case study. For example, travel demand models would have been useful in evaluating the alternatives, but it is unlikely that credible models could have been developed for population segments as unique as mental health patients.

The indicators were service sensitive without obviously exaggerating the magnitudes of impacts. The differences in routes between plans were small, but the indicators demonstrated which subgroups benefited most and revealed the relative magnitude of the benefits.

The measure of convenience, although adequate for the MCIG case study, is not complete. For route-planning problems where high load factors exist, the measure of convenience should be extended to include seat assurance (3). In communities where weather conditions are sufficiently poor to discourage walking, waiting, and transferring, the measure of convenience would require larger penalties associated with these trip elements (3). Once the definition of convenience has been established, required computations are straightforward and inexpensive.

Any additional service to one particular major trip generator will increase ridership to other locations as well. The indicator presented here is not directly applicable to estimating numbers of potential riders. However, methods have been developed for predicting ridership on the basis of population within walking distance of new bus routes (6), a measure similar to the indicator presented here. Further research into the relation between indicator values and ridership would be a beneficial step in improving current transit planning techniques.

REFERENCES

1. G.J. Fielding, R.E. Glauthier, and C.A. Lave. Performance Indicators for Transit Management. Transportation, Vol. 7, 1978, pp. 365-379.
2. M. Wachs. Consumer Attitudes Toward Transit Service: An Interpretative Review. Journal of the American Institute of Planners, Vol. 42, No. 1, Jan. 1976, pp. 96-104.
3. A.J. Horowitz. Subjective Value of Time in Bus Transit Travel. Transportation, Vol. 10, 1981 (in preparation).
4. S.S. Stevens. On the Operation Known as Judgement. American Scientist, Vol. 54, No. 4, 1966.
5. A.J. Horowitz. The Subjective Value of Time Spent in Travel. Transportation Research, Vol. 12, 1978, 385-393.
6. Peat, Marwick, Mitchell, and Company. Analyzing Transit Options for Small Urban Communities. U.S. Department of Transportation, Jan. 1978.

Publication of this paper sponsored by Committee on Bus Transit Systems.

Houston's I-45 Contraflow Transit Project

ROBERT N. TAUBE AND CHARLES A. FUHS

A general report on the unique characteristics and results of Houston's North Freeway contraflow operation is presented, including the overwhelming response to the project by both bus and vanpool patrons. The North Freeway (I-45) Contraflow Transit Project began operation in August 1979 as Houston's first major effort to provide freeway preferential treatment for transit movement. The facility provides a daily travel-time saving of approximately 30 min during the line-haul portion of the commuting trip. Use of the lane is restricted to authorized vehicles, which include registered and approved buses and eight-passenger vanpools. The North Freeway project is the longest contraflow project in the country [15.4 km (9.6 miles)], the first to operate in both the morning and evening peak periods, and the first to restrict lane use to authorized vehicles that display an appropriate permit. In the first 44 weeks of operation, bus ridership increased by 227 percent and vanpool ridership increased by 114 percent. The project was initiated as an 18-month demonstration project sponsored in part by the Service and Methods Demonstration program of the Urban Mass Transportation Administration. The success of the project has led to a decision to continue operations beyond the demonstration period.

In 1974, shortly after the city of Houston purchased the local bus system from a private operator, discussions with the Texas State Department of Highways and Public Transportation (TSDHPT) were held regarding provisions of preferential treatment for transit. The North Freeway (I-45) was first recognized as appropriate for the application of a technique identified as "contraflow" in January 1975 (1). By March 1975, the Houston City Council authorized the Office of Public Transportation (OPT) to submit an application to the Urban Mass Transportation Administration (UMTA) requesting funds for initiation of preferential treatment on Houston freeways, specifically including contraflow on the North Freeway.

In June 1975, UMTA approved a Service and Methods Demonstration (SMD) program Section 6 grant (under the Urban Mass Transportation Act of 1964, as amended) to implement corridor preferential treatments in Houston.

TSDHPT confirmed the feasibility of contraflow in March 1976 and by June 1977 had submitted final plans to the city along with approval from TSDHPT administration and the Federal Highway Administration (FHWA). In order to fully cover the costs of construction as they were defined, in November 1977 the city of Houston applied for and received an additional UMTA Section 5 grant (under the Act as cited above) (2). One week later, TSDHPT let bids for construction of contraflow. TSDHPT was also retained to supervise construction of the project. Construction began in February 1978 and was completed about 16 months later.

As part of the operations agreement reached with TSDHPT to supervise construction of the contraflow project, the city of Houston committed itself to operate the project and "prior to the commencement of such operation...the City's and State's authorized representatives shall promulgate and file an operating plan for the Project." No contraflow-lane (CFL) operation was to begin until this plan was approved and an ordinance duly enacted. The Metropolitan Transit Authority (MTA) assumed responsibility for this effort from the city upon the formation of MTA in 1979. The operating plan finalized and made legal the following: (a) operating hours and schedule, (b) requirements for authorized vehicles, (c) requirements for authorized drivers, (d) rules and regulations of the lane, (e) enforcement procedures, (f) CFL daily setup and take-down procedures, (g) CFL maintenance responsibility and procedures, and (h) emergency and breakdown procedures.

The plan was made the official ruling document by an MTA-TSDHPT operations agreement, which also provided a contraflow project management team to oversee the project and make amendments to the plan by mutual consent of the TSDHPT project engineer and the MTA project manager. This arrangement has proved to work very well. Amendments to the plan can be made quickly and effectively without amending the governing operations agreement.

Of special interest in securing the operations agreement was MTA's ability to enforce CFL restrictions. This was the first case in which TSDHPT imposed a restriction on the use of a traffic lane (versus restricting vehicle use of the general traffic lane). The Texas State Highway and Public Transportation Commission was empowered with this authority, but the city was required to enact an ordinance making this restriction legal and allowing for their police to enforce it. The ordinance was passed on July 25, 1979, and by August 15 MTA and the city of Houston enacted an agreement to provide enforcement for the project.

In concert with the contraflow project, TSDHPT initiated entry ramp controls with localized mainlane density detectors. This metering was similar to other installations on Houston freeways and was originally intended to provide improvements within freeway segments that are experiencing congestion in the peak direction. The approach was modified to incorporate anticipated impacts from CFL operation. It was hoped that minor amounts of off-peak direction metering would activate when needed at selective ramps, divert entering traffic along the frontage road or other parallel arterials, and alleviate level-of-service reductions on the through lanes.

Construction for ramp metering was jointly funded by the Federal-Aid Urban Systems (FAUS) program and TSDHPT. Work on this installation proceeded concurrently with contraflow construction, and the ramp controls were activated on March 20, 1979.

To make use of contraflow within a corridor that had little transit service, park-and-ride facilities were planned (3). The following descriptions provide a summary of these facilities:

1. North park-and-ride lot--Located at the northern terminus of the CFL, the north lot has the capacity to park 750 automobiles. This lot was built by TSDHPT, funded through the FAUS program, and opened in May 1980. The facility was filled to 85 percent of capacity after six months of operation.
2. Kuykendahl park-and-ride lot--Located approximately 10 km (6.5 miles) north of the northern terminus, the Kuykendahl facility was MTA's first constructed park-and-ride lot, opening in January 1980, and has the capacity to park 1300 automobiles. The facility was filled to 60 percent of capacity after nine months of operation.
3. Champions park-and-ride lot--The Champions lot was leased and began operating simultaneously when contraflow opened. Located approximately 22 km (14 miles) north of the northern terminus of the CFL, this lot has the capacity to park 300 automobiles and has been filled to capacity since the fourth month of operation.

CHARACTERISTICS OF NORTH FREEWAY

The North Freeway is a full standard six- and eight-lane Interstate facility completed between 1959 and 1962 that serves one of the fastest-growing corridors in Houston. The corridor is estimated to have experienced a 58 percent increase in population since 1970 and has a current population of more than 500 000 (4). According to TSDHPT automatic traffic counts, average weekday traffic on the North Freeway has increased from 96 000 vehicles in 1970 to a current 135 000. Travel-time surveys indicate that the distance that could be traveled during the peak hour in 1969 had been cut by 40 percent by 1976. The duration of reduced travel speeds [<32km/h (<20 miles/h)] had also increased to encompass 2-h peak periods each morning and afternoon. In view of a growth rate in traffic of almost 5 percent annually during the 1970s, the contraflow project was conceived as an immediate solution to the serious capacity problem that was developing and as a means to demonstrate public response to a premium transit service.

In 1974, when contraflow was being evaluated for the North Freeway, the peak-hour traffic splits were generally acceptable for this application. Acceptable standards for implementing contraflow included peak-direction distributions of 70 percent or more. I-45 in the morning had this attribute, but the trend of the afternoon peak was already beginning to be below this level. Ramp-metering improvements, already slated for installation on the freeway, were tailored to minimize contraflow impacts on free-flowing conditions in the off-peak direction. By the time contraflow became operational, the trend of the afternoon directional split was below 60 percent, and other measures described in this paper were taken to alleviate resultant traffic impacts.

There were a number of other freeway characteristics that allowed for or favored contraflow over other preferential freeway treatments. I-45 included full 3.6-m (12-ft) lanes, high-mast lighting, and, except at several bridge structures, continuous-median and other emergency parking shoulders. Parallel frontage roads throughout much of the project provided supplemental capacity from overflows that might be created in the off-peak direction when a lane was borrowed for CFL operation. In addition, wider-than-typical medians at the northern and southern extremities of the congested segment provided an opportunity to terminate contraflow, as described in the following section on project design.

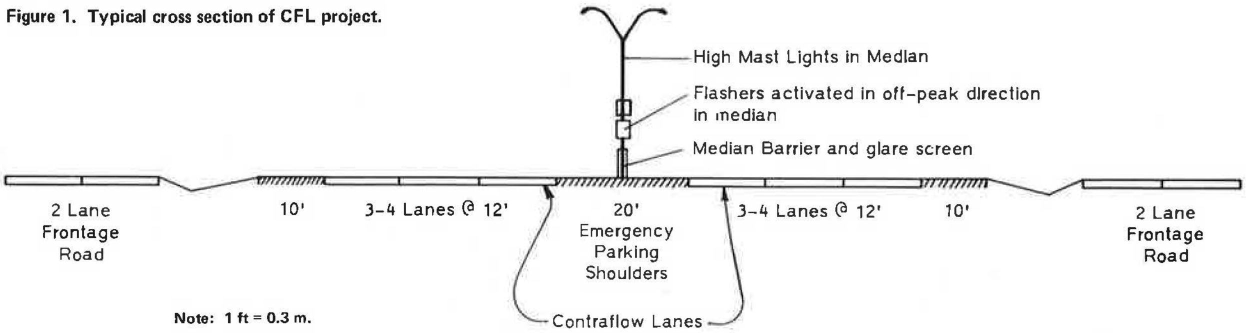
PROJECT DESIGN

The North Freeway CFL extends 15.4 km (9.6 miles) from the Houston downtown area. The CFL borrows one 3.6-m (12-ft) lane adjacent to the median in the off-peak direction for use during both peak periods. Continuous-median emergency shoulders are 3 m (10 ft) wide and allow for emergency passing of disabled vehicles throughout the majority of the lane. A typical cross section of the project is shown in Figure 1.

At the northern terminus, the freeway median widens to accommodate a left-hand entry ramp. This 30-m (100-ft) wide median separation between opposing directions facilitates a safe and effective CFL termination, as shown in Figure 2. Two entries enable authorized vehicles in the morning to enter the lane either from the peak direction or by a special buttonhook ramp from a primary arterial serving the nearby North Shepherd park-and-ride lot. In the afternoon, vehicles can similarly exit by either of two ramps at this location.

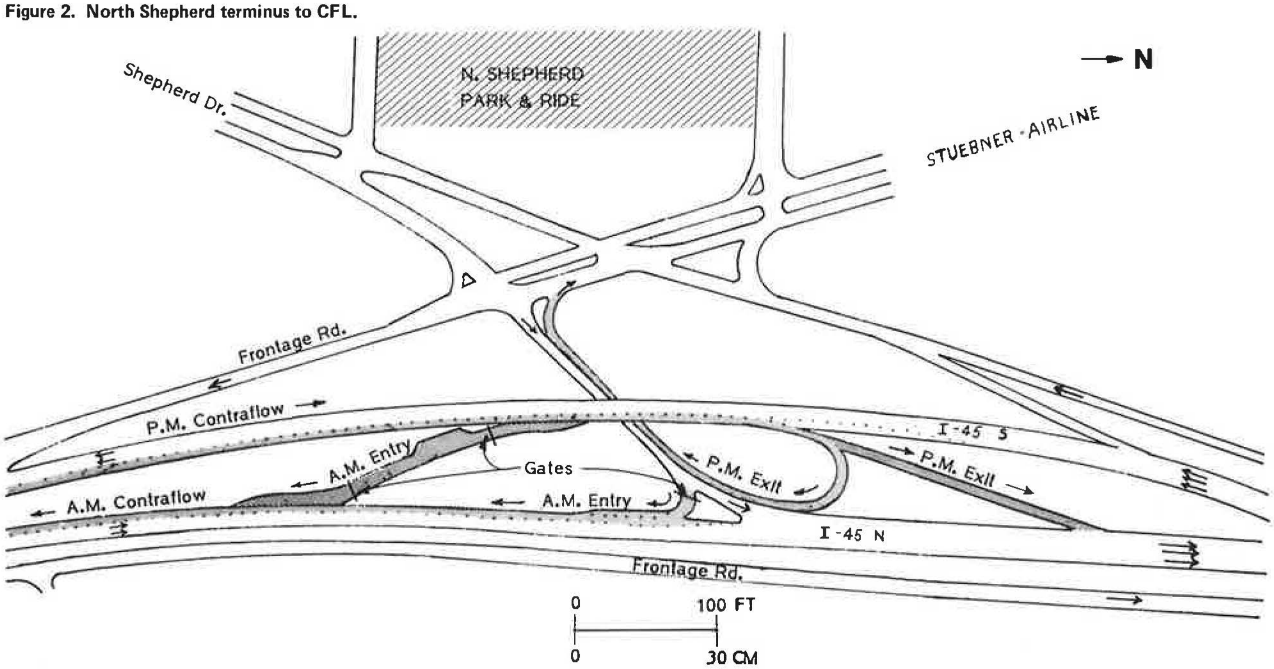
The southern terminus of contraflow is complicated with the interchange of I-10 with I-45. Prior to this interchange, a median crossover allows the morning contraflow operation to connect to a reversible-flow lane delineated on a 3-m inside shoulder of a viaduct portion of the southbound lanes of

Figure 1. Typical cross section of CFL project.



Note: 1 ft = 0.3 m.

Figure 2. North Shepherd terminus to CFL.



I-45, as shown in Figure 3. At the south end of the viaduct, a left-hand ramp is avoided by connecting the reversible shoulder lane to an exclusive reversible lane constructed within the median between ramps. This reversible lane feeds into an outbound ramp connector from downtown. During the morning period, this short connector also operates as a contraflow lane. This combination of lane treatments allows authorized vehicles to gain exclusive access to the downtown street network. The outbound CFL vehicles travel directly to the reversible-lane entry in mixed traffic.

At midpoint along the lane, a unique crossover has been constructed for intermediate entering and exiting capability and for emergency diversion of all CFL traffic in the event an incident blocks the lane further downstream. The crossover is designed with staggered openings for entering and exiting, as shown in Figure 4, and is separated from other traffic on either side by precast concrete median barriers.

Along the line-haul portion of the lane, contraflow warning devices include median signs and flashers every 300 m (1000 ft), diamond symbol markings on the pavement, changeable lane controls over the innermost two lanes at transition points, and use of 46-cm (18-in) pylons placed into predrilled holes in the pavement at intervals of every 12 m (40 ft).

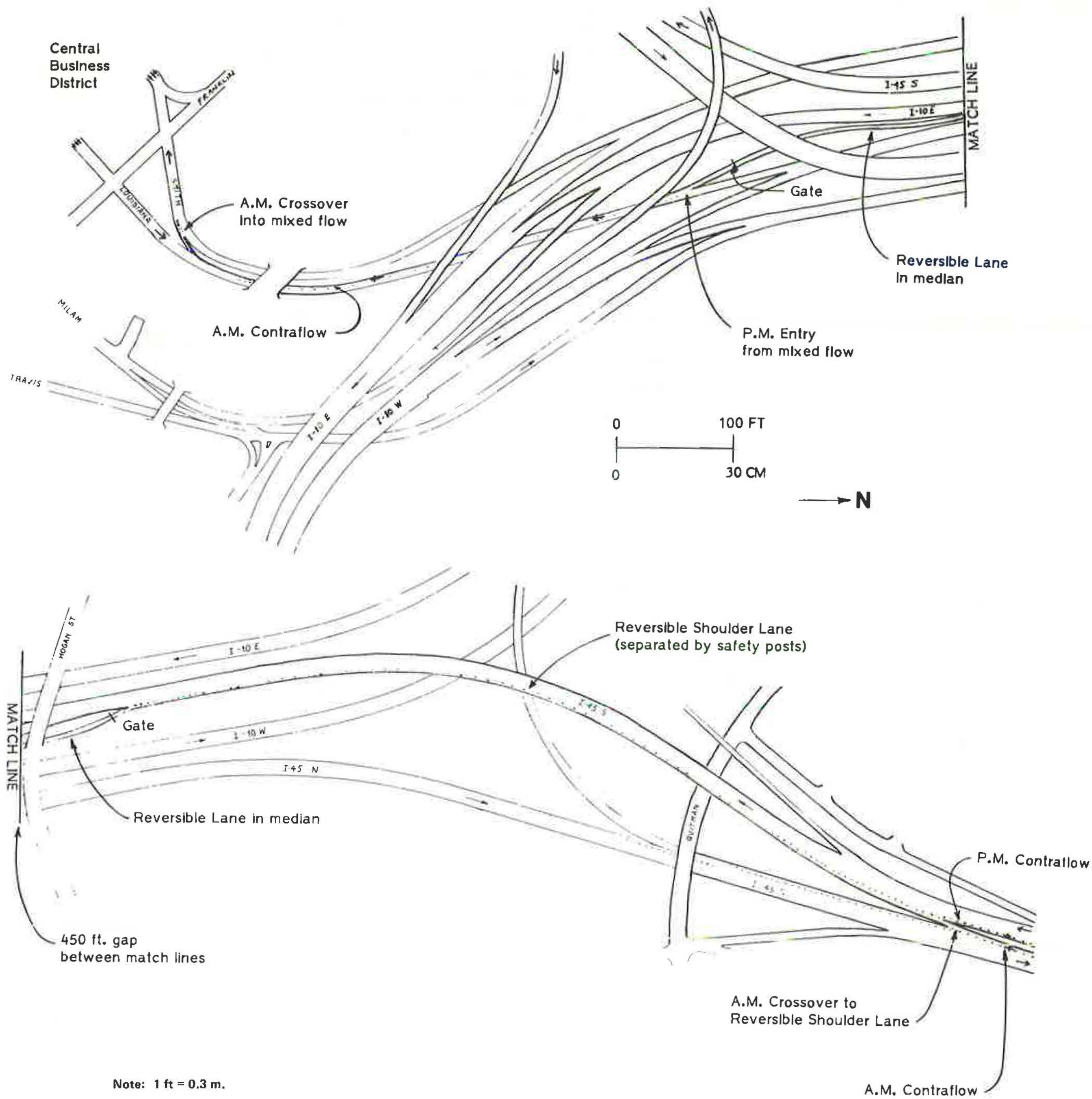
OPERATING PLAN

Setup and take-down procedures and supervision of the CFL are vested in the MTA Operations Department. Twice daily, 1200 pylons must be deployed from two specially designed stakebed trucks that are responsible for deploying pylons into every other hole. A third truck, a pickup driven by the crew supervisor, follows this platoon to ensure that all holes are filled and to activate switches for changeable message signs and signals. A total of 18 MTA employees organized into two shifts are assigned to deploy contraflow. These shifts include two wrecker drivers and two extras. The platoon is escorted by two units of the Houston Police Department.

The setup procedure requires the deployment to be performed with the flow of traffic. The take-down procedure is performed against (contra) the flow of traffic. This is done to minimize the disruption to traffic while providing protection to the crew and vehicles. Morning setup begins at 4:30 a.m. and is complete by 6:00 a.m. Take-down begins at 8:30 a.m. and is complete by 10:00 a.m. Similarly, evening setup occurs between 2:30 and 4:00 p.m. and takedown between 6:30 and 8:00 p.m.

Labor cost for the CFL crew represents the major operational expenditure at approximately $30 000/month. Other operational costs, given in Table 1,

Figure 3. Downtown terminus to CFL.



Note: 1 ft = 0.3 m.

Figure 4. CFL midpoint crossover at I-610.

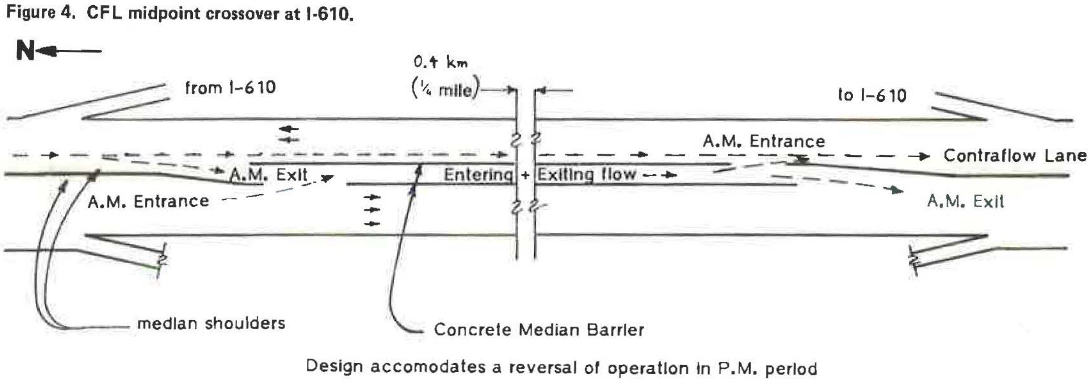
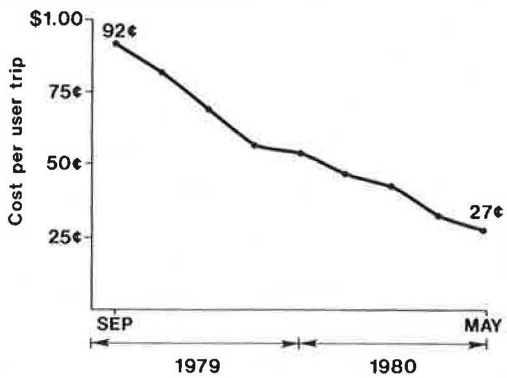


Table 1. CFL monthly operating costs.

Item	Cost ($) September 1979	January 1980	May 1980
Setup/take-down operation			
Labor	30 000	33 000	33 000
Supplies	2 600	2 600	2 600
Enforcement	14 200	6 400	6 100
Wrecker (contract)	15 000	15 000	0[a]
Facility maintenance and repair	3 000	3 000	3 000
Total	64 800	60 000	44 700

[a]By April the MTA wrecker replaced temporary contract wrecker service.

Figure 5. Operating cost of CFL distributed among user trips.



encompass total monthly expenditures. Operating costs for the first year totaled about $650 000. If these expenses are distributed over the number of contraflow users, the resulting cost per user trip is shown in Figure 5. The decline in cost from $0.92 in September 1979 to $0.27 in June 1980 is a result of increased ridership and decreased operating requirements since project start-up.

Two basic groups of vehicles--vanpools and buses--are included as potential CFL users. In order for these vehicles to be authorized, rather rigid requirements are placed on potential users. Eligible vehicles include

1. All MTA transit vehicles,
2. Suburban commuter buses operated under contract to MTA,
3. Other full-size transit vehicles being operated on regularly scheduled services and approved by MTA pursuant to the requirements as listed, and
4. Vans designed to carry eight or more passengers, including the driver, and approved by MTA pursuant to the requirements as listed.

The following vehicle requirements must be met by vehicles under items 3 and 4 above before the vehicle can be authorized to use the CFL:

1. A van must have at least eight passengers registered, including the driver. The driver is responsible for keeping a monthly log of the pool's ridership, subject to MTA inspection.
2. Each vehicle and driver must maintain minimum insurance requirements as set forth by MTA.
3. MTA must be provided a current, valid copy of the insurance policy for each vehicle.
4. A valid Texas vehicle-inspection sticker must be displayed.
5. A valid contraflow authorization decal, provided on vehicle inspection by MTA, must be displayed on front and back windshields.
6. Authorized vehicles must be driven by a certified contraflow driver when on the CFL.

To be certified to drive an authorized vehicle on the CFL, every driver (including substitute and backup drivers) must

1. Have a valid state of Texas chauffeur's license,
2. Have a good driving record,
3. Complete MTA-sponsored contraflow training,
4. Maintain in possession at all times a CFL driver identification card, and
5. Abide by the rules and regulations explained during CFL training.

This unique approach to the authorization or restriction of vehicles to a transit preferential treatment greatly simplified enforcement and provided close controls over Houston's first step toward a regional transitway system. Unauthorized vehicles were identified if they did not display a permit and were deterred by police stationed at the entry points. The number of attempted violations has averaged about one per day.

CFL USE

During the first 44 weeks of project operation, CFL use increased steadily in absolute nunbers, as shown in Figures 6 and 7. Vehicle trips increased to 61

Figure 6. CFL peak-period vehicle movement.

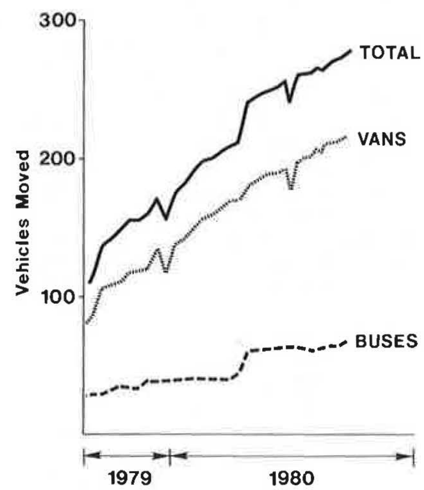
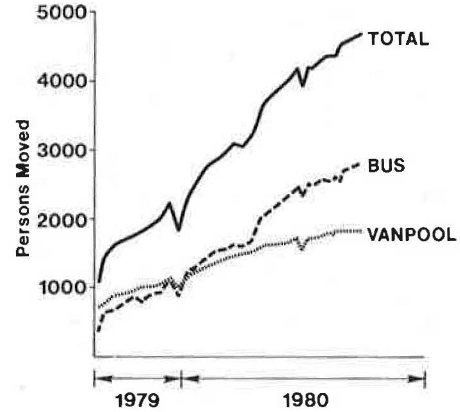


Figure 7. CFL peak-period person movement.



bus trips and 188 vanpool trips during each peak period, which represented more than a twofold increase since the project began operation. About 85 percent of the bus trips were made by contract carriers operating MTA express and park-and-ride routes. The remaining 15 percent involved private carriers making intercity and airport shuttle trips.

Person movement on the CFL initially reflected 1200 person trips/peak period, which was absorbed from previously operating vanpools and private bus service. By July 1980, total peak-period movement had grown to more than 4300 person trips, more than a threefold increase in patronage.

Steady increases in bus ridership have been attributed, in part, to the staggered openings of several new park-and-ride lots during the first 36 weeks. When CFL operation began, the only park-and-ride spaces available to bus commuters were 750 spaces at temporary lots. With the completion of all lots and the transfer of temporary operations to permanent sites, about 2400 parking spaces were made available to commuters.

Originally, the project was intended only for buses. It became apparent prior to opening, however, that bus volumes alone would not make the use of the lane adequately visible to oncoming traffic; thus, vanpools were identified as a supplemental, manageable group of high-occupancy users. An extensive corporate- and developer-sponsored vanpooling program in Houston helped contraflow achieve the immediate high level of use reflected in the first week with 85 vanpools. The ratio of vans to buses has remained rather consistent at about three to one. Person movement in vanpools originally exceeded that in buses, but by February this trend was reversed. Bus patronage in June represented 59 percent of all person movement on contraflow.

A strong peaking of demand on the CFL has been experienced, particularly among vanpool users. About 60 percent of the demand for contraflow has been concentrated within the peak hours. During isolated 15-min segments, more than 900 passengers were being transported on the lane. This peaking characteristic, unencumbered by the congestion constraint, has intensified since the project began. This intensity of use during the morning and afternoon peak hours has created the person-moving equivalent of 1.5 peak-direction freeway lanes. By June, the CFL was moving almost 25 percent of the peak-direction persons traveling the freeway during these hours.

The CFL, however, is still carrying less than 50 percent of its vehicle capacity during isolated periods of strong peaking. Because available capacity was apparent, after six months of project operation it was proposed that carpools be authorized to use the lane. The joint operation management team studied this proposal and determined that (a) authorized carpools could not be readily distinguished from violators, (b) management and authorization procedures would be difficult, and (c) the resulting impact could saturate the peak hours without improving visibility throughout the peak operating periods.

Whereas contraflow operation was planned to save users an average 15 min on each trip, a vanpool survey conducted after four months of operation indicated that 48 percent of users thought that they were saving 15 min or more in the morning period. Fully 74 percent expressed this same feeling about the evening period, and 34 percent of these indicated a saving of more than 20 min. These perceptions may be reasonable, since "before" travel speeds during the evening peak hours were 27 km/h (17 miles/h), which would represent a 34-min trip.

The CFL experienced two accidents involving authorized vehicles during operation periods the first year. Both accidents involved vehicles from adjacent off-peak-direction lanes losing control, skidding into the lane, and colliding with authorized vans. During this period, the CFL logged about 1 200 000 vehicle-km (750 000 vehicle-miles) of use.

Authorized vehicles became disabled 15 times on the lane during the first 44 weeks. A continuous-median shoulder along the CFL kept the majority of these disabled vehicles from disrupting lane operation.

IMPACTS ON OTHER FREEWAY USERS

Although the CFL removed about 2300 vehicles from peak-direction traffic during the first 10 months, latent demand and growth in the corridor have resulted in negligible impacts on peak-direction traffic volumes and travel speeds. In the off-peak direction, average speeds in the morning period were reduced about 13 percent to 77 km/h (48 miles/h), but no traffic congestion resulted. Impacts in the evening period, however, were significant in the northern portion of the project. Use of ramp metering was supplemented with temporary ramp closures at selected locations to improve unacceptable travel speeds (5). Controls on traffic flow forced some diversion to parallel frontage roads. This diversion helped to improve main-lane travel speeds to about 72 km/h (45 miles/h) but did not affect vehicle throughput in the freeway corridor. Most diverted traffic remained on the frontage roads and entered downstream of the critical segment.

Because of the significant evening off-peak-direction impact and initial low use of the CFL, after 12 weeks of operation the project was estimated to have had a net effect of increasing total delay time among users and nonusers of about 500 person-h daily. After ramp closures were implemented and higher use was reported by 31 weeks of operation, this characteristic had shifted to reflect a net decrease in delay time of about 720 person-h daily.

Freeway accidents reported for the period from August 1979 through February 1980 were not significantly increased from levels before project implementation (6). These levels may be compared with those for other contraflow projects in Table 2 (6,7).

Public acceptance of contraflow was considered imperative, although not decisive, to underscoring support for other subsequent high-occupancy-vehicle improvements in Houston. It was felt that any initial criticism could be overcome if the project catalyzed a perceptive shift to buses and vans while not forcing the off-peak-direction flow into levels of service worse than those for the peak direction. The regional press was objective, if not openly favorable, when CFL operation began. The safety of

Table 2. Accident rates for various contraflow projects.

Project	Before/After CFL	Period	Accidents (per million vehicle-km) Peak Direction	Off-Peak Direction
I-45, Houston	Before[a]	Morning	1.1	1.1
		Evening	2.1	1.1
	After[b]	Morning	0.9	1.4
		Evening	1.1	1.9
I-495, New Jersey[c]	After	Morning only	1.9	2.3
US-101, Marin County, California[d]	After	Evening only	1.4	2.4

[a]January 1979-August 1979 data.
[b]1975-1976 data.
[c]1972-1975 data.
[d]1972-1976 data.

the project was occasionally questioned, and the press responded to several minor incidents within the first few months. After ramp closures were implemented, public criticism of the impacts on the off-peak direction was markedly reduced, although underuse of the lane during portions of the peak period continued to create some criticism.

CONCLUSIONS

After 44 weeks of project operation, the general conclusion of TSDHPT, MTA, and the public is that the North Freeway contraflow demonstration has proved successful. The level of use and its continued increase have exceeded expectations. The fact that about 2300 vehicles have been removed from peak traffic and that transit is providing a desired alternative to the automobile in this corridor has made a significant impact on the expectations for MTA's regional transitway goal.

It should be noted that this paper is an interim report. UMTA's SMD program sponsored an evaluation in October 1980 that provided an opportunity for more detailed data collection and evaluation. Other reports will be forthcoming. However, the information provided is sufficient to support the decision of MTA and TSDHPT to continue contraflow operation beyond the 18-month demonstration period until such time as a separated high-occupancy facility can be incorporated into the North Freeway.

REFERENCES

1. Feasibility of Contraflow Lanes on IH 45 (North Freeway). Texas State Department of Highways and Public Transportation, District 12, Houston, Jan. 1976.
2. UMTA Section 5 Capital: Preferential Treatment--Construction of a Contraflow Lane on North Freeway. Houston Office of Public Transportation, Aug. 1977.
3. Report on Evaluation of Size and Location of "Park and Ride" Facilities Near IH 45 North and the North City Limits of Houston. Texas State Department of Highways and Public Transportation, Houston, Houston Urban Project, Oct. 12, 1976.
4. Growth Options for Houston: Technical Report. Rice Center, Rice Univ., Houston, March 1978.
5. W.R. McCasland. Summary of Ramp Closure Results. Texas Transportation Institute, Texas A&M Univ., College Station, Jan. 17, 1980.
6. State Accident Statistics: Region 4. Education Service Center, Houston, Jan. 1978-Feb. 1980.
7. Beiswenger, Hoch, and Associates. Safety Evaluation of Priority Treatment Techniques for High-Occupancy Vehicles. Federal Highway Administration, U.S. Department of Transportation, 1979.

Publication of this paper sponsored by Committee on Bus Transit Systems.

Evaluation of a Contraflow Arterial Bus Lane

WILLIAM D. BERG, ROBERT L. SMITH, JR., THOMAS W. WALSH, JR., AND THOMAS N. NOTBOHM

In 1979, the city of Madison, Wisconsin, conducted a 90-day trial experiment in which a contraflow arterial bus lane was closed and all buses were rerouted into mixed-traffic lanes on a parallel arterial. The findings and conclusions of that experiment, as well as comments on generalizable conclusions that might be drawn from the Madison experience, are presented. Evaluation criteria included traffic performance, safety, transit revenue, transit ridership, and environmental impacts. The study findings supported the conclusion that the permanent closing of the bus lane would be undesirable principally because of anticipated increases in bus accidents and higher rates of fuel consumption and pollutant emissions.

In 1966, the city of Madison, Wisconsin, constructed a contraflow bus lane along a 0.9-mile section of University Avenue in conjunction with the initiation of one-way traffic flow on University Avenue and West Johnson Street, an adjacent arterial (1). As Figure 1 shows, West Johnson Street provided four lanes for eastbound traffic (parking was prohibited on both sides). University Avenue provided four lanes for westbound traffic plus one lane to be reversed for eastbound bus service. The one-way pair of arterials serves as the principal access to the Madison central business district (CBD) from extensive residential areas on the west side of the city. Both arterials also pass through the heart of the 40 000-student Madison campus of the University of Wisconsin.

The University Avenue contraflow lane functioned without difficulty until March 1, 1967, when a student walked into the side of an eastbound bus and was seriously injured. Considerable discussion ensued, and there were claims that the bus lane was ill-advised and that eastbound bus operations should be moved to Johnson Street. This proposal was presented to the Madison Common Council on May 23, 1967, where it was rejected by unanimous vote. Following further study and discussion over the next several years, on May 5, 1970, the Common Council again rejected a proposal to move eastbound buses to Johnson Street. In the years following 1970, the contraflow lane was used by increasing volumes of bicyclists but nevertheless operated successfully and without major incident. In recent years, University Avenue and West Johnson Street have each carried more than 20 000 vehicles/day. In a given hour, as many as 40 buses share the contraflow lane with as many as 300 bicycles. In 1976, the right curb lane on University Avenue was designated as a reserve lane for buses, bicycles, and right-turning vehicles.

Then, in 1978, a controversy arose. After extensive evaluation of alternative design projects for the overall improvement of the University Avenue-Johnson Street corridor, the Madison Common Council rejected the entire set of candidate alternatives and expressed a renewed interest in relocating eastbound bus operations to Johnson Street. The principal issues underlying the relocation sentiment were closely related to the design features of the proposed University Avenue improvements, the heavy use of the bus lane by bicyclists, and the large concentrations of pedestrian movements crossing University Avenue during university class-change times. Groups of students and downtown residents were vocal in their opposition to the bus lane because of