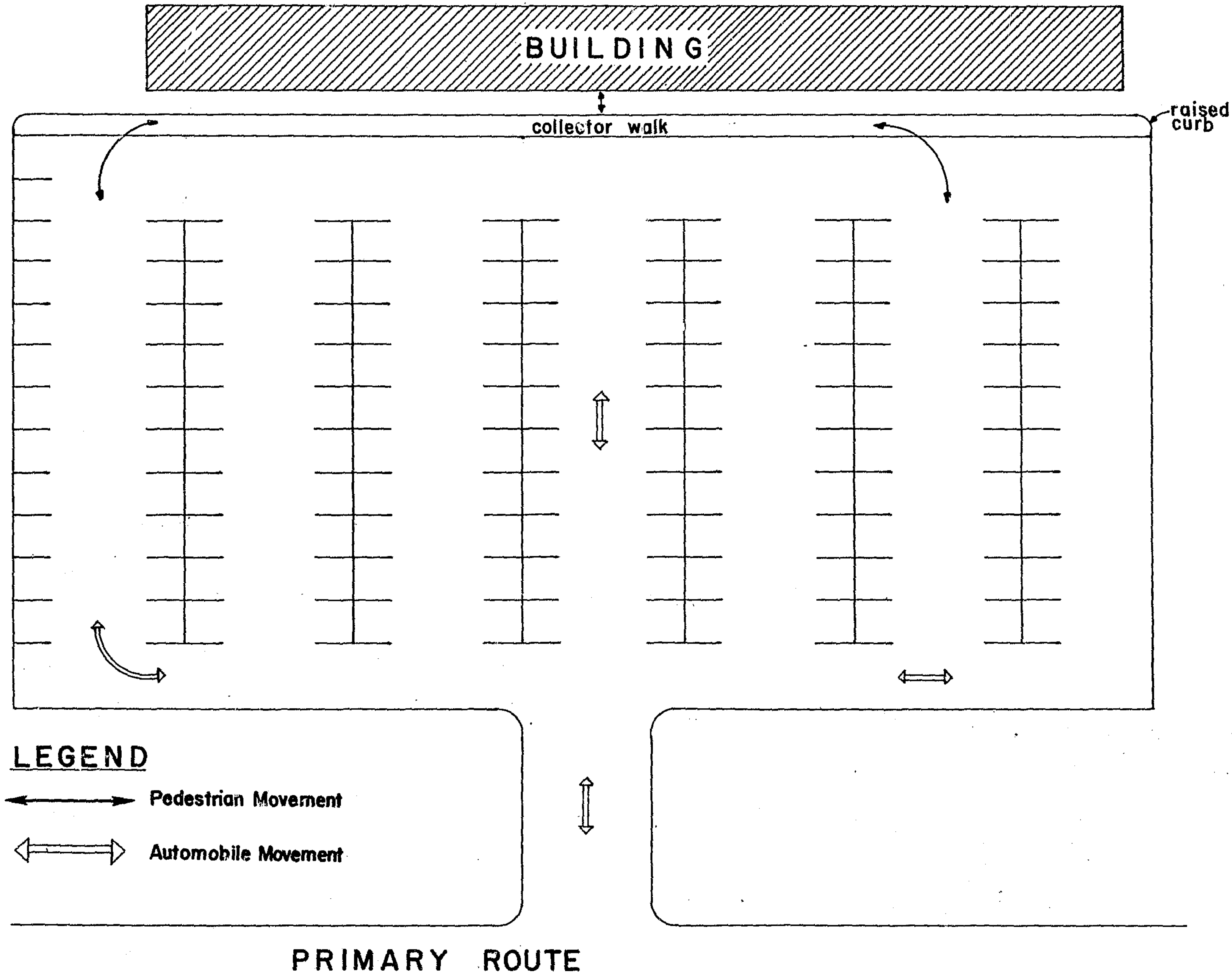

Figure 13-3. Parking lot circulation plan serving one building.

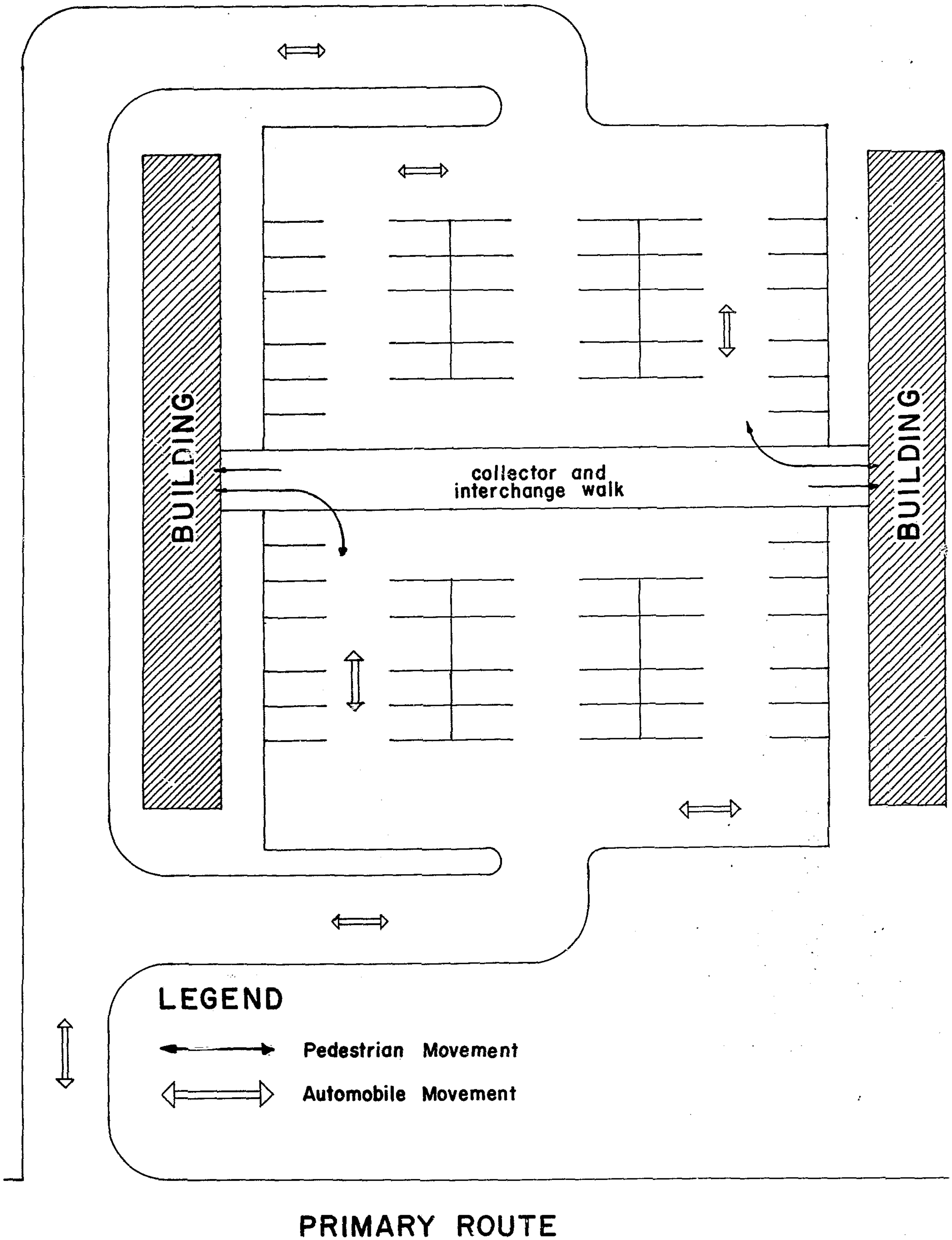

Figure 13–4. Parking plan serving two buildings with pedestrian interchange.

vering. A combination of types may be used on irregular shaped lots if the parking stalls are clearly marked and aisle space A is adequate for the parking angle of largest degree.

Type parking	*Square feet per car*	*A*	*B*	*C*	*D*	*E*
Parallel	297	12′	8′	—	22′	8.5′
35°	335	11.5′	15′	21.4′	14′	8.5′
45°	299	12′	19′	13′	12′	8.5′
60°	276	18′	20′	10′	9.8′	8.5′
90°	228	25′	19′	—	8.5′	8.5′

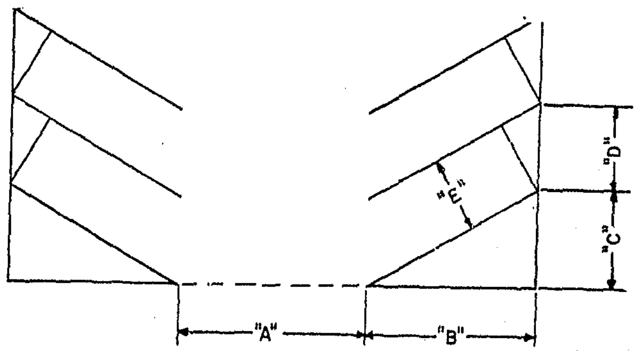

Figure 13-5. Dimensions for parking stalls for various types of parking.

b. Temporary Parking. Military police normally establish only temporary parking facilities for a temporary period or a special event.

(1) Prior to establishing a temporary parking area, the military police will conduct a survey of the area to be used. During this survey all areas not to be used because of obstructions, including ruts, rocks, and trees, should be marked off. If time permits, a diagram of the area should be made. All parking lots should have a number of clearly defined entrances and exits. In planning entrances and exits every effort must be made to insure that, if

RECOMMENDED MINIMUM DIMENSIONS FOR PARKING AREA LAYOUT

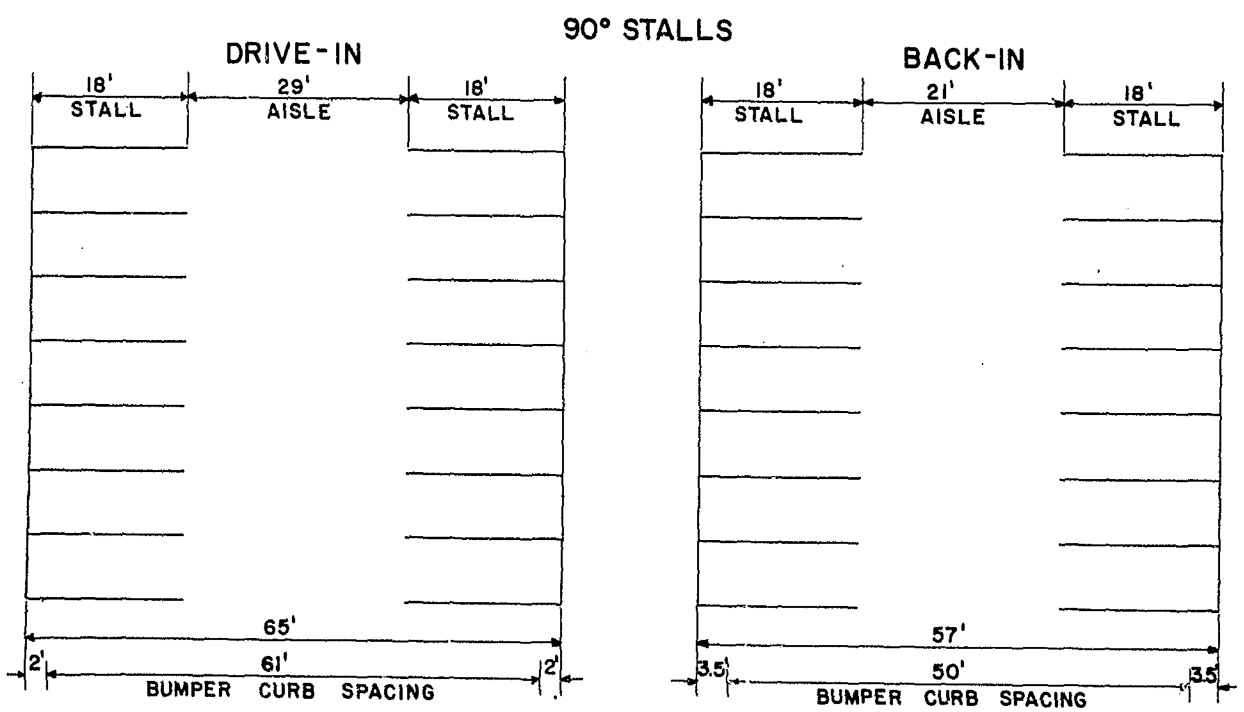

Figure 13-6. Minimum dimensions for parking area layout, 90° stalls.

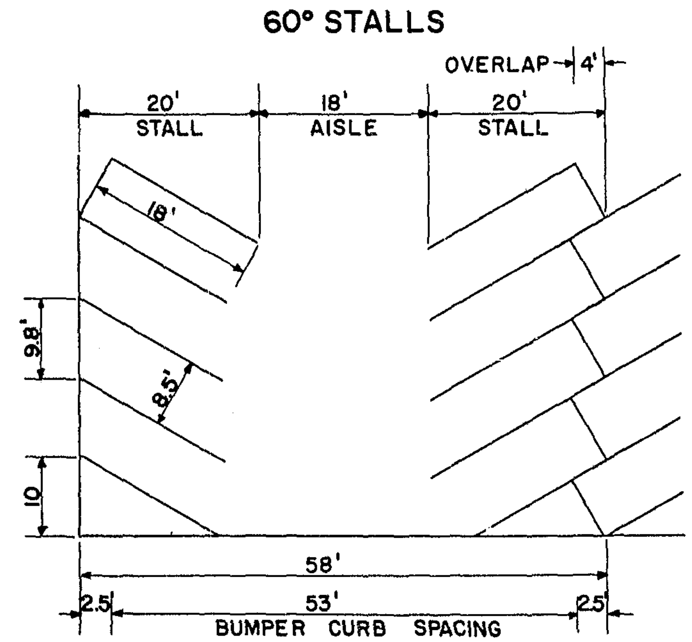

Figure 13-7. Minimum dimensions for parking area layout, 60° stalls.

possible, traffic enters and exits on secondary roads. When it becomes necessary to use a primary road, additional control is necessary to reduce congestion and prevent accidents. An adequate reservoir space inside the entrance is essential when traffic enters from a primary road. When considering movement into and through a parking lot, every attempt should be made to segregate pedestrian and vehicle traffic.

(2) When it is anticipated that vehicles using the temporary facility will enter and exit in relatively short periods of time, the parking plan should provide for use of 90° parking stalls. The outside row of vehicles should be a single row of vehicles backed in. Parking this row of vehicles will consume the most time and should be filled by directing only a limited amount of traffic to this area. Other vehicles should be placed in double rows. The recommended minimum stall width is 9 feet if overall parking area is sufficient; length is 20 feet. To provide for emergencies and allow for early departures, an aisle of 23 feet is provided between the double row of vehicles. If it is anticipated that a large number of small cars will use the parking facility, it may be desirable to designate an area for these, thereby achieving maximum utilization of space. In filling the area every effort is made to insure that it is accomplished without congestion. During the period when the parking area is to be emptied every effort must be made to provide for equal flow from each parking aisle. In allotting moving time the change of flow should be done during breaks in the stream of traffic or when all traffic has stopped. This will reduce the time that is lost during the safety period allocated for a change of direction.

(3) When the requirement for parking is to provide space under conditions of constant vehicle turnover, such as during an exhibit, the parking plan should provide for use of 60° parking stalls 9 feet wide. This angle provides ease in entering and leaving the parking stall. The aisles will provide for one-way traffic and should be a minimum of 18 feet wide. Controls must be maintained to insure that drivers do not cruise to find parking space. If there is a shortage of military policemen for this duty, the one-way flow on aisles and the direction of angle should be alternating. The roadway on both ends of the parking area must have a minimum width of 24 feet to accommodate two-way traffic. Signs should be erected to reduce confusion and congestion. Tapes or lines may be used to mark stalls to provide for better parking.

13-3. Conduct of Parking Studies

Parking studies may be generally classified as parking inventories, parking usage studies, and facility parking service studies. Methods of conducting these three studies follow:

a. Parking Inventory.

(1) *Collecting data.* This study is conducted to determine the actual number of spaces available, either on- or off-street. Normally, an installation map which reflects existing parking facilities is used. For a large installation, several maps, each of which represents a section of the installation, may be required. Code numbers are placed on the map to indicate the specific off-street and on-street areas to be studied. The actual coun of parking spaces is made by military policemen who enter the information on the field sheet (fig 13-9, on-street; fig 13-10, off-street). One sheet i used for each block, area or parking lot. The proper code number for the area is entered on each sheet. For marked areas, the actual number of spaces is listed. For unmarked areas, an estimate of spaces is made based on measurements of the area. A rolling measuring device may be used to help estimate these spaces. Reserved or restricted spaces are tallied separately. In this connection, it is good procedure to conduct frequent review and study of reserved spaces.

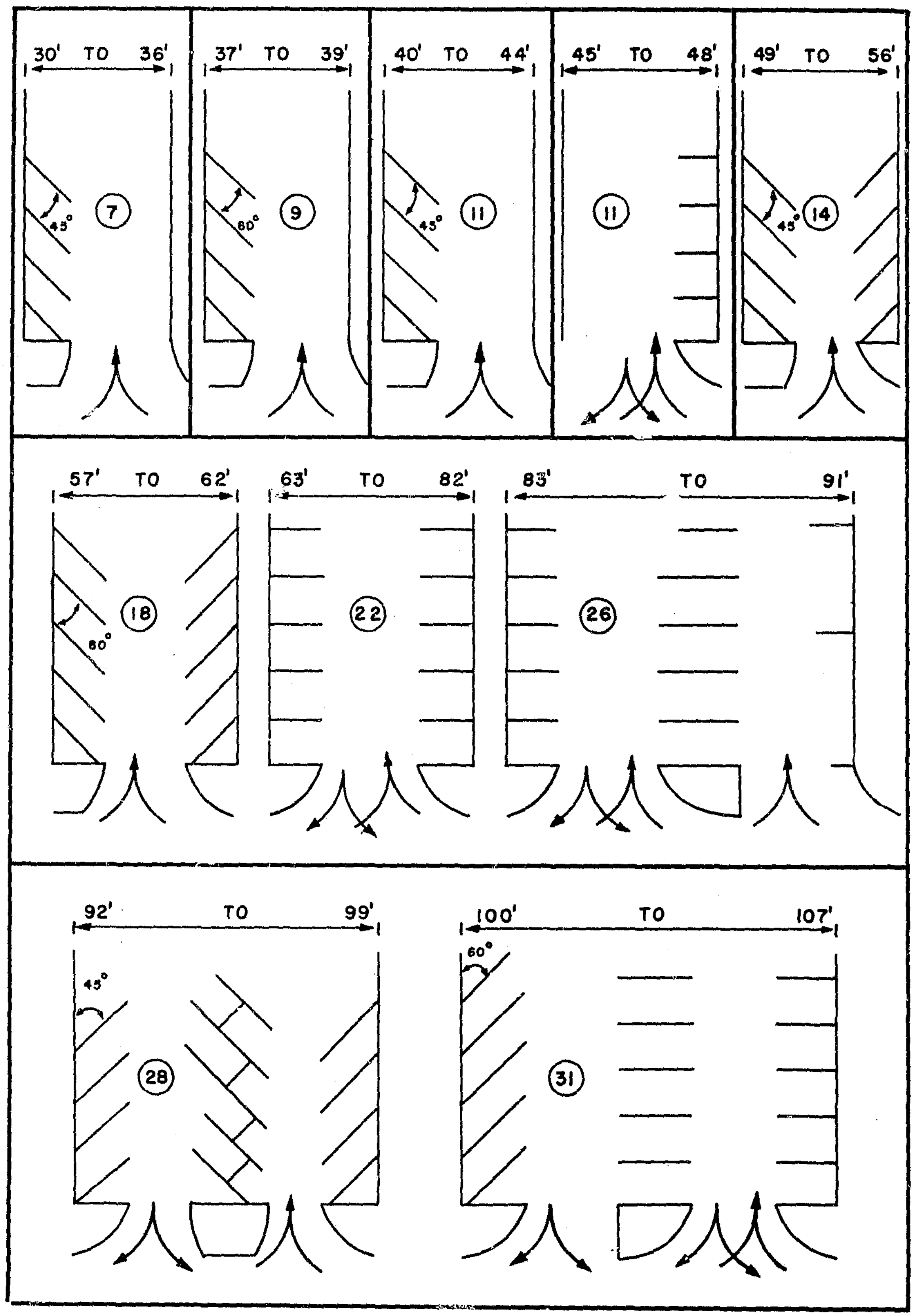

Figure 13–8. Parking stall layouts for interior lots of various frontages.

BLOCK NO. ____________

Sketch Block above and identify boundary streets.

List the following on each block face:

1. No. of available parking spaces.
2. Angle parking 90° 60° 45° If applicable.
3. No. parking zones.
4. Time limit zones.
5. Driveways

DATE ____________ RECORDER ____________

Figure 13–9. Parking inventory field sheet for on-street parking.

Award of such spaces should be based on high, uniform requirements existing throughout the installation. Aerial photos taken at a vertical angle from a low altitude may be of assistance in a comprehensive type study. The parking inventory affords military police with an excellent opportunity for checking condition of regulatory signs and markings. Notation for

1. LOT NO. ____________
2. Facility served:
3. Ground area covered ____________ sq. ft.
4. No. of vehicle stalls ____________.
5. Parking time limits
6. Parking surface ____________ Condition ____________.
7. Stall marking details:

   ____ 90° ____ 60° ____ 45° Other ____________.

   Width of stall ____________.

   Depth of stall ____________.
8. Sketch lot on reverse side of this sheet showing—
   - (a) Outside dimensions of parking area.
   - (b) Location and dimensions of entrances and exits.
   - (c) Aisle widths.
   - (d) Circulation pattern.
   - (e) Layout of stalls showing number of stalls in each row.

DATE ____________ RECORDER ____________

Figure 13–10. Parking inventory field sheet for off-street parking.

Location North side of Provost Street
From 1st Avenue to 2nd Avenue
Weather Clear Time: From 0800 to 1000
Record Starting Time of Each Roundtrip at Top of each Column Below

0800	0815	0830	0845	0900	0915	0930	0945
001	✓	✓	E	E	E	677–843	✓
684	✓	✓	✓	✓	✓	E	E
453	8963	✓	✓	E	4285	✓	✓
222	E	E	548–270	✓	✓	E	E

Date 5 Oct Recorder Gifkins

Figure 13–11. Parking usage survey field sheet.

corrections may be made on the field sheets. Military police may also check post vehicle decals for inspection dates during the inventory.

(2) *Summarizing data.* Information taken from the field sheets may be summarized in a number of ways. Totals for a particular area or street may be placed on the installation map next to the code number. Results may also be reflected graphically by bar graph or tabular graph with each bar representing one of the code areas.

b. Parking Usage Surveys.

(1) *Definition.* Usage is a significant measure of parking adequacy. Usage includes the number of vehicles parking in a specific area and the length of time or duration of parking acts within the area. Types of vehicles, hazardous conditions and practices, and many other pertinent data may be collected during the conduct of this survey.

(2) *Conduct of survey.* The survey is conducted during normal duty hours in order to determine average usage. For special purpose areas (exchange, theater, commissary, etc.), the survey is conducted during those periods of maximum usage. An observer is assigned to a specific area of such size that will permit him to check each parking space once during a 15-minute period for on-street parking, and once during a 30-minute period for off-street park-

LOCATION N. Side of Provost St. from 1st to 2nd Avenue

Parking duration	Vehicles		Vehicle hours		Parking duration	Vehicles		Vehicle hours	
	Number	Percent	Number	Percent		Number	Percent	Number	Percent
.25 hr	120	17.1	30	5.2					
.50	60	8.5	30	5.2					
.75	200	28.4	150	25.7					
1.00	250	35.7	250	42.9					
1.50	54	7.7	81	13.9					
2.00	15	2.1	30	5.2					
2.50	3	0.4	8	1.4					
3.00	1	0.1	3	0.5					
					TOTALS	703	100	582	100

DATE OF STUDY 5 Oct 73
AVERAGE DURATION .83 hr.
PERCENT OVERTIME 10.3

PARKING SPACES AVAILABLE 60
SPACE HOURS AVAILABLE 600
UTILIZATION PERCENTAGE 97
(EFFICIENCY)

Figure 13–12. Parking usage survey summary sheet.

Date ______________________

Parking Space ______________________

1. What was origin of the trip?
   ( ) Off-post. Entered Gate No. ____________
   ( ) On-post. Departed ______________________
   (bldg number, unit, or activity)
2. What is immediate destination? ______________________
3. What is purpose of trip?

( ) Employment	( ) Shopping
( ) Official trip	( ) Eat
( ) Personal Errand	( ) Recreation
( ) Other ______________________	

4. Parking Times
   In __________hours.
   Out __________hours.
5. Type of vehicle
   ( ) POV
   ( ) Military commercial vehicle
   ( ) Military tactical vehicle
   ( ) Trucks
   ( ) Taxi
6. How often is this parking area used? ______________________
7. Suggestions (if any) for improvement of parking ______________________

Figure 13–13. Parking questionnaire.

ing. For long-time parking areas the period may be extended as required. One observer can check about 60 curb spaces in a 15-minute period. The observer walks a predetermined course and records the license plate (last three digits) or the decal numbers on the field sheet (fig 13–11). Parking time limits for each space should be noted on the field sheet the first time the route is checked. The same route is followed on subsequent trips so that each space is represented by the same horizontal line on the field sheet. All spaces must be represented by a line on the field sheet. Several empty unmarked spaces in a row can be estimated by pacing or by use of a measuring rolling device. For example, one parking parallel space is equal to 20 to 22 feet. An empty parking space can be recorded by the letter E or another symbol as desired. When the same vehicle is observed in the same space on a subsequent tour, the observer notes this with a checkmark rather than by a repetition of the license number. This procedure enables the reviewers to pick out the longer term parking. Reserved spaces are reflected on the field sheet with the letter R.

(3) *Summarizing data.* Parking usage data is consolidated on a summary sheet (fig 13–12). Duration of parking is determined by the number of consecutive times the same vehicle was observed in the same parking place and by the period of time used for each complete observation trip. For example, if a vehicle was observed twice and the round trip tour observation required 30 minutes, the duration would be 1 hour. Other factors reflected in the summary are computed as follows:

Vehicle hours = Parking duration (hours) × number of vehicles.

Average duration = total number of vehicle hours divided by total vehicles.

Percent overtime = the sum of the figures in the vehicle percent column for all durations in excess of the legal limits.

Space hours of parking available = number of spaces available × the number of hours of parking the spaces can provide (usually 8, 10, or 12 hours).

Utilization percentage (efficiency) = total vehicle hours ÷ space hours available.

c. Facility Parking Service Study. This study reflects the specific parking areas which serve a particular facility. Adequate publicity is necessary to support the collection effort required by this study. A sample sheet for interview or for use as a questionnaire is shown in figure 13–13. The sample sheet is intended as a guide only, and should be revised to meet local requirements. Data may be obtained in a number of ways:

(1) By personal interview at the time the vehicle is parked.

(2) By distribution of a questionnaire either to the driver or by inserting it under the windshield wiper to be completed by the driver after his return to the vehicle. The questionnaire will identify the parking space, and should include instructions for its return.

13–4. Special Type Facilities

The criteria presented up to this point would be applicable to most parking problems arising to the provost marshal. However, special consideration must be shown in various phases of parking planning for special type facilities found on military installations. While the basic principles developed are still applicable, these facilities tend to develop special demands or needs that must be considered which may result in a deviation from accepted principles. In the area of special type facilities, there are no set principles of parking to follow. The best approach is a well balanced combination of parking studies, parking area design, and common sense.

a. Major Headquarters. Major headquarters, by the nature of their operations, generate a type of parking need quite different from the parking demand for workers and normal day-to-day visitors. Normally, worker parking areas are to the rear of, or separated from, the headquarters area, yet experience has shown a need for close-in, high turnover rate parking adjacent to the main entrance. These areas are mainly used by vehicles, normally official, assigned to general grade officers or visiting VIP. To meet this special parking demand, several principles should be followed:

(1) Access to the headquarters should be rapid and separate from the routes to normal parking areas.

(2) Generally, parallel curb parking is acceptable, but with larger than normal dimensions.

(3) These areas should be adequately marked and enforced to preclude unauthorized parking.

(4) Command action should be encouraged to keep the spaces to the needed low number.

b. Exchanges and Commissaries. Exchanges and commissaries present problems in two areas which must be considered. The greater problem is the rapid turnover rate in the parking areas of these activities. As a result, the circulation plan must be well designed to prevent congestion in the aisles. Whenever turnover rate increases, there will be a larger volume of vehicles entering and leaving the area. If the circulation plan is faulty, there will be a slowing down of movement with complaints resulting. The second problem area will be in the individual parking stall design. While 8- or 9-foot widths may normally be acceptable in parking areas designs, it should be noted that in parking areas where patrons generally are carrying packages or bundles, it is difficult to enter parked cars. It is recommended that parking stalls be 10 or 10½ feet in width in these parking areas.

c. Hospital Areas. In hospital areas there arises the problem of short-term as opposed to all day parking. This is caused when hospital employees and staff members utilize the same parking areas as out-patients or visitors to the facility. Here walking distance gathers additional importance. Out-patients should be permitted to park as closely as possible to the hospital facilities. Employees and staff members should be directed to park in outlying or completely separated areas. In hospital areas, it is often true that every consideration is shown to patrons except in the area of parking. A second problem to consider in relation to hospitals, is that of emergency vehicle access and parking. It is mandatory that adequate maneuvering and parking space be allocated immediately adjacent to emergency entrances. If possible, the access routes should be separate from the routes serving the normal parking areas. These emergency vehicle parking areas should be adequately marked and strictly enforced by military police.

13-5. Consideration for "Compacts"

Compact cars may be given special consideration in the design or alteration of parking areas. The compact car requires less space than the normal size automobile. Use of the normal stall represents a waste of parking area. Special sections and spaces may be designed for the small cars; however, this approach may evoke criticism and cause enforcement problems. Drivers of compacts may continue to use the larger spaces if the small ones are filled. Further, drivers of normal size cars may use a portion of the smaller spaces if the larger spaces are full. Another problem area is the equitable allocation and proper location of the segregated spaces. Any effort to establish separate spaces for the compacts should be confined initially to a single experimental section before any large scale renovation of parking is attempted.

13-6. Application of Studies

a. The parking inventory will point out the geographical distribution of parking capacity.

b. The parking usage survey assists in resolving current parking problems and in determining future requirements by—

(1) Pointing out areas of greatest parking demand.

(2) Detecting areas where parking is critical because of inadequate capacities.

(3) Evaluating efficiency of parking areas. An efficiency of 85 percent is generally considered as maximum for short-time parking. For long-time parking, an efficiency of 95 percent is considered to be maximum.

(4) Identifying areas in which parking time limits are not consistent with usage. In these cases time limits may require changing, or greater enforcement may be necessary.

c. The parking facility service study will assist in determining the proper size and location of parking facilities needed for the various installation activities. It will also assist in planning for future parking facilities required by new facilities or movement of existing facilities. The provost marshal, as a member of the master planning committee for the installation, can be of great assistance in considering parking requirements in all new construction planned. This should include consideration of cost of traffic facilities in estimating construction expense.

CHAPTER 14

ACCIDENT RECORDS STUDIES

14-1. General

The Provost Marshal's traffic section reviews and analyzes traffic accident data to improve enforcement, engineering, and education programs. Traffic accident investigators, in addition to investigation, may make traffic control and engineering recommendations. These can serve as basis for a spot study. The traffic accident records yield valuable information needed by those concerned with traffic problems. Analysis of these records serves to—

a. Permit identification and treatment of high accident locations.

b. Assist in the evaluation of roadway design factors.

c. Furnish guidance in the planning and programing of improvements and remedial steps by establishing priorities of action.

d. Evaluate effectiveness of actions taken in "before" and "after" studies.

14-2. Accuracy of Basic Data

The validity of any analysis of accident records depends on the accuracy of the basic information. This is particularly important when considering the *causes* of accidents. There is rarely a single basic cause for an accident. Normally, the accident occurs as a result of a complex combination of a variety of factors. The routine classification "following too closely," "speed too fast for conditions," etc., may fail to reveal the true cause of the mishap. Accordingly, it is essential that records under review be accurate and detailed. It may be possible to extend an obvious reason to a more accurate causation through analysis. For example, a number of collisions at one intersection resulting from failure to observe a signal may have been caused by a sight obstruction in front of the signal.

14-3. Automatic Data Processing (ADP)

ADP facilitates the tabulation, compilation, and detailed examination of information available to the provost marshal traffic section. ADP may be adapted for on-post traffic analysis. One example of an input processing plan is shown in figure 14-1. The individual who codes the information must be able to evaluate the narrative portion of the traffic accident report. This insures a uniform analysis of each report and overall statistics have more meaning. Information on accidents is extracted from reports (DA Forms 3975 and 3946), and coded according to a preplanned system. An example of one item input system is shown in figure 14-2. Detailed code sheets may be used for each of the items listed. Examples are contained in figures 14-3, through 14-7. The items may then be entered and processed. Data for each item is found in the appropriate code sheet, or entered by number (example: day of accident, complaint number, etc.). Figure 14-2 reflects a data processing plan with items and source of information for each. A sample worksheet is shown in figure 14-8.

After input is completed, ADPS may be used for analysis of accident data. Data for required reports may also be coded and completed with ADP. Examples used are taken from a system developed by the Provost Marshal, Fort Benning, Georgia. It is noted that the system described is only one approach to ADP utilization. It may be expanded to provide for report requirements, record and maintain point assessments, and other pertinent traffic information. This system may be revised as required to fit local requirements, equipment, and capabilities.

14-4. Accident Experience at Selected Locations

a. General. There are six basic steps in a study of accidents at those locations which may require specific attention. These are—

(1) Obtaining sufficient accident data (para 14-3).

(2) Selecting high accident frequency locations in order of severity.

(3) Preparing collision diagrams and condition diagrams as required.

(4) Summarizing facts.

ON-POST TRAFFIC ACCIDENT ANALYSIS

OPERATION	ACTION AGENCY	REMARKS			
		Item	Columns	Form	Section
1. Accident Reports (Forms 3975, 3946) delivered to Manual Coding Section	OSB				
2. Assigns code numbers, post on worksheet, FB (PM) Form	Manual Coding Section	Location	1-11	19-32	6
		Day	12-13	19-32	6
		Month	14-15	19-32	6
		Year	16	19-32	6
		Hour	17-18	19-32	6
		Day of Week	19	19-32	6
		Cause	20-21	3975	6)
				3946	15,16)
		Type	22-23	19-68	16
		Intoxicants	24	19-32	6,8
		Area	25,26	19-68	2
		Driver	27,28	19-32	1
		Owner	29	19-68	6
		Driver Age	30,31	19-32	4
		Road Factors	32	19-68	3
		Weather	33	19-68	3
		Seatbelts	34	19-68	
		Major Comd	35-37	19-32	3
		Total Injuries			
		Fatalities	38-40	19-68	11
		Traffic Engr	41	19-68	3
		Complaint No	42-46	19-32	Front
		Vehicle Code	47-48	19-68	5
		Light Conditions	49	19-68	3
3. Keypunches required information on IBM cards.	Keypunch Section				
4. Delivers to Data Processing for required reports.	Manual Coding Section				
5. Sorting and storage sequence.	Data Processing	Sort alphabetically by primary street name. Parking lot accidents will be coded with PARK in Columns 1-5.			

Figure 14-1. Input data processing plan (Fort Benning, Georgia).

(5) Making field observations at the locations and during the hours of the collisions reported.

(6) Analyzing the facts and the field data and prescribing remedial treatment.

b. Traffic Spot Maps.

(1) One method of identifying locations with high accident frequency is the traffic spot map (FM 19-26). This map is designed to show those locations which have high accident and traffic violation occurrence. The map should be large enough to include the complete road net of a post, camp, station, or city. The spot map is an important source of information for the traffic accident prevention program. It will be located so that the military policeman can use it when preparing for duty. At the end of each year, the map should be photographed and the picture filed for future reference and for comparison with the current spot map.

(2) After an accident report or a report of traffic violation has been processed, the traffic section will post the location of the incident on the map by use of a pin. The pin will be marked

Columns	Digits	Item	Remarks
1-5	5	Primary street	Code sheet A2
6	1	At or in intersection	Code sheet A2
7-11	5	Secondary street	Code sheet A2
12-13	2	Day of accident	
14-15	2	Month of accident	
16	1	Year	
17-18	2	Hour	
19	1	Day of week	Code sheet A4
20-21	2	Cause of accident	Code sheet A1
22-23	2	Type accident	Code sheet A1
24	1	Alcohol involved	Code sheet A1
25-26	2	Area of accident	Code sheet A1
27-28	2	Category of driver	Code sheet A3
29	1	Vehicle owner	Code sheet A4
30-31	2	Driver age	
32	1	Road factors	Code sheet A4
33	1	Weather	Code sheet A4
34	1	Seat belts	Code sheet A4
35-37	3	Driver, major command	Code sheet A5
38	1	Minor injuries	(Number)
39	1	Injuries, hospitalization	(Number)
40	1	Fatalities	(Number)
41	1	Traffic engineering	(Study needed?)
42-46	5	Complaint No.	
47-48	2	Vehicle code	Code sheet A4
49		Light conditions	Code sheet A4

Figure 14-2. Data processing plan on-post traffic accidents (Fort Benning, Georgia).

on its head with a symbol, or pins with heads of different colors may be used. These symbols or colors will be explained in the map legend and may represent type of violation, classification of accident, and other appropriate data. Usually no more than five or six such symbols or colors will be used.

(3) The maps used should be large scale and pertain to a limited and well-defined area such as an installation, or a portion of it if the area is complex in composition.

c. Collision Diagram. After identification of a high accident frequency location such as an intersection or a curve, it is necessary to examine and analyze conditions at that location. To analyze such a situation, it is desirable to put the accidents in a form permitting study and analysis. The form most commonly used is a collision diagram. The preparation of such a diagram presumes that reliable records are available which give data on direction of travel, date, time of day, and weather conditions. These facts are graphically presented in one collision diagram.

(1) The diagram consists of an outline map of a street location on which the accidents are depicted by lines and symbols showing the directions of movement of vehicles and pedestrians (fig 14-9). The map should also reflect the locations of stationary objects which were involved in the traffic accidents. If desired, additional symbols may be used to reflect the type of accident (fig 14-10).

(2) The collision diagram is prepared as follows:

(*a*) Draw intersection.

(*b*) Identify diagram.

(*c*) Identify streets.

(*d*) Indicate north.

(*e*) Plot in accidents to include—

1. Direction of travel.

2. Date of accident.

3. Time of accident.

4. Road conditions.

5. Weather conditions.

6. Unusual circumstances such as condition of driver; actions of driver; and act of God (tornado, flood, etc.).

(3) Care should be taken to see that one diagram does not cover two different sets of physical conditions. For example, it would be a mistake to include in one diagram the accidents which occurred at an intersection before a stop sign was installed, as well as the accidents occurring after the sign was erected.

(4) After such a diagram has been prepared,

AREA

01. Troop housing
02. Family housing
03. Gates
04. Headquarters (MP)
05. School
06. Railroad crossing
07. Highway
08. Parking lot
09. PX
10. Commissary
11. Warehouse
12. Open

CONTRIBUTORY (CAUSE)

01. Reckless driving
02. Driving while drunk
03. Improper backing
04. Following too close
05. Improper passing
06. Misjudging clearance
07. Excessive speed
08. Inattentive driving
09. Operating unsafe vehicle
10. Failure to maintain control
11. Failure to yield
12. Failure to properly supervise children
13. Failure to secure vehicle
14. Disregarded stop signal
15. Improper overtaking
16. Improper turn
17. Improper parking

ALCOHOL INVOLVED

1—YES
2—NO

TYPE ACCIDENT

01. Rear end collision
02. Backing
03. Collision with fixed object
04. Right angle collision
05. Sideswipe

TYPE ACCIDENT

06. Collision with parked vehicle
07. Overturning
08. Head-on collision
09. Pedestrian struck by vehicle
10. Noncollision
11. Pedestrian striking vehicle
12. Train—Auto
13. Collision with portable object
14. Bicycle—vehicle
15. Motorcycle—vehicle
16. Scooter—vehicle
17. Vehicle—railroad train
18. Vehicle—animal
19. Other
00. Unknown age

COMPLAINT NUMBER

5 Digits

Figure 14-3. Code sheet A-1, classification, causes, areas (Fort Benning, Georgia).

analysis takes the form of a search for points of similarity between accidents. Points of similarity may be—

(*a*) Cars coming from the same direction in the majority of accidents.

(*b*) Cars colliding when they come from the same two directions, for example, eastbound and northbound colliding.

(*c*) Accidents predominantly of one type such as cars making left turns colliding with cars coming from the opposite direction.

(*d*) Pedestrians walking in one direction encountering difficulty. For example, pedestrians may be involved in accidents as they walk westward from the east curb.

(*e*) Accidents occurring in only one season of the year.

(*f*) Accidents occurring predominantly at one time of day or under one light condition.

(*g*) Accidents occurring under some peculiar weather condition such as on wet pavement.

(5) When analysis has revealed one or more clues or points of similarity, an investigation should be made in the field. This investigation should be made at the time and under the

(ALAMO) ALAMO ROAD (MP)
(ALDR) ALDRICH ROAD (HC)
(ALEK) ALEKNO ROAD (MP)
(AIRBO) 101st AIRBORNE (OA)
(ALLIS) ALLISON AVE (BPH)
(ANDER) ANDERSON STREET (MP)
(ANGER) ANGER STREET (MP)
(ARROD) ARROWHEAD RD (BP&OC)
(ARROC) ARROWHEAD RD (SH)
(AUDER) AUDERMARDE RD (GA)
(AUST) AUSTIN LOOP (MP)
(AXTON) AXTON ROAD (HC)

(BABB) BABBIT ROAD (HC)
(BACK) BACKSTROM ROAD (HC)
(BAKER) BAKER STREET (EC)
(BALL) BALL STREET (MP)
(BALTZ) BALTEZELL AVE (MP)
(BANHA) BANHALTZ STREET (MP)
(BARRO) BARRON STREET (MP)
(BANRY) BANRY AVENUE (BPH)
(BASS) BASS ROAD (HC)
(BEAN) BEANE STREET (MP)
(BEAR) BEAR STREET (HC)
(BEAUD) BEAUDIN STREET (BP)
(BECK) BECKER ROAD (HC)
(BELF) BELFRY ROAD (MP)
(BELK) BELKO STREET (MP)
(BEND) BENDER STREET (MP)
(BENJ) BENJAMIN STREET (MP)
(BENNO) BENNING BLVD (OUT GO)
(BENNI) BENNING BLVD (IN COM)
(BENT) BENTLY STREET (MP)
(BERG) BERGEN STREET (MP)
(BESS) BESSINGER LOOP (SH)
(BIDD) BIDDLE STREET (HC)
(BIRN) BIRNEY STREET (HC)
(BILL) BILLS STREET (MP)
(BJORN) BJORNSTAD STREET (MP)
(BLESS) BLESSING STREET (MP)
(BLISS) BLISS STREET (MP)
(BLOCK) BLOCKHAM STREET (MP)
(BOB) BOBO STREET (MP)
(BOLL) BOLLING STREET (HC)
(BOLT) BOLT STREET (MP)
(BOURG) BOURG AVENUE (SH)
(BOX) BOX SPRINGS ROAD (OA)
(BRAD) BRADSHAW ROAD (MP)
(BREM) BREMER STREET (MP)
(BRIN) BRINSON ROAD (HC)
(BECAD) BECADHEAD CIRCLE (HC)
(BRYAN) BRYANT STREET (MP)
(BUCK) BUCKEYE ROAD (HC)
(BUDD) BUDD STREET (HC)
(BUENA) BUENA VISTA ROAD (OA)
(BUFF) BUFFALO ROAD (OA)
(BULL) BULLS EYE ROAD (OA)
(BURR) BURR STREET (MP)
(BUSH) BUSHNELL ROAD (SH)

(BUTT) BUTTS STREET (OC)
(BRILP) BRIGADE LOOP (MP)
(BURN) BURNEY STREET (HC)
(BROS) BROSTROM STREET (CT)
(BROCK) BROCKMAN STREET (MP)

(CACT) CACUTUS ROAD (OA)
(CACL) CAGLE STREET (MP)
(CAGL) CAGLE LOOP (MP)
(CAREY) CAREY STREET (MP)
(CARP) CARPENTER STREET (MP)
(CENT) CENTRAL AVENUE (SH)
(CHAP) CHAPEL ROAD (HC)
(CHEN) CHENEY STREET (MP)
(CHES) CHESNEYS STREET (MP)
(CHRIS) CHRISTOPHER RD (MP)
(CLARK) CLARKE ROAD (MP)
(CLAY) CLAY STREET (HC)
(CLIF) CLIFTON AVENUE (BPH)
(COFF) COFFEE ROAD (HC)
(COLL) COLLINS DRIVE (HC)
(COLLP) COLLINS LOOP (MP)
(COLUM) COLUMBUS AVE (SH)
(COMP) COMPTON STREET (MP)
(CONN) CONNELL STREET (MP)
(CONNR) CONNERS CTREET (MP)
(CORN) CORNELL STREET (HC)
(COURT) COURT AVENUE (BPH)
(CRAG) GRAIG COURT (CT)
(CRAGD) CRAIG DRIVE (CT)
(CRETT) CRETTY STREET (MP)
(CROS) CROSBIE ROAD (HC)
(CUFF) CUFF ROAD (HC)
(CUSS) CUSSETA ROAD (SH)
(CUSSH) CUSSETA ROAD (HC)
(CUST) CUSTER ROAD (MP)

(DICK) DICKERSON STREET (MP)
(DIAL) DIAL STREET (MP)
(DILBY) DILBOY STREET (MP)
(DISAL) DISALBO STREET (SH)
(DIXIE) DIXIE ROAD (MP)
(DOUG) DOUGLAS STREET (HC)
(DRAB) DRABORNE ROAD (MP)
(DURL) DURLINSKY STREET (MP)
(DUKE) DUKE STREET (HC)
(DUDD) DUDDERAR STREET (MP)
(DULE) DULEVITZ STREET (MP)

(EAME) EAMES AVENUE (MP)
(EDDY) EDDY BRIDGE (MP)
(EDWA) EDWARDS STREET (MP)
(EIGHT) EIGHTH DIV ROAD (HC)
(ECHO) ECHOL STREET (MP)
(ECKE) ECKEL STREET (MP)
(ESAB) 82nd AIRBORNE RD (MP)
(ETHST) EIGHTH STREET (SH)
(ELCA) ELCANEY ROAD (HC)
(ELEV) ELEVENTH STREET (SH)

Figure 14-4. Code sheet A-2, approved abbreviation streets and roads (Fort Benning, Georgia).

01-Enlisted, E1	27-NCO, E7	45-COL
02-Enlisted, E2	28-NCO, E8	46-GEN
03-Enlisted, E3	29-NCO, E9	50-Civilian employee
04-Enlisted, E4	30-Warrant Officer	51-Civilian concessionaire
05-Specialist, E5	31-OCS	52-Civilian
06-Specialist, E6	40-Foreign Officer	53-Dependent wife
07-Specialist, E7	41-LT	54-Dependent child
24-NCO, E4	42-CPT	60-Unknown
25-NCO, E5	43-MAJ	
26-NCO, E6	44-LTC	

Figure 14-5. Code sheet A-3, personnel (Fort Benning, Georgia).

circumstances indicated by the collision diagram. As far as safety permits, the circumstances of the accident should be re-enacted by pedestrians or drivers proceeding in the proper directions. By such methods, a physical explanation for the accident concentration may be found and necessary corrective steps taken.

(6) Normally, whenever a collision diagram is made, a companion condition diagram is compiled.

d. Condition Diagram. The condition diagram (fig 14-11) is a scale drawing which provides an accurate picture of the physical conditions at the location under study. Dotted lines on figure 14-11 show the required visibility for the 85 percentile speed of the road. The shaded lines are the actual visibility triangle. The visibility triangle depicts the area clearly visible to a driver at a given intersection. This diagram is used to evaluate the effect of obstructions to the driver's view and reflects conditions of concern to the military policeman.

(1) To prepare a condition diagram, a rough sketch is normally made at the scene. From this sketch the diagram is then prepared. If the diagram is placed on an $8^1/_2 \times 11$-inch sheet of paper, a scale of 30 to 40 feet per inch is suggested. The observations and measurements should include—

(*a*) Curb lines and/or roadway limits.
(*b*) Property lines.
(*c*) Sidewalks and driveways.
(*d*) View obstructions on corners.
(*e*) Physical obstructions on the roadway.
(*f*) Ditches.
(*g*) Bridges, overpasses, and culverts.
(*h*) Traffic signals, signs, and pavement markings.
(*i*) Street lighting.
(*j*) Percentage and direction of grades.
(*k*) Type of road surface.
(*l*) Types of occupancy for adjacent property.
(*m*) Road or route designations.
(*n*) Irregularities such as holes, washboarding, dips, etc.

(2) A review of the condition diagram in conjunction with the collision diagram should indicate some of the contributing causes of traffic accidents. When such causes are known, action may be taken that will lead to a reduction in traffic accidents. A condition diagram may disclose vision obstructions as contributing to accidents. When this is the case, removable obstructions such as shrubbery, signs, or parked cars should be cleared. The clearance distance from the intersection depends upon the normal speed of traffic on the affected streets. Drivers of vehicles proceeding at the normal speed on one street should be able to see a car proceeding at normal speed on the intersecting street early enough for either driver, or both, to react and bring his car to a stop short of the point of potential collision. A table of distances traveled while the driver is reacting and braking his car to a stop is shown in figure 14-12.

OWNER OF VEHICLE

1. Government
2. Private
3. Commercial
4. Nonappropriated fund
5. Stolen
6. Borrowed
7. No Vehicle

DAY OF WEEK

1. Sunday
2. Monday
3. Tuesday
4. Wednesday
5. Thursday
6. Friday
7. Saturday
8. Holiday

ROAD FACTORS

1. Curve
2. Straightaway
3. Intersection
4. Parking Lot

LIGHT CONDITIONS

1. Daylight
2. Dawn
3. Dusk
4. Dark—street lights
5. Dark—no street lights

WEATHER

1. Clear
2. Rain
3. Ice
4. Fog
5. Snow

SEAT BELTS

1. None
2. Seat belts used
3. Had seat belts, but not used

TRAFFIC ENGINEERING STUDY NEEDED

1. No
2. Yes

VEHICLE CODE

01. Two-door sedan
02. Four-door sedan
03. Station wagon
04. Convertible
05. Panel truck
06. Pickup truck
07. Truck
08. Jeep
09. Sport
10. Other
11. House trailer
12. Boat trailer
13. Bicycle
14. Motorcycle/scooter
15. Heavy equipment
16. Bus

Figure 14-6. Code sheet A-4, roadway, vehicle, driver, conditions (Fort Benning, Georgia).

Figure 14-12 illustrates the application of reaction plus braking data to a problem of vision obstructions at intersections.

(3) Usually a study of this type is made by two men, one taking a station at Point B and sighting toward the other standing at Point A. Vision obstructions, shrubbery, signs, parked cars, etc., should be removed from the triangle thus established. If a building extends into the critical sight triangle, removable obstructions such as parked cars should be cleared to the point that they represent no more severe ob-

AAD—11th Div
AGA—USAG
AIS—USAIS
ARM—Other Active Army (non-Fort Benning)
BDE—197th Inf Bde
BNK—Bank employee
BUS—Howard bus
CAV—1st Cav Div
CDC—CDCIA
CTC—USAICTC
CIV—Civilian
CON—PX Concession
DAC—Dept. of the Army Civilian
DEP—Dependent
DOD—Other Active Military (Non-Army)
FSS—Foreign student
HUM—HUMRRD
INF—Inf Board
LAC—LAAC
MAH—Martin Army Hosp
MED—428th Med Bn
MHS—Med Holding Students
MTU—USAMTU
NCO—NCOOM
OCS—Officer Candidate
OOM—MOOM
PXE—PX employee
RES—Reserve Component
RET—Retired
RTC—ROTC
SEC—Second Div
TAX—Taxi company
TEC—TEC Gp
TSB—Student Brigade
TSS—TSB student
WEA—Weather Sqdn

Figure 14-7. Code sheet A-5. Unit/Office/Status classification (Fort Benning, Georgia).

COLUMNS 1-11			12-13	14-15	16	17-18	19	20-21	22-23	24	25-26	27-28	29	30-31	32	33	34	35-37	38	39	40	41	42-46	47-48	49	50	51	52	53	54	55
CODE A2							A4	A1	A1	A1	A1	A3	A4		A4	A4	A4	A5				A4		A4							
LOCATION																															
Primary street	At or in intersection	Secondary street	Day of accident	Month of accident	Year	Hour	Day of week	Cause of accident	Type of accident	Alcohol involved	Area	Category of driver resp	Vehicle owner	Driver age	Road factors	Weather	Seat belts	Driver major command	Minor injuries	Injury hospitalize	Fatalities	Traffic eng.	Complaint number (6 digits)	Vehicle code							

Figure 14-8. Data processing worksheet—traffic accident analysis (Fort Benning, Georgia).

COLLISION DIAGRAM (PREPARED 10 OCT 73)

LOCATION MAPLE AVE. & TENTH STREET

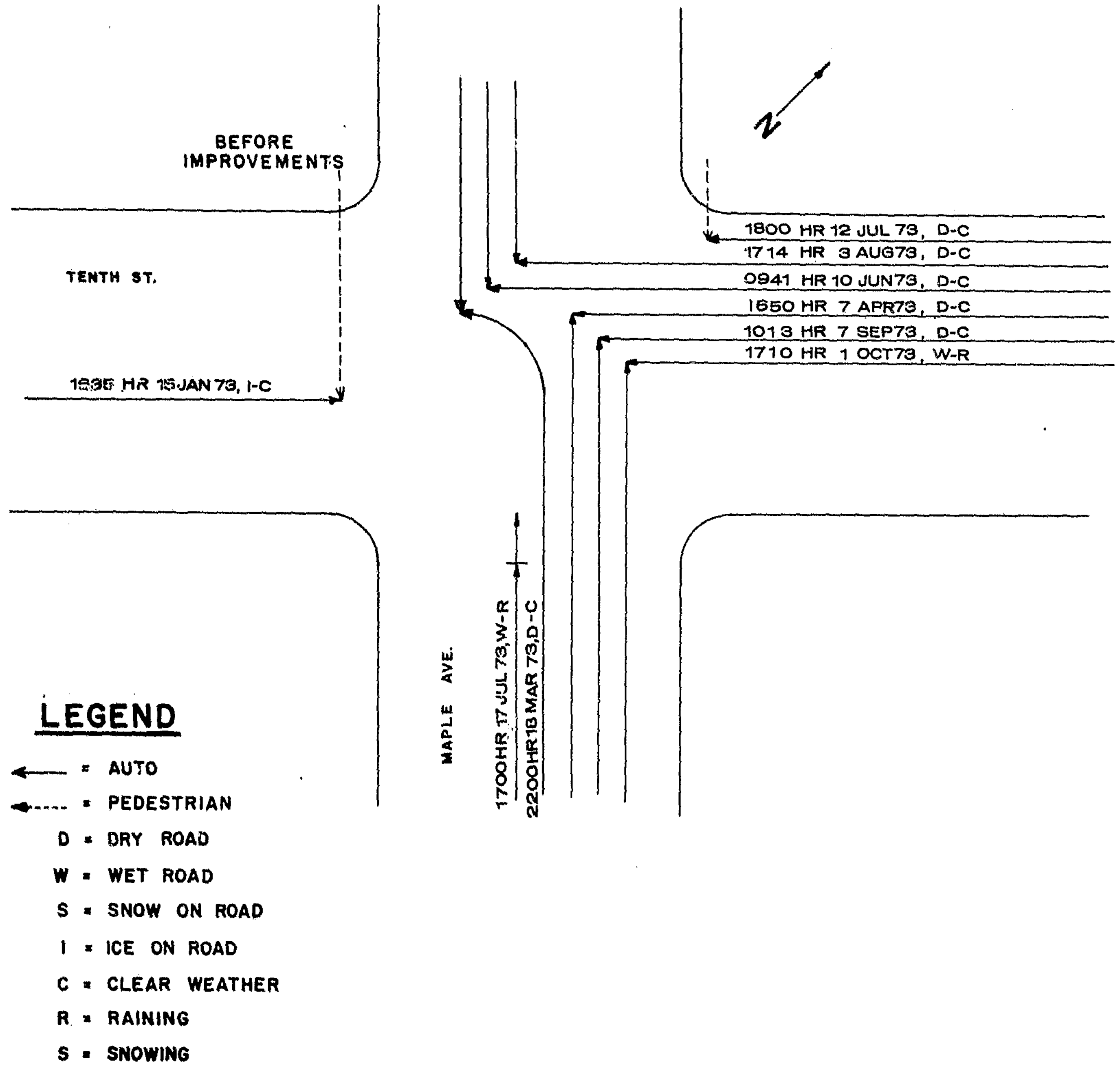

Figure 14-9. Collision diagram.

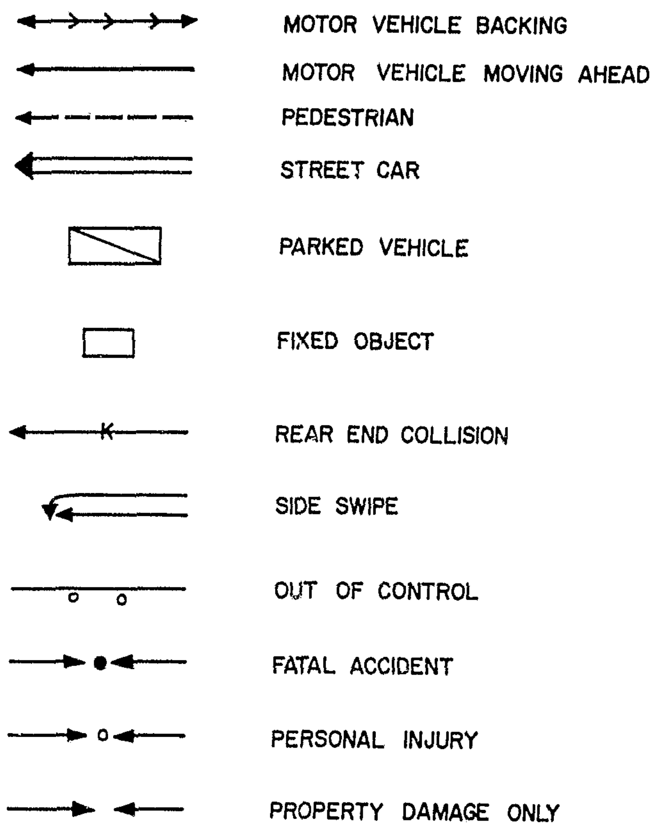

Figure 14–10. Symbols for collision diagram.

struction than the building itself. Under such circumstances persistent accident experience may dictate the use of some type of warning sign on the less important of the two streets.

e. Summarizing Data and Making Recommendations. The compilation of accident data is in itself of little value. It must be summarized in understandable, meaningful terms which serve as a basis for recommendations and remedial actions. The repetitive principle of collision offers assistance in analysis. This principle suggests that if certain conditions influence the vehicle, driver, roadway, or control, accidents may occur. It may be safe to assume that similar influences in the future will also cause accidents. In other words, past performance is used to predict future events. In summarizing accident data, it is necessary to segregate and group those influences which cause accidents. These influences may then be given the required attention.

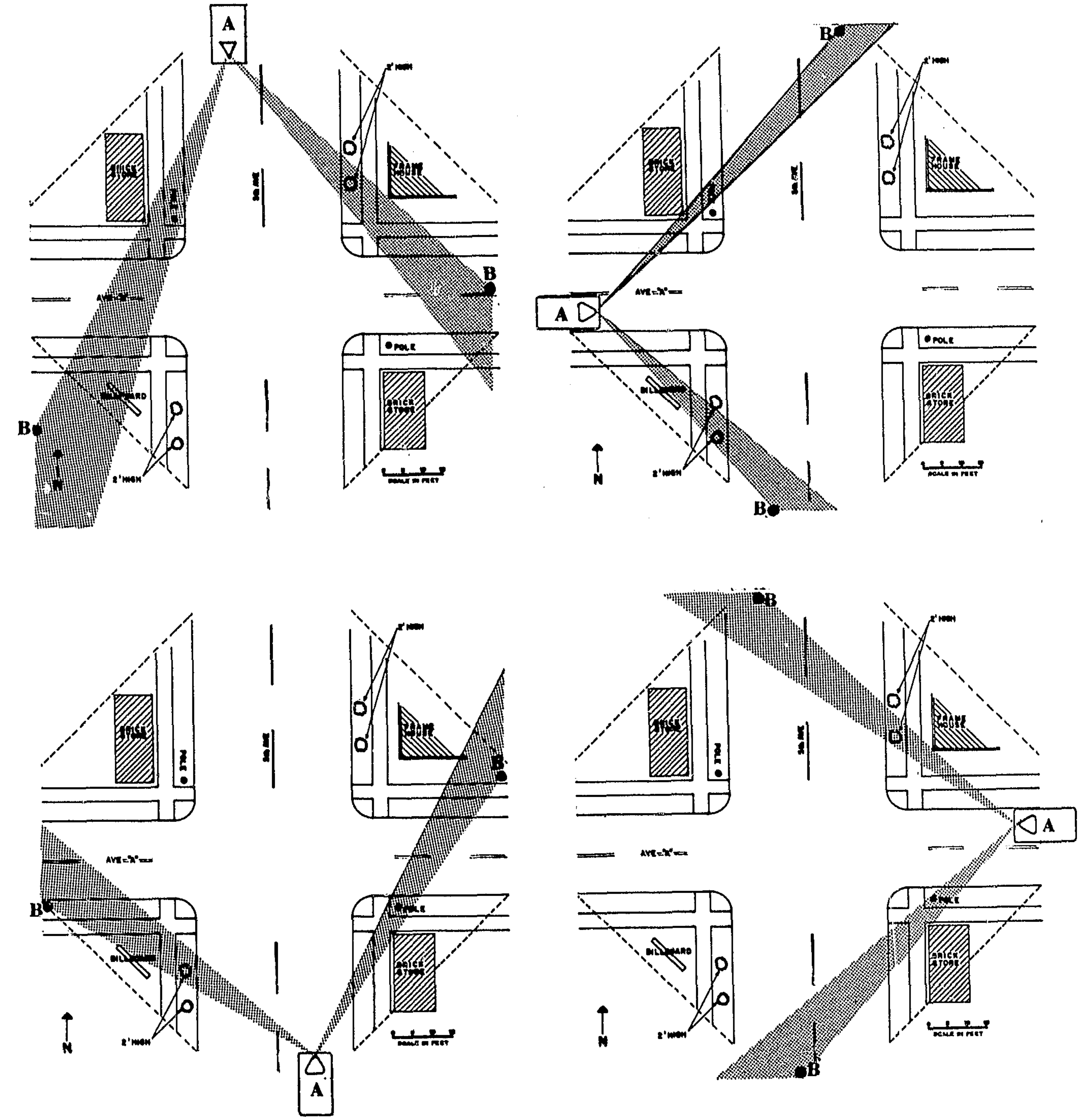

Figure 14–11. Condition diagram.

Speed		Braking distance		Reaction distance	Total stopping distance	
Miles per hour	Feet per second	Minimum practical (F = 0.65) feet	Recommended for use in traffic control planning (F = 0.35) feet	Simple reaction time, for most drivers, ¾ second feet	Minimum feet	Recommended feet
5	7	3	2	5	8	7
10	15	5	10	11	16	21
15	22	12	22	16	28	38
20	29	21	38	22	43	60
25	37	32	60	27	59	87
30	44	47	85	33	80	118
35	51	63	115	38	101	153
40	59	82	153	44	126	197
45	66	104	195	50	154	245
50	73	128	238	55	183	293
55	81	155	290	61	216	351
60	88	185	342	66	251	408
65	95	217	405	71	288	476
70	103	252	467	77	329	544
75	110	289	536	82	371	618
80	117	328	609	88	416	697
85	125	370	688	93	463	781
90	132	425	771	99	524	870
95	139	463	860	104	567	964
100	147	514	952	110	624	1062

Figure 14-12. Vehicular stopping distances from various speeds.

CHAPTER 15

OTHER STUDIES

15-1. Transit Checks

This study is conducted to secure information on the use of private or Government-owned mass transit facilities The study is used to provide a basis for improvement, adjustment, or inauguration of a transit system. The study involves the tabulation of numbers of persons utilizing the transit system by loading point, unloading point, time, day of the week, military or civilian, and other such information. City offices and transit companies may contribute information for these studies. Users desiring further information on this study are referred to the *Manual of Traffic Engineering Studies*, published by the Institute of Traffic Engineers.

15-2. Access Roads Study

An access roads study provides a basis for changes in the highway system, and has application in long-range requirements to improve traffic operations (AR 55-80 and AR 210-20). The study is a collection and combination of the following studies under one title:

a. Vehicle registration (chap 3).

b. Motor vehicle volume (chap 7).

c. Vehicle occupancy (chap 9).

d. Transit check (chap 15).

APPENDIX A

REFERENCES

A-1. Army Regulations (AR)

55-29	Military Convoy Operations in CONUS.
55-80	Highways for National Defense.
55-162	Permits for Oversize, Overweight, or Other Special Movements on Public Highways.
190-5	Motor Vehicle Traffic Supervision.
190-15	Traffic Accident Investigation.
190-45	Records and Forms.
190-46	Provost Marshal Activities.
210-20	Master Planning for Permanent Army Installations.
310-25	Dictionary of United States Army Terms.
310-50	Authorized Abbreviations and Brevity Codes.
385-40	Accident Reporting and Records.
385-55	Prevention of Motor Vehicle Accidents.

A-2. Field Manuals (FM)

19-1	Military Police Support, Army Divisions and Separate Brigades.
19-4	Military Police Support, Theater of Operations.
19-5	The Military Policeman.
19-10	Military Police Administration and Operations.
19-20	Military Police Criminal Investigations.
19-25	Military Police Traffic Control.
19-26	Military Police Traffic Accident Investigation.
55-1	Army Transportation Services in a Theater of Operations.
55-10	Army Transportation Movements Management.
55-15	Transportation Reference Data.
55-30	Army Motor Transport Operations.

A-3. Technical Manuals (TM)

5-822-1	Traffic Study Requirements.
21-305	Manual for the Wheeled Vehicle Driver.

A-4. Department of the Army Pamphlets (DA Pam)

108-1	Index of Army Motion Pictures and Related Audio-Visual Aids.
310-series	Military Publication Index series.

A-5. Training Films (TF)

19-2271	The Traffic Accident Spot Map (4 min).
19-2272	The Collision Diagram (5 min).
19-2275	Motor Vehicle Spot Speed Studies—Setting Up Mirror Boxes (6 min).
19-3541	Military Police Traffic Control—Part I—Traffic Control Plan (21 min).
19-3542	Military Police Traffic Control—Part II—Traffic Supervision, Policies and Procedures (20 min).

A–6. Miscellaneous Publications

Manual on Traffic Engineering Studies, Institute of Traffic Engineers, Washington, DC, 1964.

Manual On Uniform Traffic Control Devices for Streets and Highways, Department of Transportation/Federal Highway Administration, Washington, DC, 1971.

Procedure Manual, Public Administration Service, Chicago, 1958.

Public Roads, Vol 29, No 5, Petroft, BB, December 1956.

Uniform Vehicle Code and Model Traffic Ordinance, National Committee on Uniform Traffic Laws and Ordinances, Washington, DC 20024.

A–7. Forms

DA Form 3975 Military Police Report.

DA Form 3946 Military Police Traffic Accident Investigation.

DA Form 3626 Vehicle Registration and Driver Record.

APPENDIX B
GLOSSARY

Access road—Public roads, existing or proposed, needed to provide essential access to military installation and facilities, or to industrial installations and facilities in the activities of which there is specific defense interest. Roads within the boundaries of military reservation are excluded from this definition unless such roads have been dedicated to public use and are not subject to closure.

Accident spot map—An area or installation map showing the location of vehicle accidents by means of symbols. Symbols may represent accidents classified as to daylight hours, night hours, injury or death.

Angle parking—Parking where the longitudinal axes of vehicles form an angle with the alignment of the roadway.

Center line—A line marking the center of a roadway between traffic moving in opposite direction.

Collision diagram—A plan of an intersection or section of roadway on which reported accidents are diagramed by means of arrows showing manner of collision.

Combined condition and collision diagram—A condition diagram upon which the reported accidents are diagramed by means of arrows showing manner of collision.

Condition diagram—A plan of an intersection or section of roadway showing all objects and physical conditions having a bearing on traffic movement and safety at that location. Usually these are scaled drawings.

Cordon counts—A count of all vehicles and persons entering and leaving a district (cordon area) during a designated period of time.

Cordon area—The district bounded by the cordon line and included in a cordon count.

Crosswalk—Any portion of a roadway at an intersection or elsewhere distinctly indicated for pedestrian crossing by lines or other markings on the surface. Also, that part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the trafficway measured from the curbs, or in the absence of curbs, from the edges of the traversable roadway.

Delay—The time consumed while traffic or a specified component of traffic is impeded in its movement by some element over which it has no control, usually expressed in seconds per vehicle.

Desire line—A straight line between the point of origin and point of destination of a trip without regard to routes of travel (used in connection with an origin-destination study).

Divided street—A two-way road on which traffic in one direction of travel is separated from that in the opposite direction by a directional separator. Such a road has two or more roadways.

85 percentile speed—That speed below which 85 percent of the traffic units travel, and above which 15 percent travel.

Fixed-time controller—An automatic controller for supervising the operation of traffic control signals in accordance with a predetermined fixed-time cycle and divisions thereof.

Fixed-time traffic signal—A traffic signal operated by a fixed-time controller.

Flashing beacon—A section of a standard traffic signal head, or a similar type device, having a yellow or red lens in each face, which is illuminated by rapid intermittent flashes.

Flashing traffic signal—A traffic control signal used as a flashing beacon.

Floating car—An automobile driven in the traffic flow at the average speed of the surrounding vehicles.

Flow diagram—The graphical representation of the traffic volumes on a road or street network or section thereof, showing by means of bands the relative volumes using each section of roadway during a given period of time, usually 1 hour.

High frequency accident location—A specific location where a large number of traffic accidents have occurred.

Intersection approach—That portion of an intersection leg which is used by traffic approaching the intersection.

Lateral clearance—The distance between the edge of pavement and any lateral obstruction.

Lateral obstruction—Any fixed object located adjacent to the traveled way which reduces the transverse dimensions of the roadway.

Left turn lane—A lane within the normal surfaced width reserved for left turning vehicles.

Manual traffic control—The use of hand signals or manually operated devices by traffic control personnel to control traffic.

Manual counter—A tallying device which is operated by hand.

Mass transportation—Movement of large groups of persons.

Multiaxle truck—A truck which has more than two axles.

Occupancy ratio—The average number of occupants per vehicle (including the driver).

Odometer—A device on a vehicle for measuring the distance traveled, usually as a cumulative total, but sometimes also for individual trips, with an indicator on the instrument panel where it is usually combined with a speedometer indicator, or in the hub of a wheel in some trucks.

Off-peak period—That portion of the day in which traffic volumes are relatively light.

Offset lanes—Additional lanes used for traffic which is heavier in one direction. Also known as unbalanced lanes.

Off-street parking—Lots and garages intended for parking entirely off streets and alleys.

On-street parking—The use of street and alleys (may be angle or parallel parking) for parking of vehicles.

Origin-destination studies—A study of the origins and destinations of trips of vehicles and passengers. Usually included in the study are all trips within, or passing through, into or out of a selected area.

Overall speed—The total distance traversed divided by the travel time. Usually expressed in miles per hour and includes all delays.

Overall time—The time of travel, including stops and delays except those off the traveled way.

Parallel parking—Parking where the longitudinal axis of vehicles are parallel to alignment of the roadway so that the vehicles are facing in the same direction as the movement of adjacent vehicular traffic.

Parking duration—Length of time a vehicle is parked.

Passenger vehicle—A free-wheeled, self-propelled vehicle designed for the transportation of persons but limited in seating capacity to not more than seven passengers, not including the driver. It includes taxicabs, limousines, and station wagons, but does not include motorcycles. (In capacity studies, also includes light reconnaissance vehicles, and pickup trucks.)

Passenger (transit) volume—The total number of public transit occupants being transported in a period of time.

Peak period—That portion of the day in which maximum traffic volumes are experienced.

Pedestrian—Any person afoot. For purpose of accident classification, this will be interpreted to include any person riding in or upon a device moved or designed for movement by human power or the force of gravity, except bicycles, including stilts, skates, skis, sleds, toy wagons, and scooters.

Percent of grade—The slope in the longitudinal direction of the pavement expressed in percent which is the number of units of change in elevation per 100 units of horizontal distance.

Percent of green time—The percentage of green time allotted to the direction of travel being studied.

Property damage—Damage to property as a result of a motor vehicle accident that may be a basis of a claim for compensation. Does not include compensation for loss of life or for personal injuries.

Public highways—The entire width between property lines, or boundary lines, of every way or place of which any part is open to use of the public for purposes of vehicular traffic as a matter of right or custom.

Public transit—The public passenger carrying service afforded by vehicles following regular routes and making specified stops.

Reflectorize—The application of some material to traffic control devices or hazards which will return to the eyes of the road user some portion of the light from his vehicle headlights, thereby producing a brightness which attracts attention.

Regulatory device—A device used to indicate the required method of traffic movement or use of the public trafficway.

Regulatory sign—A sign used to indicate the required method of traffic movement or use of the traffic way.

Right turn lane—A lane within the normal surfaced width reserved for right turning vehicles.

Roadway—That portion of a trafficway including shoulders, improved, designed, or ordinarily used for vehicle traffic.

Separate turning lane—Added traffic lane which is separated from the intersection area by an island or unpaved area. It may be wide enough for one- or two-lane operation.

Shoulder—The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.

Sight distances—The length of roadway visible to the driver of a passenger vehicle at any given point on the roadway when the view is unobstructed by traffic.

Signal cycle—The total time required for one complete sequence of the intervals of a traffic signal.

Signal controller—A complete electrical mechanism for controlling the operation of traffic control signals, including the timer and all necessary auxiliary apparatus mounted in a cabinet.

Signal face—That part of a signal head provided for controlling traffic from a single direction.

Signal head—An assembly containing one or more signal faces that may be designated accordingly as one-way, two-way, multi-way.

Signal phase—A part of the total time cycle allocated to any traffic movements receiving the right-of-way or to any combination of traffic movements receiving the right-of-way simultaneously during one or more intervals.

Simple intersection—An intersection of two traffic ways, with four legs or approaches.

Speed—The rate of movement of a vehicle, generally expressed in miles per hour.

Stopping sight distance—The distance required by a driver of a vehicle, traveling at a given speed, to bring his vehicle to a stop after an object on the roadway becomes visible.

Street width—The width of the paved or traveled portion of the roadway.

Through movement—See *through traffic*.

Through street—A street on which traffic is given the right-of-way so that vehicles entering or crossing the street must yield the right-of-way.

Through traffic—Traffic proceeding through a military installation, or portion not originating in or destined to that military installation or portion thereof.

Time cycle—See *signal cycle*.

Traffic—Pedestrians, ridden or herded animals, vehicles, street cars, and other conveyances, either singly or together, while using any street for purposes of travel.

Traffic accident—Any accident involving a motor vehicle in motion that results in death, injury, or property damage.

Traffic actuated controller—An automatic controller for supervising the operation of traffic control signals in accordance with the immediate and varying demands of traffic as registered with the controller by means of detectors.

Traffic control—All measures except those of a structural kind that serve to control and guide traffic and to promote road safety.

Traffic control device—A traffic control device is any sign, signal, marking, or device placed or erected for the purpose of regulating, warning, or guiding traffic.

Traffic demand—The volume of traffic desiring to use a particular route or facility.

Traffic engineering—That phase of engineering that deals with the planning and geometric design of streets, highways, and abutting lands, and with traffic operations thereon, as their use is related to the safe, convenient, and economic transportation of persons and goods.

Traffic flow—The movement of vehicles on a roadway.

Traffic flow pattern—The distribution of traffic volumes on a street or highway network.

Traffic generator—A traffic producing area such as a post exchange, parking lot, or administrative center.

Traffic signal interval—Any one of the several divisions of the total time cycle during which signal indications do not change.

Trafficway—The entire width between property lines (or other boundary lines) of every way or place of which any part is open to use of the public for purposes of vehicular traffic as a matter of right or custom. On military installation the word "public" refers to those persons having authorized access to, and use of, the common roadway facilities.

Transit vehicle—A passenger carrying vehicle, such as a bus or streetcar which follows regular routes and makes specific stops.

Travel time—The total elapsed time from the origin to destination of a trip.

Turning movement—The traffic making a designated turn at an intersection.

Two-way streets—A street on which traffic may move in opposite directions simultaneously. It may be either divided or undivided.

Type of accident—The kind of motor vehicle accident, such as head-on, right-angle, etc.

Type of surface—The class of surface such as concrete, asphalt, gravel, etc.

Uninterrupted flow—The flow of vehicles under ideal conditions resulting in unrestricted movement.

Vehicle—Every device in, upon, or by which any person or property is or may be transported or drawn upon a highway, except those devices moved by human power or used exclusively upon stationary rails or tracks.

Vehicle occupancy—The average number of occupants per automobile, including the driver.

Volume—The number of vehicles passing a given point during a specified period of time.

Warning sign—A sign used to indicate conditions that are actually or potentially hazardous to highway users.

Warrant—Formally stated conditions that have been accepted as minimum requirements for justifying installation of a traffic control device or regulation.

Zone (origin-destination studies)—A division of an area established for the purpose of analyzing origin-destination studies. It may be bounded by physical barriers such as rivers and highways, or may be the location of individual work organizations that have duty stations in relatively close proximity.

INDEX

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