Assessing HOV Lane Utilization and Occupancy Rates

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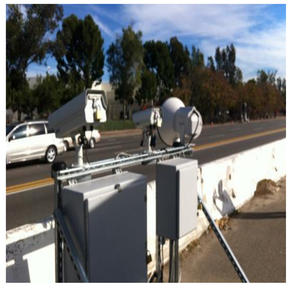
ABSTRACT

This study evaluated the performance of existing HOV lanes in Tennessee as viable travel-time incentives for promoting carpooling and reducing congestion. While the overall person-moving capacity of the HOV lanes may be slightly higher than the general-purpose lanes, the travel–time incentives for legitimate HOV lanes users in Tennessee has been severely diminished by violators. The study conducted a literature review on HOV lane occupancy detection technologies which could be utilized to assist in managing both HOV corridors and evaluation of performance strategies to address high violation rates. Furthermore, the study evaluated HOV lane utilization rates and HOV lane occupancy violation rates in the state. Estimating utilization rates as the percentage of vehicles that use the HOV lane compared to all other General Purpose (GP) lanes, the study found that the average HOV lane utilization in Tennessee is 23% and the HOV lane violation rate is about 84%. The HOV lane occupancy violation rates were evaluated by taking the percentage of Single Occupancy Vehicles (SOVs) compared to the total vehicles using the HOV lanes during AM and PM peak hours. It was found that only 15% to 20% of vehicles using the HOV lanes in Tennessee are those with 2+ occupants as required by law; the remaining 80% to 85% are single occupancy vehicles (SOVs). Findings are expected to support operational goals of transportation agencies with HOV systems and potential improvement strategies.

HOV DETECTION TECHNOLOGY

- From the literature, the most recent study on video HOV detection technology was conducted by Xerox for the California Department of Transportation (Caltrans) Pilot in Orange County, California using the Xerox Vehicle Passenger Detection System (VPDS).
- Xerox installed the VPDS equipment on the northbound lane of Interstate 5 with a view to the inside lane. The findings from the Caltrans Pilot of the Xerox VPDS indicated that the system was able to perform at an accuracy rate of 95+% for the purposes of identifying SOVs in the HOV lanes. Human roadside observers achieved a 36% accuracy rate during the pilot.
- Based on the literature review, it was observed that most HOV lane monitoring and enforcement activities are largely done manually. While research indicates that no automated HOV detection systems have been established to detect occupancy at 100% accuracy, commendable efforts have developed systems to determine occupancy to high degrees.



FIELD DATA COLLECTION

- Data was collected in selected locations along the HOV lane corridors listed below, and operational performances were then evaluated with respect to (1) HOV lane utilization rates and (2) HOV lane occupancy violation rates.
- Two sources of data collection were used: (1) a high-speed traffic video unit called Miovision Scout to measure traffic flow by lane and (2) manual/visual counting using observation of the HOV lanes only. Data from the site (HOV lanes) and Google Earth helped identify a number of sites for traffic counts and occupancy observations.

Location	Corridor	Direction	HOV lane Miles
Nashville	I-40 East	Eastbound and Westbound	32
	I-24	Eastbound and Westbound	52
	I-65 North	Northbound and Southbound	10
	I-65 South	Northbound and Southbound	28
Memphis	I-40	Eastbound and Westbound	13
	I-55	Northbound and Southbound	10

HOV LANE OCCUPANCY VIOLATION RATES

- HOV lane occupancy data was gathered during peak hours within the same periods the traffic flow per lane data was collected. These in-vehicle occupancy visual inspections were conducted from a high point (bridge/overpass) above the subject HOV lane. The aim was to determine whether the occupants in the vehicles traveling on the HOV lane had one (i.e., SOV) or two or more people (i.e., HOV).

$$\text{HOV Lane Violation Rate} = \frac{\text{SOVs on HOV Lane}}{\text{SOVs} + \text{HOV on HOV Lane}}$$

- the HOV lane occupancy violation rate traveling toward downtown Nashville (AM hours) is 82%, and outward from downtown Nashville (PM hours) is 81%.
- The HOV lane occupancy violation rate traveling toward downtown Memphis (AM hours) is 88%, and the rate outward from downtown Memphis (PM hours) is 86%.
- HOV lane violations are higher in Memphis compared to Nashville HOV corridors (87% vs. 81%).
- Only 15% to 20% of vehicles using HOV lanes were those with 2+ occupancy, as required by law. A higher percentage of the vehicles using HOV lanes during HOV operational hours were SOVs. The PM traffic was found to be slightly higher than that of the AM traffic; however, the AM violation rates were higher than PM violation rates.

Data Location		AM Peak		PM Peak	
		Violation Rate	Total on HOV Lane (SOV)	Violation Rate	Total on HOV Lane (SOV)
I-65 North Side of Nashville	Chadwell Dr.	83%	1970 (1635)	84%	2639 (2201)
	Due West Ave.	Data Not Collected		80%	2083(1669)
	Average	83%		83%	
I-65 South Side of Nashville	Cool Springs Blvd.	79%	1275(1005)	83%	1545(1278)
	Harding Place	82%	2673(2208)	81%	3071(2477)
		81%		82%	
I-40 East Side of Nashville	Old Hickory Blvd.	85%	1820(1543)	79%	2500(1983)
I-24 East Side of Nashville	Waldron Rd.	85%	2036(1731)	79%	2757(2161)
	Fortress Blvd.	73%	1224(898)	Data Not Collected	
		79%		79%	
I-40 East of Memphis	Whitten Rd.	87%	2414(2110)	86%	3323(2861)
I-55 South Memphis	Winchester Rd.	89%	1924(1712)	85%	2584(2187)

HOV LANE UTILIZATION RATES

- The per lane traffic counts using the Miovision Scout video unit were disaggregated and sorted before calculating utilization rates. The utilization of the HOV lanes during peak hours was evaluated as the percentage of vehicles that use the HOV lane to those using general purpose (GP) lanes. The table below summarizes the data collected by lanes and the utilization rates.

$$\text{HOV Utilization Rate} = \frac{\sum \text{HOV Lane traffic}}{\sum \text{GP lanes traffic} + \text{HOV Lane traffic}}$$

- The average HOV lane utilization during morning (AM) hours toward downtown areas is 22% for Nashville area and 25% for Memphis area.
- The HOV lane utilization when traffic is moving outside downtown areas during PM peak hours are 25% for Nashville area and 27% for Memphis area.
- Combining Nashville and Memphis area numbers, the AM HOV lane utilization rates toward downtown areas in Tennessee is about 24% and the utilization rate during PM peak hours from downtown areas is 26%.
- Overall, the average of combined utilization of HOV lanes (percentage of traffic that is in the designated HOV lane) in Tennessee is 23%.

	AM							
	Towards Nashville Downtown				Out of Nashville Downtown			
	HOV Lane	GP (Adjacent to HOV)	All other GP lanes	Utilization	HOV Lane	GP (Adjacent to HOV)	All other GP lanes	Utilization
I-65 South of Nashville	3312	3994	6530	24%	3210	3818	4903	27%
I-65 North of Nashville	1952	2258	11131	13%				
I-24 East of Nashville	2090	2609	3374	26%	1589	2138	3620	22%
I-40 East of Nashville	1897	2469	2804	26%	618	1361	1732	17%
	PM							
	Towards Nashville Downtown				Out of Nashville Downtown			
	HOV Lane	GP (Adjacent to HOV)	All other GP lanes	Utilization	HOV Lane	GP (Adjacent to HOV)	All other GP lanes	Utilization
I-65 South of Nashville	2820	3479	4777	25%	3248	3017	5384	28%
I-65 North of Nashville	834	1399	6680	9%	2369	2554	10508	15%
I-24 East of Nashville	2139	2495	3061	28%	3634	3554	6269	27%
I-40 East of Nashville	748	1525	1980	18%	2444	2788	3008	30%
	AM							
	Towards Memphis Downtown				Out of Memphis Downtown			
	HOV Lane	GP (Adjacent to HOV)	All other GP lanes	Utilization	HOV Lane	GP (Adjacent to HOV)	All other GP lanes	Utilization
I-55 South of Memphis	2062.5	2339.5	5002	22%	934	1492	2389	19%
I-40 East of Memphis	2661	2895	4007	28%	1120	1870	3166	18%
	PM							
	Towards Memphis Downtown				Out of Memphis Downtown			
	HOV Lane	GP (Adjacent to HOV)	All other GP lanes	Utilization	HOV Lane	GP (Adjacent to HOV)	All other GP lanes	Utilization
I-55 South of Memphis	900	1764	3223	15%	2626	3125	4825	25%
I-40 East of Memphis	1867	2461	3301	24%	3436	3314	4871	30%

CONCLUSIONS

- Infrared (IR) technology is superior to the visible light-based technology with an infrared (IR) technology from Xerox, known as the Xerox Vehicle Passenger Detection System (XVPD) as a potential option for states such as Tennessee.
- The average HOV lanes utilization rate in Tennessee is 23%.
- The average HOV lanes occupancy violation rate in Tennessee is 83%.

ACKNOWLEDGEMENTS AND DISCLAIMER

This research was funded through the State Research and Planning (SPR) Program by the Tennessee Department of Transportation and the Federal Highway Administration. This paper is disseminated under the sponsorship of the Tennessee Department of Transportation and the United States Department of Transportation in the interest of information exchange. The State of Tennessee and the United States Government assume no liability of its contents or use thereof. The contents of this paper reflect the views of the authors who are solely responsible for the facts and accuracy of the material presented. The contents do not necessarily reflect the official views of the Tennessee Department of Transportation or the USDOT.

Transportation Research Board, 98th Annual Meeting

TRB paper: 19-00077