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METHODOLOGY FOR IMPROVEMENT OF CAPACITY OF URBAN ROADS

BY

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1. INTRODUCTION

With the increase in population and migration of rural population to urban centres, the road networks of our cities are under lot of pressure. Additionally, there is increase in vehicle ownership and thus vehicles on roads, are increasing every day.

Proper approach to improve and manage the road traffic is essential, otherwise there is going to be total confusion, delays and insecurity while travelling.

Any given traffic situation has three components

- Vehicle Operator
- Vehicle
- Roadway

We would generally discuss only roadway conditions. Therefore, to obtain ideal conditions for uninterrupted flow, following characteristics of good roadway are required :-

- Twelve feet lane widths;
- Six feet clearance between the edge of the travel lanes and the nearest obstructions or objects at the roadside and in the median ;
- 60 mph design speed for two lane roads;
- All passenger cars in the traffic stream;

Ideal characteristics for signalized intersection approaches include:-

- Twelve feet lane width;
- Level grade;
- No curb parking on the intersection approaches;
- All passenger cars in the traffic stream;
- All vehicles traveling straight through the intersection;
- Intersection located in a non C.B.D. area;
- Green signal available at all time.

2. TRAFFIC FLOW FACTORS

Following are important traffic flow factors:-

1. Speed
2. Volume
3. Density

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Therefore to carry out any improvements in a section of road we should try to attain the design speed by obtaining ideal roadway conditions.

Channelization is an important way of improvement in traffic conditions.

3. CHANNELIZATION

3.1 Purposes of channelization

In modern highway practice, colour and surface-texture differences in pavements, painted stripes, raised bars, curbings, raised islands, and road guards are widely employed to direct or control vehicle and pedestrian movements. When properly placed, they have increased intersection capacity, improved traffic-flow conditions, and decreased vehicular and pedestrian accidents. Appropriate channelizing devices are included as an integral part of any new intersection or interchange. In addition, they offer an extremely useful and relatively inexpensive tool for correcting some of the deficiencies of existing roads and streets.

Among the more important purposes of channelization are the following:-

By channelization, vehicles can be confined to definite paths. When drivers or pedestrians have free choice of routes through large all-paved intersections, their actions cannot be predicted by others. This creates confusion and congestion and often leads to accidents.

In addition, accidents are more likely, since each vehicle is exposed for longer distances to others making conflicting movements.

By channelization, the angle between intersecting streams of traffic can be made more favourable. When cross traffic meets at flat angles the accidents that occur usually are serious once, just as head-on collisions are. The relative speed between the two vehicles is high, and practically all the kinetic energy of both is dissipated by damaging the vehicles or their occupants. As the direction of meeting swings away from head-on, accidents generally become less severe. It has now been established that, all things considered, the intersection of traffic streams at about right angles (75° to 105°) is most favourable. Besides decreasing accident severity, meeting at this angle reduces the distance and time during which opposing vehicles can be in conflict, and thus reduces accident opportunity. The right-angle crossing also provides drivers with the most favourable condition for judging the relative position and speed of approaching vehicles.

By channelization, drivers can be forced to merge into moving traffic streams at flat angles (10° to 15°) and proper speeds. Entry in this manner causes little disruption to traffic or decrease in capacity on the main thoroughfare. Where traffic enters at larger angles, accident hazard is greater, and fewer vehicles are

accommodated since the gap in the moving stream must be longer before entry can be made. Access other than by merging usually should be subject to stop-sign control.

By channelization, speed control can be established over vehicles entering an intersection. One method of accomplishing this is to bend the traffic stream. Another is to funnel the vehicles into a narrowing opening. This causes the driver to feel hemmed in, and he reacts by reducing his speed. Funneling also is effective in preventing overtaking and passing in a conflict area. In cases where speed control is the aim, carefully planned superelevation is an important adjunct to channelizing.

By channelization, prohibited turns may be prevented.

By channelization, refuge may be provided for turning or crossing vehicles and for pedestrians. This is illustrated by the provision of turning lanes and of protected areas for cross traffic and pedestrians at the center of the street.

By channelization, points of conflict may be separated in such a way that the driver faces only one decision at a time. This reduces confusion and accidents because the driver can reach the proper decision in a shorter period of time.

Channelizing devices provide protected locations for essential traffic-control devices.

3.2 Channelizing devices

The various channelizing devices exert different degrees of control over driver and vehicle. On the one hand, striping and changes in pavement surface merely suggest the appropriate path and speed. On the other hand, nonmountable road guards, curbs, or bumper blocks like those sometimes used on the exposed ends of streetcar loading zones positively prohibit encroachment by the vehicle. Between the extremes fall such devices as raised bars made of concrete or bituminous mixtures or mountable curbs over which a vehicle may pass if the driver so desires. In selecting the device that will work best in a given situation, the designer must weigh such factors as the space available for the installation, its cost, traffic volumes and speeds, the seriousness of the accidents that may result from vehicles entering the prohibited areas, and the influence of police supervision on driver behavior. For example, all these conditions differ greatly between rural and urban locations, and designs appropriate for one may not fit the other.

Curbing and raised islands bounded by curbs are particularly important channelizing devices. If curbs border bituminous pavement, single curb or combined curb and gutter is used. Generally, where water is to flow along the gutter, combined curb and gutter is to be preferred. With concrete pavement, combined curb and gutter or integral curb is generally chosen. Curb and gutter is placed first as a separate operation, and thus provides an excellent means for

establishing proper pavement grades. Careful control of grades and pavement smoothness is more difficult if the designs call for integral curb.

In many situations, high visibility is an important requirement for curbings. In these cases it is common practice to use white Portland cement in the concrete or to paint the curbing. Many agencies further increase visibility by providing indentations in the curb face which will reflect headlight rays back to the driver. Installing special reflectors in the curb face offers another method of increasing visibility.

The height of nonmountable curbings seldom exceeds 7 in., as greater heights catch fender edges or other low-hanging parts of passenger cars. Vehicles striking such curbs straight-on will pass over them, but those hitting at small angles usually will be deflected back into the roadway again without serious damage to the vehicle.

Road guards provide a positive means of confining vehicles to designated roadways. They are usually 2 ft. or more in height, and vehicles striking them will suffer some damage, at least to body parts. Road guards appear most frequently on rural roads in rolling or mountainous country where the combination of high fills and tortuous alignment is common. They consist of a continuous "rail element" supported at intervals by sturdy posts. Approved rail elements include steel-wire cable, woven steel-wire tape, steel strip, steel plate, woven steel-wire fabric, steel-plate beam, or timber. Posts may be of treated or untreated timber, steel, or precast concrete.

3.3 Design of Intersections at Grade

Most highways intersect at grade, which makes the intersection area a part of both roads. In this area must occur all crossing and turning movements. Typical intersections at grade, ranging from simple to complex. For intersections of roads or streets carrying little traffic, no further treatment is needed, with the possible exception of signs or other traffic-control devices. However, as the importance of one or both of the thoroughfares increases, other features must be added to the design.

A careful traffic count and estimate for the future, including data regarding each turning movement, must precede the design of an important intersection. Only in this way can those movements that are heavy be favoured in the design. Traffic information coupled with knowledge of lane capacities leads to decisions regarding the number of lanes to be supplied. The speeds at which vehicles will approach and move through the intersection will govern many dimensions, particularly minimum sight distances in various directions and the radii of curves. Likewise, decision regarding the need for traffic signals currently or in the future will affect certain features of the design.

In laying out intersections, characteristics of driver and vehicle and the possibility of accidents and their frequency and severity must be always kept in mind. As stated earlier, drivers should be confronted with but one decision at a time. Further, they should be guided into the proper channels for their intended routes and prevented from doing wrong or unpredictable things. It is important that spacious areas which permit "open-field running" be eliminated by the provision of directional island that leave little choice of route. Pavement and islands that supply direction to the converging streams of traffic should lead to blending at very small angles. It is preferably to use single large islands rather than several small ones, as single large ones are less confusing to drivers.

Most important intersections must accommodate large trucks and the radii of all curves made long enough for them. For the inside edge of 90-degree turns at low-speed intersections, the AASHO recommends as a minimum a three-centered compound curve with radii successively 120, 38, and 120 ft. Because the vehicle does not track and its front overhangs, minimum lane width near the center of the curve approaches 20 ft.

Sometimes a study of traffic-flow data indicates that relatively few vehicles perform a particular turning movement at a given intersection. If this movement complicates the design or increases congestion, it should be eliminated completely and provision made for its in some other way. For example, vehicles desiring to make left turns often are directed to the right completely around an adjacent block; then they pass through the intersection with normal cross traffic.

Certain design features of complicated intersections often require testing by actual use. In such cases it is common to place temporary channelizing islands made of sandbags which can be easily shifted around. Sand sprinkled over the roadways will indicate vehicle paths. After the design has been proved, the permanent installation is made.

3.4 Rotary Intersections

A rotary intersection is one in which all traffic merges into and emerges from a one-way road around a central island.

Because of the relatively large area required for their development, the extra travel distance within them, the necessary speed reduction on the part of all entering vehicles, and the limited capacity of the weaving sections, rotaries are not being used today except in special instances. It is found possible to handle greater volumes than formerly was thought feasible in at-grade intersections, combining channelization and traffic signal controls. It is found that partial-cloverleaf grade separations are comparable in over-all development and operating costs rotaries properly designed. Thus the range of traffic volume conditions wherein the rotary is considered most suitable has narrowed considerably during the last decade. Many existing rotaries in urban and suburban areas have been made operable under increasing traffic volumes only

through installation of traffic signal controls and stop-and-go operation for which their over-all shape is poorly suited.

Some recent interchange designs for freeways have combined over undercrossings for through traffic with rotaries at ground level to distribute traffic to local streets.

3.5 Grade Separations

When one highway crosses another at grade, capacity is reduced to that of the intersection. Furthermore, some or all of the vehicles must slow down or stop to permit the passage of crossing and turning traffic. There are many points of conflict, with accompanying accident opportunity. A grade separation structure eliminates these difficulties. Capacity will rise to that of the traffic lanes. Vehicles can travel at uniform speed, which reduces both travel time and operating costs. Accident opportunity is almost entirely eliminated. On the other hand, since right-of-way, construction, and maintenance costs of grade-separation structures are great, they can be afforded only on high-type facilities which carry large columns of traffic.

Provisions for grade separation between freeways and the ordinary streets selected to carry traffic across are relatively simple. They consist merely of bridges to carry one facility over the other. Arrangements for smooth access and egress between cross streets and ground-level or depressed freeways likewise are not difficult if sufficient right-of-way width can be had. As a rule connections to elevated freeways present more difficulties.

In settled areas, freeways crossings solely for pedestrians often are needed. These offer no serious problem if the freeway is either elevated or depressed. If the freeway is near ground level the solution is less satisfactory. Since the minimum vertical clearance above a roadway is 14 ft., users of an over crossing must climb a stairway or ramp rising 15 ft. or more. With undercrossings, vertical clearances total only about 8 ft., but policing becomes a serious problem since the walkways are not visible until the approach ramp or stairway has been descended. A compromise solution that raises the freeway grade some 4 ft. at the undercrossing has sometimes proved best. The pedestrian must still descend a short stairway or ramp, but the entire length of the walkway is visible from the approach sidewalks.

At the intersection of two freeways or where a freeway intersects a major highway, an interchange may be required. An interchange not only offers grade separation between the two traffic arteries, but in addition provides easy routes for vehicles transferring from one through facility to the other.

The most common interchange is the cloverleaf. With it, the intersecting arteries are separated, and in addition all eight turning movements are accomplished free of intersections where vehicles paths must cross.

Interchange design must begin with a traffic estimate showing the number of vehicles that will be performing each maneuver. Only in this manner can important movements be favoured. Design speed on through roadways should conform to that of the approaching freeways, but that on ramps and connections may be considerably lower. Several tentative layouts generally are made, from which estimates of right-of-way, construction, maintenance, and user costs are developed. Design details evolve from studies of capacity, sight distance, grade, curvature, superelevation, and channelization.

4. EXISTING CONDITIONS

Following deficiencies are found on our Urban Roads:-

(i) Width of median is too small and thus turning vehicles do not have sufficient place.

(ii) There are numerous places for turnings which are conflict points.

(iii) There are numerous street roads joining the major roads, without merging lanes.

(iv) Parked vehicles occupy the main through lanes. Proper parking areas should be developed.

(v) Merging lanes are either missing or too small.

(vi) Shoulders should be free of parked vehicles.

(vii) Water infringes on the running lanes, whenever there is rain due to lack of drainage of outer lane.

(viii) Lack of road markings.

(ix) Lack of road signs.

5. SUGGESTIONS

Lot of confusion and delays could be avoided if improvements of roads are carried out keeping in view the following:-

- Proper lane width
- Proper clearance from obstruction
- Adequate parking
- Elimination of animal drawn vehicles
- Separate lanes for cyclists
- Proper passages for pedestrians

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- Adequate parking
- Elimination of animal drawn vehicles
- Separate lanes for cyclists
- Proper passages for pedestrians

The tendency to provide a divider (median) on the roads without carrying out other improvements needed in a section of road would be creating problems instead of improvements.

Mismanagement and misbehaviour on the roads would lead to many delays and loss of life and damage to vehicles.

It is time we wake up and manage our vehicular and pedestrian traffic on scientific lines. If present situation continued to prevail there would be total confusion on our roads especially with increasing vehicular population in urban areas.

Attached drawings (figure 1 to 8) clarify various hurdles on our roads now-a-days.

We must evolve training programmes so that vehicle drivers are properly trained. Similarly we should develop traffic controlling authority so that we sincerely obey to road regulations for our safety and others security.

FIGURE-1

Houses & Shops
Houses & Shops
Houses & Shops
Houses & Shops
Houses & Shops
CONFLICTING MOVEMENT.
Houses & Shops

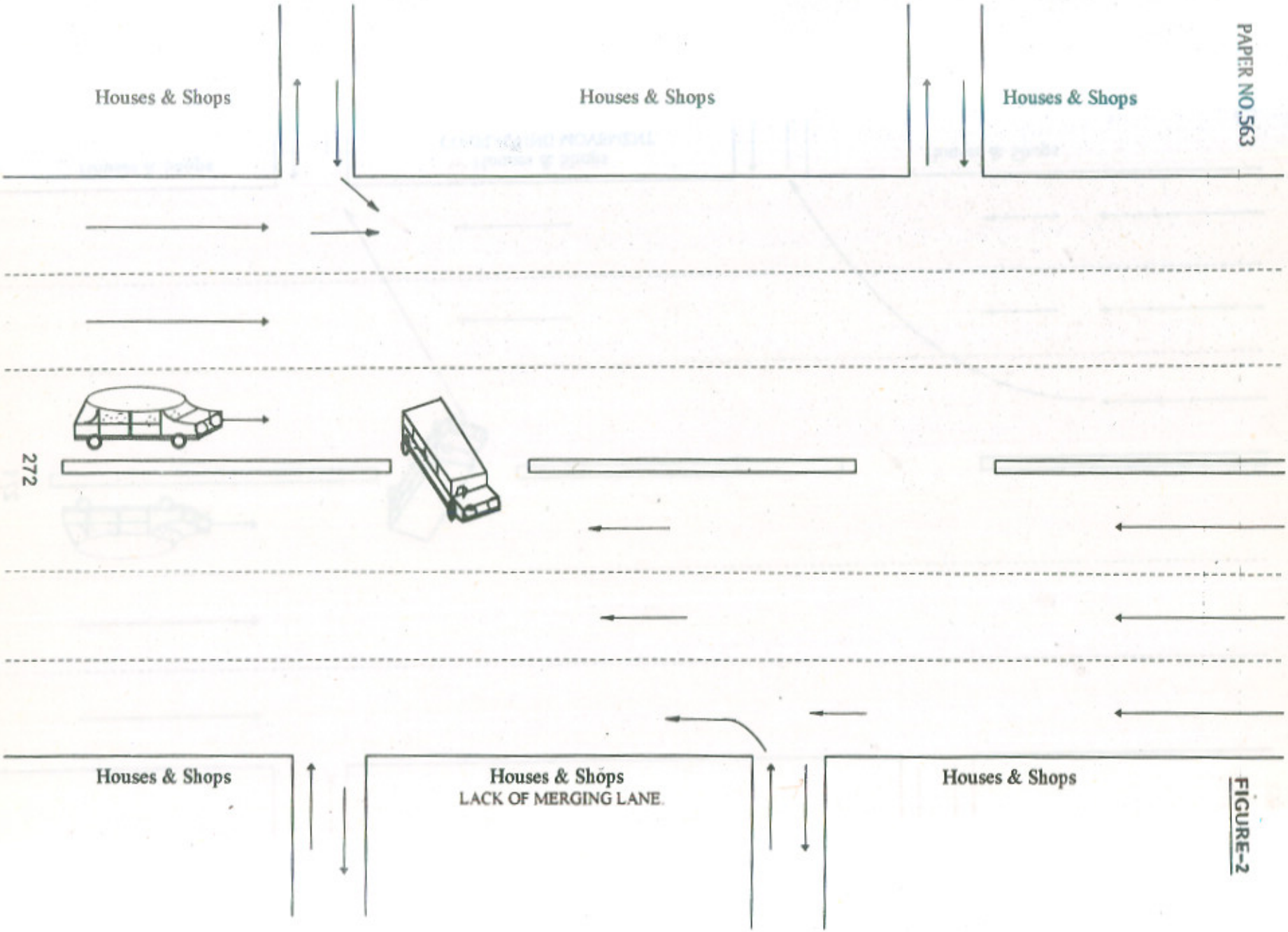

Houses & Shops
Houses & Shops
Houses & Shops
Houses & Shops
Houses & Shops
LACK OF MERGING LANE
Houses & Shops

FIGURE-2

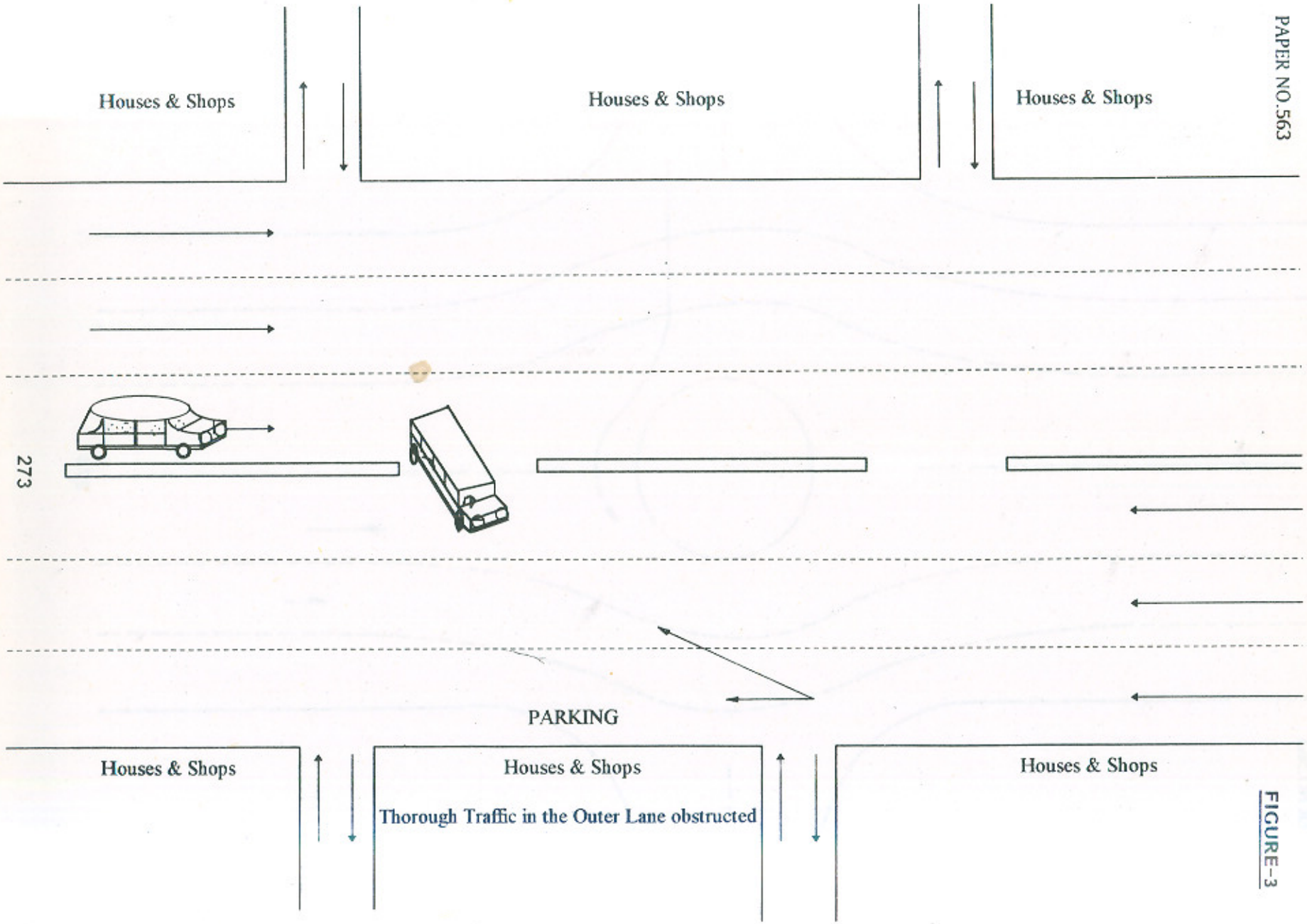
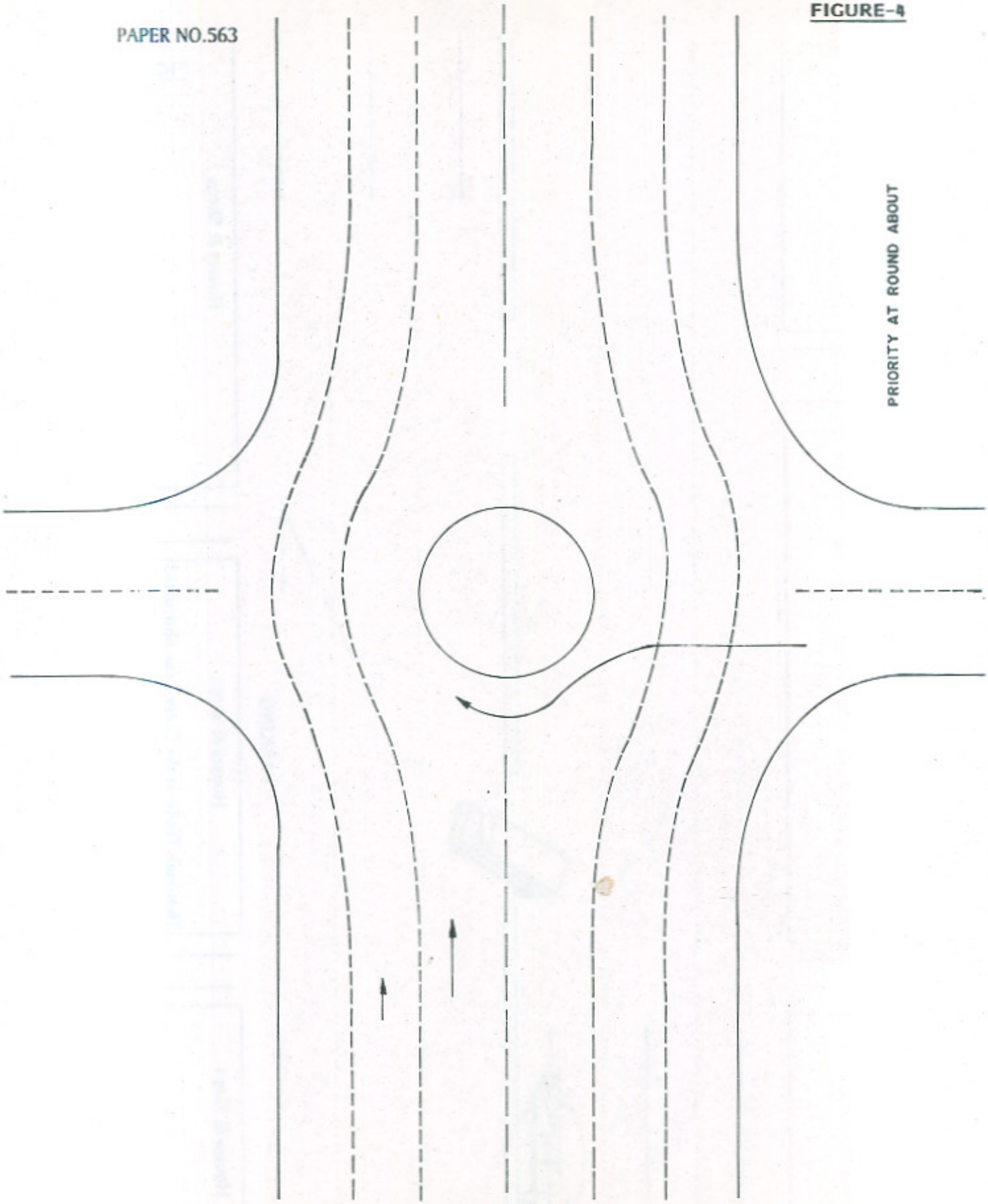

Houses & Shops
Houses & Shops
Houses & Shops
PARKING
Houses & Shops
Houses & Shops
Thorough Traffic in the Outer Lane obstructed
Houses & Shops

FIGURE-3

FIGURE-4



Houses & Shops
Houses & Shops
Houses & Shops
INSUFFICIENT
Houses & Shops
Houses & Shops
Houses & Shops
Insufficient distance between various openings in central median.

FIGURE-5

FIGURE-6

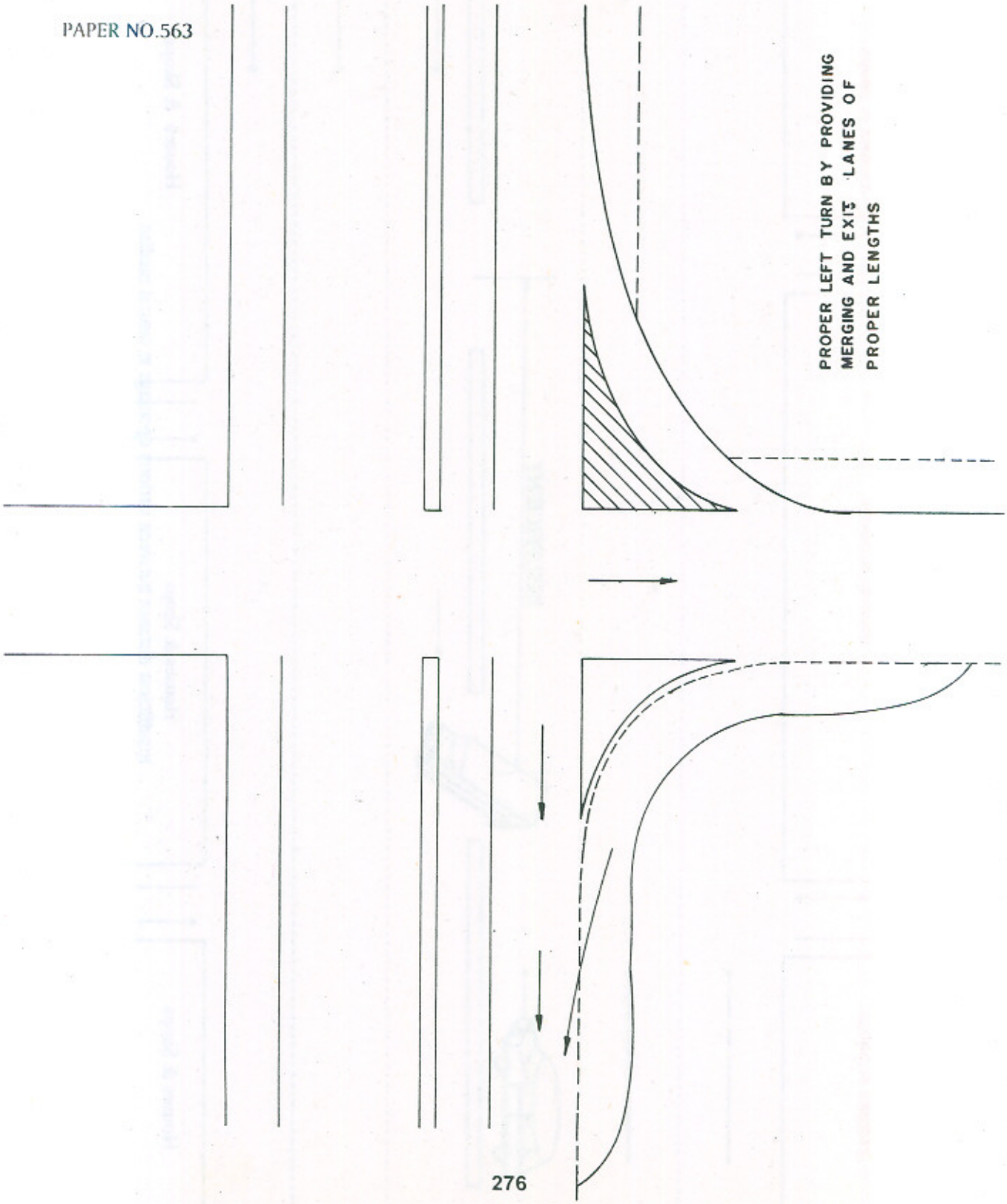
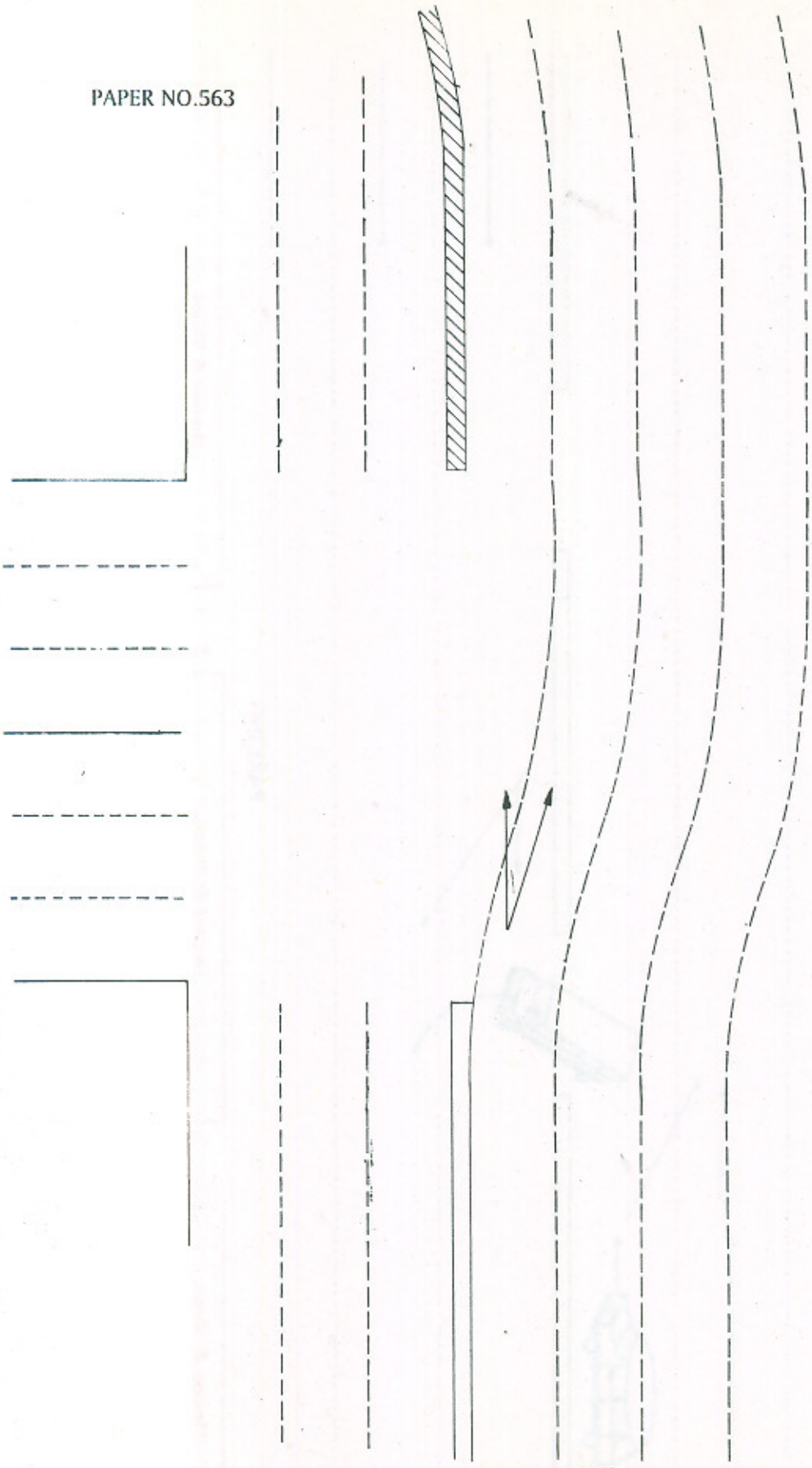
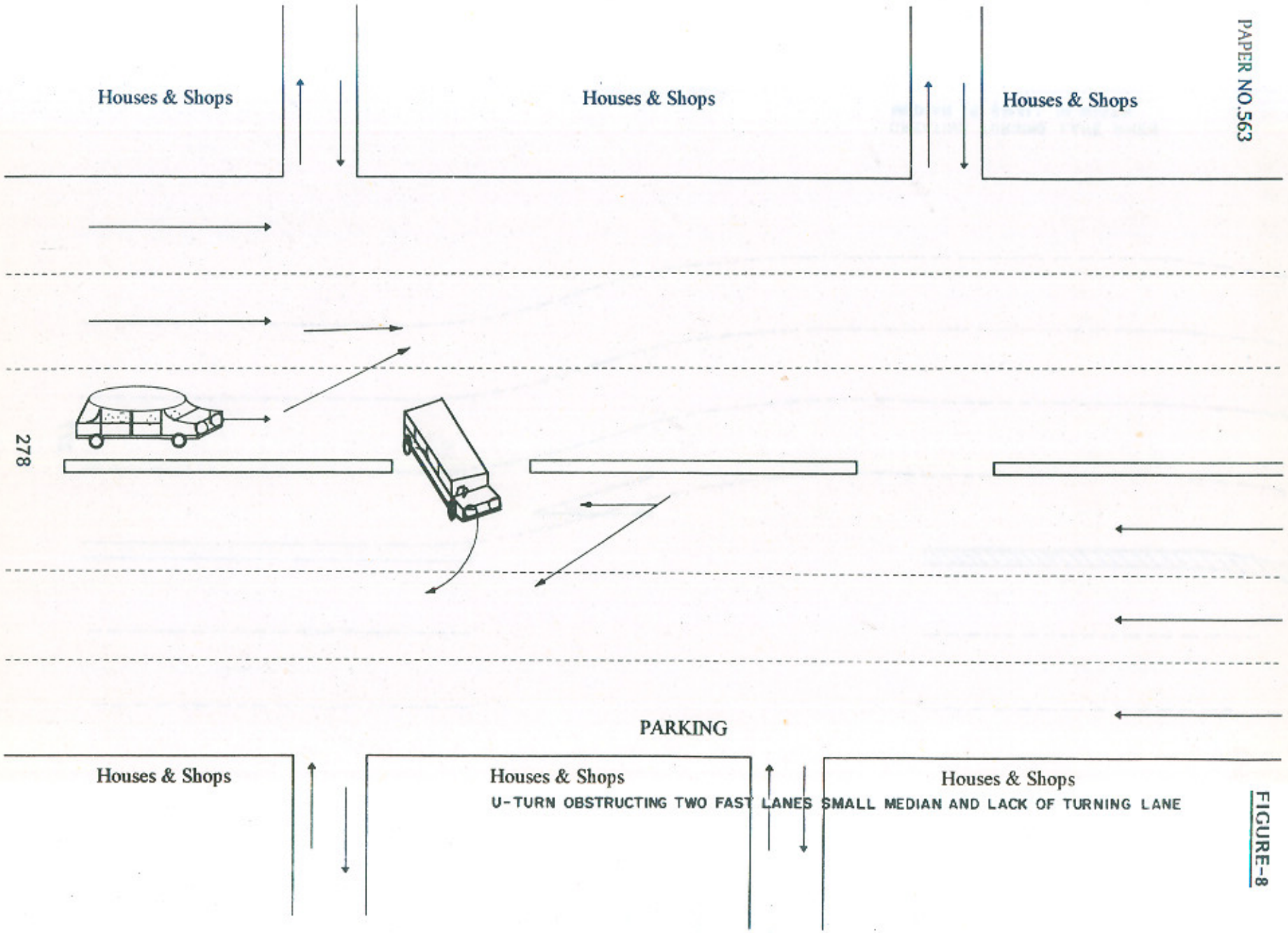

PROPER LEFT TURN BY PROVIDING
MERGING AND EXIT LANES OF
PROPER LENGTHS

FIGURE-7



CREATING TURNING LANE WHEN MEDIAN IS SMALL IN WIDTH.



U-TURN OBSTRUCTING TWO FAST LANES SMALL MEDIAN AND LACK OF TURNING LANE

FIGURE-8