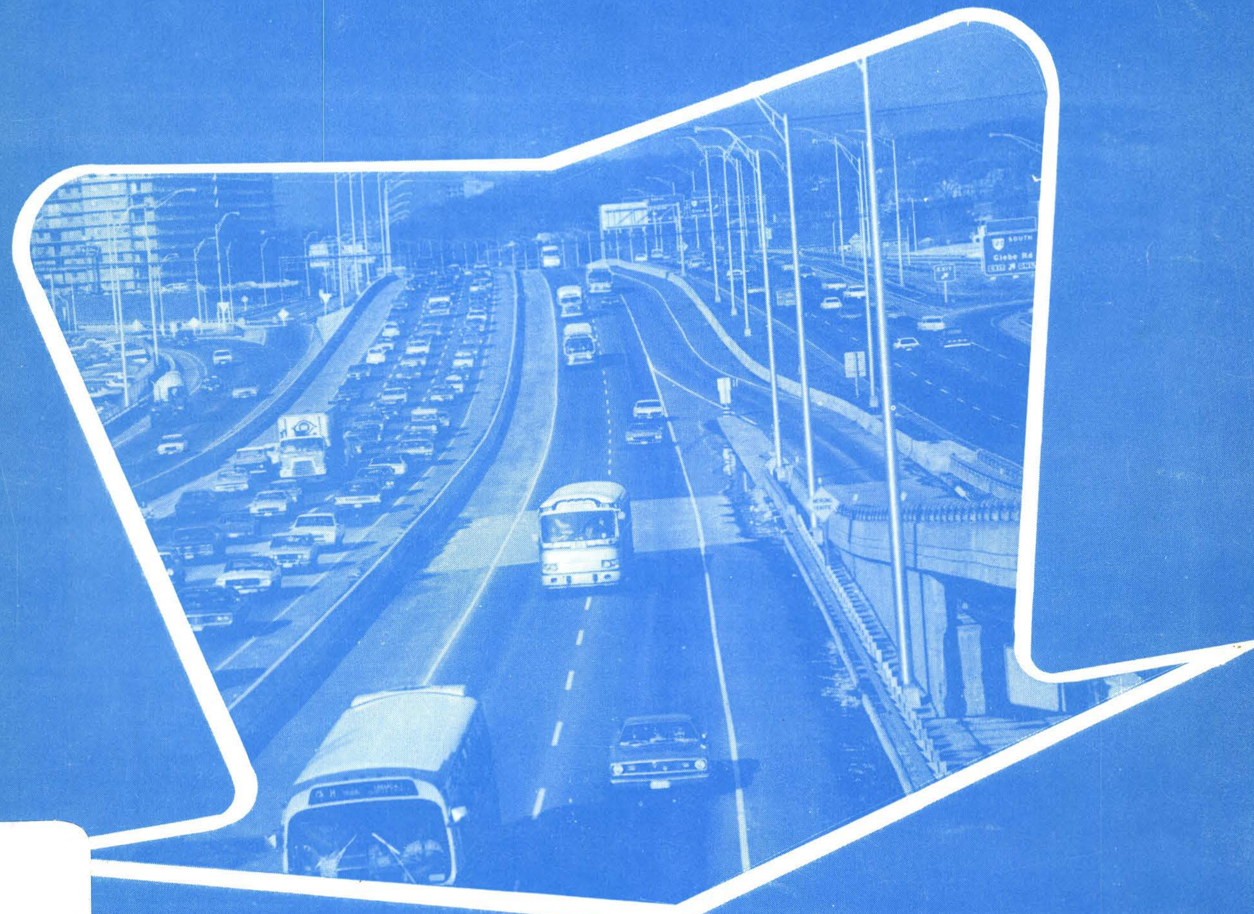
PREFERENTIAL TREATMENT for HIGH OCCUPANCY VEHICLES



U.S. DEPARTMENT OF TRANSPORTATION
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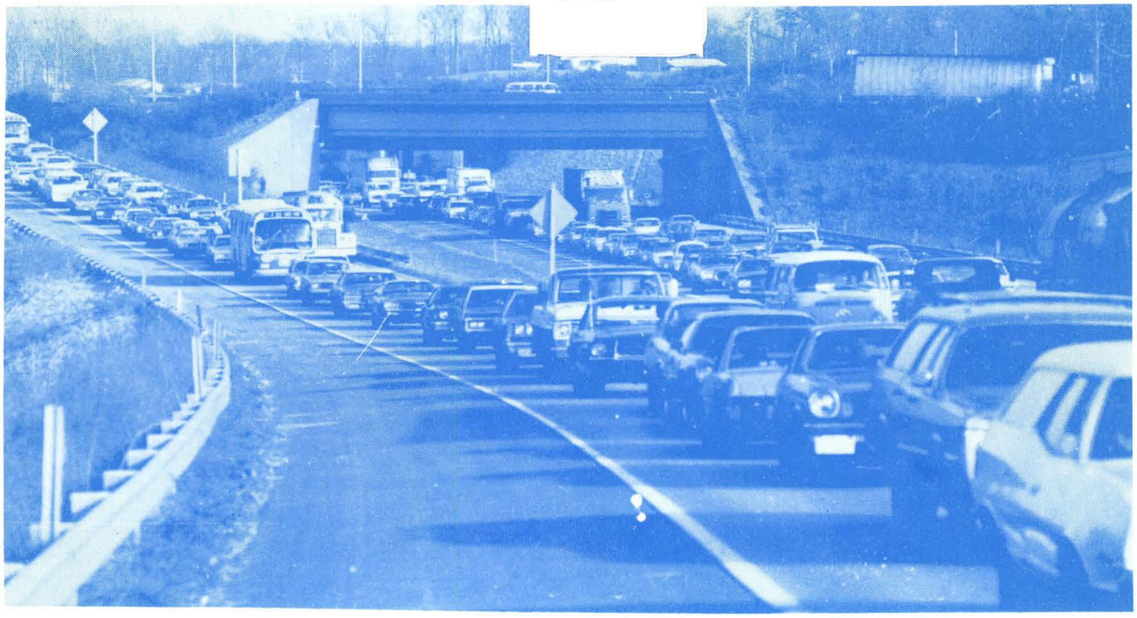
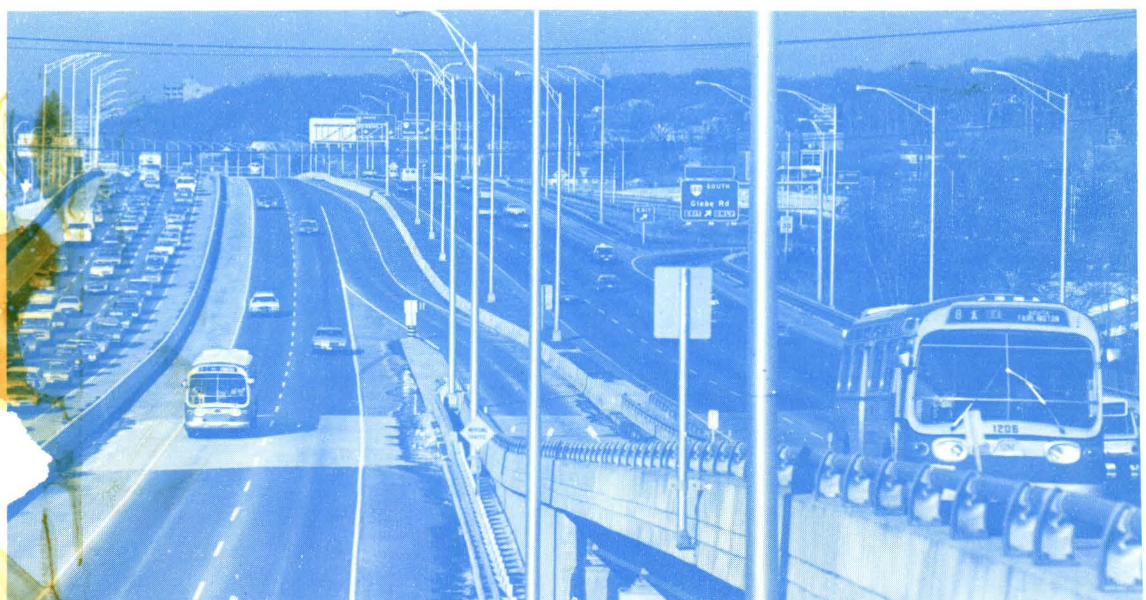




CONTENTS

*************************** INTRODUCTION ***************************

The suggestion that the peak period capacity of our urban roadways could be augmented without increasing the number of vehicles using these roadways, would - at least until very recently - elicit skeptical responses at best. The further suggestion that this could be accomplished quickly, inexpensively, and in an environmentally advantageous and energy-conservative manner, would have been dismissed as just another wishful thought perpetrated by transportation planners. Yet, on congested roadways across the nation, projects providing preferential treatment for high occupancy vehicles are quickly proving that the achievement of such seemingly lofty goals is both feasible and practical.

Key to the success of these projects has been the interpretation of the concept of highway capacity in terms of the maximum movement of people rather than vehicles. For example, an existing freeway traffic lane reserved for the exclusive use of buses can increase the person moving capacity of the lane by several orders of magnitude. It has been conclusively demonstrated that such an exclusive bus lane can accommodate peak hour volumes of over 25,000 passengers with capacity to spare; in contrast, 2,600 persons per hour is the maximum volume that can be expected on a mixed traffic lane without buses under ideal conditions (using the national average occupancy of approximately 1.3 persons per vehicle during rush periods.)

The provision of exclusive or preferential lanes for high occupancy vehicles is not enough by itself. In order to capitalize on the potential capacity, positive incentives must also be provided to attract transit riders from driver-only autos, and to encourage carpooling among those not served by transit. Such features as modern express buses, fringe parking lots, bus terminals, free or reduced rate parking for carpools, in addition to time and cost savings, can all work together to induce the driver-commuter to switch to a higher occupancy mode.

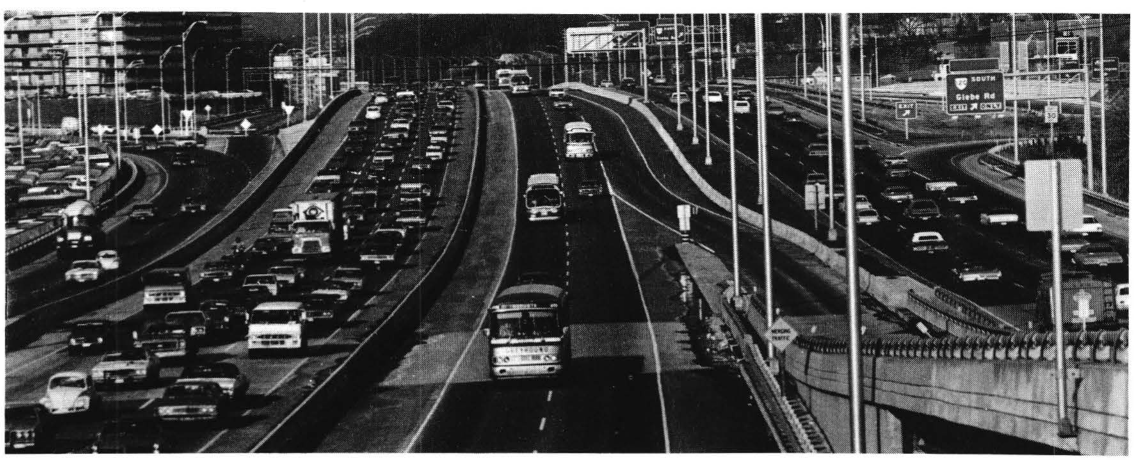
This publication illustrates several innovative techniques for providing preferential treatment for high occupancy vehicles.

******* EXCLUSIVE FREEWAY LANES FOR CARPOOLS AND BUSES *******

To encourage the more efficient utilization of limited freeway facilities in urban areas, lanes have been reserved for the exclusive use of carpools and buses on several major freeways in the United States. The projects described here range from specially constructed busways to contra-flow lanes, where buses make use of an underutilized lane from the opposing traffic stream.

SHIRLEY HIGHWAY (I-95) - Northern Virginia

- *Two reversible median lanes reserved for high occupancy vehicles, with special bus access ramps at interchanges.*
- *Eleven-mile facility from Springfield, Virginia, to Washington, D.C.; nine miles completed to date.*
- *Implemented in stages from 1969 to 1971. Opened to carpools with four or more occupants December 10, 1973.*
- *Financed with Interstate funds. UMTA funds of $5.6 million for new buses, fringe parking, shelters and project evaluation.*
- *Time savings of 10 to 15 minutes; 30 minutes during height of Shirley Highway reconstruction.*
- *Over 16,000 round-trip passengers on 300 buses use the facility daily.*



Shirley Highway bus and carpool lanes.

Exclusive bus ramp to Shirley Highway bus and carpool lanes.

The Shirley Highway, a 17½-mile section of Interstate 95, serves as one of the principal corridors for Northern Virginia commuters employed in and around the Pentagon and downtown Washington, D.C.

As early as 1964, plans were initiated to provide two exclusive, reversible bus lanes as part of the proposed widening of I-95. The practicality of these plans was examined by a study funded by the Federal Highway Administration in 1968. As a result of an interim recommendation of the study, the first 5-mile section of the exclusive lanes was opened to bus traffic in September 1969. An additional 4 miles of temporary busway was opened in spring 1971, allowing buses to utilize the exclusive roadway all the way from Springfield to Washington, D.C. Due to continuing construction in conjunction with the widening of I-95, parts of this 4-mile segment of the busway are still restricted to a one-lane operation.

The reversible lanes are used in the peak direction during the morning and evening rush periods, with a total of more than 16,000 daily bus passenger trips in each direction. Bus patrons accrue substantial time savings over automobile occupants traveling in the regular lanes. This traveltime advantage, combined with improvements in routing, scheduling and equipment, have all contributed to the ever growing success of the busway. It is noteworthy that while the number of automobiles using the Shirley Highway in the last year during peak hours has doubled - due to the completion of several major improvements - bus ridership has not diminished.

The entire busway project is complemented by reserved rush-hour bus lanes on 14th Street and other major arterials in downtown Washington. An Urban Mass Transportation Administration (UMTA) grant in 1969 provided additional funds for modern new buses, passenger shelters, fringe parking lots and an evaluation program for the entire project.

On December 10, 1973, the 9-mile completed portion of the bus lanes was opened to carpools with 4 or more occupants. Even though the carpools must exit from the priority facility before reaching Washington, they still enjoy a 10-minute traveltime advantage over lower occupancy automobiles. Carpools and buses will share the entire length of the facility when the Shirley Highway reconstruction project is completed in 1975.

Temporary busway during Shirley Highway reconstruction.

SAN BERNARDINO BUSWAY - Los Angeles

- *Two lanes, one in each direction, reserved for buses at all times.*
- *Eleven miles of busway along the San Bernardino Freeway; 7 miles of busway within freeway median, 4 miles alongside the freeway.*
- *Seven-mile median busway lanes opened January 1973; remaining 4 miles to be completed in 1974.*
- *$60 million cost - includes engineering, right-of-way, construction, terminals and buses.*
- *Time savings of 10 minutes or more, depending on freeway congestion.*
- *1,000 peak-period passengers initially; increased to 2,500 upon completion of terminal and fringe parking lot; 17,000 daily round trip passengers expected upon completion of project.*

The San Bernardino Busway was conceived early in 1970 to provide express commuter bus service between a fringe parking facility in El Monte and the Los Angeles CBD, a distance of 11 miles. The first 7 miles was completed in early 1973, and limited bus service began in February of that year. Regular service followed in July, upon completion of the El Monte terminal and fringe parking facility.

San Bernardino Busway in Los Angeles.

El Monte Terminal and fringe parking for the San Bernardino Busway.

The 7-mile portion beginning at the El Monte terminal consists of one 17-foot bus lane in each direction. Located in the median of the freeway, the bus lanes are separated from regular traffic by 10-foot shoulders delineated by plastic traffic posts. The remaining 4 miles of busway are being built alongside the freeway. This section consists of one 12-foot lane in each direction with 4-foot exterior and 8-foot interior shoulders; the bus lanes are further separated from each other and from regular freeway traffic by concrete barriers. As part of the project, two additional bus stations are being built along the busway route. The total cost of the project, including right-of-way acquisition, construction and equipment (100 new high-speed buses), is estimated at $60,000,000. Approximately $48,000,000 of this cost is being financed jointly with FHWA and UMTA funds ($40,000,000 from Federal-aid Interstate funds.)

Patronage has increased steadily, from 1,000 passengers opening day in January 1973 to 2,500 peak period passengers (one-way) in July of that year, when the El Monte terminal and fringe parking facility was opened to the public. Projections are for 17,000 round-trip passengers daily when the full 11 miles of the busway become operational. Data collection and evaluation efforts for the entire project will continue through 1976.

INTERSTATE-495 - Northern New Jersey

- *Underutilized lane of outbound roadway reversed for exclusive use of inbound buses during morning peak period. Special access ramps provided.*
- *2½ miles in length; opened to bus traffic December 1970.*
- *Total cost: $634,000; time savings of 8 to 15 minutes.*
- *40,000 bus passengers on 950 buses during typical morning peak period.*

The scheme for a contra-flow freeway bus lane on this 2½-mile segment of I-495 between the New Jersey Turnpike and the Lincoln Tunnel was implemented in 1970 following a series of studies and field tests. During the morning peak period, the underutilized inside westbound traffic lane of this six-lane freeway is reversed to become a fourth lane in the peak eastbound direction, for the exclusive use of buses. The bus lane is clearly marked by manually placed plastic traffic posts every 40 feet along the lane striping, 80 directional signs mounted directly over the westbound lanes and 50 changeable message traffic signs.

Contra-flow bus lane on I-495 approaching the Lincoln Tunnel.

Buses enter the exclusive lane on a specially constructed, grade-separated ramp at the New Jersey Turnpike interchange with I-495. Since the contra-flow lane is only 11 feet wide and has no shoulders, a standby tow truck near the bus lanes is available to remove disabled vehicles immediately.

The highest flows on the bus lane were experienced during transportation emergencies created by commuter railroad strikes. During the peak period 50,000 passengers were carried in the single bus lane; it performed perfectly, with no stoppages or delays. The project was financed by a $500,000 grant from the Urban Corridor Demonstration Program, in addition to $134,000 from the Turnpike Authority for the special access ramps. Since its inception in December of 1970, the bus lane's safety record has been excellent.

Placement of traffic posts each morning prior to contra-flow operation.

LONG ISLAND EXPRESSWAY - New York City

- *One underutilized outbound lane reversed for inbound buses; buses enter special lane via median crossover.*
- *Two miles in length.*
- *Opened to bus traffic October 1971.*
- *Start-up costs under $100,000 with a daily operating cost of $500.*
- *Time savings of up to 15 minutes.*
- *Ten thousand peak period passengers on 200 buses.*

On the Long Island Expressway in New York City, a contra-flow bus lane for Manhattan-bound buses during morning peak hours was established in October 1971. Located between the Brooklyn-Queens Expressway and the Queens-Midtown Tunnel, the scheme is similar to that of the New Jersey I-495 facility.

Contra-flow bus lane on the Long Island Expressway in New York City.

The westbound buses gain access to the special bus lane by crossing over through a cut in the existing median barrier. The buses proceed on the 2-mile special lane to the tunnel plaza, where they are given priority treatment over regular traffic entering the tunnel. Carrying about 10,000 passengers, the buses are making the normally 18-minute trip in 3½ minutes; opposing traffic in the remaining eastbound lanes is not experiencing delays despite the loss of a lane. The express service provides a no-transfer ride direct from residential areas to the central business district.

Public response has been favorable, and demand for this type of transit service into Manhattan continues to grow, despite premium fares three to four times those of local buses and subways.

Sign directing buses onto the contra-flow lane.

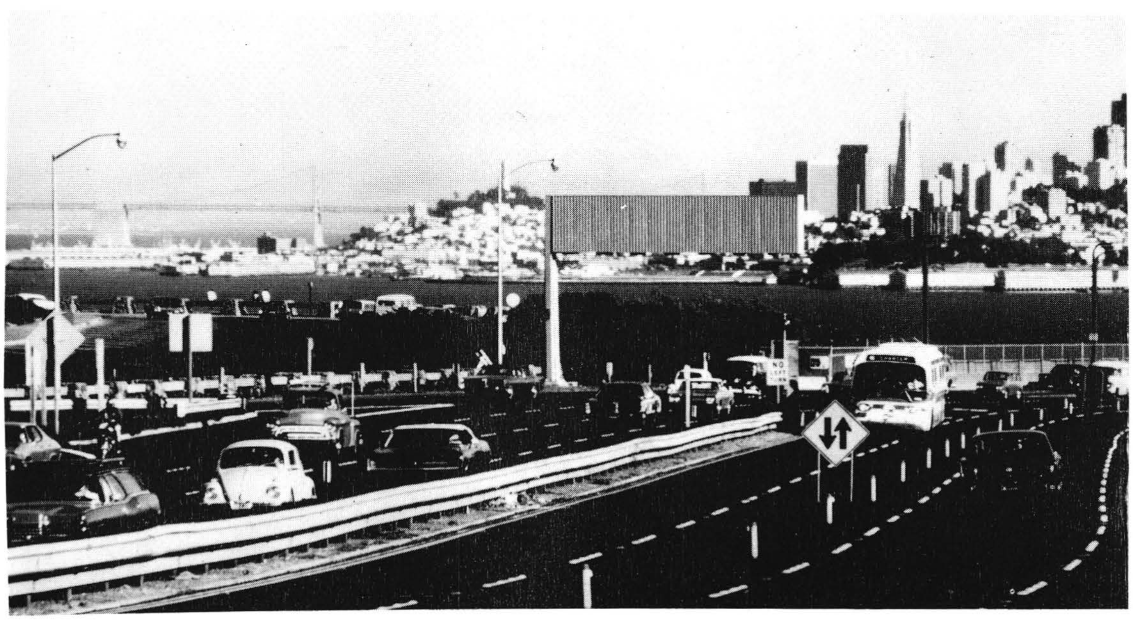
Buses enter the contra-flow lane via a median crossover.

U.S. ROUTE 101 - San Francisco

A 5-mile contra-flow bus lane in the San Francisco Bay Area was put into operation in September of 1972, from the northern terminus of the Golden Gate Bridge to Richardson Bay, in the U.S. 101 corridor. An 80-20 directional split of traffic permits the evening closing of two of the four lanes in the non-peak direction without delaying the existing traffic. One of the two closed lanes acts as a buffer between traffic in opposite directions.

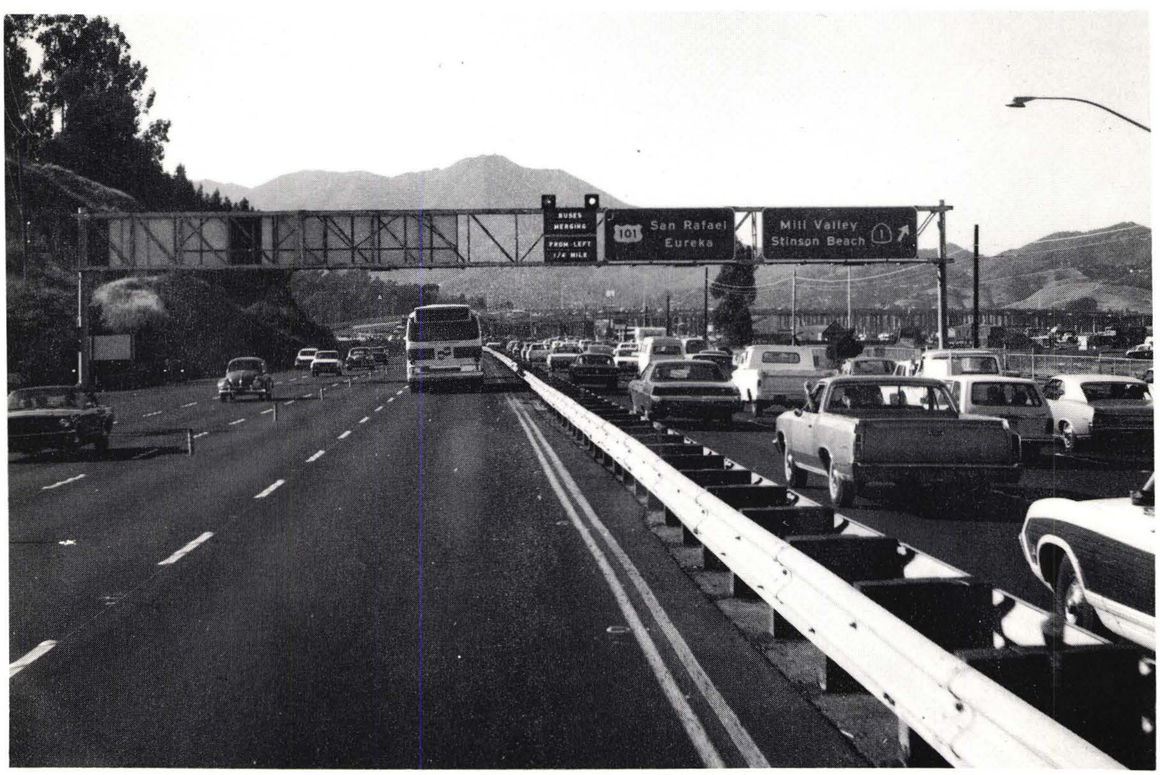
Buses cross over to the left side of the median barrier at the north end of the bridge, and return to the regular traffic lanes through a cut in the existing median barrier near Richardson Bay. On typical evenings, transit passengers enjoy anywhere from 3 to 20 minutes traveltime advantage, depending on congestion. The removal of the buses from the regular freeway lanes further enhances traffic flow; in the past, the relatively slow buses were partially responsible for the congestion on the long Waldo Grade.

The Golden Gate Bridge, Highway, and Transportation District, with help from the UMTA capital grant program, has been providing expanded bus service in the corridor. At present, 5,000 passengers are riding on the evening buses using the special lane. Plans call for extending use of the contra-flow operation to the morning peak period.



Contra-flow bus lane on U.S. Route 101, north of the Golden Gate Bridge.

Buses use the reversed lane during the evening peak period.



U.S. Route 101 contra-flow lane near Richardson Bay.

Where conditions do not justify separate busways or reserved freeway lanes, buses and carpools can be accorded priority treatment with special access privileges to freeways or bridges. Several such projects are currently underway.

BLUE STREAK - Seattle

The provision of exclusive freeway bus lanes may not be justified in less congested urban areas. In such cases, buses traveling in mixed traffic can accrue time savings if they are provided exclusive access-egress ramps.

Seattle's Blue Streak demonstration project, initiated in September of 1970, illustrates this type of facility. High-speed transit buses between downtown Seattle and outlying fringe parking areas mix with regular traffic on the reversible express lanes of Interstate 5. In the morning, as the buses approach the CBD, they exit using an exclusive ramp which feeds into a special downtown circulation loop. In the evening, the process is reversed, with the bus ramp becoming one-way in the opposite direction.

A.M. Blue Streak buses enter downtown Seattle from an exclusive freeway ramp.

P.M. buses leave downtown on the reversible ramp.

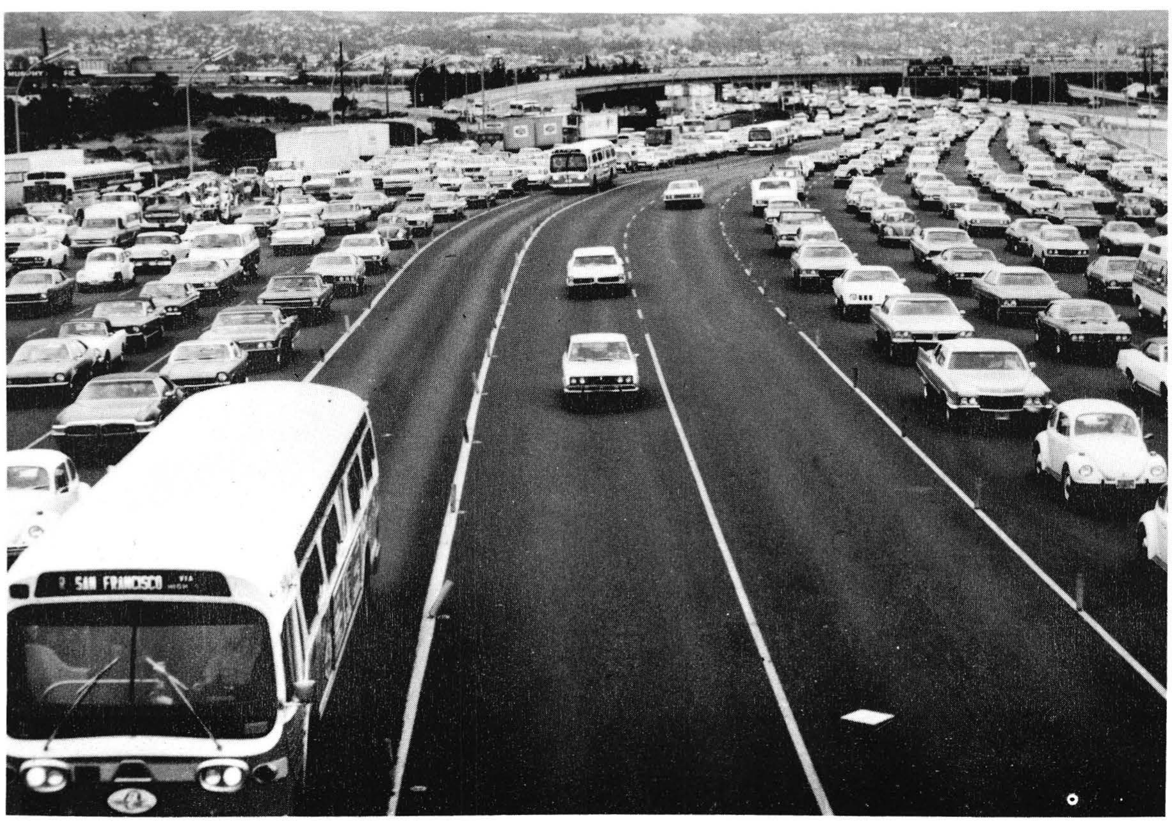
The reversible bus ramp was established by closing an existing ramp to automobile traffic, thus keeping construction costs to a minimum.

The Blue Streak project, jointly funded by the Washington State Highway Commission, the Federal Highway Administration, the Urban Mass Transportation Administration and the Seattle Transit System, also provides for the purchase of new buses, the construction of fringe parking lots, and a study to evaluate the impact of the demonstration on transit usage in the Seattle area. Blue Streak serves more than 10,000 daily two-way passengers.

SAN FRANCISCO-OAKLAND BAY BRIDGE

- *Three center lanes of 17-lane toll plaza reserved for buses and carpools during the morning rush period.*
- *Single reserved bus lane implemented April 1970; two carpool lanes initiated December 1971.*
- *Start-up costs less than $100,000.*
- *Minimum time savings of 5 minutes.*
- *More than 20,000 passengers on 520 buses, and nearly 1,800 carpools use the reserved lanes during the morning peak.*

A project has been underway since 1970 on the approach to the 17-lane toll plaza of the San Francisco-Oakland Bay Bridge to provide priority treatment for high occupancy vehicles in the morning rush period. A study had concluded that reserving one of the 5 bridge lanes would unduly aggravate traffic conditions on the remaining 4 lanes; besides, the biggest bottleneck was occurring in the toll plaza vicinity, not on the bridge itself.



Exclusive bus and carpool lanes through the toll plaza of the San Francisco-Oakland Bay Bridge.

Since April of 1970, one-half mile of the center lane approaching the toll plaza has been set aside for the exclusive use of buses between the hours of 6 and 9 A.M. The buses do not stop to pay toll; a log is maintained of the number of bus crossings and the transit company is billed on a monthly basis. Bus patrons have been saving a minimum of 5 minutes in travel time since the special lane was put into operation.

The priority treatment was expanded to carpools in late 1971, when 2 additional lanes through the toll plaza were set aside for automobiles with a minimum of 3 occupants. At the same time, all three priority lanes were lengthened to 1 mile. Carpools may purchase monthly toll passes at greatly reduced rates. Prominently displayed, the passes obviate the need for carpools to stop at the toll booths.

A survey taken August 3, 1973, found over 20,000 passengers enjoying their ride into San Francisco on 538 buses using the exclusive lanes, together with 1,772 carpools. It is significant that average auto occupancy through the entire toll plaza increased from an average of 1.33 to 1.44 persons per car. Total cost for implementing the project was under $100,000.

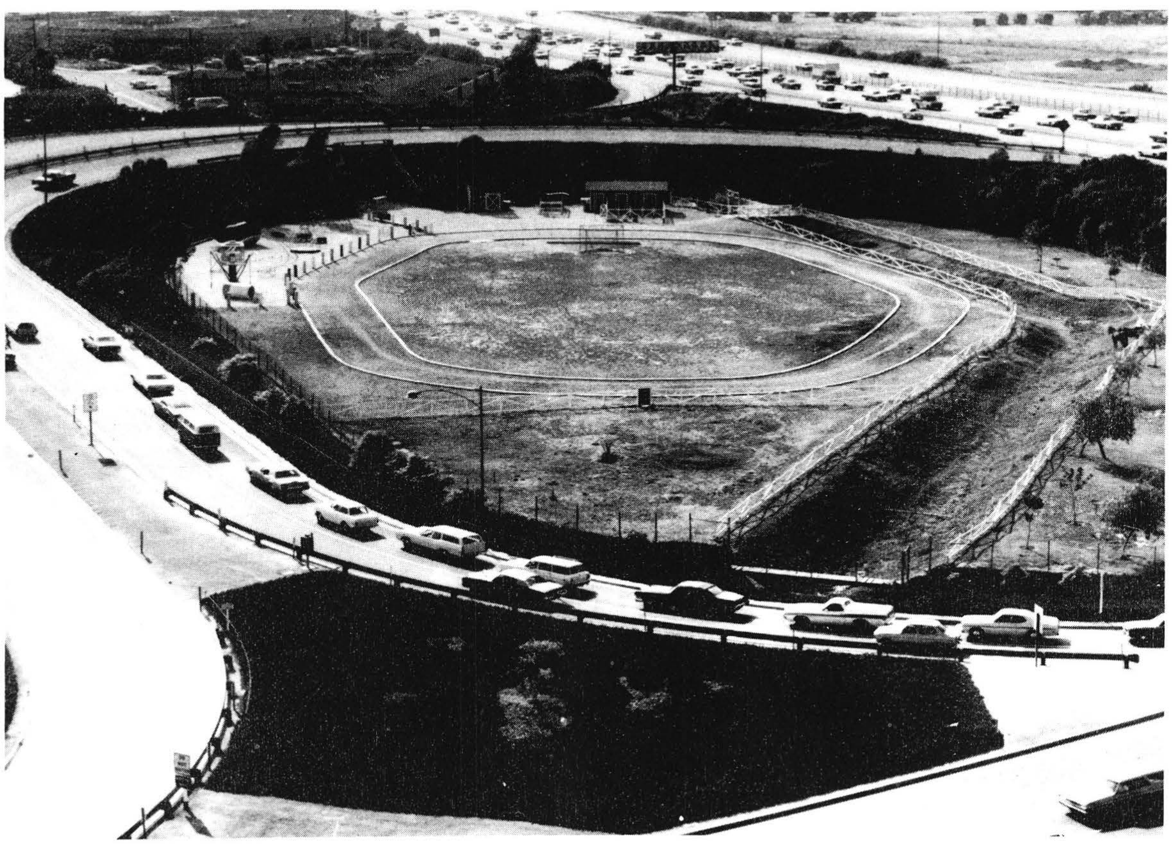
The Bridge Authority is in the process of further improving the preferential treatment granted to high occupancy vehicles. Traffic signals now being installed will meter each of the 17 lanes as they leave the toll plaza; the 3 priority lanes will receive extra green time in order to gain quicker access onto the bridge itself. In the event of accidents or other traffic incidents, the metering system can be manually controlled to allow maximum access for emergency equipment and to direct traffic into the unobstructed lanes.

Toll plaza approach.

SAN DIEGO FREEWAY - Los Angeles

Freeway congestion can be diminished and people carrying capacity of freeways increased by metering low occupancy vehicles at on-ramps while providing bypass lanes for vehicles with higher occupancies. To test the possibility of inducing higher vehicle occupancy through the provision of a positive incentive, an experiment was initiated in June 1973 on an existing metered on-ramp from Lakewood Boulevard to the San Diego Freeway in the Los Angeles area. By restriping the interchange area, an additional lane was created quickly and inexpensively. The new 12-foot outside lane can be used by both carpools entering the bypass lane and vehicles choosing to continue south on Lakewood Boulevard, without affecting the metered storage lane.

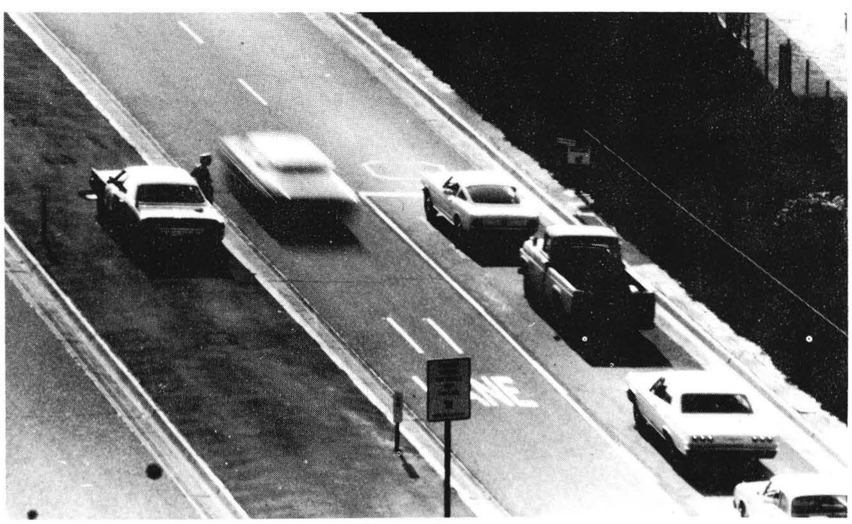
Carpools are defined as vehicles occupied by two or more persons, an understandable definition in light of Los Angeles' average peak period auto occupancy of 1.2 persons per vehicle and the fact that 85 to 90 percent of all vehicles are occupied only by the driver. By using the bypass lane, carpools accrue a 7 to 9 minute traveltime advantage over driver-only vehicles queuing in the metered storage lane.



Carpool bypass lane on metered freeway ramp near Los Angeles.

Operation of the carpool bypass lane.

Preliminary results of the experiment are impressive: average daily carpool use of the ramp has increased 120 percent and the average occupancy of all vehicles using this ramp has surpassed 1.5 persons per vehicle. Personal interview surveys conducted at six ramps in this vicinity found that 80 to 100 new carpools had been formed one month after the opening of the bypass lane, and that 160 to 180 passengers in these carpools formerly drove alone. Violations have been fewer than expected, and public acceptance of the project has been excellent.



Initial enforcement of the carpool bypass lane.

INTERSTATE -35W - Minneapolis, Minnesota

The Minnesota Department of Highways is currently implementing a freeway surveillance and control system along Interstate 35W south of the Minneapolis CBD. The project includes television surveillance along the freeway and the installation of metering signals on all of the entrance ramps from downtown Minneapolis to Burnsville. Bus bypass lanes are being constructed on nine of the metered ramps to allow express buses access to the freeway without being delayed at the ramp signals. The improvements in the I-35W corridor are budgeted at $6 million including $800,000 for construction of the bypass lanes.

The bypass lanes on the entrance ramps will serve an established express bus system in the I-35W corridor. Since the express service was instituted in December 1972, bus ridership has increased from 11,000 to nearly 29,000 trips weekly. The ramp metering system helps maintain favorable traffic flow conditions on the freeway, and the bypasses allow buses preferential treatment to make use of this higher level of service.

Bus bypass lane on metered ramp to I-35W, Minneapolis.

DULLES AIRPORT ACCESS ROAD - Northern Virginia

In July 1973, Reston Commuter Bus, Inc. (RCB), a volunteer organization providing peak period transportation to 1,100 of the 40,000 local residents, obtained permission to use the Dulles Airport Access Road to commute between Reston and downtown Washington, D.C. This 13-mile road is dedicated to the exclusive use of airport traffic; once on it, vehicles cannot exit prior to reaching the airport nor can they enter at any place but the airport on the return trip. With the permission of the Federal Aviation Administration, which has jurisdiction for the highway, and a $350,000 contribution from the Reston developer, two exclusive gate-controlled ramps were designed and built by the Virginia Department of Highways. The gates are activated by bus detector loops embedded in the pavement and by a magnetic card issued to each driver.

Since the Dulles Airport Access Road splits the Reston community into two sectors, buses collect passengers in each sector and then meet at the exclusive ramps to exchange passengers and pool those with common destinations. In the evening for the return trip the process is reversed at a point in Rosslyn, Virginia, just outside Washington, D.C. The special ramps are saving Reston buses an average of 15 minutes, a time reduction of 20 per cent.

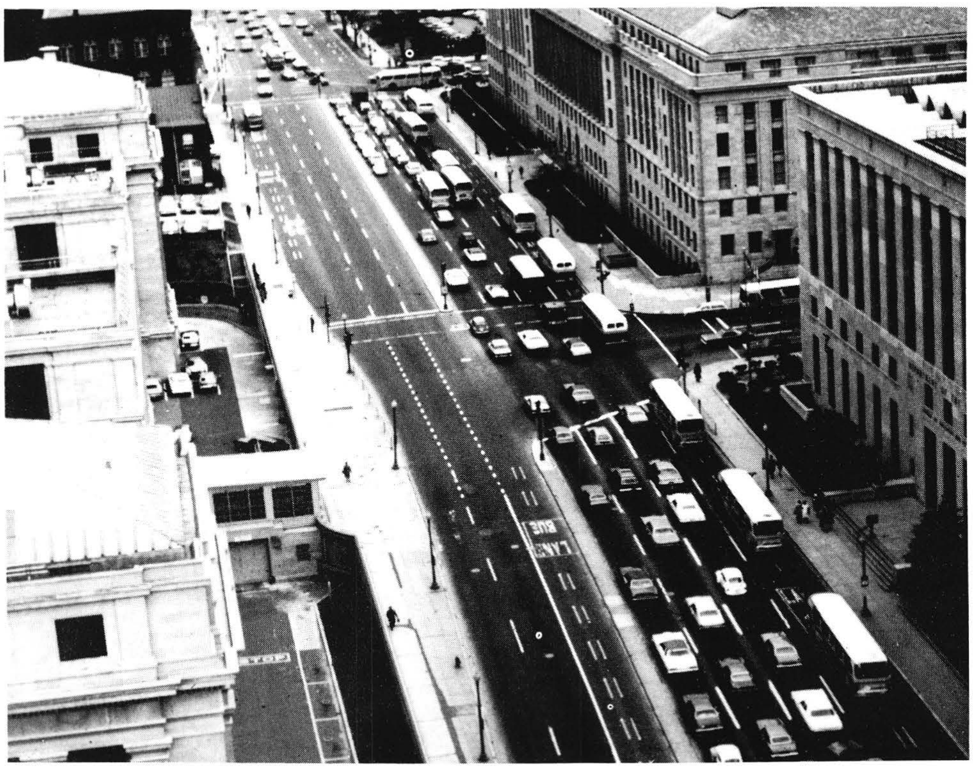
Reston buses gain access to the Dulles Airport Road at specially constructed ramps.

************ PREFERENTIAL TREATMENT ON CITY STREETS ************

Bus priority can be provided on city streets as well as on freeways. Several methods can be used, including reserved lanes, contra-flow lanes, bus streets and bus signal activation.

RESERVED LANES

Reserved bus lanes on city streets are common in many cities throughout the country. The simplest scheme is to reserve the curb lane on major arterials for buses and right-turning vehicles. An alternate method, especially for express or left-turning buses, would be to reserve a median lane. A reversible median lane along an express bus route could serve buses both in the morning and evening peak period.



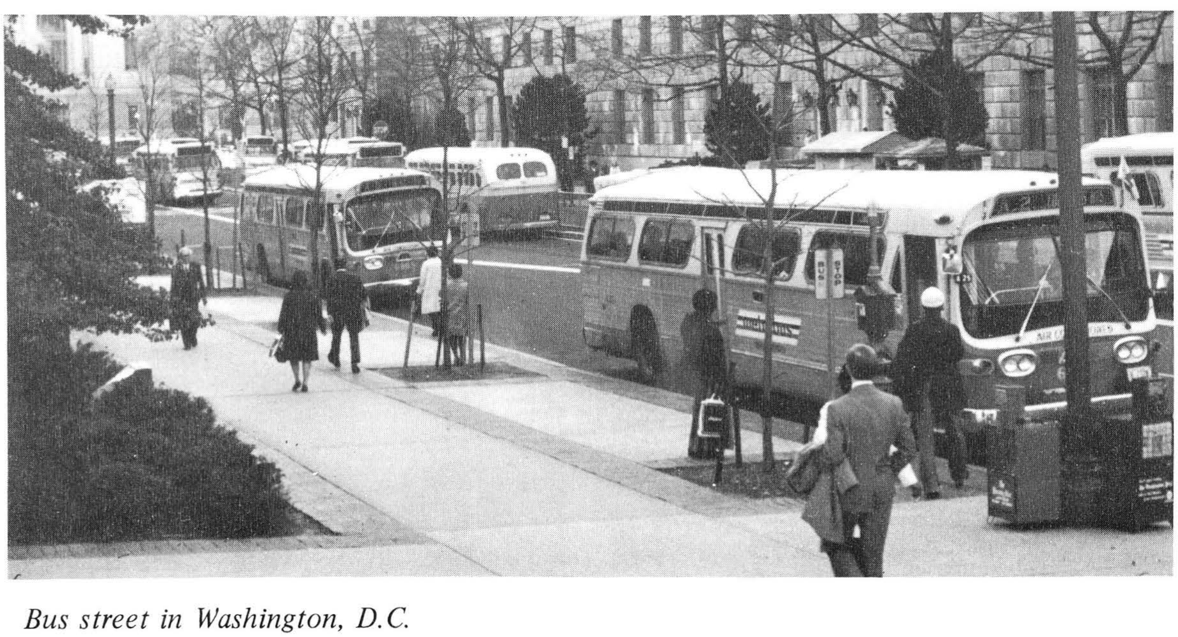
Reserved bus lanes in Washington, D.C.

Reserving the curb lane for buses and right-turning vehicles will not be effective if right turn traffic overloads the lane. In such a case a "bus only" restriction should be considered.

Curb lane for buses only, Washington, D.C.

BUS STREETS

City streets can be reserved entirely for bus operations when the bus volume is sufficient to utilize the allotted space. This type of preferential treatment is limited to streets where access to local businesses by regular traffic is not required. In Washington, D.C., for example, a one-block section of a downtown street is reserved for buses and serves as a terminal area for several major bus routes.



Bus street in Washington, D.C.

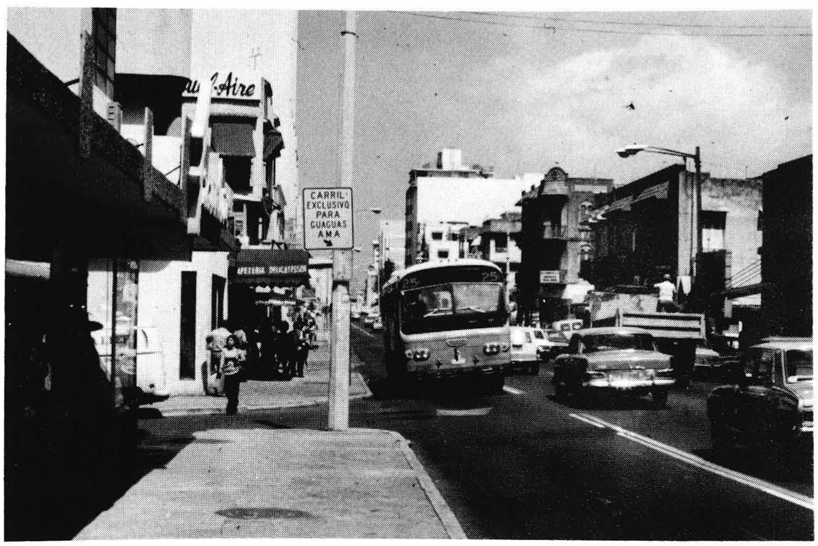
CONTRA-FLOW LANES

Still another method of priority treatment on congested urban arterials - contra-flow bus lanes - is gaining prominence. Contra-flow lanes are typically implemented by reserving one lane of a multi-lane, one-way arterial street for buses traveling in the opposite direction. The contra-flow technique is largely self-enforcing since violators of the reversed bus lane are highly visible. This approach is not new; such a system has been in operation on the main shopping street in Harrisburg, Pennsylvania, for the past 10 years. More recently, contra-flow lanes have been implemented as part of a downtown circulation loop for buses in Seattle.

Contra-flow bus lane in downtown Harrisburg, Pennsylvania.

Contra-flow bus lane in Seattle.

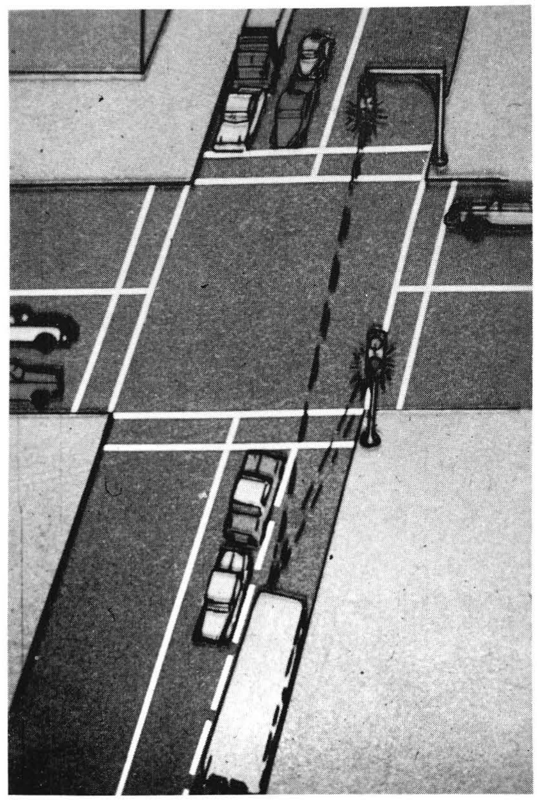
Two views of contra-flow bus lane project in San Juan, Puerto Rico.



A contra-flow project in the heavily congested city of San Juan, Puerto Rico, has proven very successful. Contra-flow bus lanes have been implemented on two parallel, one-way arterials. Each ten-mile arterial consists of 4 lanes; 3 lanes are used by regular traffic, while the 4th lane is permanently reversed for the exclusive use of buses. The contra-flow lane is clearly marked by pavement striping and signs at intersections and along the regular traffic lanes to alert motorists traveling in the normal direction.

In operation since May 1971, the contra-flow bus lanes have cut transit time for San Juan commuters along this corridor by 35 percent, at the same time establishing an excellent safety record.

SIGNAL ACTIVATION



Bus signal activation improves bus travel-time on city streets.

Bus travel times can be improved by providing preferential treatment at signalized intersections. Equipment can be installed on buses allowing them to preempt normal traffic signal timing patterns.

A computerized traffic system has been installed in Washington, D.C., to control 111 downtown intersections. The system is being implemented on an experimental basis to evaluate signal control strategies.

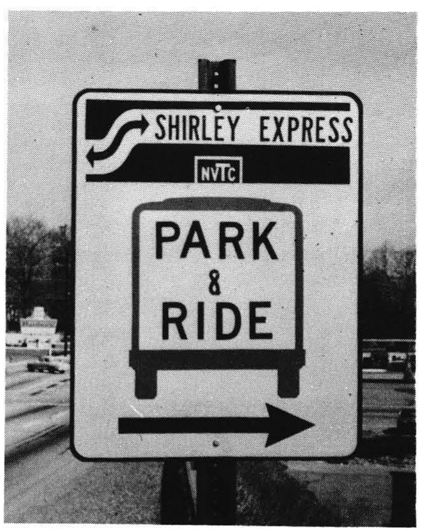
The traffic control project includes implementation of a Bus Priority System. The bus priority control strategy is designed to exercise control on a cycle-to-cycle basis. Five hundred buses have been equipped with special transmitters which activate detectors in the pavement at selected intersections. The strategy provides preferential treatment by giving more green time to buses, when warranted, by extending the green phase. The decision to grant additional green time is a function of passenger volumes, vehicular queues in and around the intersection, and the arrival time of the bus. The objective of this project is to develop strategies to control traffic signals and provide bus priority by digital computer.

The attractiveness of public transit can be further enhanced by providing amenity features such as modern bus terminals, fringe parking and passenger shelters.

FRINGE PARKING

Fringe parking provides a convenient method to assemble commuters in order to take advantage of a higher occupancy mode. Fringe parking is especially useful in low density residential areas in the suburbs where bus collection and distribution is not economical. Parking lots may be found nearer the CBD, however, where vehicle capacity restraints are severe, at bridges and tunnels, for instance. Buses can make far better use of limited roadway facilities.

Fringe parking can be provided at low cost to the community through cooperation between local businesses and transit officials. In the Shirley Highway corridor, two such lots are provided by shopping center managers in return for the associated publicity for the shopping center. Since the centers do their heaviest business on nights and weekends, the unused spaces in their parking lots are used by weekday commuters for fringe parking. In return, the shopping center receives additional business and publicity from the commuter who finds it a convenient place to shop on his way home from work. In Milwaukee, freeway flyer bus routes originate from shopping centers which provide fringe parking. In exchange, the names of the shopping centers are used as route designations for the buses. A very attractive fringe parking lot was provided by the Virginia Department of Highways to serve express bus commuters to downtown Richmond. Nearly 450 persons utilize the specially constructed lot and the bus service daily.

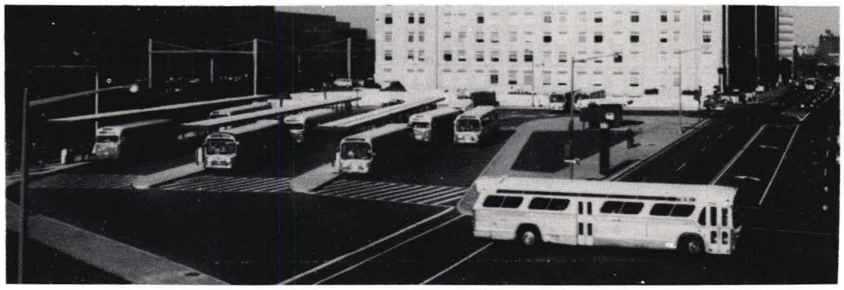


Sign directing commuters to fringe lot.

Fringe parking near Richmond, Virginia.

TERMINALS

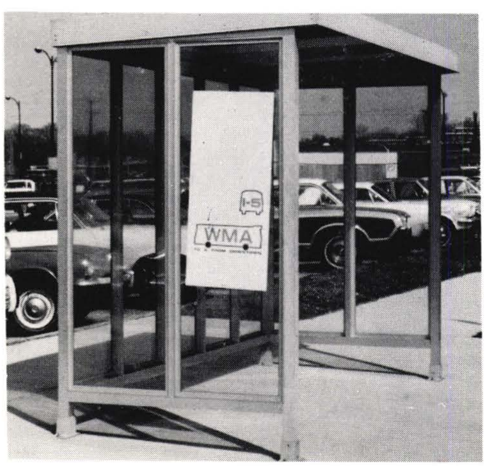
Terminals provide a safe and efficient interface for transit users. In the downtown area, off-street bus terminals can provide for the loading and discharge of high passenger volumes without the pedestrian and vehicular conflicts associated with on-street facilities. Even in less congested areas terminals can provide a comfortable environment wherever waiting passengers congregate as at fringe parking lots or major route destinations.



Bus terminal in Washington, D.C. (above), and the El Monte Terminal of the San Bernardino Busway in Los Angeles.

PASSENGER SHELTERS

Where large scale terminals are not warranted, passenger shelters can at least provide a modicum of comfort for waiting passengers.



Passenger shelters near Washington, D.C. (left), and Richmond, Virginia (below).