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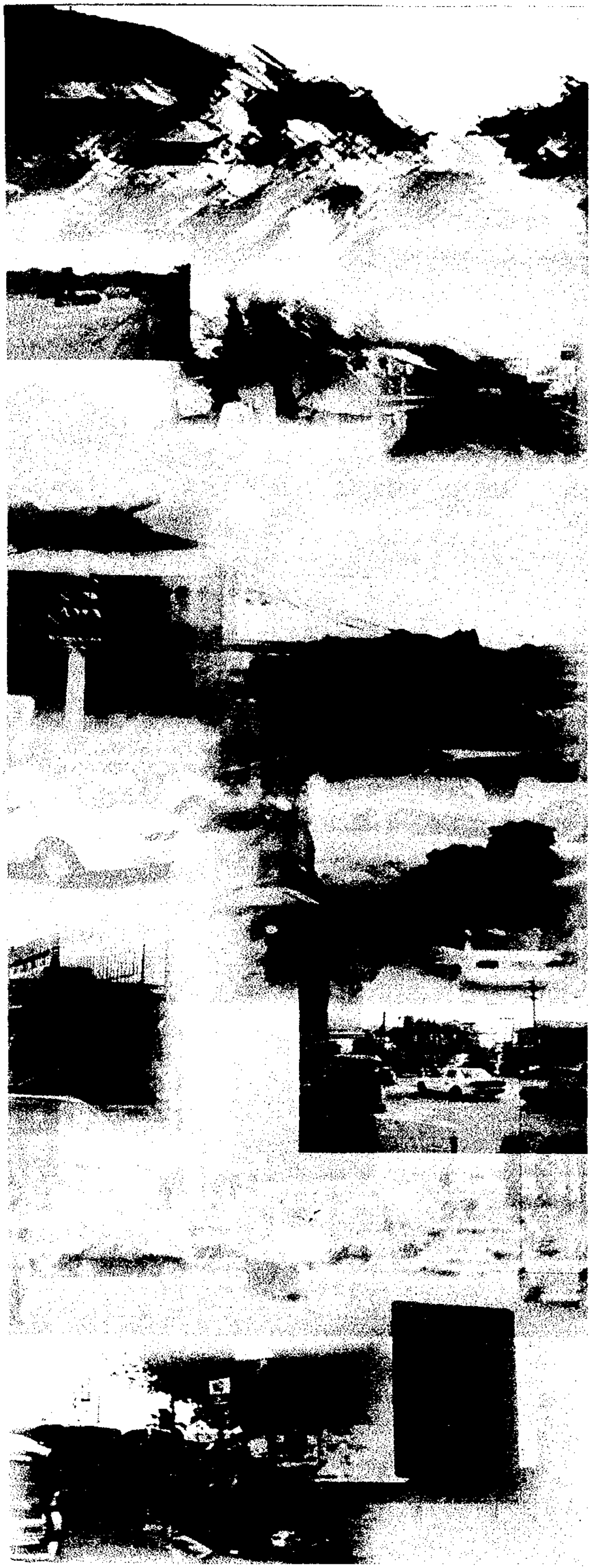
SSTRIMM

The Study on the Formulation of
Small-Scale Traffic Improvement Measures for Metro Manila

Traffic Management Manual

for Local Government Units

November 2001



Japan International Cooperation Agency

Project Consultants:

transportas

University of the Philippines
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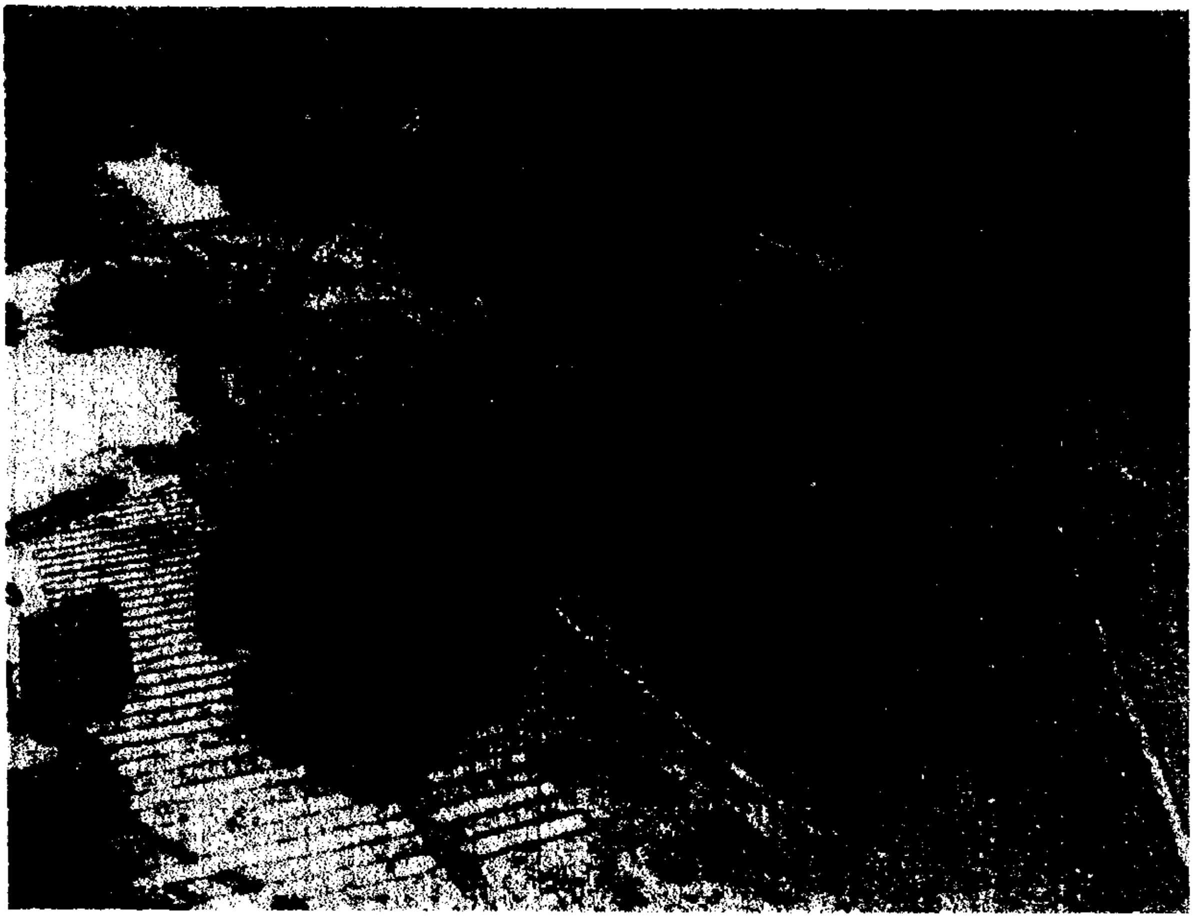
SSTRIMM
Traffic Management Manual



Introduction

Introduction

This manual is intended to help the 17 local governments comprising the Metropolitan Manila region in addressing their traffic problems. It describes the procedures to be followed and the tools to be used by Local Government Units towards increasing the efficiency of available road space. It assumes the perspective of personnel working at the LGU level in identifying congested roads and intersections, in assembling empirical data, in formulating solutions within the ambit of the powers of LGUs (rather than national agencies), in securing funding and broad support, and in carrying them out for the greater benefit of road users.

Rationale for Traffic Management

There are not enough roads to accommodate the growing volume of motor vehicles in urban areas. Funds for new roads and mass transit are simply inadequate; even if money is available, the city could not keep on converting land into roads. Greater reliance must therefore be placed on the following:

(a) improved urban public transport systems;
(b) more intensive management of travel demand; and
(c) traffic management techniques to increase the practical capacity of available road space.

This Manual focuses on the third aspect: *How to squeeze more capacity from existing roads.* Road capacity is interpreted in this Manual as people being carried through the streets per hour, rather than motor vehicles per se.

In 1991, Republic Act 7160, or the Local Government Code, was enacted. It gave local government units or LGUs a lot of autonomy, as well as responsibilities. Ensuring the accessibility to schools, to places of work and leisure, to markets, and to health and social points of interests are essential to their vitality. The Implementing Rules and Regulations of RA 7160 cover the delivery of basic services and facilities (Rule V), which

THE PREMISE IS THAT TRAFFIC CONGESTION MAY BE UNAVOIDABLE IN LARGE CITIES, BUT IT DOES NOT HAVE TO BE A FACT OF LIFE NOR CAUSE INTOLERABLE SUFFERINGS. IT CAN BE ALLEVIATED AND MADE MORE BEARABLE.

includes the construction and maintenance of infrastructure facilities funded by the LGU to serve the needs of the residents, in particular city/municipal roads and bridges, traffic signals and road signs, and other similar facilities (Rule V, Art. 25). The IRR also include the powers to open (or close) roads, alleys, parks or squares, whether temporarily or permanently (IRR Rule VIII, Articles 43, 44 and 45).

The premise is that traffic congestion may be unavoidable in large cities, but it does not have to be a fact of life nor cause intolerable sufferings. It can be alleviated and made more bearable.

Rationale of this Traffic Management Manual

The long-term master plan for the development of transportation system for the Greater Metropolitan Manila region was completed in 1999 with technical assistance from the Japan International Cooperation Agency (JICA). The undertaking was called MMUTIS – acronym for the "Metro Manila Urban Transportation Integration Study". Aware that local government units have to become active participants in the realization of the plan's objectives – principally reduced traffic congestion – the JICA launched in October 2000 a project dubbed Small-Scale Traffic Improvement Measures for Metro Manila (SSTRIMM).

SSTRIMM has four major components, viz.:

- Identification and preparation of doable traffic management measures at the local government level;
- Implementation of two or more demonstration or pilot small-scale traffic improvement measures;
- Development of local traffic management capabilities through seminars and workshops, and learning-by-doing exercises; and
- Enhancing and sustaining that capability through an easy-to-use traffic management manual, including appropriate management models and guides, for the targeted LGUs.

This **Local Traffic Management Manual** is the fourth component mentioned above. It is a practical reference guide for LGU officials and their staff in undertaking traffic improvement measures.

Limitations

It is impossible to cover all conceivable topics on traffic management in a folio like this, without this Manual becoming unwieldy. Users are encouraged to refer to other technical sources for deeper treatment of some topics, and to consider this volume as merely the first edition of an evolving Manual of local traffic management practices.

Definition of Terms

Brief definitions of a few terms frequently used in this Manual are given below. More Transportation and Traffic Terms can be found in Annex A.

Alley – A narrow lane between houses or buildings giving access to the rear of those houses or buildings.

Auxiliary Lane – The portion of the roadway adjoining the through traveled way for parking, speed change, turning, storage for turning, weaving, truck climbing or for other purposes supplementary to through traffic movement.

Average Daily Traffic – The average 24-hour volume, being the total volume during a stated period divided by the number of days in that period. Unless otherwise stated, the period is a year. The term is commonly abbreviated as ADT.

Average Overall Travel Speed – For all traffic, or component thereof, the summation of distances divided by the summation of overall travel times.

Average Running Speed – For all traffic, or component thereof, the summation of distances divided by the summation of running times.

Average Spot Speed – The arithmetic mean of the speeds of all traffic, or component thereof, at a specified point.

Bicycle – any two-wheeled vehicle designed to be propelled solely by human power.

Bicycle path or lane – a way established for the exclusive use of bicycle, including tricycles propelled by human power, but excluding push carts and animal drawn vehicles.

Built-up area - an area with streets normally characterized by relatively low speeds, wide ranges of traffic volumes, narrower lanes, frequent intersections and driveways, significant pedestrian traffic, and prevalence of businesses and houses; any area with entries and exits especially sign posted as such or defined in domestic legislation

Capacity – The maximum number of vehicles which has a reasonable expectation of passing over a given section of a lane or a roadway in one direction, or in both directions for a two-lane or a three-lane highway, during a given time period under prevailing roadway and traffic conditions.

Carriageway – the part of the road normally used by vehicular traffic.

Center – in relation to a thoroughfare, means a line or series of lines, marks or other indications placed at the middle of the thoroughfare or, in the absence of any such line, lines, marks, or other indications, the middle of the main traveled portion of the thoroughfare.

Channelized intersection – an intersection provided with islands meant to guide and limit vehicle movements.

Clearway – a length of carriageway generally defined by signs, along which vehicles may not stop or be left standing at times of the day as provided on the signs.

Control of Access – The condition where the right of owners or occupants of abutting land or other persons to access, light, air, or view in connection with a highway is fully or partially controlled by public authority.

Full control of access means that the authority to control access is exercised to give preference to through traffic by providing access connections with selected public roads only, by prohibiting crossings at grade or direct private driveway connections.

Partial control of access means that the authority to control access is exercised to give preference to through traffic to a degree that, in addition to access connections with selected public roads, there may be some crossings at grade and some private driveway connections.

Corridor – A strip of land between two termini within which traffic, topography, environment and other characteristics are evaluated for transportation purposes.

Crosswalk – A marked lane for passage of pedestrians, bicycles, etc., traffic across a road.

Cul-de-sac Street – A local street open at one end only and with special provision for turning around.

Curb Loading Zone – Roadway space adjacent to a curb and reserved for exclusive use of vehicles during loading or unloading of passengers or property.

Cycle – any vehicle which has at least two wheels and is propelled solely by the muscular energy of the persons on that vehicle, in particular by means of pedals or hand-cranks.

Cycle Time – The time required for one complete sequence of signal indications.

Dead-end Street – A local street open at one end only without special provision for turning around.

Deceleration Lane – a speed change lane used for decreasing speed, preparatory to stopping or exiting a fast lane.

Delay – The time lost while traffic is impeded by some element over which the driver has no control.

Fixed Delay – Delay caused by traffic controls.

Operational Delay – Delay caused by interference between components of traffic.

Design Capacity – The maximum number of vehicles that can pass over a lane or a roadway during one hour without operating conditions falling below a pre-selected design level.

Design Speed – A speed determined for design and correlation of the physical features of a highway that influence vehicle operation. It is the maximum safe speed that can be maintained over a specified section of highway when conditions are so favorable that the design features of the highway govern.

Design Volume – A volume determined for use in design, representing traffic expected to use the highway. Unless otherwise stated, it is an hourly volume.

Detectors – Mechanical or electronic devices that sense and signal the presence or passage of vehicular traffic at one or more points in the roadway.

Direction of traffic and appropriate to the direction of traffic – the right-hand side if, under domestic legislation, the driver of a vehicle must allow an oncoming vehicle to pass on his left; otherwise these expressions mean the left-hand side.

Directional Distribution – The directional split of traffic during the peak or design hour, commonly expressed as percent in the peak and off-peak flow directions.

Diverging – The dividing of a single stream of traffic into separate streams.

Divided road – a highway or road with separated carriageways for traffic traveling in opposite directions.

Drainage Easement – An easement for directing the flow of water.

Driver – any person who drives a motor vehicle or other vehicle (including a cycle), or who guides cattle, singly or in herds, or flocks or draught, pack or saddle animals on a road.

Driveway – A private road giving access from a public way to a building on abutting grounds.

Easement – A right to use or control the property of another for designated purposes.

Encroachment – Unauthorized use of highway right of way or easements as for signs, fences, buildings, etc.

Expressway – A divided arterial highway for through traffic with full or partial control of access and generally with grade separations at major intersections.

Flow – Movement of traffic.

Footway – that portion of road set aside for pedestrian use only.

Frontage Road – A local street or road auxiliary to and located on the side of an arterial highway for service to abutting property and adjacent areas and for control of access.

Frontage Street – A local street or road auxiliary to and located on the side of an arterial highway for service to abutting property and adjacent areas and for control of access.

Grade – The rate of ascent or descent of a roadway, expressed as a percent; the change in roadway elevation per unit of horizontal length.

Grade separation – A crossing of two highways, or a highway and a rail- road, at different levels.

Green Time – That period of any phase assigning right of way to that movement(s) of vehicular traffic.

Guardrails – Traffic barriers used to shield hazardous areas from errant vehicles.

Headway – The spatial distance or time interval between the front ends of vehicles moving along the same lane or track in the same direction.

Highway – any public thoroughfare, public boulevard, avenue, park alley and callejon, but shall not include roadway upon grounds owned by private persons, colleges, university or other similar institutions.

Horn – includes any or every device for signaling by sound.

Interchange – A system of interconnecting roadways in conjunction with one or more grade separations, providing for the movement of traffic between two or more roadways on different levels.

Interrupted – Non-continuous movement of traffic.

Intersection – any level crossroad, junction or fork, including open areas formed by such crossroad or fork; the place at which two or more roads cross.

Interval – A discrete portion of the signal cycle during which signal indications do not change.

Lane – A strip of roadway used for a single line of vehicles; one of the longitudinal strips from which the carriageway can be divided, whether or not defined by longitudinal road markings

Laned thoroughfare – means a thoroughfare divided into two or more marked lanes for vehicular traffic.

Level of Service – A qualitative rating of the effectiveness of a highway in serving traffic, measured in terms of operating conditions. Note: The Highway Capacity Manual identifies operating conditions ranging from "A" for best operation (low volume, high speed) to "E" for poor operations at possible capacity load.

Level-crossing – any level intersection between a road and a railway or tramway track with its own track formation.

LGU – an acronym for Local Government Units, either provincial, city or municipal government, empowered under RA 7160 to pursue traffic management plans and programs.

Local Road – A street or road primarily for access to residence, business or other abutting property.

Local Street – A street or road primarily for access to residence, business or other abutting property.

Major Street – An arterial highway with intersections at grade and direct access to abutting property, and on which geometric design and traffic control measures are used to expedite the safe movement of through traffic.

Marked cross-walk – means a portion of a thoroughfare between two parallel lines marked across the thoroughfare, intended for use of pedestrian.

Median – The portion of a divided highway separating the traveled ways for traffic in opposite directions.

Median Lane – A speed-change lane within the median to accommodate left-turning vehicles.

Merging – the converging of separate streams of traffic into a single stream.

Motorcycle – means any two-wheeled vehicle, with or without a side-car, which is equipped with a propelling engine. LGUs may also treat as motorcycles in their local ordinances three-wheeled vehicles whose unladen mass does not exceed 400 kg. The term "motor cycle" does not include mopeds, although LGUs may, provided they make a declaration to this effect treat mopeds as motorcycles.

Motor vehicle – any power-driven vehicle which is normally used for carrying persons or goods by road or for drawing on the road, vehicles used for the carriage of persons or goods. This term embraces trolley-buses, that is to say, vehicles connected to an electric conductor and not rail-borne. It does not cover vehicles, such as agricultural tractors, which are only incidentally used for carrying persons or goods by road or for drawing, on the road, vehicles used for the carriage of persons or goods; exceptions are roadrollers, trolley cars, street sweepers, sprinklers, lawn mowers, bulldozers, graders, fork-lifts, amphibian trucks, and cranes if not used on public highways and vehicles run only on rails or tracks, and tractors, trailers and traction engines of all kinds used exclusively for agricultural purposes

Motorway – a road specially designed and built for motor traffic, which does not serve properties bordering on it, and which:

(i) Is provided, except at special points or temporarily, with separate carriageways for the two directions of traffic, separated from each other either by a dividing strip not intended for traffic or, exceptionally, by other means;
(ii) Does not cross at level with any road, railway or tramway track, or footpath; and,
(iii)Is specially sign-posted as a motorway;

No parking area – means a portion of a thoroughfare between two consecutive "No Parking" signs and with arrows pointing generally towards each other or other appropriate signs.

One-Way Thoroughfare – means a thoroughfare on which vehicles are permitted to travel in one direction only, as indicated by appropriate signs or signals.

Overall Travel Speed – The speed over a specified section of highway, being the distance divided by overall travel time.

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

Overpass – A grade separation where the subject highway passes over an intersecting highway or railroad; also called Overcrossing.

Overtake – to pass or attempt to overtake or pass a slower-moving vehicle traveling in the same direction.

Park or Parking – The act of stopping and keeping a motor vehicle for a time on a public way.

Parked – a vehicle is said to be parked if it is stationary for the period during which the vehicle is not limited to the time needed to pick up or set down persons or goods.

Parking area – means a portion of the thoroughfare where parking is permitted as indicated by appropriate notices or parking signs.

Parking Lane – An auxiliary lane primarily for the parking of vehicles.

Passenger Car Equivalence – The representation of larger vehicles, such as trucks and buses, as equal to a quantity of passenger cars for use in Level of Service and capacity analyses. The magnitude of the equivalency is dependent upon vehicle size and weight, vehicle operating characteristics, vehicle speeds, and roadway characteristics such as gradient.

Passing – The length of highway required for a vehicle to execute a normal passing maneuver as related to design conditions and design speed.

Pedestrian – A person traveling on foot.

Pedestrian Path – A footway or track reserved for use by pedestrians or joggers.

Permissible maximum mass – the maximum mass of the laden vehicle declared permissible by the competent authority of the State in which the vehicle is registered.

Phase – Those right of way and clearance intervals in a cycle assigned to any independent movement(s) of vehicular traffic or pedestrians.

Pre-Timed Signal – Any type of traffic control device installed solely for the purpose of assigning right of way to emergency vehicles at locations where standard traffic control devices are unwarranted.

Profile Grade – The trace of a vertical plane intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the context.

Progressive Signal System – A series of traffic control signals timed and coordinated in such a way as to provide optimum movement of traffic through the system.

Right Turn on Red (RTOR) – A turning movement at an intersection which provides for movement of traffic during a fixed delay. Usually allowed and regulated by statute.

Right-of-Way – A general term denoting land, property, or interest therein, usually in a strip, acquired for or devoted to transportation purposes.

Road – A general term denoting a public way for purposes of vehicular travel, including the entire area within the right of way. (Recommended usage: in urban areas - highway or street; in rural areas - highway or road); entire surface of any street open to traffic.

Road marking – any traffic control device laid out or painted on the surface of the road or carriageway used to regulate traffic or to warn or guide road users, used either alone or in conjunction with other signs or signals to emphasize or clarify their meaning.

Roadside Control – The public regulation of the roadside to improve highway safety, expedite the free flow of traffic, safeguard present and future highway investment, conserve abutting property values, or preserve the attractiveness of the landscape.

Roadside Development – Those items necessary to the complete highway which provide for the preservation of landscape materials and features; the rehabilitation and protection against erosion of all areas disturbed by construction through seeding, sodding, mulching and the placing of other ground covers; such suitable planting and other improvements as may increase the effectiveness and enhance the appearance of the highway.

Roadway – (General) The portion of a highway, including shoulders, for vehicular use. A divided highway has two or more roadways. (In construction specifications) The portion of a highway within limits of construction.

Roundabout – an intersection where all traffic travels in one direction around a central or circular island.

Running Speed – The speed over a specified section of highway, being the distance divided by running time.

Running Time – The time the vehicle is in motion.

Separation line – a line marked on the pavement of a thoroughfare to separate traffic traveling in opposite directions.

Setback Line – A line outside the right of way, established by public authority or private restriction, on the highway side of which the erection of buildings or other permanent improvements is controlled.

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

Sidewalk – That portion of the roadway primarily constructed for the use of pedestrians.

Sight Distance – The length of highway visible to the driver.

Signal Change Interval – That portion of any phase warning the vehicular traffic or pedestrians of that movement(s) of the impending termination of the right of way for that movement.

Signal Head – An assembly containing one or more signal lenses which control a vehicular traffic or pedestrian movement.

Signal Indication – The illumination of traffic signal lens or of a combination of lenses at the same time.

Spacing – The distance between consecutive vehicles measured front to front; if expressed in time units, term used is Headway.

Speed – The rate of vehicular movement, generally expressed in miles per hour.

Speed-Change Lane – An auxiliary lane, including tapered areas, primarily for the acceleration or deceleration of vehicles entering or leaving the through traveled way.

Standing – a vehicle is said to be standing if it is stationary for the time needed to pick up or set down persons or to load or unload goods.

Stop line – a line marked across the thoroughfare near a traffic control signal, stop sign, children's crossing or intersection.

Stop or Stopping – The act of bringing a motor vehicle to a halt.

Stopping Distance – The length of highway required to safely stop a vehicle traveling at design speed.

Street – A general term denoting a public way for purposes of vehicular travel, including the entire area within the right of way.

Thirtieth Highest Hourly Volume – The hourly volume that is exceeded by 29 hourly volumes during a designated year. (Corresponding definitions apply to any other ordinal highest hourly volume, as tenth, twentieth, etc.)

Thoroughfare – means that portion of a road improved, designed or used for vehicular travel exclusive of the shoulder.

Through Street – Every highway or portion thereof on which vehicular traffic is given preferential right of way and at the entrances to which vehicular traffic from intersecting highways is required by law to yield right of way to vehicles on such through highway in obedience to either a stop sign or a yield sign, when such signs are erected.

Through Traveled Way – The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

Time Cycle – The time required for one complete sequence of signal indications.

Toll Road or Toll Tunnel – A highway or tunnel open to traffic only upon payment of a direct toll or fee.

Traffic Actuated Signal – A traffic control signal whose right of way interval selection and interval times are varied by the demands of vehicular traffic for those intervals or movements.

Traffic Control Device – A sign, signal, marking or other device placed on or adjacent to a street or highway by authority of a public body or official having jurisdiction to regulate, warn, or guide traffic.

Traffic Control Signal – Any device whether manually, electrically, or mechanically operated by which traffic is alternately directed to stop or permitted to proceed.

Traffic Island – a defined area within the roadway, usually at an intersection and set off above ground level, from which traffic is intended to be excluded and which is used for control of vehicular movements and as pedestrian refuge.

Traffic Lane – The portion of the traveled way for the movement of a single line of vehicles.

Traffic management authority – refers to the city's or municipality's organization or office designated and authorized to perform traffic engineering, planning, education, and/or enforcement activities.

Traffic Markings – 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 the objects within or adjacent to the roadway, officially placed for the purpose of regulating, warning, or guiding traffic.

Traffic Operation Plan – A program of action designed to improve the utilization of a highway, a street, or highway and street network, through the application of the principles of traffic engineering.

Traffic Sign -- A device mounted on a fixed or portable support whereby a specific message is conveyed by means of words or symbols, officially erected for the purpose of regulating, warning, or guiding traffic.

Traffic Signal – A power-operated traffic control device by which traffic is regulated, warned, or alternately directed to take specific actions.

Trailer – a vehicle not otherwise self-propelled, includes caravan but excludes the rear portion of an articulated vehicle;

Transportation Plan – A program of ac ion to provide effectively for present and future demands for movement of people and goods. This program must necessarily include consideration of the various modes of travel.

Traveled Way – The portion of the roadway for the movement of vehicles, exclusive of shoulders.

Two-way Thoroughfare - means any thoroughfare where traffic is permitted in opposite directions.

Underpass – A grade separation where the subject highway passes under an intersecting highway or railroad; also called Undercrossing.

Uninterrupted - Continuous movement of traffic.

U-turn – means a movement which causes a vehicle facing or traveling in one direction to face or travel in the opposite, or substantially the opposite direction.

Vehicle – means any conveyance or other device propelled or drawn by any means and includes an articulated vehicle and a bicycle and, where the context permits, includes an animal driven or ridden, but does not include a train.

Vehicle – is said to be:

(i) Standing" if it is stationary for the time needed to pick up or set down persons or to load or unload goods; and

(ii) Parked" if it is stationary for any reason other than the need to avoid interference with another road-user or collision with an obstruction or to comply with traffic regulations, and if the period during which the vehicle is stationary is not limited to the time needed to pick up or set down persons or goods; it shall be open to the LGU concerned to regard as "standing" any vehicle which is stationary for a period not exceeding that fixed by local legislation, and to regard as "parked" any vehicle which is stationary for a period exceeding that fixed by local legislation;

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

Waiting – means a vehicle permitted to remain stationary with the motor running.

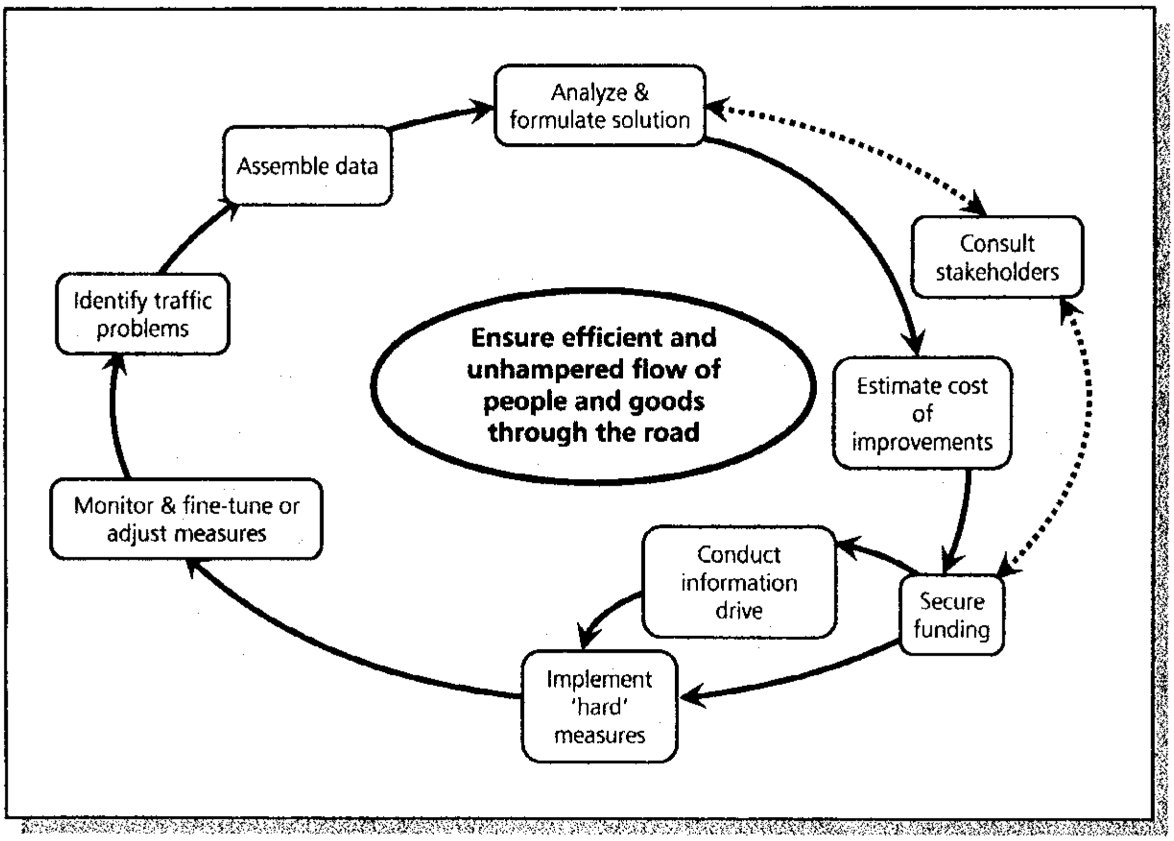
Weaving – The crossing of traffic streams moving in the same general direction accomplished by merging and diverging.

Zoning – The division of an area into districts and the public regulation of the character and intensity of use of the land and improvements thereon.

Overview of the Traffic Management Process

Figure 1 illustrates the traffic management process based on the "3T" philosophy: Think before (and after) you Tinker with Traffic.

Figure 1 **Basic Traffic Management Processes**



A **process** is an ordered group of related tasks and activities performed sequentially and repetitively to accomplish a purpose. In traffic management, the purpose is **to ensure efficient and unhampered flow of people and goods through the road network.**

The tasks to be performed are discussed in this Manual in five parts, as follows:

- Part I - Problem Identification and Data Gathering
- Part II - Analysis and Formulation of Solutions (Core of Traffic Engineering)
- Part III - Pre-Implementation Routines
- Part IV - Execution and Monitoring
- Part V - Special Cases

History of Traffic Management Measures in Metro Manila

In order to gain an appreciation of traffic management schemes in Metro Manila, this portion of the Introduction of this Traffic Management Manual presents a history of such measures, as culled from the Metro Manila Urban Transportation Integration Study (MMUTIS) Technical Report on Traffic Management.

Bus Waiting Shed

Enhancing the attractiveness of public transportation is one of the traffic management measures aimed at reducing the number of private vehicles. But passenger conversion from private vehicles to public transport is hardly practiced in Metro Manila. For example, under the TEAM projects, bus waiting sheds were built only for the convenience of bus and jeepney commuters. Rehabilitation of damaged bus waiting sheds is now being planned by the Metro Manila Development Authority (MMDA).

Yellow Box

In the early 1980s, Metro Manila introduced a yellow box pavement marking at crucial intersections. A yellow box is a yellow pavement marking in the shape of a box featuring diagonal lines and which are applied inside intersections. The markings indicate that a vehicle should not enter an intersection when the exit is not yet clear. It is intended to prevent blocking of intersections and thus avoid the congestion which results from random crossing practices. Intersection blocking is commonly done at many intersections in Metro Manila. The practice worsens the already severe traffic situation. Enforced properly, the yellow box scheme often proved effective in lessening perennial congestion. However, even though many intersections feature the yellow box markings, drivers often ignore them. Enforcement lacked legal basis. Because of this, traffic enforcers seldom enforced it and the scheme has fallen into disregard.

Pedestrian Barriers

To prevent pedestrians from crossing streets haphazardly, pedestrian barriers were built on medians of major thoroughfares like EDSA, Taft Avenue, España, etc. Pedestrian barriers have also been erected on the edge of sidewalks in some intersections or in some road sections to prevent pedestrians from spilling onto the road to wait for buses or jeepneys at inappropriate locations. Pedestrian barriers have proven effective in preventing pedestrians from making unwarranted road crossings.

One-way System

The one-way system has shown effectiveness in improving traffic flow. The system made signal coordination easier and reduced conflicting movements in intersections. But successful implementation depended on certain factors. For example, it at least needed two contiguous streets to be effective. In Metro Manila, the one-way system has been adopted at many locations since the 1970s. Early implementation included Mabini Street and Del Pilar Street in the City of Manila. In 1986, the one-way system was introduced in Makati, a premiere business and residential district. Some one-way systems, however, were not well planned and failed to rationalize congestion. The one-way system introduced at the Domestic Road, in Pasay City, and at Quirino Avenue, in Parañaque, are examples of poor planning. An off-again, on-again style of implementation created confusion among motorists and traffic enforcers alike.

Pedestrian Overpass / Underpass

Pedestrian overpasses were built in the past two decades in Metro Manila. In TEAM Phase III, additional overpasses were constructed across major streets like EDSA. To shepherd pedestrians and encourage the use of an overpass, pedestrian barriers were also built along the medians leading to an overpass. The large pedestrian volume necessitated the construction of these structures. Also, crossing by pedestrians in intersections takes more time than vehicle crossing. Pedestrian crossing limited the flexibility of the signal timing adjustment. Under standard signal phasing, movement of turning vehicles conflicts with the pedestrian flow, thus increasing accidents involving pedestrians. Pedestrian overpasses physically separates the movement of pedestrians from the vehicle flow and removes these problems. But overpasses can sometimes be an inconvenience to pedestrians, particularly to the handicapped and elderly. In terms of traffic management, a pedestrian underpass has the same benefit as that of a pedestrian overpass. The construction and maintenance cost of a pedestrian underpass is, however, higher than that of an overpass. A pedestrian underpass with escalators was introduced in Makati City in 1996. Another two similar underpasses are being constructed along Ayala Avenue, Makati's primary thoroughfare.

Bus Stop Separator

To restrict unwarranted overtaking by buses of other buses at bus stops using inner lanes, bus stop separators, with a length of about 60 to 100 meters, were constructed between the bus lane and the lanes for general traffic at most of the bus stops along EDSA. Buses were required to stay within the outer two lanes and to follow the buses ahead of them. Although the intention was understandable, the bus stop separator did not work as intended. Some buses still stayed outside the bus lane especially those avoiding delay. Some buses even use the separators to load and unload passengers. In a way, the separators also posed a hazard to other traffic because it was not highly marked and visible. Because of these shortcomings, bus separators were eventually removed.

Traffic Efficiency Zone

Tried in the mid-1970s when the Metro Manila Commission was just created, the TEZ involved closure of many cross roads and prohibition of left turning movements along primary roads declared as efficiency zones. The object was to achieve free-flowing and unhampered flow along the major thoroughfares like an expressway. The experiment was a failure, in that it overlooked origin-destination of trips or desire lines, and caused horrendous traffic jams at the termini of the TEZs.

Pook Batayan

Pook Batayan (or place of discipline) was a joint project participated by government agencies, private companies and non-governmental organizations. In this scheme, traffic enforcers and traffic volunteers, from the participating organizations, formed traffic watches at critical intersections. Normally, private companies were assigned an intersection near their office. These companies donated funds to help purchase and install traffic signs, guide signs, and pavement markings. Watch huts, where team members conducted enforcement and provided guidance to motorists, were constructed. To some extent, the project was effective in cultivating discipline among drivers. However, the project gradually died due to a lack of effort to sustain it.

EDSA Bus Lanes

In 1990, a bus lane system was introduced along EDSA. Two outside lanes of the six-lane avenue were designated as bus lanes on weekdays. A yellow lane line marking was applied between the bus lanes and the other lanes. Initially, the bus lane was enforced during the morning and afternoon peak hours. It was later extended to whole days except for Saturdays, Sundays and Holidays. A minimal information campaign however restricted drivers and traffic enforcers from fully understanding the objectives of the program. Some thought that the bus lane was intended to confine buses within the bus lanes and that they should not take the inner lanes. The rules for right-turning vehicles were also not clearly defined. But the scheme helped streamline and improve bus operation. The scheme is still in effect although minor changes were instituted. Enforcement however has become lax. Today, because the number of buses plying EDSA is so large, two outer lanes are always occupied by buses. These lanes have become de facto bus lanes although the ruling does not strictly say so.

Bicutan Traffic Discipline Project

In 1991, the Traffic Engineering Center (TEC) together with the Southern Police Command, the City Government of Parañaque, the association of jeepneys and bus companies, launched the Bicutan Traffic Discipline Project to ease the chaotic traffic condition at the Bicutan Interchange. The cause of the problem was analyzed, then a staffing schedule, a logistics program, and handouts were prepared. Personnel were assigned at specific points and instructed to do specific tasks such as instructing bus drivers not to load and unload passengers other than at bus stops, or warning pedestrians not to jaywalk. After implementation, the disorderly condition disappeared, resulting in lesser congestion. The project showed that traffic could be improved if discipline is observed. The project, however, was not sustained due to a lack of enthusiasm from the enforcers.

Toll Free Hours

In 1990, the Philippine National Construction Corporation (PNCC), a company managing the North and South superhighways, made the expressway toll free until 7:00 A.M. The measure was intended to disperse traffic volume and lower the peak hour demand. To some extent, the move eased the traffic congestion during peak hours. But the project was terminated for unknown reasons.

Reversible Lanes

The reversible lane scheme has been tried and implemented at various thoroughfares (e.g. EDSA, the South Superhighway, Commonwealth Avenue, etc.) where traffic demand tended to be unbalanced during certain hours and one lane in the opposite direction is used to relieve the flow in the road with higher demand. Effects of the reversible lane scheme varied per location. It worked well for the South Expressway. For EDSA, the reversible lane was not so effective as its capacity was often restricted by constant bottlenecks. The queue length on the congested side became shorter because of the additional lanes but travel time remained the same. It should be noted that at certain locations, drivers, without being told to, automatically adopt the reversible lane scheme when congestion happens.

Signal Battery Back-up System

During the power outages in 1992, the Traffic Engineering Center (TEC), with financial help from the French government, installed a set of batteries and a charger at 90 signalized intersections to supply power to the signal system during brownouts. However, the system only provided power for a maximum of two hours. Its capacity was not large enough when an outage lasted longer. To improve its limitations, another scheme was used to provide continuous back-up power during long brownouts. This was done by connecting a traffic signal to a nearby building with power generator. When a brownout occurred the signal was switched to the building's generator manually.

Restrictions on Provincial Buses

In 1992, the City of Manila banned provincial buses plying between Metro Manila and the provinces from using its streets. The move inconvenienced bus passengers coming or going to the provinces as they were forced to alight at points outside of Manila and take another ride into the city. The ban was later lifted because of the disadvantages it created for provincial commuters.

Bus Stop Segregation Scheme

The bus stop segregation scheme was intended to organize loading and unloading at bus stops. Buses plying along EDSA were divided into two groups based on their destination. Bus stops were delineated at different locations for each group with markings and signs indicating the group number. Buses were required to stop and load/unload passengers only at their designated bus stop. This scheme was aimed at enhancing the convenience of public transportation. No evaluative study was conducted to determine effectiveness of the project. The scheme is believe to be still in effect but documentation of driver compliance has not been determined. In November 1977, the bus stop segregation scheme was modified into the Modified Bus Segregation Scheme. The modification divided the buses into three groups. Each group was given a maximum of 10 allowable stops in pre-designated areas. Groups were identified by stickers color-coded in tangerine, yellow, gold and green. Bus stops were also provided with signs indicating which color group should load and unload at specific points. Bus rides were expected to move considerably faster as the buses were allowed no more than 10 stops along the whole length of EDSA.

Tulong Daan 2000

A joint undertaking participated in by the Quezon City government, the TEC, the DOTC Action Center, LTFRB/LTO, PNP Central Police District Command, MOTOR (a non-governmental organization), and the Rotary Club of Neopolitan Fairview. Its objectives were to implement traffic improvement measures (e.g. reversible lane, etc), instill discipline among road users, and to train local traffic management units in traffic management planning and implementation.

Truck Ban and Truck Routes

A truck ban during peak hours and designated truck routes were implemented since the 1980s to help decongest roads and prevent the intrusion of trucks into narrow streets. In 1994, a revised truck ban was adopted by the Metropolitan Manila Authority pursuant to MMA Ordinance No. 5. The new rules prohibited trucks from using EDSA from 6:00 A.M. to 9:00 P.M. between Pasong Tamo and Balintawak. The Ordinance also enforced new truck ban hours (6:00 A.M. to 9:00 A.M. and 5:00 P.M. to 9:00 P.M. for other truck routes.) But the restrictions posed a problem since EDSA and the truck routes where the only major links connecting Manila's domestic and international freight and container port with the factories located in the northern, eastern, and southern suburbs of the metropolitan area. Limiting cargo traffic between the two points risked hampering a crucial economic activity.

Odd/Even Number Scheme

In December 1995, an odd/even traffic scheme was implemented along the major thoroughfares in Metro Manila like EDSA, Buendia Avenue, España Avenue, R. Magsaysay Boulevard, etc. Vehicles with plate numbers ending in an even number were banned from 7:00 to 9:00 in the morning and 17:00 to 19:00 in the afternoon on Mondays, Wednesdays and Fridays. Those with plate numbers ending in an odd number were restricted for the same period on Tuesdays, Thursdays, and Saturdays. The measure however exempted carpoolers. Cars with three or more passengers, including the driver, were free from the restriction. The scheme should have helped reduce volume and congestion. Although a survey was conducted by the Transport Planning Service of the DOTC, no official report has been published. The effects of the measure is yet to be quantitatively evaluated.

Unified Vehicular Volume Reduction Program (UVVRRP / Color Coding System)

The odd/even scheme was modified into the color coding system in June 1996. For one day every week, all motor vehicles (excluding large trucks, emergency vehicles and other exempted vehicles) were banned from all Metro Manila thoroughfares from 7 A.M. to 7 P.M. This was based on the last digit of the license plate number. Vehicles with plate numbers ending in 1 and 2 were barred during Mondays. Those with plate number ending in 3 and 4 on Tuesdays, and those with 5 and 6 on Wednesdays, and so forth. During weekends and holidays the restriction was lifted. Government vehicles, ambulances, fire trucks, school buses, vehicles carrying perishable goods, etc. were exempted. Buses, jeepneys and taxis were initially included. The trucks were controlled by the truck routing scheme and the truck ban. By December 1, 1996, buses, jeepneys and taxis were exempted from the scheme to help alleviate increasing passenger demand.

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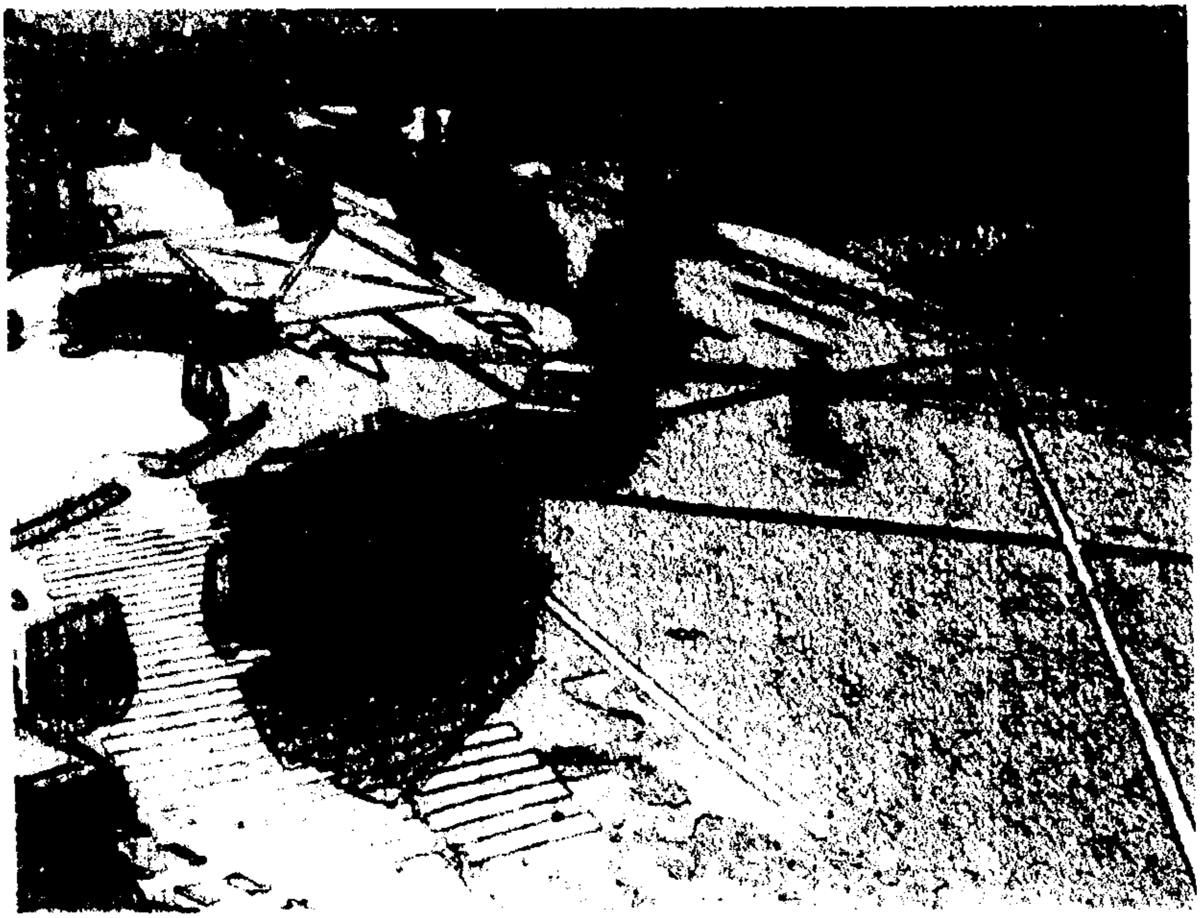


Part I

Problem Identification and Data Gathering

Part I

Problem Identification and Data Gathering

1.1 Getting Started

The first step in any undertaking is to identify the problem. Ask any motorist or traffic cop on the beat, and he will probably tell you his favorite 'pet peeve' or hellish traffic bottleneck point or traffic chokepoint. However, if you ask several persons, you could end up with different areas.

This section of the Manual offers some guidelines on a more systematic method of identifying the 'chokepoint' requiring priority attention from local traffic authorities. Then, the Manual suggests the kind of data required and how to gather them in order to characterize the problem into a format amenable for solution.

1.2 Defining the Traffic Problem

1.2.1 What is a chokepoint?

A choke point can be an intersection, or a section of a busy road, or a block bounded by several roads. It is usually a segment of the busiest streets in the urban areas of the city – where the most number of vehicles pass each day – and where travel delays are longest.

A traffic bottleneck, simply defined, is a point in the traffic stream wherein more vehicles enter the upstream flow of a road section that can get out of the downstream end. An example of this is when a three-lane road narrows down to two lanes.

There are, however, other factors that may cause "bottleneck" conditions. In order to identify these locations, some indicators are frequently used that would signal traffic congestion problems.

What constitutes a traffic bottleneck point? One that satisfies many of the following criteria:

- Heavy volumes of motor vehicles and/or pedestrians;
- Slow-moving traffic, bumper-to-bumper conditions that recur throughout the day;
- Often requires intervention of traffic enforcers to avoid or unblock gridlocks;
- Cause of many complaints from motorists and pedestrians;
- Site of many vehicular accidents, or nightmarish traffic jams;
- Congestion or delays in that point often cascades (in a chain-reaction) to other streets;
- Too many conflicts (e.g., left turns, U-turns, right turns, etc.) in traffic flows;
- An area of recurring headaches, if not exasperation, to local traffic authorities.

Of course, if the local traffic management authority has a system of data collections and traffic surveys, many of the above criteria can be quantified and the problem area identified in a more objective (less subjective) manner.

1.2.2 Indicators of Traffic Bottlenecks

There are two general categories of indicators of traffic bottlenecks: those measurable and those describable. The indicators can either be observable causes of traffic congestion, or effects of such causes that characterize the bottleneck. These indicators do not necessarily differentiate among bottlenecks at signalized intersections, unsignalized intersections, or mid-sections.

Measurable Indicators

Measurable indicators of traffic bottlenecks or traffic congestion problems include the following:

- Queue length
- Intersection throughput
- Travel speed
- Travel time
- Delay time
- Volume – capacity ratio (VCR)
- Signal cycle time (for signalized intersections)
- Number of traffic accidents
- etc.

Queue Length. This is the most visible and measurable indicator of traffic congestion, or a traffic bottleneck. Road sections have inherent carrying capacities usually expressed in terms of the number of vehicles (or passenger car units / PCUs) per lane of road for a given period of time, usually per hour. Once this road capacity is exceeded by the traffic demand, a vehicle queue will start to form. The length of queue will depend on the free flow density of the road, and the congested flow density.

Intersection Throughput. Road capacity values are usually given for stretches of road sections. Once the subject road meets with another at an at-grade intersection, their traffic capacities will be reduced as vehicles on one road will need to share the same space with those of the intersecting road. The capacity of each road is thus limited by the intersection capacity. The throughput of an intersection is an indicator of its effectiveness. The measures usually used are "level of service" indicators, average vehicle delay, volume to capacity ratio, etc.

Travel Speed / Travel Time / Delay Time. These can also be measurable indicators of congestion. The lower the travel speed, the longer the travel time, which may be attributable to delay time.

Volume to Capacity Ratio (VCR). VCR is the ratio of the traffic demand volume, usually expressed in equivalent passenger car units (PCUs) and the roadway capacity, similarly expressed. A VCR of 1.0 would thus indicate that the roadway is operating at rated capacity. In order for an intersection to operate without congestion, VCR should normally be lower than 0.9.

Signal Cycle Time. For signalized intersections, the length of the signal cycle time may indicate problem areas. Very long (more than 240 seconds) cycle times would be annoying to most motorists, whereas very short cycle times (less than 40 seconds) would render a very low intersection capacity.

Number of Traffic Accidents. If traffic accident records are kept by the LGU, the number of incidences may indicate traffic problems that should be looked into in more detail.

It should be noted that there are other measurable indicators of traffic bottlenecks that may be added to those in this list. One drawback of the aforementioned indicators is that one needs to gather enough relevant information for each potential bottleneck site in order to quantify the magnitude of the congestion problem. This should be workable if there are unlimited resources in addressing the data requirements.

Describable / Observable Indicators

With the limited time allowed in identifying suitable problem locations that can be analyzed and the general lack of available information on measurable indicators, other describable indicators are listed. These indicators, as mentioned previously, may not necessarily be the effects of the congestion problem, but can be causes as well. They may not necessarily determine the magnitude of the traffic congestion problem, but may highlight potential problem areas.

Among the observable indicators are:

- Presence of vehicle queue (not necessarily measured in length)
- Blocked or grid-locked intersections
- Low intersection throughputs
- Presence of risky or dangerous maneuvers, such as vehicles driving on lanes for opposing traffic (unauthorized counterflow), near vehicle collisions, or near vehicle vs. pedestrian accidents.
- Chaotic pedestrian flows
- Unsafe pedestrian crossings
- Commuters spilling over on road pavement
- Uncontrolled roadside parking
- Frequent blowing of horns (may indicate long delays, or unruly driver behavior)
- Presence of makeshift traffic control devices, such as signs, humps, barriers (indicating a need for formal installation of such devices)

This set of indicators may assist the LGUs in locating areas with potential traffic congestion problems. The areas with such indicators may not necessarily be congested, but these are signals to potential traffic problems.

1.3 Documenting the Problem

An initial step in problem identification is to prepare a site inventory to document the problem. A simple documentation process can be as follows:

On a clean bond paper and with a sketch map (using as many sheets as necessary) describe the physical aspects of each choke point. To the extent possible, provide the following information:

a. Name and width of the road, in meters, or number of lanes (if an intersection, include all the roads);
b. Pavement type and condition (poor/good, concrete/asphalt);
c. Location and dimensions of median, island, or separator if any;
d. Sidewalk conditions, and presence of road-side frictions like street vendors;
e. Presence of hump, potholes, obstacles;
f. Presence (or absence) of such traffic control devices as traffic signals, pavement marking, delineator, traffic sign, pedestrian barrier, pedestrian overpass, etc.
g. Presence of bus / jeepney / tricycle / pedicab terminals (on-street / off-street) or loading / unloading areas;
h. Estimated volume of vehicles and pedestrians, if readily available at site.
i. Traffic regulations (one-way, turn prohibitions), etc.

It is also acceptable to explain, in concise and simple terms, what is causing the bottleneck. Does it occur during the whole day or only during morning and evening peak hours?

An example of a bottleneck point and how it was described is shown in Figure 1.3-1.

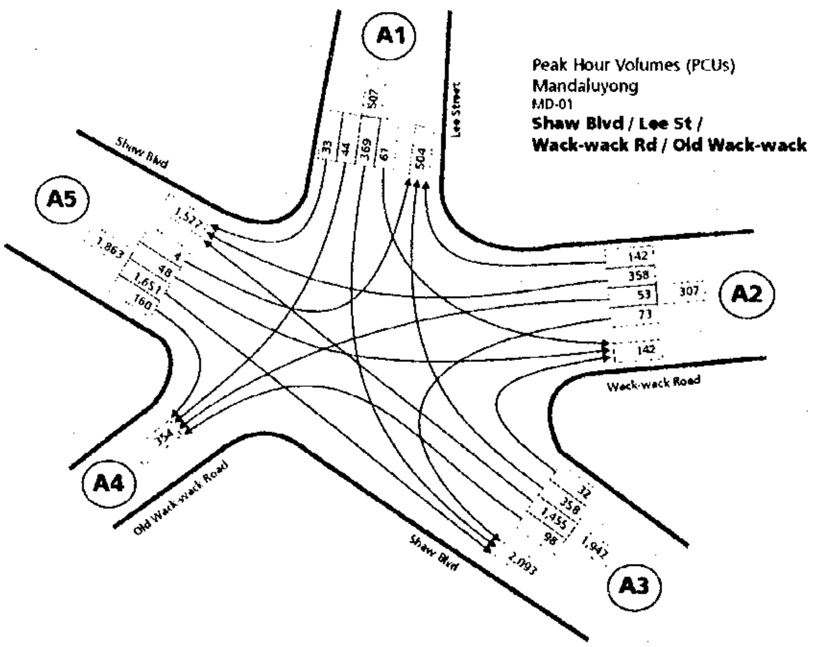
Figure 1.3-1 **An Example of a Concise Description of a Traffic Problem**

Name	**Shaw Blvd / Lee Rd / Wack-Wack Rd / Old Wack-Wack Rd**	Code	**MD-01**
Sheet	**Summary of Observations**	LGU	**Mandaluyong**

Traffic Conditions	1) Five-leg intersection with almost all turning movements allowed present numerous traffic conflicts. 2) Heavy vehicles parked along Lee St due to ongoing construction activities. 3) Lee St being utilized as an alternative route by vehicles coming from San Juan and Kalentong; 4) Vehicles turning left from Shaw (EDSA side) into Old Wack-wack Road occupy the exit lane of the northbound approach
Physical Conditions	1) A multi-leg unsignalized intersection with five intersecting roads accommodating traffic movements from all directions is what characterized this bottleneck point located in Mandaluyong City. 2) The main road, Shaw Blvd. could accommodate five lanes; whereas, the other intersecting roads have only two lanes each with width varying from 6.15 meters to 7.52 meters. 3) Shaw Blvd. is presently asphalt paved in good condition and the pavement edges have curb and gutter. The other roads are paved with concrete in good condition. 4) The physical condition of the existing intersection is adequate in terms of geometric standards as all of the pavement corners have adequate turning radius. 5) The existing pavement surface is smooth which provides unrestricted vehicle movement. 6) While the geometric conditions of the existing intersection meet standards, still the area is continuously being subjected to heavy congestion due to uncontrolled traffic movements.

Signalization	None	**Pavement Markings**	With markings	**Peak**	17:00-18:00

Approach	**Dimensions**	**Peak Hour Traffic Volumes (PCUs)**				**% Public Transport**	**Pedestrian Volume**
		Left	**Through**	**Right**	**Total**		
Lee	6 m	430	44	33	**507**	**11.09%**	Light
Wack-Wack	10 m	73	53	182	**307**	**26.91%**	Light
East	15 m	390	1455	98	**1942**	**34.51%**	Light
South	7 m	NA	NA	NA	**NA**		
West	15.5 m	52	1651	160	**1863**	**16.40%**	Light
Total		945	3203	473	4619		
	Passenger Flows				21,000		



1.4 Planning for Traffic Studies

Successful traffic improvements are based on reliable facts. Field data are needed in order to ascertain actual traffic conditions, to determine trends for future work and to assess the effectiveness of solutions.

Planning for studies to collect facts requires the designing of individual field surveys to measure specific traffic parameters. The methods for the collection of these data must be consistent and clearly defined, inasmuch as the collected traffic data need to be comparable to previous and existing data.

Whether to conduct a field study, and the choice of a particular study method is dependent on the nature of the problem and the analysis that is planned. Field studies can be expensive and should not be conducted without considering the alternatives.

1.4.1 Preparing the Field Sheets

In preparing the appropriate field forms, basic data should be included to allow for cross referencing and to document factors that could possibly affect the data collection. Summarized data must be traceable to field sheets to allow cross checking for errors or lifting of additional data not earlier considered in making the summaries.

The "base" information required on all field sheets and summary sheets are as follows:

- **Index Number** -- This is a reference code identifying the field sheet. For small scale studies, a simple numbering system can be employed but for large scale studies a numbering method must be devised.

- **Station Code** – This is a reference code identifying the survey station location. In studies where several survey stations are included, the reference code provides a easy system of identification.

- **Station Name** – This refers to the exact place or area where the survey was done.

- **Station Location/Direction** – This briefly defines the location of the exact place or area where the survey was done. As much as possible a map of the area must accompany the field sheet showing graphically what was being measured and where the observers were stationed with ground measurements taken at the time of the survey. The map may be scaled or may include information in abutting land-use, and condition at the time of the survey.

- **Time** – Specification of the year, month, date, day of the week, time of day (0 hrs. to 2400 hrs.), and the duration of the survey. This is important because some traffic data differ depending on when the measurements were taken.
- **Surveyor / Enumerator**– Reveals the identity of each person, post and responsibility. Oftentimes, it is necessary to interview the surveyors to clear up inconsistencies in the collected data.

- **Weather** – This entry indicates meteorological conditions during the survey. This affects traffic and must be noted down. Usually it would suffice to say Bright, Cloudy Bright, Rainy or Wet Road.

- **Checker** – This reveals the identity of the person responsible to check the correctness of the entries on the field sheet, usually done prior to data processing. Team Supervisors are normally assigned to undertake this task but it is also possible to have a separate team of personnel assigned in the office to cross-check the data entries. The checker is tasked to verify the completeness in the entry of preliminary data such as time, date, station location. Entries that need to be checked include: data identifying the survey code, station location, time, date, direction, labeling of headings in the data being collected, consistency in the data entry, errors in writing the entries, etc. When several sheets are used for a survey type, the checker makes sure that the sheets are arranged in its proper order.

- **Coder** – This is to be filled out by the person who is assigned to "Code" the survey field sheets during the processing of the collected data. Whenever necessary, survey data collected are transformed into a prepared coding system designed to provide ease in the processing of the data and in the preparation of the summaries of the results. This is to ensure uniformity and consistency in the system of data entry.

- **Encoder** – This space is to be filled out by the person assigned to encode the survey data using a computer software program.

- **File Name** – This identifies the electronic file associated with the field sheet.

- **Method** – This helps to define the data collected in terms of accuracy or relevance. Usually the name of a standard method is simply indicated, other times a brief description is needed. This is only necessary whenever several methods of collection can be employed which would all give results in a similar format.

- **Others** – Such factors, not stated above, that might have affected the collection of data, or which makes the area being studied different from other areas with the same physical characteristics. These may be occurrence of an accident during the survey, road defects, special occasions, road repair activities, parked or stalled vehicles, unusual conditions, etc. Particularly when temporary measures are in force, a description of the traffic control measure in force should be noted in the field sheet. Not noting a truck ban during a volume survey may lead the analyst to believe that the particular route carries no trucks when in fact it is being used heavily after truck ban hours. These conditions can also be reflected on the map accompanying the field sheet.

Typical survey forms are provided in Annex C of this Manual. They may be removed and reproduced for use.

Figure 1.4-1 **A Sample of Base Information Entries on Field Sheet**

transportas		**Traffic Volume Count** Tally Sheet

Station Code VL-01	Station Name KAKUHATAN-MAC ARTHUR	Checker
Survey Date 04 MARCH 2001	Location KALUHATAN	Encoder
Weather	Direction 1-2	
Recorder / Enumerator JENNIFER GIRAY	From (place) MONUMENTO (1)	Filename
Field Supervisor	To (place) KALUHATAN (2)	Sheet of

Time Period		Car	Jeepney	Taxi	FX	Bus	Light Cargo	2 Axel	345 Axel
From	To								
6:00	6:15	𝍸-I	𝍸-𝍸-𝍸-I	𝍸-III	𝍸-I	𝍸	III	II	III

Before each survey is done, it is necessary to make a pre-survey usually consisting of a field visit and ocular inspection of the area. These help in identifying the limits of the survey and possible modification in the collection procedure. After the pre-survey, a detailed survey plan is prepared.

A Survey Plan is prepared to facilitate execution of the survey. The method of collection is defined according to the requirements for data. The necessary logistical support for the proper conduct of the survey is identified while constraints such as manpower, materials, schedules, etc can also be clearly defined. The Survey Plan serves as program information for both pre- and post-survey analysis phase.

1.4.2 **Parts of a Survey Plan**

A suggested format for the Survey Plan is given as follows:

I. Name of Survey
II. Purpose

III. Expected Output
IV. Study Area (A detailed definition of the study area, accompanied by a map of the proper scale with the necessary ground measurements)
V. Team Organization
VI. Equipment
VII. Method (A detailed discussion of method or procedure of collecting the data. This may require preparation of specific instruction for each team member. The field sheets are included in this part of the plan.)
VIII. Schedule (A detailed schedule of activities which includes man-hour requirements; conveyance schedule; Fuel schedule, if any; logistics; projected expenses, etc.)
IX. Analysis (Describes how the collected data will be analyzed to arrive at output.)
X. Miscellany. (Any other important element not stated in previous items)

1.4.3 Preparing the Survey Materials

Survey materials will consist of the following supplies and equipment:

- Survey forms (spare forms should always be available)
- Clipboards
- Pencils and sharpeners
- Folders and plastic envelopes
- Traffic counters (for volume and intersection turning movement counts, as well as for passenger counts)
- Stop watches (for travel time / delay, queuing survey)
- "Roadrunner" or measuring wheel (for taking curb/roadway measurements)
- Flashlights with spare batteries and other lighting equipment deemed necessary
- Raincoats, reflectorized vests, other protective gear for survey personnel
- Copies of permits secured in relation to the activity
- etc.

The most important thing to be done prior to the study to avoid failure is to check the condition of the equipment to be used in data collection. It should be calibrated properly, and checked if they record, store and display data properly.

1.4.4 Pre-survey Activities

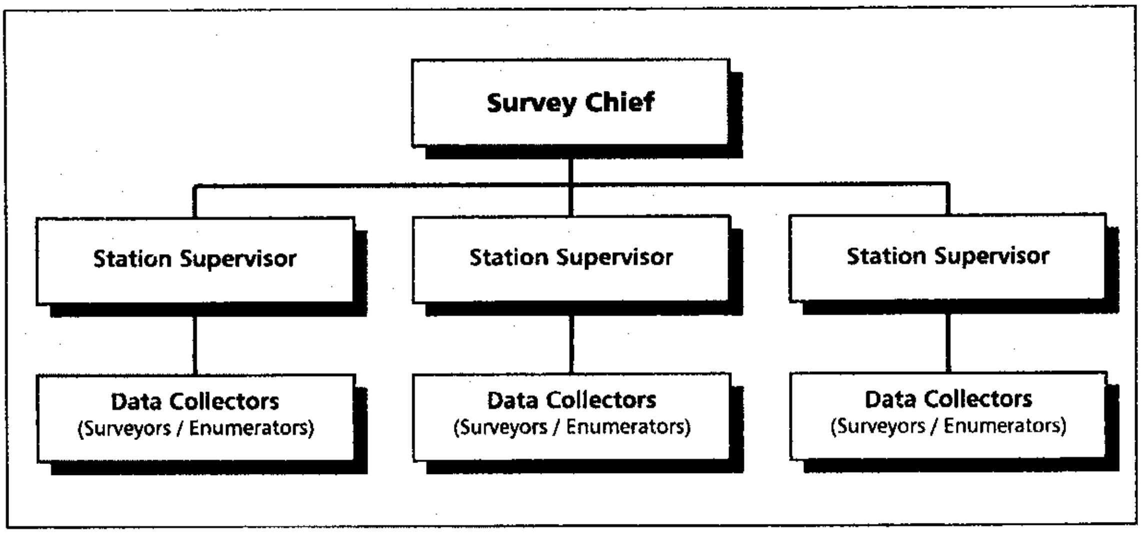
Coordination with the local barangay offices and individuals affected by the survey implementation

It would be best to coordinate with the barangay officials of the areas under study and with parties directly affected by any aspect of the planned survey activity. This would eliminate possible delays during the survey day brought about by having to secure permission to conduct the survey. They will also be able to inform the survey team of unusual occurrences not readily apparent and for survey periods extending up to late in the night, provide the necessary assistance for the smooth progress of the survey.

Survey Team Organization

Ideally, a typical survey team organization is composed of a Survey Chief, Station Supervisors, and Data Collectors.

The Supervising Engineer of the Local Government Unit (LGU) shall serve as the Survey Chief. The Survey Chief takes primary responsibility for the field work and is generally in-charge to oversee coordination work with the proper agencies prior to survey implementation. The Survey Chief is also assigned to inspect ongoing survey work at the respective stations and to facilitate smooth progress in the survey work. Station supervisors are assigned to man each station to overlook survey implementation and to act as relievers, field checkers, and coordinators whenever the need arises.



When data collection work is simple and involves a minimal number of people and with just one or two station locations, the Survey Chief can also act as the Station Supervisor.

The number of data collectors shall depend on the type of survey to be conducted. This will be further discussed in the succeeding sections covering the individual surveys.

Screening and Selection of Field Personnel

Some local government units (LGUs) maintain a pool of personnel (casuals and temporary personnel from the different offices of the LGU) whom are called upon, when required, for field work and surveys. These personnel may have the required experience and training for the fundamental surveys or even the specialized ones.

At times there may be a need to hire additional temporary personnel to undertake the field work. It is recommended that for the simple data collection activity, the temporary personnel to be hired be at least high school graduates, know how to follow instructions, have a basic understanding of the required activity and the ability to make sound decisions.

When more difficult surveys are to be implemented, the personnel to be hired should be at least college level. Although some activities may be very elementary in nature, decisions may have to be taken at the field when the person is confronted with an unusual occurrence.

Depending on the manpower requirements of the survey and the availability of funds, the Local Government Unit (LGU) may also opt to outsource the entire data collection activity and the analysis. Should this be the preferred option of the LGU, this Manual can still serve as a guide to the Supervising Traffic Engineer of the LGU in the monitoring and delivery of services by the contracted party.

Dry-run

A dry-run may not be necessary for field personnel who have experience conducting the study of interest, but it is essential for inexperienced personnel. The dry-run session is a means to test the survey instrument and the methodology to be used in data collection, to train the survey personnel in the proper conduct of the survey and to identify possible conflicts and issues that may require a change in the Survey Plan.

Fundamental surveys, like volume counts, speed, delay and inventory, normally do not require long hours of practice. The more specialized and comprehensive studies, such as person interviews, accident studies, and the like, may benefit more from extensive training of personnel and various testing of techniques prior to actual survey.

Before proceeding to the site, the survey personnel will be given a briefing on the purpose and nature of the activity. They should be made aware of possible emergencies or deviations from the survey plan, if any. They also should practice how to deal with questions that may be put their way by the public and even taught a short and standard response to satisfy most members of the public without distracting too long from the data collection task. A calm and professional approach and a referral to the supervising engineer are usually enough to diffuse even very suspicious inquiries.

A dry-run is typically held a day before or even several days before the schedule of the actual field survey as long as similar extreme conditions prevail as expected during the study. For instance, if the planned schedule of survey is a whole day, a dry run during the peak hours will be beneficial. The exercise shall require close supervision by the traffic engineer of the work being done by the enumerator to immediately identify errors or mistakes made by the enumerators.

It is suggested that the traffic engineer or the assigned supervisor carry out independently the data collection during a short period of the dry-run for purposes of comparison later to reveal obvious errors.

After the dry-run, an assessment of the effectiveness of the technique selected for data collection is made. Should extensive changes be necessary in the Survey Plan, it may be a good idea to schedule another dry-run to test those changes.

Responsibilities of the Supervising Engineer during the Conduct the Survey

On the day of the survey, there are three main responsibilities of the Supervising Engineer.

First, he/she must monitor the survey personnel to make sure that they are using agreed-upon procedures and not falsifying data. To ensure an honest effort by the survey personnel, it is sometimes good to make an unannounced inspection at the site or even the promise of one. Experience on the work, on the part of the Supervising Engineer, helps one to easily detect when falsification occurs.

Second, he/she must be at all times available for consultations on actions to be taken for unforeseen circumstances the may occur in the field. It is also recommended that a team leader be assigned to liaison with the Engineer, if and when conditions prevail that inhibit the Engineer from being physically present at the site for the duration of the survey.

Third, he/she must maintain a Survey Diary or assign a person to be responsible to take note of occurrences (such as traffic accident, parades, abrupt changes in weather conditions, etc.) that may in one way or another affect the data being collected.

The Survey Diary simply consists of a bunch of notes of time of day, type of occurrence, apparent impact on the data collection activity (if obvious enough), parties involved (if any), and other pertinent information that can aptly describe the situation.

Responsibilities of the Survey Personnel

The survey personnel must arrive at the site at least 15 minutes early in order to familiarize oneself of the area, assess conditions, get hold of equipment, record crucial "base" information required on the field sheet, assume positions, and begin at the scheduled time. The "base" information must appear on each form. It is advisable to record all the information as soon as possible and prior to start of survey rather than to wait until the end of the day to record information on a stack of forms.

It is also the individual responsibility of the survey personnel to maintain personal safety, the safety of the other members of the team and the safety of the traveling public.

1.4.5 Writing the Survey Report

It may be necessary to write a report once the survey has been completed and the data has been collected and summarized. The report will serve to make the data immediately useful or else make the use immediately apparent. The report should be as clear and as concise as possible. The report should state a description of the procedure actually used, more importantly when it involves a deviation from the Survey Plan.

In all aspects, the report should be truthful and reveal all possible constraints in the conduct of the survey. No attempt must be made to cover up errors so that proper judgment can be made as to the validity of data. It would also allow for immediate rescheduling of the survey should the need arise.

The format of a Survey Report should include the following:

I. Name of Survey
II. Purpose (State here the original intent as specified in the Survey Plan.)
III. Description of Survey Area (Location, time, weather, traffic control, condition, etc.)
IV. Output (Presentation of most important findings with inferences; summary.)
V. Method/Procedure of Data Collection (This should describe the actual procedure used and state how the actual survey differs from the plan. It should include events, or circumstances, which may have affected the collected data.)
VI. Analysis (Detailed discussion of the results and the procedure followed to arrive at the conclusions or inferences stated in the output. (Summarized Data).
VII. Appendices (Attached at this portion should be the raw data collected at the field and other relevant matters. If necessary, explanations should be included.)

1.5 Types of Traffic Surveys

The types of surveys to be conducted will depend on the nature of the traffic problem in the bottleneck area(s) identified. The surveys to be conducted will be from among the following types:

- Classified Intersection Turning Movement Counts
- Mid-block vehicle volume counts
- Passenger Occupancy Surveys
- Public Transport Terminal Dispatch Characteristics Surveys
- Travel Time / Delay Surveys
- Saturation Flow Surveys
- Passenger Boarding / Alighting Surveys
- Parking Surveys
- Pedestrian Counts
- Traffic Facilities Inventory
- Perception Interviews
- Social Surveys

1.5.1 Vehicle Volume Counts

Types

Vehicle volume counts can further be categorized into two: intersection turning movement counts, and mid-block counts. The main difference is essentially in the number movement directions being recorded. At a mid-block, only two directions will generally be recorded, and one if the street is one-way. A typical four-leg intersection with no turning restrictions will allow for 12 turning movements, excluding U-turns.

Methods

There are basically two methods of counting: mechanical using automatic recording equipment, and manual using tally method or traffic counters. Automatic recording has its greatest application where only a simple tabulation is needed of numbers of vehicles (so separation of vehicle type, direction, turning movements at intersection or driveway, lane use, etc.). Only under certain conditions can directional counts or lane use be obtained mechanically.

More commonly applied are manual methods of counting. Depending upon the degree of simultaneous flow and volumes and the number of vehicle classifications being taken, the number of personnel needed to conduct the survey will vary. At low-volume intersections, all movements including vehicle classification can be performed by one person. At higher volume intersections, it is necessary to have two or more persons counting the vehicular movements.

Vehicle Classifications

Vehicle volume counts can be classified using various vehicle classifications. For initial comparative purposes, vehicle classification can follow the DPWH-TEC classification system, however, a much more detailed breakdown of classifications should be considered depending on the specific problem in the area and type of analysis required. For example, where *trisikads* or pedicabs are prevalent or common in the area being surveyed, these should also be counted under a separate category.

The DPWH-TEC classification system uses only five (5) classifications, namely:

1) Car/Jeep
2) Jeepney
3) Bus
4) Truck
5) Others

A more detailed classification system was utilized by the Metro Manila Urban Transportation Integration Study (MMUTIS).[1] The MMUTIS Study undertook numerous traffic surveys to develop a comprehensive transport database for Metro Manila. The Study introduced a 15-vehicle classification system wherein private vehicles were distinctly categorized from public transport vehicles (i.e. jeepneys utilized for private use were classified under Utility Vehicle). The classifications were given as follows:

1. Pedicab	9. HOV[2] Taxi
2. Bicycle	10. Car / Jeep (owner-type)
3. Motorcycle	11. School / Company / Tourist Bus
4. Tricycle	12. Utility Vehicle
5. Jeepney (PUJ)	13. Truck
6. Standard Bus	14. Trailer
7. Minibus	15. Others[3]
8. Taxi	

Depending on the purpose of the count and the availability of resources to conduct the count, the vehicle classifications can be reduced to a minimum number but sufficient enough to provide the required data for the analysis of the problem or increased to provide for a more detailed analysis. When necessary, commercial vehicles can further be broken down by numbers of axles and/or weight. In summary, the degree of classification should be related to the purpose of the count.

[1] The MMUTIS Study Recommendations were recently adopted as the Transport Master Plan for Metro Manila.
[2] HOV = High Occupancy Vehicle. HOV taxi normally refers to shared taxis, also known as FX.
[3] "Others" may include construction equipment such as payloaders and graders, and animal-drawn vehicles.

For the SSTRIMM project, a total of eleven vehicle classifications were generally utilized. Where pedicab traffic was prevalent, a twelfth classification (trisikads / pedicabs) was used. Given the scope and requirements for the analysis, the vehicle classifications used were as follows:

1) Motorcycle
2) Tricycle
3) Car/Jeep/Van
4) Public Utility Jeepney
5) Taxi
6) HOV Taxi
7) Bus
8) Light Cargo
9) 2-Axle Truck
10) 3-Axle (or more) Truck
11) Others
12) *Trisikads/Pedicabs*

Figure 1.5-1 illustrates the typical vehicle types and their definitions.

Survey Personnel Requirements for a Manual Count

A typical team for an eight (8) hour shift for a single station is usually composed of two observers per direction of flow when vehicle classifications exceed five. An ocular inspection of the site and preliminary observation of the vehicle flow can facilitate decision making for survey personnel planning. For intersection counts, it is advisable to limit the number of classifications so as to minimize the number of required survey personnel. A technique also being employed in some surveys is to conduct turning movement directional counts (unclassified) at intersections and simultaneous classified volume counts at mid-block stations adjacent to the intersections.

Deployment of survey personnel is usually based on an 8-hour shifting of teams. A full day count of 24-hours would require three shifts. In practice, the first shift is from 6:00 to 14:00, second shift is from 14:00 to 22:00 and night shift (sometimes referred to the graveyard shift) is 22:00 to 6:00 the following day. For 16-hour counts, two shifts are necessary. When resources are limited, survey periods mostly cover only peak hours. The Supervising Engineer must have made initial observations of the traffic conditions in order to ascertain the appropriate survey periods for analysis.

To avoid fatigue and degraded performance, breaks of 10 to 15 minutes should be allowed per observer. The station supervisor also acts as a reliever and should be able to schedule the breaks such that all of the observers will each be accorded a chance to rest.

Figure 1.5-1 **Vehicle Types and Descriptions**

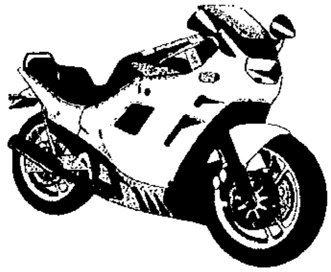
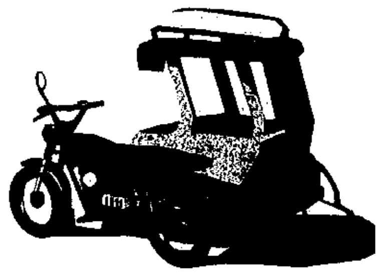
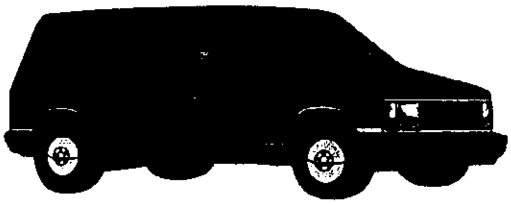
Motorcycles All two- or three-wheeled vehicles. Typical vehicles in this category have saddle type seats and are steered by handled bars rather than a wheel. This category includes motorcycles, motor scooters, mopeds, motor powered bicycles.	
Tricycle All motorcycles with sidecars, whether used for public transport or for private trips.	
Passenger Car All sedans, coupes, and station wagons manufactured primarily for the purpose of carrying passengers and including those passengers cars pulling recreational or other light trailers. Owner type jeeps are usually classified under passenger cars.	
Pick-up Vehicles with space provided in the rear for goods transport. Usually they are of the open type. Closed-type pick-ups used for private transport are usually classified as passenger cars as well.	
Van / Utility Vehicle Can also be classified as passenger car depending on the purpose of the survey.	

Figure 1.5-1 **Vehicle Types and Descriptions** (continued)

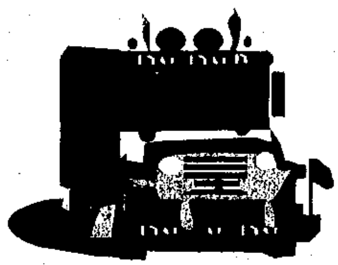
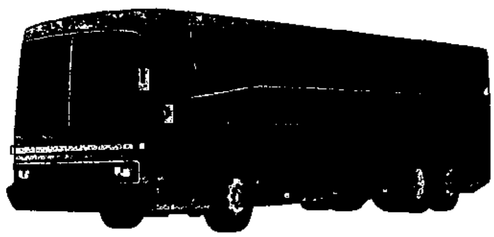
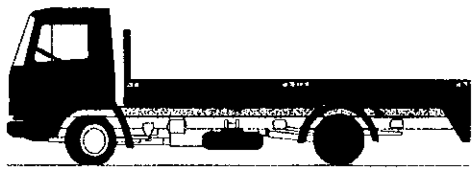
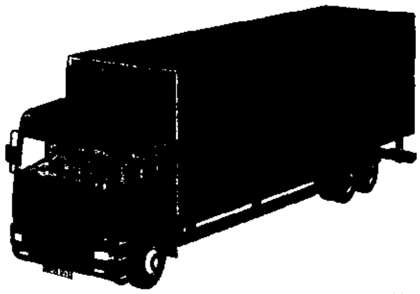
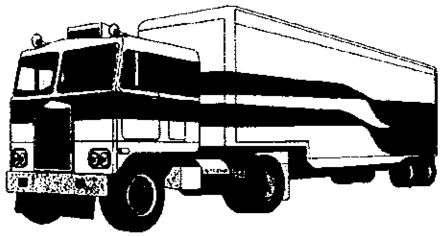
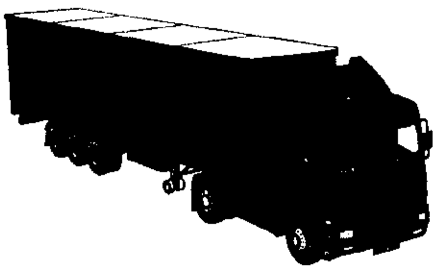
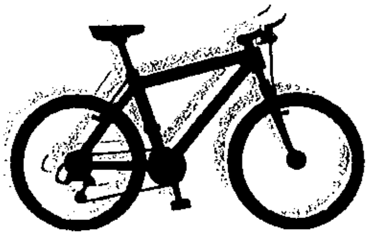
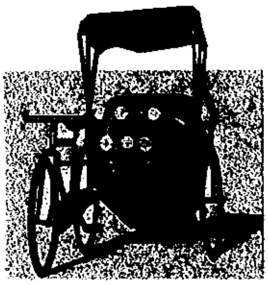
Taxi Passenger car registered as public utility vehicle and operating	
Jeepney usually operating as a public transport conveyance. Privately operated jeepneys are usually classified under utility vehicles.	
Buses All vehicles manufactured as traditional passenger-carrying buses with two axles and six tires or more axles. This category includes only traditional buses (including school buses) functioning as passenger-carrying vehicles.	
Light Goods Vehicle Two-axle, four-tire vehicles primarily used for cargo transport. It could be of the open type (as shown) or closed type vans.	
Two-Axle, Six-Tire, Single Unit Trucks All vehicles on a single frame including trucks, camping and recreational vehicles, motor homes, etc., having two axles and dual rear wheels.	

Figure 1.5-1 **Vehicle Types and Descriptions** (continued)

Three-Axle Single Unit Trucks All vehicles on a single frame including trucks, camping and recreational vehicles, motor homes, etc., having three axles.	
Four Axle Trucks All trucks on a single frame or articulated with four or more axles.	
Five-Axle Singe Trailer Trucks All five-axle vehicles consisting of two units, one of which is tractor or straight truck power unit.	
Bicycle Two-wheeled non-motorized transport vehicle.	
Pedicab Bicycle equipped with sidecar for transport of passengers, normally two.	

Survey Personnel Requirements for an Automatic Count

The number of field survey personnel would decrease when automatic methods of counting are employed and will depend on the equipment to be used.

Survey Procedure

The simplest means of conducting manual counts is through the tally method where each observed vehicle is recorded with a tick mark on the prepared survey form. A sample tally form, Form C1 is given in Annex C of this Manual. The form allows for whatever classifications may be desired. A stopwatch or watch is required to cue the observer to the desired count interval. When several watches are used, the Supervising Engineer or Station Supervisor must see to it that they are all synchronized. It is suggested that 15-minute intervals (or shorter, if necessary) is adequate for capacity analysis. If a peak-hour factor is sought, 5 minute counts are preferable. By doing so, one can minimize chances of error while detection would be easier. If and when an error is detected, which nonetheless can occur, a system for correction can be devised based on observed trends.

When manual traffic counters are utilized, readings are also recorded by vehicle type in the prescribed Survey Form C2. When the end of the interval is reached, the observer reads the counter, records the data on a field form. Resetting the counter to zero after every interval can be time consuming and susceptible to error. Current practice where readings are taken on a cumulative basis is easier to manage and with the proper spreadsheets, errors are easily detected once the observations are keyed into a computer.

Post Survey Activities

At the end of each survey period, the field sheets are submitted by the station supervisors to the Survey Chief. The Survey Chief ensures the completeness of the survey forms and the required identification entries, spot check for errors, inconsistencies, etc. and then submits to the office for data entry and processing.

A separate team is assigned to check for errors and inconsistencies that would require further verification and validation before the field sheets are turned over to the encoding section. Once encoded, the data files are subjected to logic checks to detect errors in encoding before the final printouts are prepared.

The entire process involves a series of data checks before the final worksheets are prepared, printed and analyzed.

Figure 1.5-2 **Sample of Accomplished Field Survey Form for Volume Counts**

transportas		**Traffic Volume Count** Tally Sheet
Station Code VL-01	Station Name KARUHATAN-MAC ARTHUR	Checker
Survey Date 04 MARCH 2001	Location KARUHATAN	Encoder
Weather	Direction 1-2	
Recorder / Enumerator JENNIFER GRAY	From (place) MONUMENTO (1)	Filename
Field Supervisor	To (place) KARUHATAN (2)	Sheet of

Time Period From	Time Period To	Car	Jeepney	Taxi	FX	Bus	Light Cargo	2 Axel	345 Axel
6:00	6:15	卌-1	卌-卌-卌 1	卌-|||	卌-1	卌	|||	||	|||
6:15	6:30	卌-卌-||	卌-卌-卌 卌-1	卌-卌-||	|||	卌-|||	||||	|	|
6:30	6:45	卌-卌-卌 卌-卌	卌-卌-|||	卌-|||	卌-1	卌-卌- 1	||	||	||
6:45	7:00	卌-卌-卌 卌-卌-卌	卌-卌 卌-卌 |||	卌-卌-||	||||	卌-卌-|||	卌-1	|||	
7:00	7:15	卌-卌-卌 卌-卌-卌 卌-||	卌-卌-卌 卌-||	卌-卌-卌 ||	卌-||	卌-|||	|||	||	
7:15	7:30	卌-卌-卌 卌-卌-卌 卌-卌-卌 ||	卌-卌-||| 卌-卌-||| |||	卌-卌-卌 ||||	|||	卌-卌 |||	||||	||	
7:30	7:45	卌-卌-卌 卌-卌-卌 卌-卌-卌 ||||	卌-卌-卌 |||	卌-卌 卌-卌	卌-||	卌-||	||||	|||	
7:45	8:00	卌-卌-卌-卌 卌-卌-卌-卌 卌-卌-卌 卌-1	卌-卌 卌-卌 卌	卌-卌-卌 卌-1	卌-|||	卌-卌	卌-1	|||	

Volume Data Presentations

Traffic volume data can be presented in several ways depending on the planned use of the data. Most often, summary tables and graphical forms are prepared. Graphs and bar charts are suitable for illustrating traffic volumes over time. Peak periods are readily discernible.

Figure 1.5-3 shows a volume count spreadsheet for surveys conducted for a particular location, with graphs and other presentation elements. This is for an individual turning movement.

Figure 1.5-4, on the other hand shows a summarized table combining the different turning movements at an intersection.

Figure 1.5-3 **Example of Volume Count Summary Result for an Individual Turning Movement**

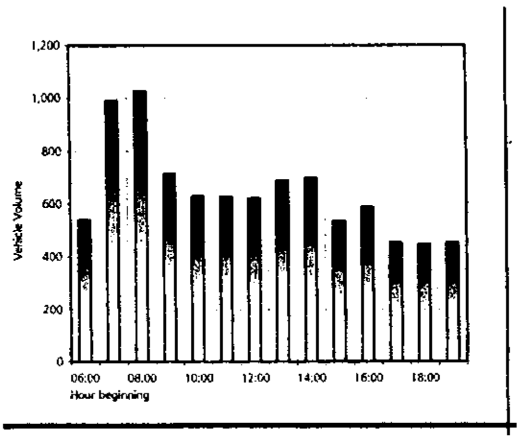
Pasay Rd EB left to Paseo de Roxas NB

Paseo de Roxas - Benavidez - Pasay Road Signal Studies

Wed 26 July 2000
6:00 - 20:00

Time Period		Vehicle volumes						Volume in PCUs*					
		car	jeepney	bus	truck	others	**total**	car	jeepney	bus	truck	others	**total**
Hourly Volumes													
06:00	07:00	346	161	0	9	23	**539**	346	225	0	20	23	**614**
07:00	08.00	511	438	0	8	33	**990**	511	613	0	18	33	**1,175**
08:00	09:00	566	406	1	16	37	**1,026**	566	568	2	35	37	**1,209**
09:00	10:00	402	258	0	16	41	**717**	402	361	0	35	41	**839**
10:00	11:00	373	172	0	25	60	**630**	373	241	0	55	60	**729**
11:00	12:00	389	167	2	23	45	**626**	389	234	4	51	45	**723**
12:00	13:00	390	160	0	19	51	**620**	390	224	0	42	51	**707**
13:00	14:00	413	190	0	23	63	**689**	413	266	0	51	63	**793**
14:00	15:00	416	185	0	24	74	**699**	416	259	0	53	74	**802**
15:00	16:00	315	150	1	21	49	**536**	315	210	2	46	49	**622**
16:00	17:00	357	179	2	13	37	**588**	357	251	4	29	37	**678**
17:00	18:00	283	150	0	8	12	**453**	283	210	0	18	12	**523**
18:00	19:00	299	128	0	2	20	**449**	299	179	0	4	20	**503**
19:00	20:00	313	118	0	9	15	**455**	313	165	0	20	15	**513**
Summaries													
06:00	12:00	2,587	1,602	3	97	239	**4,528**	2,587	2,243	7	213	239	**5,289**
12:00	18:00	2,174	1,014	3	108	286	**3,585**	2,174	1,420	7	238	286	**4,124**
18:00	20:00	612	246	0	11	35	**904**	612	344	0	24	35	**1,016**
06:00	**20:00**	**5,373**	**2,862**	**6**	**216**	**560**	**9,017**	**5,373**	**4,007**	**13**	**475**	**560**	**10,428**

Time Variation (total vehicles)



* PCU Equivalents

turn	car	jeepney	bus	truck	others
left	1.0	1.4	2.2	2.2	1.0
through	1.0	1.4	2.2	2.2	1.0
right	1.4	2.0	2.8	2.8	1.4

Turning Movement

Figure 1.5-4 **Example of Summarized Volume Count Results**

Location: Shaw Boulevard and Wack-wack Intersection
Date: 23 February 2001

Hourly Vehicle Volumes

Time Period		From Lee				From Wack Wack Rd				From Shaw Blvd / EDSA				From Shaw Blvd / Kalentong			
		l - w	l - 2	l - 3	l - 4	w - l	w - 2	w - 3	w - 4	2 - l	2 - w	2 - 3	2 - 4	4 - l	4 - w	4 - 2	4 - 3
06:00	07:00	31	191	14	15	94		11	38	140	36	7	1054	1	21	1152	20
07:00	08:00	50	431	64	18	120		21	31	211	34	62	1188		36	1587	89
08:00	09:00	42	443	53	13	75	90	13	50	181	37	89	1171	1	21	1483	77
09:00	10:00	62	366	33	5	95	73	13	41	192	46	84	1055	2	35	1426	86
10:00	11:00						84				46						
11:00	12:00						51				46						
12:00	13:00						57				32						
13:00	14:00						71				41						
14:00	15:00						74				20						
15:00	16:00						95				51						
16:00	17:00	63	395	41	22	156	80	49	48	285	28	135	1319	4	32	1418	143
17:00	18:00	63	354	39	31	141	73	56	47	336	33	95	1290	4	49	1457	156
18:00	19:00	75	253	50	12	257	63	8	62	30	37	52	516	10	42	1282	75
19:00	20:00	63	213	25	17	210	74	9	34	133	45	52	1182	6	24	1255	102
20:00	21:00	35	134	26	5	92	63	9	44	126	34	45	1032	6	36	1225	104
21:00	22:00	9	80	9	5	65	29	7	16	71	47	37	753	4	30	745	46

Hourly PCU Volumes

Time Period		l - w	l - 2	l - 3	l - 4	w - l	w - 2	w - 3	w - 4	2 - l	2 - w	2 - 3	2 - 4	4 - l	4 - w	4 - 2	4 - 3
06:00	07:00	30	197	10	14	93		9	37	142	36	6	1199	1	23	1284	20
07:00	08:00	44	433	58	15	120		16	28	213	34	62	1351		36	1801	89
08:00	09:00	38	470	50	11	79	108	11	44	198	39	94	1354	2	24	1684	77
09:00	10:00	56	397	39	6	98	76	13	36	214	51	89	1245	2	32	1661	86
10:00	11:00						86				51						
11:00	12:00						60				49						
12:00	13:00						60				34						
13:00	14:00						74				44						
14:00	15:00						71				20						
15:00	16:00						98				50						
16:00	17:00	60	406	42	22	168	85	50	44	306	29	141	1486	4	30	1589	154
17:00	18:00	61	369	44	33	142	73	53	40	358	32	98	1455	4	48	1651	160
18:00	19:00	73	264	47	12	265	64	7	56	27	39	50	625	10	39	1414	77
19:00	20:00	64	212	25	21	215	73	9	29	133	46	54	1311	6	24	1396	104
20:00	21:00	37	138	23	4	91	64	9	43	132	32	44	1177	6	34	1388	106
21:00	22:00	8	81	6	3	66	28	6	13	72	49	39	869	3	37	846	47

Passenger Car Equivalent Factors

Different vehicle types have different physical and operating characteristics. Their effects on the traffic stream would vary from one vehicle type to another. The impact on the basic passenger car unit (PCU) of slow-moving vehicles and heavy vehicles interacting with gradients and length of gradients, roadside friction, varying shoulder widths, etc are taken into account by the application of "Passenger Car Equivalent Factors". These factors are a function of roadside friction, shoulder width, carriageway width, gradients and lengths of gradients.

Based on studies carried out in the Philippines, the Highway Planning Manual of the Department of Public Works and Highways (HPM-DPWH) recommends the following Passenger Car Equivalent Factors (PCEF) for calculations of traffic levels for standard two-lane roads:

a) Bicycle: PCEF = 0.3
The basic PCEF is estimated to be 0.3. Although most often, bicycles counts are deemed negligible.

b) Motorcycle: PCEF = 0.5
The basic PCEF is about 0.5 for general conditions. However, when shoulder width and carriageway width are relatively wider, it would be easier for another vehicle to pass. Pedicab

c) Tricycle: PCEF = 1.0
The basic PCEF is equal to 1.0 because tricycles, although smaller in size than a passenger car, generally travel at a slow speed of 25-30 km./hr. and can cause considerable queuing on roads.

d) Car / Pick-up / Owner-type Jeep: PCEF = 1.0
Per definition, the basic PCEF is equal to 1.0

e) Taxi: PCEF = 1.0
The classification of Taxi is usually grouped with passenger cars and is given an equivalent factor of 1.0.

f) Jeepney: PCEF = 1.5
Since jeepneys are relatively more slow-moving than cars, the basic PCEF is equal to 1.5. Jeepneys tend to stop more often and therefore, causing other vehicle to slow down and even stop.

g) HOV Taxi: PCEF = 1.5
HOV taxis are equivalent to jeepneys, although smaller in capacity and have a basic PCEF equal to 1.5

h) Mini-bus: PCEF = 2.0
The basic PCEF is equal to 2.0 standard conditions. Roadside friction element is as of jeepney but gradients and shoulder widths formulas are the same as truck.

i) Standard Bus: PCEF = 2.5
The basic PCEF is equal to 2.5 in flat terrain. Roadside friction, gradients and shoulder width are, in principle, the same as with trucks.

j) Light Truck / Light Commercial Vehicles: PCEF = 2.0
The basic PCEF is equal to 2.0. Although trucks may have a bigger impact on road capacity than buses, roadside friction is not considered a restraining factor since trucks do not stop regularly and when they stop, it normally is off the road.

k) Heavy trucks: PCEF = 2.5
Heavy trucks are assigned a higher PCEF of 2.5.

l) Others: PCEF = 1.0
The classification "Others" is grouped with passenger cars and is given an equivalent factor of 1.0.

1.5.2 Pedestrian Counts

Pedestrian counts are essential in determining if traffic signals are warranted, for the location and design of sidewalks and crosswalks, for the design and implementation of pedestrian safety improvements and for determining appropriate controls and control operations.

The methodology and survey procedure for pedestrian counts is similar to that for vehicular counts (see Section 1.4.1). The volume of pedestrians passing a point, entering an intersection, or using a particular facility such as crosswalk or sidewalk can be studied and recorded. Counts are usually samples of actual volumes although more often, continuous counts are conducted.

Most types of pedestrian counts are taken manually by direct observation. Classification may or may not be necessary, and are easily, and accurately obtained with trained observers. Examples of classification categories are age group, sex, type of behavior, etc. Survey forms used vehicular counts can also be used for pedestrian counts.

1.5.3 Travel Time / Delay Surveys

Travel time surveys are conducted to establish the amount of time it takes to traverse a road or highway segment. When combined with the length of the segment under study, the mean travel speed can be computed. Measurements and causes of delays occurring within the segment are also noted. The resulting travel time is time when vehicle is actually in motion. Consequently, the running speed is determined.

Applications
The travel time and delay survey is particularly useful in identifying congestion locations in the street system and according to type of delay, duration and frequency. It is also applied to determine efficiency of a route with respect to its ability in moving traffic. More often, it is conducted to evaluate the effectiveness of traffic improvements using before-and-after studies. However, when results are to be comparable, similar conditions must exist at the times of data collection.

Methods
Travel time and delay studies may be conducted using the average vehicle, moving vehicle, license plate, direct observation, or interview method. As in most data collection activities, the choice of method depends on the purpose of the study, the area under study, the time of day of interest, the personnel, equipment, and resources available.

The most common method, the average vehicle, commonly referred to as one method under the "test-car technique" uses a test vehicle. With the average vehicle method, data can be collected as the test vehicle traverses the study route either by manual or automatic method. The data being measured consist of travel time, distance traveled, type, location, duration and cause of traffic delay. The recommended minimum total length of a single route to be studied is roughly 1.6 kilometers.

Survey Personnel/Equipment Requirements
The manual method requires a driver, a recorder, and two stopwatches. If an automatic recording device is used in the test car, then only the driver is needed. Automatic recording devices normally come with various control buttons that record travel distance, travel time, and locations of delay or other significant points by a system of coded numbers that are imprinted on the continuous paper readout. Some devices are equipped with data storage devices that can be linked to a computer system for processing.

Survey Procedures
A test vehicle is driven along the study route in accordance with one of the following operating conditions:

1) Average-car technique, wherein the vehicles travels according to the driver's judgment of the average speed of the traffic stream
2) Floating-car technique, wherein the driver "floats" with the traffic by passing as many vehicles as pass the test car

3) Maximum-car technique, wherein the test vehicle is driven at the posted speed limit unless impeded by actual traffic conditions.

Most commonly used is the average-car technique, although the maximum-car technique is said to be the best base for measuring traffic performance.

Before the runs are made, the beginning and ending points of the route under study are identified. The test car should run passed these locations in accordance with the selected operating condition. Control points, usually intersections, are then selected as reference locations where time readings are taken. When distances between control points are not readily available, readings from the odometer meter are also recorded.

Before the survey begins, the recorder enters the base information as required for in the prescribed form. When the survey begins, one stopwatch is started as is passes the beginning point in manual method, otherwise, in automatic method the equipment is activated to indicate start of test run. The vehicle is driven the length of the study route. Time readings are taken at predetermined control points. When the test vehicle is stopped or forced to travel slowly, the recorder uses the second stopwatch to measure the duration of the delay. Also taken note of are the location, duration and cause of each delay in the appropriate spaces provided for in the form C3, provided for in Annex C. Codes for common causes of delays are used in recording and provided for in the survey form.

As the test vehicle passes the ending point of the route, the recorder stops the first stopwatch and notes down the total time for the test run.

Figure 1.5-5 illustrates a sample survey form for travel time and delay studies

Data Processing and Presentation

Data collected from the survey is processed to compute for total delay, travel time, running time and average travel speed. A sample summary table is presented in Figure 1.5-6.

Graphical summaries plotting both average overall travel speeds by road sections and the cumulative travel times can be prepared to describe the quality of traffic movement along a route. An example is given in Figure 1.5-7.

Figure 1.5-8 shows an example of a speed variation chart. These are generated based on the resulting speeds calculated from the travel time / delay surveys. The speed for each road section surveyed is plotted against a distance-based horizontal axis.

Time contours can also be used for presentation purposes. Figure 1.5-9 provides an example of a time contour map.

Figure 1.5-5 **Example of a Filled-up Travel Time / Delay Survey Form**

Field Sheet 1

Route Name: **Batangas - Calamba**
Direction: **Northbound**

Run Number **2**
Date of Survey: **Thu 12 Feb 1998**
Start Time: **08:45**

	Station Name	Kilometer Reading (km)	Passing Time (mm:ss)	Delay 1 Ca	Delay 1 Stop	Delay 1 Start	Delay 1 Delay	Delay 2 Ca	Delay 2 Stop	Delay 2 Start	Delay 2 Delay	Delay 3 Ca	Delay 3 Stop	Delay 3 Start	Delay 3 Delay
12	Batangas City Proper	0.0	00:00	JP	03:29	04:13	00:44	JP	07:06	08:14	01:08				
11	Bypass Road to Bauan	5.1	14:08												
10	Junction leading to Ibaan	5.6	15:29												
9	San Jose Junction	15.4	27:11												
8	Mataas na Kahoy Junction	24.0	37:15												
7	Y-Junction after Lipa	27.8	43:09												
6	Y-Junction before Lipa	29.6	47:18	PED	48:21	48:54	00:33								
5	Inoslaban Junction	32.7	53:12												
4	Malvar	35.2	57:47	BP	58:05	58:28	00:23	LT	63:16	63:31	00:15	SS	67:24	69:45	02:21
3	Tanauan	45.3	72:39												
2	First Junction to Sto. Tomas	48.8	75:34												
1	SLE Calamba Exit	57.9	90:18												

Legends for Causes of Delay:

T *General Congestion*	BP *Buses (un)loading*	S *Traffic Signal*	PK *Parked Vehicles*
PED *Pedestrians Crossing*	JP *Jeepneys (un)loading*	SS *Stop Sign*	LT *Left Turning Vehicles*
A *Traffic Accident*	O *Others (specify)*		

Figure 1.5-6 **Summary for Travel Time Survey Results**

Travel Time Summary

Route Name: **Batangas - Calamba**
Direction: **Northbound**

Run Number **2**
Date of Survey: **Thu 12 Feb 1998**
Start Time: **08:45**

	Station Name	Passing Time (mm:ss)	Travel Time (mm:ss)	Total Delay (mm:ss)	RunningTime (mm:ss)	Kilometer Reading (km)	Run Distance (km)	Travel Speed (km/h)	Running Speed (km/h)
12	Batangas City Proper	00:00	14:08	01:52	12:16	0.0	5.1	21.7	24.9
11	Bypass Road to Bauan	14:08	01:21	00:00	01:21	5.1	0.5	22.2	22.2
10	Junction leading to Ibaan	15:29	11:42	00:00	11:42	5.6	9.8	50.3	50.3
9	San Jose Junction	27:11	10:04	00:00	10:04	15.4	8.6	51.3	51.3
8	Mataas na Kahoy Junction	37:15	05:54	00:00	05:54	24.0	3.8	38.6	38.6
7	Y-Junction after Lipa	43:09	04:09	00:00	04:09	27.8	1.8	26.0	26.0
6	Y-Junction before Lipa	47:18	05:54	00:33	05:21	29.6	3.1	31.5	34.8
5	Inoslaban Junction	53:12	04:35	00:00	04:35	32.7	2.5	32.7	32.7
4	Malvar	57:47	14:52	02:59	11:53	35.2	10.1	40.8	51.0
3	Tanauan	72:39	02:55	00:00	02:55	45.3	3.5	72.0	72.0
2	First Junction to Sto. Tomas	75:34	14:44	00:00	14:44	48.8	9.1	37.1	37.1
1	SLE Calamba Exit	90:18				57.9			
			90:18	05:24	84:54		57.9	38.5	40.9

Figure 1.5-7 **Travel Time Chart**

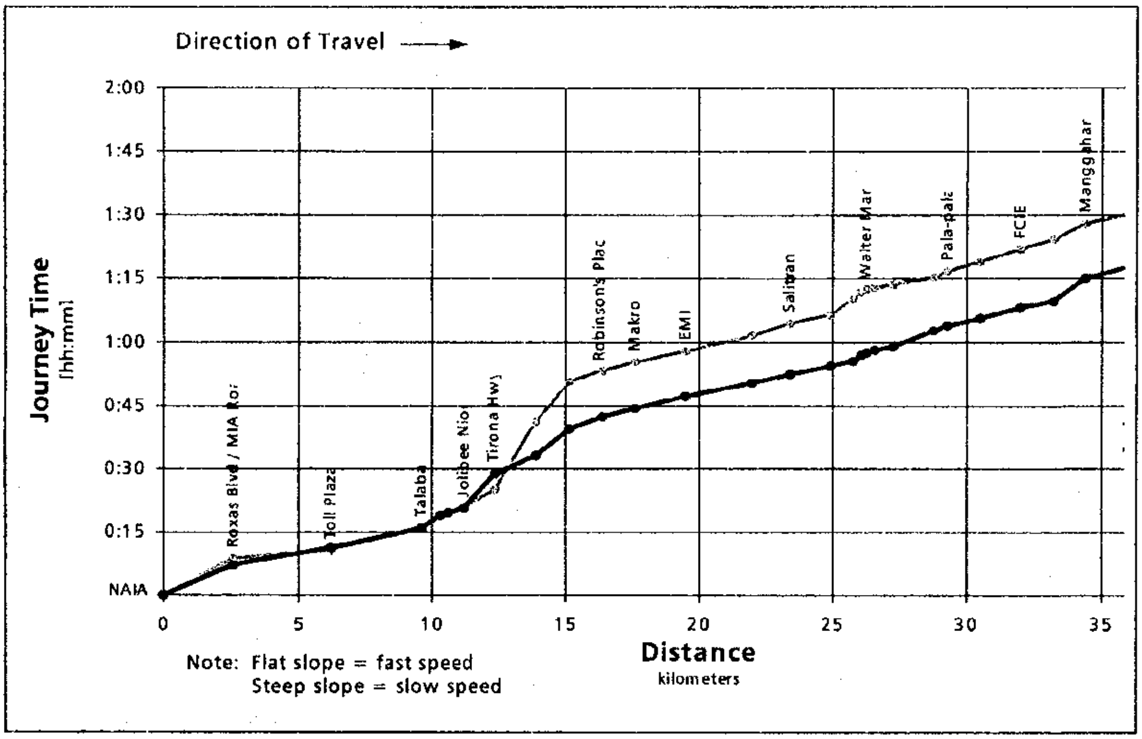


Figure 1.5-8 **Travel Speed Variation Chart**

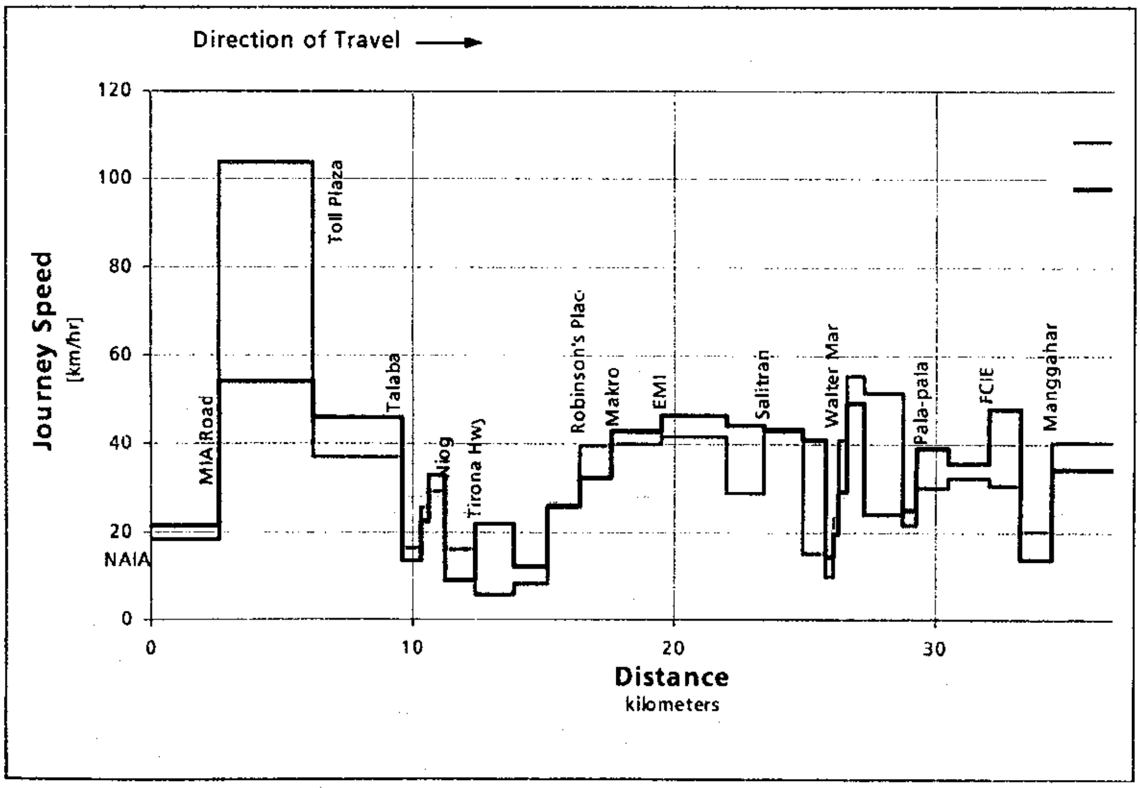
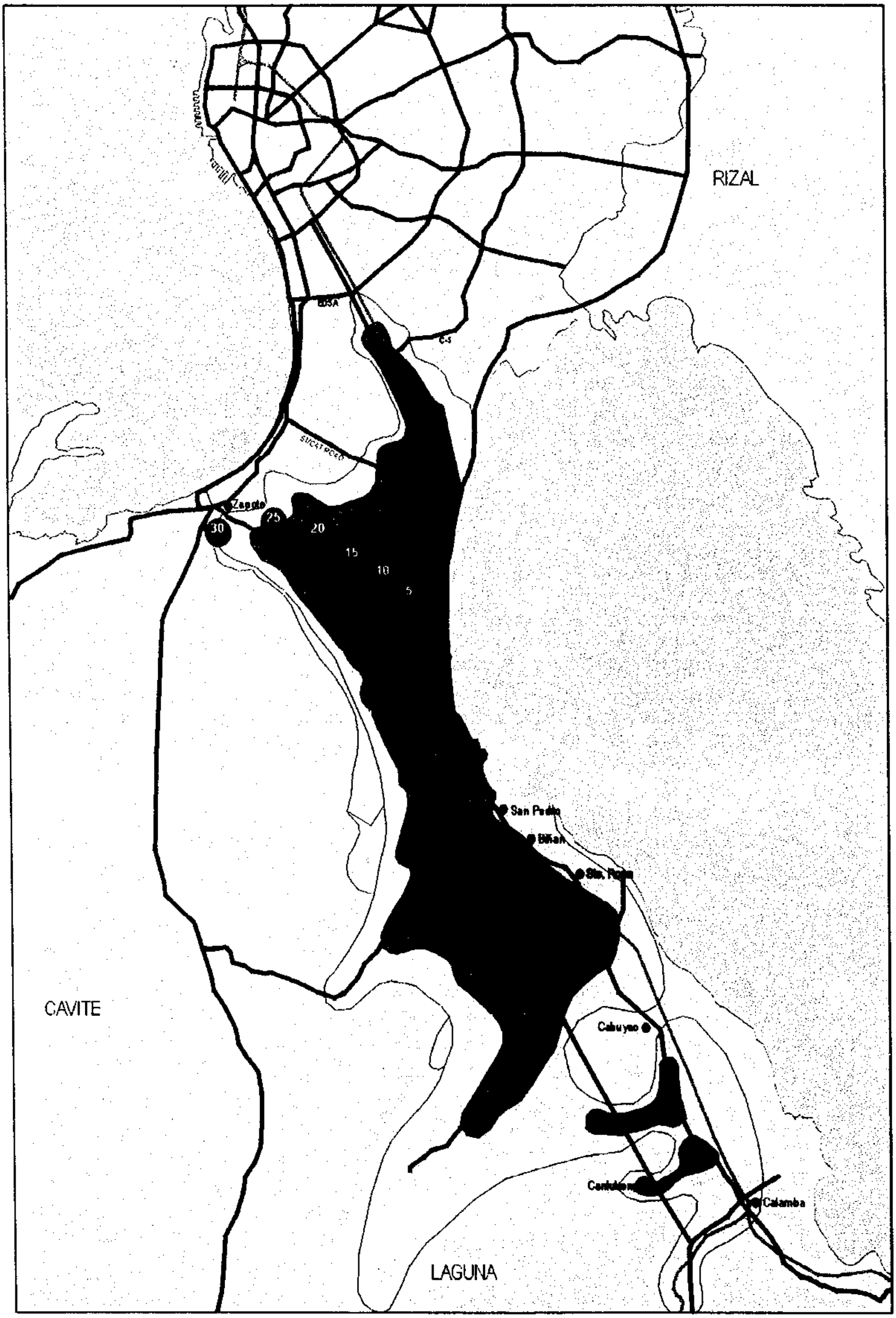
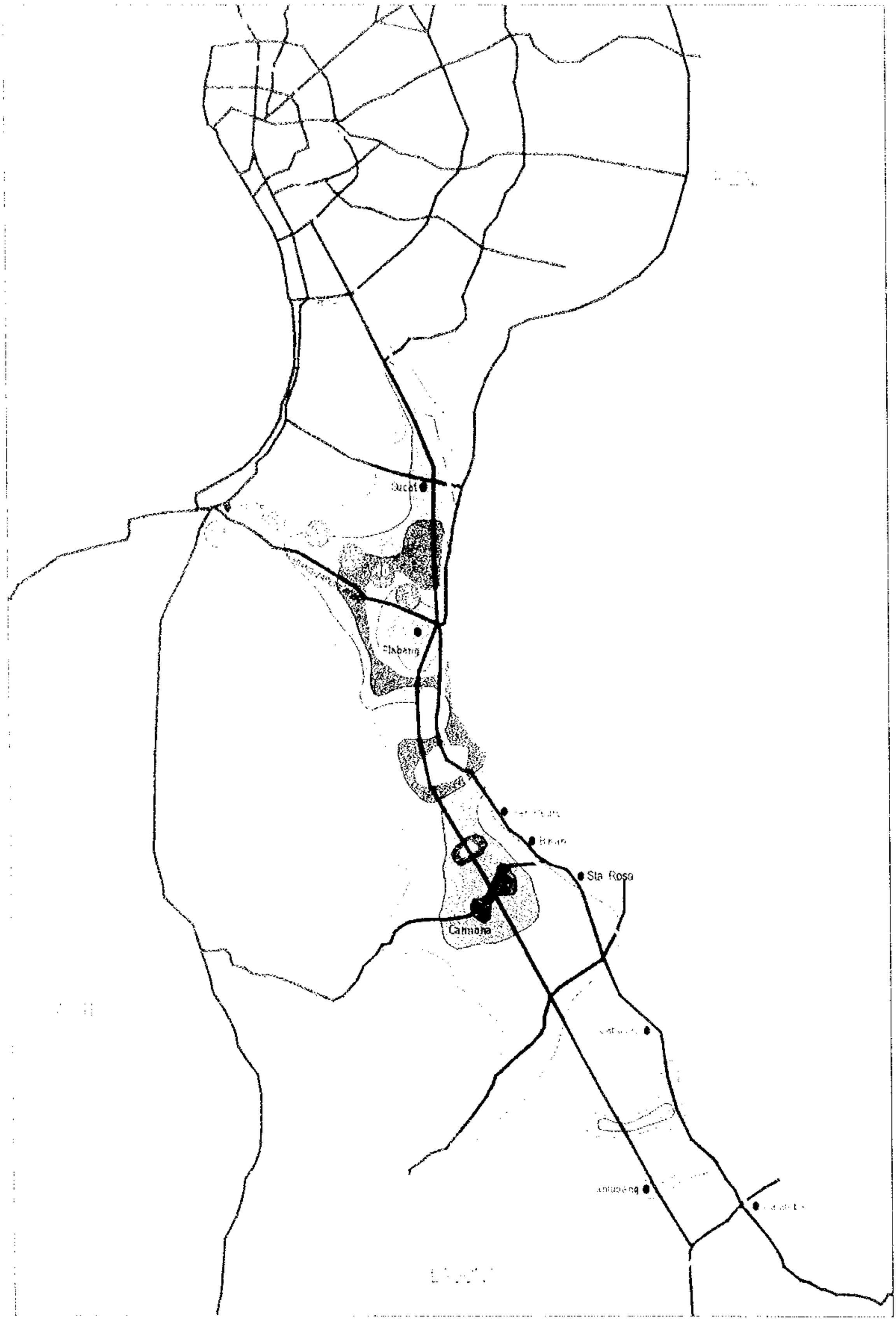


Figure 1.5-9 **Example of a Travel Time Contour Map**



Example of a Travel Time Contour Map



1.5.4 **Intersection delay**

Intersection delay studies are conducted to evaluate the performance of intersections in allowing traffic to center and pass through or enter and turn onto another route. A primary factor evaluated in this study is the effectiveness of the traffic control at the intersection. In comparison to the travel time and delay studies, this procedure provides a detailed evaluation of stopped-time delay at the particular intersection.

Applications
The primary application of this survey is to evaluate the efficiency of various types of intersection control devices and traffic regulations in relation to geometric configuration of the intersection approaches. It can also be utilized to determine the proper timing sequences for traffic signal installations. Moreover, this study can also be applied for the evaluation of delays to pedestrian traffic.

Methods
Data on intersection delay can be collected by the manual method of with a delay meter that accumulates the number of vehicle-seconds of stopped-time delay. More often, the manual method is applied since delay meters are not easily available.

Survey Personnel Requirements
Generally, one observer equipped with a stopwatch is required for each intersection approach that is being evaluated. If the traffic volume on the approach is too heavy for one observer to count and record, additional observers may be assigned.

Survey Procedures
The observations are usually taken during periods of congestion when excessive delays are likely to occur. If results are to be comparable for before-and-after studies, similar conditions must exist at both times of data collection.

The manual method involves the counting of vehicles stopped in the intersection approach at successive intervals. A typical duration for these intervals is 15 seconds, although other values can be selected. For an intersection controlled by a fixed-time signal, the sampling interval should be selected such that no repetitive counting shall occur in the same portions of the signal cycle. One way to eliminate this problem is to have staggered starting times for the sampling operation to produce a discontinuous process which will prevent repetitive counting with respect to the signal cycle.

The stopwatch is started in the beginning of the study to advise the observer of the proper intervals. The procedure requires the observer to count and record the number of vehicles stopped on the approach for each observation time indicated. The sample field sheet shown as Form C4 in Annex C is arranged for a 15-sec. time interval.

A vehicle is counted more than once in the delay determination if it is stopped during more than one sampling interval. A separate tabulation of the approach volume is made for each time period by classifying the vehicles as either stopping or not stopping. The number of stopping vehicles is always equal to or less than the total number of vehicles stopped on the approach for a specific time interval, because vehicles can be delayed for more than one sampling period.

The analysis of intersection delay data is shown in the example study given in Figure 1.5-10.

Figure 1.5-10 **Intersection Delay Data Analysis**

INTERSECTION DELAY SURVEY

Location: MONTILLANO ST./MONTILLANO EXT/NATIONAL HWY
Approach: NATIONAL HWY (MANILA TO LAGUNA) Date: Jul-27-01 (Friday)
Comment: 4-legged intersection, some improvements have started initiated by the LGU

Time Minute started at	Total number of vehicles stopped in the approach				Approach Volume	
	+ 0 sec	+ 15 sec	+ 30 sec	+ 45 sec	Number Stopped	Number Not Stopped
07:30 PM	10	0	0	0		
07:31 PM	0	14	14	1		
07:32 PM	1	6	10	17		
07:33 PM	21	21	0	0		
07:34 PM	0	9	14	17		
07:35 PM	13	14	17	17		
07:36 PM	17	17	17	0		
07:37 PM	0	2	3	7		
07:38 PM	12	16	16	16		
07:39 PM	3	5	1	0		
07:40 PM	0	1	0	0		
07:41 PM	7	8	10	12		
07:42 PM	13	0	0	5		
07:43 PM	9	4	0	4		
07:44 PM	7	12	12	6		
07:45 PM	0	0	2	3		
			TOTAL	463	174	163
			Approach Volume			337

Total Delay = Total Number Stopped * Sampling Interval
= 463 * 15 = 6,945 veh-sec

Average delay per stopped vehicle = $\frac{\text{Total Delay}}{\text{Number of Stopped Vehicles}}$

= $\frac{6{,}945}{174}$ = 40 sec

Average delay per approach vehicle = $\frac{\text{Total Delay}}{\text{Approach Volume}}$

= $\frac{6{,}945}{337}$ = 21 sec

Adjusted ave.delay per approach vehicle = 21 * 1.3
= 27 sec

Percent of Vehicles stopped = $\frac{\text{Number of stopped vehicles}}{\text{Approach Volume}}$

= $\frac{174}{337}$ = 51.63%

1.5.5 Passenger Occupancy Surveys

Passenger occupancy counts are normally carried out to determine passenger flow characteristics at certain corridors. The object of the count is the total number of passengers carried by a single vehicle according to vehicle classification and directional flow.

Survey Personnel Requirements
Unlike volume counts where the number of observers is critical to the desired output, passenger occupancy surveys require a minimal number since observations are recorded on a sampling basis. In practice, one observer is assigned to record passenger counts on the various vehicle classifications per direction of flow. If traffic volume is low, it is sometimes workable to have only one observer for two or more directions and depending on the desired sampling size.

Survey Procedures
The occupancy counts are conducted on a random sampling method. However, sampling rates of as high as possible (up to 100% depending on total volume) can be attempted. Otherwise, an attempt can be made to have the sampling rates for each vehicle classification as close as possible to the actual proportion of each type in the total traffic flow stream.

The procedure is, using prepared field observation sheets, to record the number of passengers, excluding drivers and conductors, on board each observed vehicle, with the recording separate for each vehicle type. This is to be done for every 15-minute interval. In cases where traffic volume is high, an estimate on the passenger load, particularly for jeepneys and buses, will be recorded, instead of the actual count of passengers on-board. When the proportion of larger vehicles in a traffic flow stream is expected to be high, an alternative to actual passenger load count or estimate is the use of passenger load indicators to facilitate the collection process. The following passenger load indicators (except driver and conductor) can be recorded for the larger public transport vehicles such as buses and jeepneys:

- 1.2 – usually for buses, this indicates packed with both seated and standing passengers
- 1 – usually full with seated passengers
- 2/3 – for almost full with seated passengers
- ½ - for half full with seated passengers
- 1/3 – for a third full

In estimating total passenger demand, passenger load counts should not include drivers and conductors of public transport vehicles, while drivers on board private vehicles should be included. Operationally, it will be much easier to instruct the data collectors or passenger occupancy enumerators to exclude drivers in their counts, whether the vehicle is a private one or a public utility vehicle. Considering the possible inexperience of the enumerators in conducting field activities, complex procedures are potential causes of errors. Thus, the count of drivers can be added during the processing of the field data.

Data Processing

Processing occupancy data can be quite tedious and will require spreadsheet programs in order to calculate the number of samples gathered, estimated sampling rates (based on intersection volume counts), and average passenger occupancy levels.

Figure 1.5-11 **Summarized Passenger Occupancy Data**

C P Garcia Av between Lessage St and J S Torralba St

C P Garcia southbound
oc05 dir13

Mon 16 October 2000
7:00 to 19:00

		Public Vehicles														
		Tricycle			Multicab			PUJ			Bus			All Public Vehicles		
		Vehicles Sampled	Passengers Counted	Average Occupancy	Vehicles Sampled	Passengers Counted	Average Occupancy	Vehicles Sampled	Passengers Counted	Average Occupancy	Vehicles Sampled	Passengers Counted	Average Occupancy	Vehicles Sampled	Passengers Counted	Average Occupancy
07:00	*08:00*	362	665	**1.8**	119	322	**2.7**	50	172	**3.4**	6	22	**3.7**	537	1181	**2.2**
08:00	*09:00*	417	701	**1.7**	80	175	**2.2**	15	47	**3.1**	1	1	**1.0**	513	924	**1.8**
09:00	*10:00*	480	854	**1.8**	65	148	**2.3**	31	87	**2.8**	0	0	-	576	1089	**1.9**
10:00	*11:00*	429	854	**2.0**	81	191	**2.4**	23	70	**3.0**	3	31	**10.3**	536	1146	**2.1**
11:00	*12:00*	472	1047	**2.2**	74	166	**2.2**	25	63	**2.5**	2	5	**2.5**	573	1281	**2.2**
12:00	*13:00*	409	856	**2.1**	59	114	**1.9**	13	27	**2.1**	4	6	**1.5**	485	1003	**2.1**
13:00	*14:00*	457	838	**1.8**	59	137	**2.3**	18	44	**2.4**	0	0	-	534	1019	**1.9**
14:00	*15:00*	567	1076	**1.9**	45	104	**2.3**	23	64	**2.8**	0	0	-	635	1244	**2.0**
15:00	*16:00*	514	974	**1.9**	55	124	**2.3**	14	32	**2.3**	0	0	-	583	1130	**1.9**
16:00	*17:00*	439	981	**2.2**	58	123	**2.1**	21	58	**2.8**	0	0	-	518	1162	**2.2**
17:00	*18:00*	430	1061	**2.5**	90	261	**2.9**	23	67	**2.9**	1	4	**4.0**	544	1393	**2.6**
18:00	*19:00*	435	984	**2.3**	65	156	**2.4**	19	61	**3.2**	0	0	-	519	1201	**2.3**
07:00	*12:00*	3026	5815	**1.9**	537	1253	**2.3**	175	510	**2.9**	16	65	**4.1**	3754	7643	**2.0**
12:00	*19:00*	2385	5076	**2.1**	313	768	**2.5**	100	282	**2.8**	1	4	**4.0**	2799	6130	**2.2**
07:00	*19:00*	5411	10891	**2.0**	850	2021	**2.4**	275	792	**2.9**	17	69	**4.1**	6553	13773	**2.1**

Data Presentation

Passenger flow data can be summarized as follows:

Figure 1.5-12 **Summarized Data for Passenger Occupancy Survey Results**

Vehicle Type	Southbound		Northbound	
	Volume	Modal Share	Volume	Modal Share
Tricycle	10,891	53.5%	11,563	39.2%
Multicab	2,021	9.9%	6,161	20.9%
Jeepney	792	3.9%	4,357	14.8%
Bus	69	0.3%	138	0.5%
Motorcycle	3,239	15.9%	3,474	11.8%
Car	2,917	14.3%	2,872	9.7%
Light Truck	413	2.0%	917	3.1%
Heavy Truck	0	0%	10	0%
Total	**20,342**	**100.0%**	**29,492**	**100.0%**