TRAFFIC OPERATION IMPROVEMENTS

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Transportation system management applied to traffic engineering operations requires reevaluating basic transportation needs of those who walk, use public transportation, or drive automobiles. Replacing existing control mechanisms is not adequate. New ways must be devised for optimally sharing limited rights-of-way. Signs, channelization, traffic signals, reversible lanes, and ramp-metering policies are discussed in this paper.

Many urban communities have not applied all of the traffic engineering principles available for meeting the increasingly complex transportation needs. Traffic engineering in some less progressive areas has been viewed as a maintenance function, that is, replacing existing things in kind, rather as traffic system management. Transportation physical plants undergo constant change, and that change mandates more than keeping intact those things that worked in past years. The engineer's role is to provide improved service to meet changing needs. The resistance to change by long-established private sectors requires careful and systematic documentation of need. The supply of transportation space in urban communities is nearly static while the demands on the space increase each year.

The rise in concern about the quality of life in the urban environment is adding significantly to traffic and transportation management problems. Urban communities are seeking ways to increase amenities in their cities, and this requires space. The most apparent space is the public rights-of-way. Increasing amounts of it are being turned over to pedestrian facilities. Making space for pedestrians normally requires taking space from vehicles. I will examine many of the tools that we have available for making these trade-offs. As professionals, we must offer alternatives that our client groups can understand and weigh to make appropriate decisions.

A typical urban street is a multimodal facility and a terminal facility as well. It must, therefore, be managed properly. Some communities do such a poor job of management that the merchants have taken over the total sidewalk area for retailing and the remaining portion is taken over by newsstands. Parking is the next aspect of street space use. According to the Magna Carta, the King's highway was primarily for the movement of troops and not the stabling of horses. Guidelines clearly indicate that, if hundreds or thousands of people can use the same limited street space that can be occupied by a few people parking, then the public is better served by the movement function. Managers frequently find that shared use of this space is most efficient: movement during certain periods and loading or parking during others. When I worked in Phoenix, a parking space was normally a parking space, a loading zone was normally a loading zone, and a bus stop a bus stop. However, I found in Seattle that sometimes a given space was a parking space, sometimes it was a loading space, and sometimes it was a bus stop. Although confusion can occur, we find that with clear signing the system is quite workable.

Flexibility is a key word in traffic system management. If we have no capacity problems, then we are better off to have a consistent traffic control system—one in which a rose is always a rose and does not at 4:00 p.m. become a turnip. We are aware that through conditioning people drive by habit and relate only partially to outside stimulants. A new signal at an intersection where motorists are used to driving through without stopping may not get immediate compliance. People will still stop at a location where a stop sign has been removed until they become conditioned differently. The potential for accidents goes up significantly when such changes are made. The demand, however, for more efficient management requires that we have the flexibility to change.

The task of transportation system management becomes most difficult in those locations where demand is most competitive for the limited street space, particularly at intersections that have capacity less than that of those streets feeding them. One of the most effective tools is the traffic signal system that determines the sharing of the limited street space in equitable time intervals, eliminates the conflict, and makes the flow smoother. However, before appropriate signal control equipment is selected, the questions of most efficient directional flow need to be addressed and the questions regarding one-way, two-way, or reversible flow roadways must be answered.

ONE-WAY SYSTEMS

Nearly all existing urban streets were originally designed for use as two-way streets. One-way streets are usually installed to reduce congestion, but they also have important safety benefits. Because one-way streets handle traffic only in a single direction, they are commonly operated at least in pairs. The two streets should be located parallel and as near to each other as possible to reduce confusion and out-of-direction travel. They essentially operate as a divided highway, with a wide median being the blocks separating the two one-way streets. Capacity of a one-way street system may increase by 20 to 50 percent over the capacity of a two-way street system, primarily because of reduction in conflicts with turning vehicles. Similarly, traffic safety is normally improved 10 to 50 percent. The one-way system acts to platoon vehicles and thereby produces gaps in traffic for safer cross maneuvers by both vehicles and pedestrians. In general, a one-way system reduces travel time from 10 to 50 percent in spite of increases in overall traffic volumes.

Although the economic impact of converting to a one-way system will vary from place to place, the results of a Michigan study revealed that there was no indication of an adverse economic influence on business activity in the one-way corridor and that the number of business failures was reduced substantially after the one-way conversion. Such general improvements in traffic operations must be balanced against the following negative aspects:

1. Some vehicles must travel extra distances to reach their destinations;
2. Strangers may become confused with a one-way pattern;
3. Transit operations may be adversely affected (this factor must be taken into consideration before the one-way street system is implemented); and
4. An emergency vehicle may need to take a more circuitous route to reach its destination (this may be alleviated somewhat by fire preemption equipment or

traffic signal controls that would allow emergency vehicles preferential treatment).

A one-way street system strongly affects traffic signal operations. Traffic signals can always be progressed to provide continuous flow on one-way streets, but this can seldom be done on densely populated two-way streets. If a substantial pattern of alternating one-way streets exists (both north-south and east-west in an urban grid system) it is frequently possible to have a one-quarter cycle signal offset that will allow progressive movement at reasonable speed for all the downtown street system. This is never possible with a two-way downtown grid system.

REVERSIBLE LANES AND ROADWAYS

Seattle began reversible lane operations in 1953 and has as many as four reversible roadway sections in operation at one time. This traffic engineering concept has been applied to arterial streets as well as to freeway facilities. The concept, which is applicable in most urban areas where traffic flow is highly imbalanced, is generally applied only during peak-hour traffic conditions when a heavy flow of traffic volume can be sustained in the reversed roadway making it quite evident to the off-direction traveler that the lane is being used by the predominant traffic flow. Many of the inherent safety hazards of this type of operation can be obviated if such concepts are an integral part of the new design. For example, the 12-lane Seattle Freeway is built in three parallel sections; four lanes are reversed inbound in the morning and outbound in the evening. The system employs separate ramps as well as separated roadway. Consistency of operation is a significant factor so that commuters become accustomed to the operation. Special attention must be given to terminal conditions and access points. Care must also be exercised not to leave the operation in during periods of light traffic if the opportunity for wrong-way entering of the facility exists. Applications of reversible roadways have been successfully installed by using only signs and markings. Wherever possible, the installation should include lane control traffic signals together with physical barriers, traffic cones, barricades, or other similar devices.

CHANNELIZATION

Turbulent flow has less flow capacity than smooth flow. Anything that can be done at an intersection to reduce this turbulence will enhance capacity. The most common obstruction in the stream of traffic is a left-turner waiting for a gap in opposing vehicular and pedestrian traffic. Three primary alternatives exist. The first is to prohibit the turn. Frequently, the street pattern is such that a motorist can reach the same destination by making a left turn at some previous, less-congested intersection and experience little or no time penalty. Peak-hour turn restrictions are the most commonly used and yield flexibility by allowing the turn during off-peak hours for more direct access. Care must be exercised before installation to determine whether prohibition will solve the problem or relocate it at adjacent intersections.

The second alternative is to provide a left-turn lane exclusively for turning vehicles. This may frequently be accomplished by removing parking on approaches to the critical intersection or acquiring minor amounts of right-of-way or reducing the street margin and sidewalk area. Significant reductions of rear-end accidents can be expected. Similarly, capacity improvements can frequently be attained by a continuous two-way left-turn lane on a two-way arterial street. The prevalence of automobile-oriented, strip developments on urban highways frequently makes installation of a left-turn lane a necessity. The probability of head-on accidents on a two-way lane, initially feared by traffic engineers, has never materialized. Seattle, with more than 160 km (100 miles) of two-way lane marking in operation, has in fact experienced significant reduction of accidents in this category. The lanes also provide some degree of pedestrian refuge.

The third method is to provide an exclusive traffic signal interval to accommodate left-turn movements. Careful study must be given to such installations to ensure that ample time can be set aside for the movement without creating undue congestion by taking time away from through traffic movements. Where unbalanced flow exists, frequently a leading or lagging left-turn arrow may be provided. Analysis of street widths, traffic platooning characteristics, pedestrian volumes, and other factors is necessary to determine what is the best application.

Other geometric design and channelization improvements should also be considered. Included in these may be increasing certain curb radii to enhance the flow of transit or commercial vehicles and reviewing the width of driveways to ensure easy access and egress from commercial properties.

SIGNING AND MARKING

Signs that control the use of the street must be continually updated to ensure that they meet current conditions of traffic volume and safety and needs of abutting street property. The first requirement of a good sign is that it fulfill a need. If drivers are not adequately advised, they cannot take appropriate action and then both capacity and safety are diminished.

Similar attention needs to be given to pavement markings. Transit routes change. Vehicles get wider. Traffic volumes increase. Offsetting of the centerline together with restricting parking may be an appropriate action. More appropriate lane widths may help capacity. Even the ability to see the line is sometimes a problem. During rain and night conditions raised pavement markers provide guidance that paint cannot provide.

RAMP METERING

The basic premise of ramp metering is that more capacity and safety can be gained if traffic using a facility is controlled rather than allowed to build until it produces congestion levels that impede traffic flow. Ramp metering raises the question of who shall be served. The ability to give high-occupancy vehicles preference on major highway facilities can easily double their current carrying capacity. The manner in which a system of this nature is implemented is highly critical in that most freeway facilities were designed for free-flow rather than metered operations. If appropriate metering rates are not established, severe impacts can ensue on the feeding arterial system. Inner-city dwellers have difficulty accepting a system that gives preference to long trips. A balance needs to be exercised to ensure that those people who are willing to live closer to their destinations and thereby use less energy and less transportation physical plant are not preempted by those who make longer, less energy-efficient trips. A systematic review of the entire traffic corridor is needed to determine the impacts of a ramp-metering program.

SIGNALIZATION

The mystique that surrounds most traffic signal systems

leads most citizens to believe that, if the engineer were only smart enough, they would always receive a green light. That mystique also leads uninformed administrators to believe a traffic signal system requires a super computer. The task of the transportation system manager is to find the most cost-effective solution.

Traffic signal systems fall into two basic categories: (a) fixed-time traffic systems and (b) traffic-responsive systems. The traffic-responsive system detects and responds to actual traffic movements. One must first ensure that existing signals are warranted and second that potential new installations are warranted. One must then determine traffic flow characteristics. Is there a repetitive daily traffic flow that can be anticipated within reasonable bounds and programmed into a fixed-time traffic system, or does the traffic flow fluctuate sufficiently to require a traffic-responsive control logic?

Advances in computer technology are beginning to allow us to monitor what the traffic signal is doing at each location. In the past, we relied on visual observations by technicians or police personnel. Accurate assessments need to be made of current traffic control equipment. What is the failure rate of current equipment? What are the consequences of failures being experienced? What technology is now available to obviate this type of failure? How much can we afford to pay for the increased level of sophistication? Studies should include not only the increased capital cost of added sophistication but also the increased load to the current maintenance program. How much additional operating programming staff will be needed?

SUMMARY

The transportation system management requirement of the federal planning and funding programs is brought about largely by significant concerns relating to energy, clean air, and the most economic way to manage transportation. Traffic engineering techniques have always been geared to the cost-effective use of existing facilities, and political and funding efforts are now emphasizing those techniques. No time in history has ever been more opportune for implementing traffic engineering programs, which are highly visible and greatly needed.

FREIGHT MOVEMENT: A CRUCIAL COMPONENT OF TRANSPORTATION SYSTEM MANAGEMENT

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This paper points out how important freight movement is to the functioning of the urban economy, how urban development can be encouraged by including freight movement in the urban transportation planning process, and how the inclusion of freight movement is both logically and legally supported. It is appropriate to apply planning funds to freight movement if these activities are included in the unified planning work program. Thus, the types of freight planning activities considered appropriate can be as varied as the cities that apply for those funds as a portion of their unified planning work programs. The important role of freight planning in the transportation system management (TSM) element is explored. Examples are given of TSM actions that can significantly improve the flow of both freight and people by reducing the conflicts between these essential activities.

The crucial role of freight movement in urban areas is aptly pointed out in the advertisement of the American Trucking Associations: "If you've got it, a truck brought it." Although this statement may be an exaggeration, it makes the point that movement of freight in urban areas by trucks is essential to economic functioning—even survival—of urban communities. The movement of freight, therefore, should receive attention in the urban transportation planning process in a degree commensurate with its importance. Yet, some claim that it receives little or no direct attention in the planning process and that the attention it does receive is not adequately directed to the issue of efficiently moving freight.

The most available means for influencing the efficiency of freight movement is to include considerations of freight movement in the transportation planning process. This would bring us closer to the basic purpose of planning: to improve the quality of life. In fact, there are efforts that are expanding the planning process to specifically address the quality of life (2, 3). Unfortunately, many planners shy away from this broad purpose of planning by confining their perspectives to already familiar ones such as planning for passenger movement.

This paper shows that the inclusion of freight movement in the transportation planning process is both a logical and a necessary action. It presents arguments and examples that illustrate how a community's well-being is dependent on the efficient movement of freight. It also points out that this can be done through adjustments to the existing programs with minor redirection of planning funds. Often a significant improvement in transportation system efficiency can be achieved by giving a little extra effort to the impacts of planning recommendations on freight movement.

IMPORTANCE OF EFFICIENT FREIGHT MOVEMENT

The dependence on efficient freight movement is dramatized by occasional short-term breakdowns in the supply of freight transportation services to and from businesses and homes. A severe storm prevents supplying supermarkets with food or homes with heating oil. Truck strikes prevent supplying freight to businesses, causing them to close down and lay off workers. Sanitation workers strike, and the accumulation of refuse causes significant health hazards. These and other dramatic cases of disruptions to the efficient flow of freight attract considerable attention and reinforce its importance.

These are extreme cases in which the supply is cut off or, stated from the demand point of view, in which