EFFECTS OF UNCONTROLLED LOADING AND UNLOADING OF JEEPNEYS/ BUSES ON THE CAPACITY OF SIGNALIZED INTERSECTIONS

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abstract: The effects of uncontrolled loading and unloading of passengers by jeepneys(PUJs) and buses(PUBs) in the vicinity of signalized intersections were studied. A guideline for locating jeepney/bus stop with respect to the intersection was proposed. Some recommendations were given to minimize the effects of stopping/waiting of public utility vehicles(PUVs) on the traffic flow near the intersection.

1. INTRODUCTION

In Metro Manila, commuters rely heavily on passenger jeepneys and buses. Table 1 shows that more than 60% of the total person trips were made using these public utility vehicles. Frequent stopping of said vehicles to load and unload either anywhere or at designated stops is observed to disrupt traffic flow, and is perceived as one major cause of traffic congestion. Improper location of the stops with respect to the intersection and lack of bays also contribute a lot to the problem.

An uncontrolled loading/unloading of jeepneys/buses is defined in this paper as an activity in which drivers stop purposely either before or after the intersection to allow passengers to board or alight. This occurs most often when no traffic policeman or enforcer is present. But it also happens even when there is a traffic enforcer, who concentrates on the flow at the intersection but does not mind other related activities, such as loading and unloading, crossing of pedestrians, etc. There are factors which affect the behavior of the jeepney/bus driver with regards to stopping, namely: 1)points or locations where many waiting pedestrians gather, 2)occupancy of the jeepney or bus(driver's practice to wait for passengers close to the intersection when the vehicle has relatively few passengers.), and 3)lack of strict traffic enforcers. There is a much deeper cause for this behavior - the urge to earn more- for jeepney drivers, due to the so-called 'boundary' system and for the bus drivers, because of the 'commission' system.

Table 1. Transport Mode Share in Metro Manila

Year	1974	1980	1985	1989
Daily Person Trips, in millions	8.33	10.97	13.08	16.30
Mode Share, %				
Private Vehicle	37.4	25.60	27.50	35.20
Bus	16.4	15.80	15.60	14.60
Jeepney	46.1	58.50	56.50	49.40
Commuter Train	0.10	0.10	-	-
Light Rail	-	-	0.40	0.80
Mode Share, millions				
Private Vehicle	3.12	2.81	3.60	5.74
Bus	1.37	1.73	2.04	2.38
Jeepney	3.84	6.42	7.39	8.05
Commuter Train	0.01	0.01	-	-
Light Rail	-	-	0.05	0.13

Source: Department of Transportation and Communications

2. OBJECTIVES

In general, the study aims to obtain information on stopping charateristics of passenger jeepneys and buses within or in the vicinity of signalized intersections. More specifically, the paper seeks to:

a. determine the effects of loading/unloading of public utility vehicles on the approach capacity of the intersection, and;
b. develop guidelines on the location of jeepney/bus stops with respect to the location of the intersection.

3. LOADING/UNLOADING PRACTICES OF PUJ/PUBs

With regards to stops, road sections may be classified as:

a. free-stopping, i.e., jeepneys/buses may load/unload anywhere along the section;
b. with designated stop, i.e., jeepneys can load/unload only at designated locations within the road section.

Road sections with free-stopping are far more common in Metro Manila whereas road sections with designated stops are less common and even not well enforced at that. Along major roads, jeepneys stop at designated locations only. However, due to its peculiar design, any passenger can easily ride or alight while the jeepney is not moving(or even when the jeepney is moving!). This is a common site at the approach of an intersection during red indication of the traffic signal.

Enforcement on bus loading and unloading is very strict at some intersections along major arterials. Bus doors have to be closed while stopping at the approach. However, unruly behaviour of drivers can also be observed particularly after crossing the intersection, when every driver would try jacking for position at spots/locations where there are a number of waiting passengers. Cutting of one's path is not uncommon.

4. EFFECTS OF LOCATION OF PUJ/PUB STOPS

Based on existing practice, the location of stop has to be 30 meters away from the curb line, be it before or after the intersection. However, with the great number of jeepneys or buses wanting to make stops along major thoroughfares here in Metro Manila, overflowing of these vehicles is inevitable when the stop is located after the intersection. In the same token, double stopping often occurs when the stop is located before the intersection.(See Figure 1)

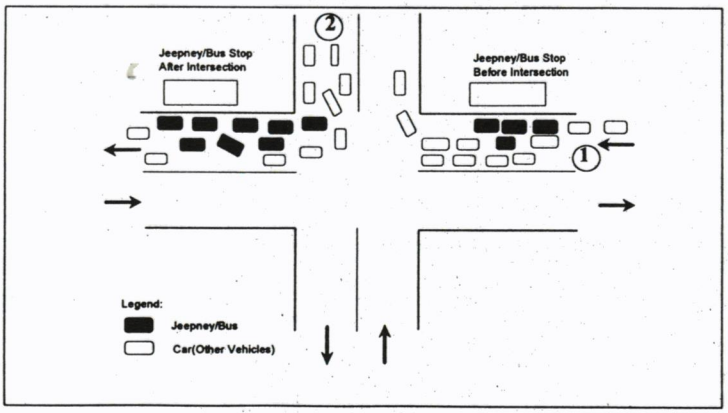

Figure 1. Location of Jeepney/Bus Stop

4.1 Effects of Stops Located After the Intersection

Some of the adverse effects of stops located after the intersection are as follows:

a. blocking right turn from other direction; this may not be severe since the vehicles may be able to use the next lane adjacent to the curb lane;
b. may cause blocking of path of through from other direction;
c. when there is long queue of stopping jeepneys, there is tendency to double-stop so as to avoid being caught inside the intersection which further causes blocking of through traffic in the same direction.

4.2 Effects of Stops Located Before the Intersection

With stops located before the intersection, the following may occur:

a. blockage of right turn traffic;
b. reduction of approach capacity by one lane almost 100% of the time; with the jeepney stop located before the intersection, even if the signal is green, the outerlane(curb lane) is always almost unutilized.

Table 2 summarizes the most likely effects of the location of stops with reference to the intersection. It will help the planner or the engineer in making a qualitative analysis and decision on the proper location of the stop depending on the criterion or criteria being used. Referring to Figure 1, for instance if traffic situation alone is to be considered and if in Approach 1, right turn and through traffic are heavy, and if in Approach 2, right turn traffic is light, then the stop has to be located after the intersection. If desired, each item may be assigned a weight in order to have a quantitative assessment.

Table 2. Effects of Location of Stops

Criteria		Location of Jeepney/Bus Stop	
		Before	After
a. Traffic Situation *Approach 1*			
i.Right Turn	Light	✓	—
	Heavy	×	—
ii. Through	Light	✓	✓
	Heavy	×	×
Approach 2			
i. Right Turn	Light	○	✓
	Heavy	○	×
ii. Probability of blockage of through		○ (low)	× (high)
b. Jeepney/Bus Drivers Chance to wait longer for passengers		○ (high)	✓ (low)
c. Passengers Passengers Expected Delay		× (more)	○ (less)

Note: (✓) - no adverse effect (○) - preferable/favorable (×) - not recommended

5. EFFECTS OF UNCONTROLLED LOADING/UNLOADING ON FLOW RATE

A signalized intersection with very congested approach was selected. The next intersection downstream is about 1.5km. and there was no observed effect on the intersection under study. The intersection was characterized by a high volume of jeepneys and buses stopping downstream right after crossing the intersection. Video coverage of the intersection was taken during morning peak and was analyzed with the help of a microcomputer.There was always long queuing at the intersection approach. Absence of loading and unloading bay before and after the intersection was noted. The exit was composed of three lanes; however, jeepneys and buses often used the outer lane for loading or unloading. Ten out of eleven cycles were observed to have outer lane blockage. The middle lane was also observed to be blocked many times although with shorter duration. Traffic flow rate, occurrence of blockage due to stopping jeepneys and buses on the outer and middle lanes, and duration of stopping were noted. Table 3 shows some pertinent information:

Table 3. Summary of Observation

Survey Location: Commonwealth Ave.-Iglesia ni Cristo Intersection
Approach: Commonwealth Ave.(Manila-bound) Date: 23 February 1995, AM Peak

Run #	Green time sec.	Cycle time sec.	Flow Rate* (during green)	% blockage+ (middle lane)	%blockage+ (outer lane)
1	46	75	1721	0.00	0.00
2	111	145	1454	8.14	73.53
3	181	225	1288	27.61	85.16
4	59	92	1477	0.00	38.25
5	90	130	1500	10.57	82.57
6	136	168	1225	18.39	78.37
7	184	211	1327	0.00	91.26
8	130	180	1332	4.28	83.49
9	138	173	1337	7.67	69.87
10	120	157	1408	9.00	73.00
11	149	195	1483	1.03	64.62

Note: * effective flow rate for each lane + as percentage of green time

5.1 Effects of Blockage on Flow Rate

Figures 2 and 3 show the decreasing flow rate as the percentage of middle lane and outer lane blockage increase. Outer lane blockage and middle lane blockage cannot be taken as independent events since it was observed that whenever there was occurrence of middle lane blockage, there was prior blockage in the outer lane.

5.2 Effects of outer lane blockage alone

To determine the effects of outer lane blockage alone, data points with no middle lane blockage were taken from Table 3(Run Nos. 1, 4, and 7). Regression line for these data points is shown on Figure 4. Further study on this is necessary since very few points were represented.

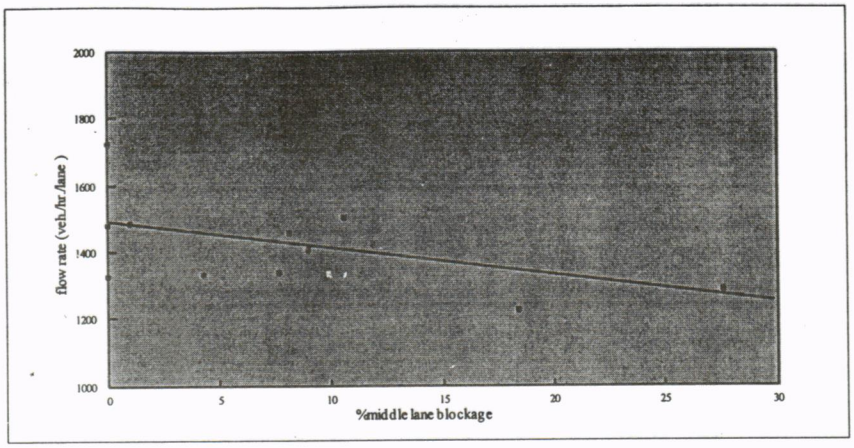

Figure 2. Effect of middle lane blockage on flow rate

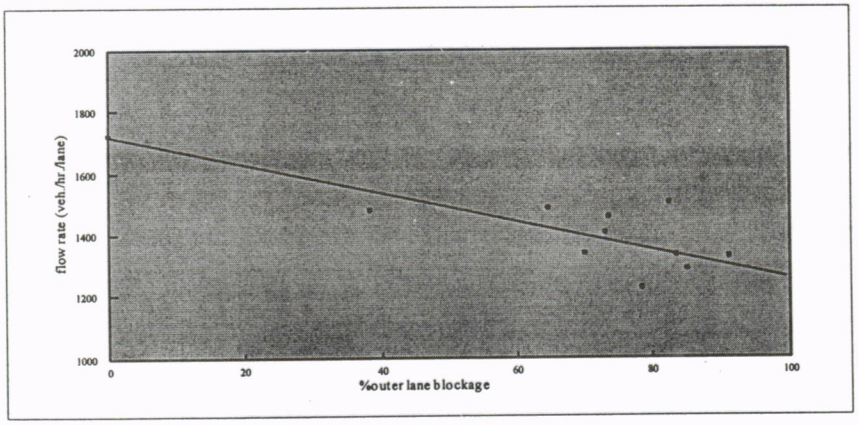

Figure 3. Effect of outer lane blockage on flow rate

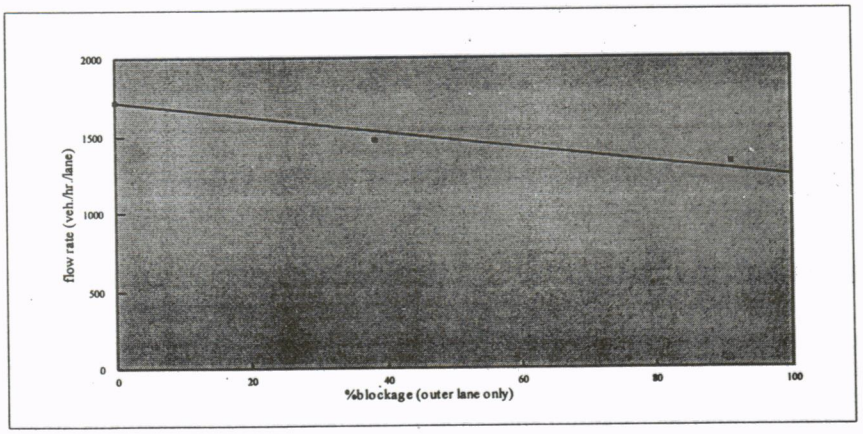

Figure 4. Effect of Outer Lane Blockage Alone on Flow Rate

6. DURATION OF STOPS OF JEEPNEYS AND BUSES

Table 4 shows the duration of stops of jeepneys and buses in order to load and unload after crossing the intersection. It is worth noting that the average stopping time(service rate) for jeepneys and buses are almost equal(11.4 and 11.3 sec., respectively).

Table 4. Service Rate Frequency Table

Class #	Interval (sec.)	Frequency	
		Bus	Jeepney
1	0-5	4	6
2	5-10	9	20
3	10-15	8	14
4	15-20	4	8
5	20-25	0	1
6	25-30	0	3
7	30-35	1	0
8	35-40	1	1
MEAN		11.3 sec.	11.4 sec.

Figure 5 shows almost the same pattern for the service rates of jeepneys and buses.

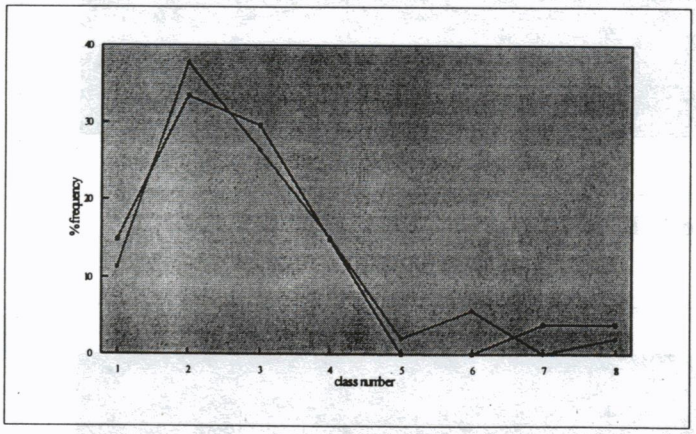

Figure 5. Service Rate(Duration of Stops) of Buses and Jeepneys

7. RECOMMENDATIONS

a. During peak hours, it is recommended to regulate the stopping of jeepneys/buses before or after the intersection as it has been shown to affect severely the capacity of the intersection approach.
b. Every intersection must be carefully studied as to the location of jeepney/bus stops(i.e., before or after the intersection). Unless it can be shown otherwise, jeepney stops should be located BEFORE the intersection. However, when the green signal starts, the drivers

should be instructed to proceed and cross. The next stop downstream should be far enough(about 50 to 100m.). The table proposed in this paper can be used as a guideline.

c. Strict law enforcement and penalties against drivers must come into play. Ways to instill discipline in the minds of commuters must be initiated through mass media.
d. Provision of jeepney/bus bays should be considered so as to minimize the effects of stopping/waiting on traffic flow.

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