to traffic congestion in urban areas. If traffic congestion has been a sustained and periodic problem in a corridor, then the introduction of a contraflow lane could significantly improve the passenger flow in the corridor. The simulation program presented in this paper provides an effective method for the transportation engineer to test the feasibility of such a lane. The interactive nature of the program allows the planner to perform the evaluation with a minimum of effort. In particular, the graphical as well as numerical summary of results easily allows the planner to compare initial and final traffic conditions.

The accuracy of this approach depends on the accuracy of each of the associated travel demand and traffic flow submodels on which it is based. These submodels, although far from perfect, have been tested and used extensively over the past 20 years. The methodology described in this paper should have comparable usefulness as a planning tool for assessing the impacts of contraflow lanes.

REFERENCES

1. D. Kaku, W. Yamamoto, F. Wagner, and M. Rothenberg. Evaluation of the Kalanianaole Highway Carpool/Bus Lane. Offices of Research and Development, FHWA, Rept. FHWA-RD-77-100, Aug. 1977.
2. H.S. Rose and D.H. Hinds. South Dixie Highway Contraflow Bus and Carpool Lane Demonstration Project. TRB, Transportation Research Record 606, 1976, pp. 18-22.
3. R.N. Taube and C.A. Fuhs. Houston's I-45 Contraflow Transit Project. TRB, Transportation Research Record 798, 1981, pp. 39-45.
4. J.W. Billheimer. The Santa Monica Freeway Diamond Lanes: Evaluation Overview. TRB, Transportation Research Record 663, 1978, pp. 8-16.
5. J.W. Billheimer. The Santa Monica Freeway Diamond Lanes: Freeway Accident Analysis. TRB, Transportation Research Record 663, 1978, pp. 1-7.
6. D. Kaku, W. Yamamoto, F. Wagner, and M. Rothenberg. Evaluation of the Moanalua Freeway Carpool/Bus Bypass Lane. Offices of Research and Development, FHWA, Rept. FHWA-RD-77-99, Aug. 1977.
7. Cambridge Systematics, Inc. Houston North Freeway Contraflow Lane Evaluation Technical Memorandum: Summary of Pre-Contraflow Conditions. Transportation Systems Center, U.S. Department of Transportation, Cambridge, MA, Aug. 1980.
8. Institute of Traffic Engineers. Transportation and Traffic Engineering Handbook. Prentice-Hall, Inc., Englewood Cliffs, NJ, 1976.
9. Cambridge Systematics, Inc. Guidelines for Travel Demand Analyses of Program Measures to Promote Carpools, Vanpools, and Public Transportation. Office of Energy Conservation and Environment, Federal Energy Administration, Nov. 1976.
10. Cambridge Systematics, Inc. Tests of Transferability and Validation of Disaggregate Behavioral Demand Models for Evaluating the Energy Conservation Potential of Alternative Transportation Policies in Nine U.S. Cities. Office of Energy Conservation and Environment, Federal Energy Administration, April 1977.
11. T. Atherton. Approaches for Transferring Disaggregate Travel Demand Models. Department of Civil Engineering, Massachusetts Institute of Technology, Cambridge, Master's thesis, Feb. 1975.
12. R.J. Paquette, N. Ashford, and P.H. Wright. Transportation Engineering Planning and Design. Ronald Press Co., New York, 1972.
13. D.R. Drew. Traffic Flow Theory and Control. McGraw-Hill, New York, 1968.
14. L.J. Pignataro. Traffic Engineering: Theory and Practice. Prentice-Hall, Inc., Englewood Cliffs, NJ, 1973.

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Abridgment

Garden State Parkway HOV Lane

JOHN C. POWERS

Operation of a lane reserved for high-occupancy vehicles (HOVs) in each direction along 12 miles of the Garden State Parkway was studied. The HOV lane was established in November 1980 by addition of a lane in each direction to the existing six-lane divided and controlled-access roadway. Peak-period traffic flows before the addition of the HOV lane were characterized by levels of service D, E, and F along 5 or more miles of the road section that was widened. Information on numerous weekday peak-period traffic characteristics collected during the first year of HOV lane operation is reported. The definition of a carpool changed from three or more to two or more occupants in June 1981. A number of comparisons are presented for the two 6-month periods as well as for data collected before the HOV lane operation. Traffic before and after addition of the HOV lane was monitored for impacts of the HOV lane on HOV use, HOV and non-HOV travel time, automobile occupancy, person throughput, accident experience, HOV lane violations, and vehicle speeds. Results in terms of travel time, persons using HOVs, and accident data are reported.

In November 1980, the newly added median lanes of each direction of travel on a 12-mile section of the Garden State Parkway were opened as concurrent-flow, continuous-access, high-occupancy-vehicle (HOV) lanes. The minimum occupancy level was set at three or more persons.

In June 1981 the carpool definition was reduced to two or more persons, and in June 1982 the restrictions were lifted entirely. This paper reviews and summarizes travel time, HOV use, and accident data collected during the first 12 months of HOV lane operation.

TRAVEL TIME SAVINGS

Comparisons of speeds in the reserved and unreserved lanes during the three-or-more operation revealed that HOVs saved more than 0.7 min/mile when congestion occurred during the northbound morning peak period (see Figure 1). At typical congestion levels during this peak period, the savings averaged as much as 3.2 min for the full length of the HOV

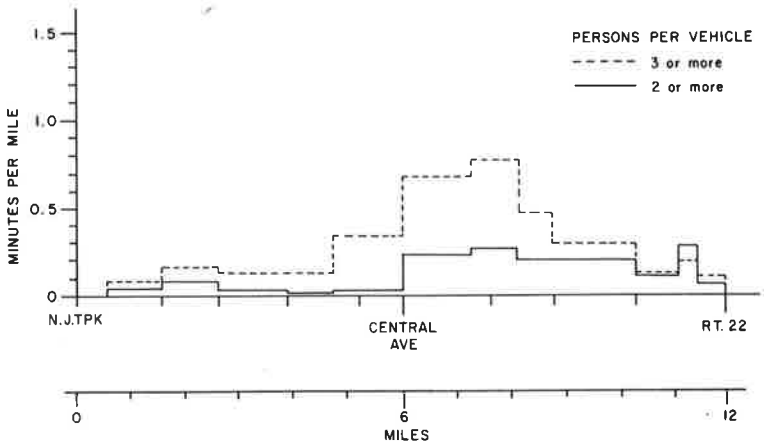


Figure 1. Typical time savings during northbound morning peak period.

lane. A travel time savings of as much as 1.3 min/mile occurred in the most-often-congested sections during the southbound evening peak period (not shown). At typical congestion levels during this peak period, the savings averaged as much as 5.1 min for the full length of the HOV lane.

Comparisons of speeds in the reserved and unreserved lanes during the two-or-more operation reveal that HOVs saved as much as about 0.3 min/mile in the most-often-congested sections in the northbound morning peak period. As a result of the relatively low congestion levels during this period, the savings averaged 0.9 min for the full length of the HOV lane during the morning peak period.

Comparisons of speeds in the reserved and unreserved lanes indicate that HOVs saved up to 0.4 min/mile in the most-often-congested sections in the southbound evening peak period. As with the morning peak period, relatively low congestion levels resulted in time savings of about 0.8 min for the full length of the HOV lane during the evening peak period.

HOV USE

Data collected in all lanes indicate that the percentage of persons traveling the Garden State Parkway northbound in the morning peak in HOVs increased by one-third from December 1980 to May 1981. The May percentage of persons carried in HOVs was four-fifths of the 1976 summer occupancy percentage but 110 percent of the 1980 summer occupancy percentage. The following table summarizes these data (in June 1981 the definition of an HOV changed to two or more persons):

	Persons Using HOVs (%)	
Time	Morning	Evening
Summer 1976	19	25
August 1980	13	21
December 1980	11	NA
May 1981	15	17
June 1981	35	49
August 1981	36	53
October 1981	31	42
November 1981	33	NA

After the change to two-or-more operation, the percentage of persons traveling the Garden State Parkway in HOVs declined to about 33 percent in November (just less than the June percentage of 35 percent) after peaking at almost 38 percent in July. During the peak hour the percentage reached nearly 40 percent, some 15 percent higher than the portion of the road reserved for HOV persons. Of these, the portion of persons in HOVs who used the HOV lane was observed to range from one-half to four-fifths after June and was as much as 31 percent of all persons on the roadway.

No comparisons are available for November, December, and January in the southbound evening peak because darkness prevented HOV counts during all or part of the hours between 4:00 and 6:00 p.m. Available data indicate that the percentage of persons traveling the Garden State Parkway in HOVs was two-thirds of the 1976 summer occupancy percentage and four-fifths of the 1980 summer occupancy.

Data for the evening peak period collected in all lanes after the change to two-or-more operation indicate that the percentage of persons traveling the Garden State Parkway in HOVs declined in October, the last month of evening data, at about 42 percent (about 6 percent lower than the 48 percent observed in June) after peaking at almost 53 percent in August. During the peak hour, percentages exceeded 56 percent, more than double the portion of the road reserved for HOV persons. The portion using the HOV lane was observed to range from two-fifths to one-half and was as much as 27 percent of all persons on the roadway.

Figure 2. Accident rates.

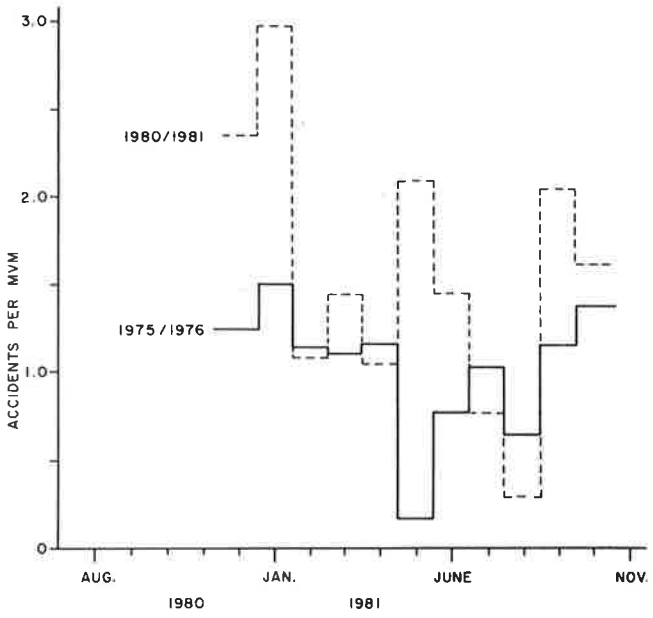


Figure 3. Volume changes during northbound morning peak period.

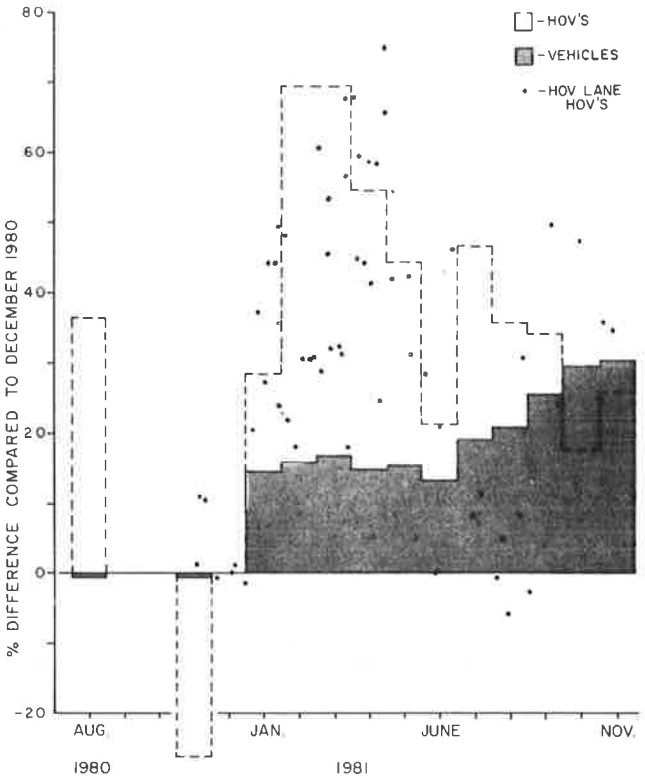
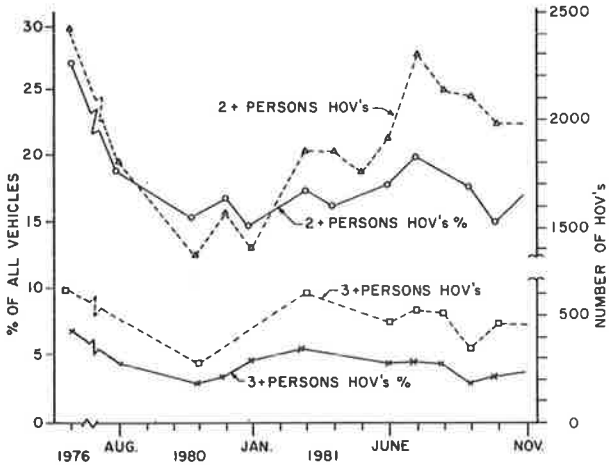


Figure 4. HOV volumes.



ACCIDENTS

The peak-period accident rates (see Figure 2) in the HOV lane section increased by as much as 100 percent to 2.97 accidents/million vehicle miles during the first two months of operation in comparison with a rate of 1.49 accidents/million vehicle miles for the same time of year in the before period of 1975-1976. Initial increases of this type have been observed on other highways where HOV lanes have been implemented. After January, peak-period accident rates in the HOV lane section declined, ranging up to 1.61 accidents/million vehicle miles. (The rates in the before period ranged up to 1.49 accidents/million vehicle miles.) Such a drop to preconstruction rates has been observed in successful HOV lane operations elsewhere.

Accidents increased from 66 to 109 in the HOV lane section (16 of these 43 accidents occurred in the first two full months) compared with an increase from 28 to 34 in a control section.

SUMMARY AND CONCLUSIONS

Although many measures were monitored for change during the study period, the basic yardstick for success was the number of HOVs. Any nonseasonal increase in the HOV percentage was accepted as a positive indicator. Although no specific share was set as a goal, a continually improving percentage was considered to be of primary importance.

Figures 3 and 4 show HOV volumes, their percentage of total volume, and the relative changes that occurred during the 12 months studied for the morning period. The evening data, which are not shown, are similar.

It was concluded that, with the exception of March 1981, changes in HOV volumes were highly related to substantial overall increases in demand, due largely to the additional capacity made available by widening (initially) and further by reducing carpool occupancy (in June 1981). It was also concluded that changes in HOV percentage, again with the exception of March 1981, were highly related to normal seasonal variations.

As expected, the addition of two-person vehicles as HOVs substantially reduced the congestion that occurred in the unreserved portions of the roadway during the first six months of operation. In fact, three years of average general growth in traffic volume would need to occur before peak volumes of unreserved-lane vehicles would be large enough to more than fill the unreserved portion of the roadway and subsequently cause increased congestion. In addition, as expected, the portion of vehicles eligible for HOV lane use exceeded the portion of the roadway reserved for them during the summer months. There were differences but, based on the comparative data collected one year apart (only several common points in the 15 or 16 months since August 1980), the Garden State Parkway and NJ-287 (the control site) changed little both before and after June 1981.

ACKNOWLEDGMENT

The contents of this paper reflect our views, and we are responsible for the facts and the accuracy of the data presented. The contents do not necessarily reflect the official views or policies of the New Jersey Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

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