Vehicle and Occupancy data collection on I-15 HOV & GP Lanes in Salt Lake Valley, Utah

Technical Report

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Abstract
This study is a data collection effort on the I-15 high occupancy lane (HOV) and the general purpose (GP) lanes in the Salt Lake Valley, Utah. Vehicle and occupancy data was collected on four locations on the I-15 for the AM northbound and the PM southbound directions during the peak periods. The average vehicle occupancy on the HOV lanes was observed to be 2.42 and for the GP lanes it was 1.11. The person throughput of the HOV lanes were also more than 100% of that of the GP lanes many locations and was higher during the PM peak than the AM peak. On an average the HOV lanes carried nearly 1/3rd of the traffic volume carried by the GP lanes but the person throughput was significantly higher than the GP lanes.

1. Introduction

On May of 2001, 16 miles of High-Occupancy Vehicle (HOV) lanes were opened on the reconstructed I-15 corridor in Salt Lake Valley, Utah. These are single lanes in each direction that operate between 600 north and 10600 south 24 hours a day, seven days a week. Buses, motorcycles, vanpools and carpools that have occupancy of 2+ and alternative fuel vehicles (also referred to as Clean Fuel vehicles) are eligible to use them. The main purpose of these facilities is to reduce the travel time for the commuters and congestion on the freeway facility. Being a recent facility in the region, transportation professionals from academic and non-academic fields are very enthusiastic to measure the system effectiveness. The National Cooperative Highway Research Program (NCHRP) report no. 414, “HOV Systems Manual”, recommends evaluation of these facilities to realize the actual project benefits. These evaluations not only help in planning the future efforts but also provide officials with a database. There are measures of effectiveness (MOE’s) to evaluate the effectiveness of HOV facilities and one of them is vehicle and occupancy count.

In this study vehicle and occupancy data was collected on selected locations on the mainline I-15 facility for both the HOV and general purpose (GP) lanes on the I-15. The corridor has four GP lanes and one left-side HOV lane per direction. The collected data was analyzed in terms of average vehicle occupancy (AVO) and 15 minute distribution of the volume. These kinds of information are useful in making potential changes in occupancy requirements, to change usage and throughput, if required in future.

2. Methodology

Manual count techniques were used to collect the data for all the four locations. For the GP lanes, occupancy and vehicle volume was recorded for all the lanes for the northbound direction in the AM peak and the southbound direction for the PM peak. On one of the locations (@ 2700 south) data was collected only for the northbound direction because collecting southbound data manually was not possible, due to safety reasons. The same was applied for the HOV lanes and vehicle volume, classification and occupancy was recorded for each of the locations, for AM and PM peak periods. Since buses and vanpools have very high rate of occupancy, they were recorded as a separate category for both GP and HOV lanes.

The data was collected for 15 minute intervals during the AM peak in the northbound direction and PM peak in the southbound direction on the freeway facility. The peak period is from 6:30AM-8:30AM in the morning and from 4:00PM-6:00PM in the evening. Considering the limitations of the study, the length of the facility, number of access points & safety issues; fours locations were chosen for data collection. Ability to observe
the occupants in the vehicle was also taken as one of the considerations for choosing the locations. All the selected locations have an overpass from which the data can be recorded safely and accurately. The AM peak direction data for 10600 south could not be collected since the HOV lanes do not start from that location in that direction.

Finally the collected data was assimilated in MS Excel spreadsheet format for all the locations separately, for both occupancy counts and the volume counts. For vehicle occupancy data; cars were classified as single occupancy vehicles (SOV) or carpools (with 2+, 3+, 4+ or 5+ occupants); vanpools were classified as 1-5, 5-10 or10+ occupants; buses were classified as empty, ½ full or full; motorcycle as 1 or 2 occupants and semi/semi trailer as 1 or 2 occupants.

3. Locations

The following four locations shown in the table were chosen for the data collection effort. The regional map of all the locations is also shown below.

<table>
<thead>
<tr>
<th>Location</th>
<th>Co-ordinate</th>
<th>Lane Configuration</th>
<th>Period/Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location 1</td>
<td>2700 south on I-15</td>
<td>4 GP lanes 1 HOV lane</td>
<td>Northbound-AM peak</td>
</tr>
<tr>
<td>Location 2</td>
<td>3900 south on I-15</td>
<td>4 GP lanes 1 HOV lane</td>
<td>Northbound-AM peak; southbound-PM peak</td>
</tr>
<tr>
<td>Location 3</td>
<td>4900 south on I-15</td>
<td>4 GP lanes 1 HOV lane</td>
<td>Northbound-AM peak; southbound-PM peak</td>
</tr>
<tr>
<td>Location 4</td>
<td>10600 south on I-15</td>
<td>3 GP lanes 1 HOV lane</td>
<td>Southbound-PM peak</td>
</tr>
</tbody>
</table>

![Regional Map of Locations](image-url)
4. Data Analysis

The collected data is analyzed for the traffic volume variation on 15 minute intervals for the AM and the PM peak periods of two hours. The 15 min volume was plotted for all the five lanes (ie. 4 GP and 1 HOV lane) for all the four locations.

Since the traffic volume data was recorded in different modes with the number of occupants; the person throughput was also computed from the occupancy and the vehicle volume for all the lanes during both the peak periods. The person throughput was calculated as:

\[
\text{Person throughput for lane 'n' = sum ( # of occupants in mode 'm' x traffic volume of mode 'm' during peak period)}
\]

\[
\text{where } m = \text{SOV, carpool (# 2,3,4 & 5), vanpool, bus, motorcycle, semi/trailer}
\]

\[
n = \text{GP lanes 1 thru 4 and HOV lane}
\]

Inferences on the average vehicle occupancy (AVO), were deduced from person throughout and traffic volume for the GP lanes and the HOV lane. The AVO was calculated as:

\[
\text{AVO = person throughput in peak period / total volume in peak period}
\]

The following sections will discuss the results of the collected data, traffic volume variation, person throughput and the AVO for the HOV and GP lanes on all the four locations.

4.1 @ 3900 south on I-15 (AM – PM peak)

The figure 1 & 2 below show the AM peak volume profile for 3900 S on I-15 for the HOV and the GP lanes. It can be seen that the GP1 has the highest traffic volume during both the AM and PM peak periods. The traffic volume variation is more consistent for all the lanes during the AM peak period than the PM peak. The peak AM 15 minute traffic volume is from 7:15am – 7:30am.

From figure 3 it can be inferred that during the AM peak period the HOV lanes carry approximately 33% the volume carried by the GP lanes (with GP lanes carrying 3952 vehicles and the HOV 1266). However in terms of person throughput the HOV lanes carry almost 67% of the persons than the GP lanes.

From figure 4 it can be inferred that the HOV lanes carry approximately 50% of the traffic volume carried by the GP lanes but in terms of the person throughput the HOV lanes carry 110% of the persons carried by the GP lanes. The PM peak person throughput for HOV lanes is much higher than the AM peak.

The AVO for the GP lanes for both the AM and the PM peak is little more than 1 but for the HOV lanes it is more than 2. This shows that the GP lanes predominantly carry single occupancy vehicles but the HOV lanes have a significant amount of carpools as well.
4.2 @ 4900 south on I-15 (AM – PM peak)

The AM and PM peak volume showed in figures 5&6 depicts that the traffic volume variation is almost similar for both the peak periods. The AM peak 15 minute period is from 7:30am-7:45am and the PM peak is from 4:15pm-4:30pm. The HOV lane volume is the least and GP 1 has the highest traffic volume during both the peak periods of the day.

From figure 7 it can be seen that the HOV lanes carry only 32% of the traffic volume than the GP lanes. In terms of absolute number the traffic volume carried by the HOV lane during AM peak period is 1290 and by GP lanes it is 3951. However, in terms of person throughput the HOV lanes carry 73% of the throughput than the GP lanes. The absolute number for HOV lanes is 3095 persons and for GP it is 4225 approx.

The PM peak throughput and volume figures depicted in figure 8 shows that the HOV lanes have a much higher person throughput than the GP lanes. In terms of volume the HOV lanes carry approx 58% of the traffic carried by the GP lanes but in terms of throughput the HOV lanes carry approx 131% of the persons carried by the GP lanes. The absolute throughput numbers are 5649 persons for HOV and 4294 for the GP lanes.

4.3 @ 2700 south on I-15 (AM peak-northbound only)

The 15 minute volume profile in figure 9 shows that GP 3 has the maximum volume on this location. The variation in the traffic volume is similar for all the lanes during the peak period. The peak 15 minute interval is from 7:45pm-8:00pm approximately for all the lanes. The traffic volume on the HOV lanes is almost consistent for the entire peak period.

From figure 10 it can be seen that the HOV lanes carry approx 25% of the traffic volume carried by the GP lanes but in terms of person throughput the HOV lanes carry almost 58% of the people carried by the GP lanes. The AVO for GP lanes is 1.08 but for the HOV it is 2.53. So, the HOV lanes carry a lot number of carpools than the GP lanes.

4.4 @ 10600 south on I-15 (PM peak-southbound only)

The traffic volume variation shown in figure 11 depicts that the highest volume is recorded for GP 1. However, there is not much of a variation in terms of absolute volume for all the GP lanes on this location. There is no specific 15 minute peak within the PM peak period and the volume is almost consistent.

From figure 12 it can be seen that the HOV lanes carry approximately 77% of the traffic carried by the GP lanes but in terms of the person throughput the HOV lanes throughput is 157% than the GP lanes. The AVO for GP lanes is 1.14 but for the HOV lanes it is 2.32. Again the HPV lanes more much more people than the GP lanes.
5. Summary

The AVO for the HOV lanes on an average is 2.42 for all the locations whereas for the GP lanes it is 1.11 (refer table 1). This shows that there is a significant number of carpools on HOV than on the GP lanes. The highest AVO for HOV lanes is at 2700 S and 4900 S (PM peak) with a value of 2.53.

Table 1. Average vehicle occupancy (AVO) for GP & HOV lanes

<table>
<thead>
<tr>
<th>Location</th>
<th>GP Lanes</th>
<th>HOV Lane</th>
</tr>
</thead>
<tbody>
<tr>
<td>2700 S (AM peak northbound)</td>
<td>1.08</td>
<td>2.53</td>
</tr>
<tr>
<td>3900 S (AM peak northbound)</td>
<td>1.11</td>
<td>2.32</td>
</tr>
<tr>
<td>3900 S (PM peak southbound)</td>
<td>1.12</td>
<td>2.39</td>
</tr>
<tr>
<td>4900 S (AM peak northbound)</td>
<td>1.07</td>
<td>2.4</td>
</tr>
<tr>
<td>4900 S (PM peak southbound)</td>
<td>1.13</td>
<td>2.53</td>
</tr>
<tr>
<td>10600 S (PM peak southbound)</td>
<td>1.14</td>
<td>2.32</td>
</tr>
</tbody>
</table>

**Average** 1.11 2.42

The person throughput for the HOV lanes is much higher than the GP lanes. Table 2 below shows the percentage of traffic and the person throughput carried by the HOV lane as compared to the GP lanes. It can be seen that even through the HOV lanes carry less traffic volume than the GP lanes still the person throughput is very high. For the locations 3900 S (PM peak), 4900 S (PM peak) &10600 S (PM peak) the percentage of HOV person throughput is more than 100% of the GP lanes.

Table 2. Person throughput of GP & HOV lanes

<table>
<thead>
<tr>
<th>Location</th>
<th>Volume</th>
<th>% carried by HOV compared to GP</th>
<th>Person throughput</th>
<th>% carried by HOV compared to GP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GP lanes</td>
<td>HOV lane</td>
<td>GP lanes</td>
<td>HOV lane</td>
</tr>
<tr>
<td>2700 S (AM peak northbound)</td>
<td>3309.25</td>
<td>821</td>
<td>24.81</td>
<td>3597.5</td>
</tr>
<tr>
<td>3900 S (AM peak northbound)</td>
<td>3952</td>
<td>1266</td>
<td>32.03</td>
<td>4351</td>
</tr>
<tr>
<td>3900 S (PM peak southbound)</td>
<td>4004.5</td>
<td>2053</td>
<td>51.27</td>
<td>4459.75</td>
</tr>
<tr>
<td>4900 S (AM peak northbound)</td>
<td>3951.25</td>
<td>1290</td>
<td>32.65</td>
<td>4225.5</td>
</tr>
<tr>
<td>4900 S (PM peak southbound)</td>
<td>3817</td>
<td>2237</td>
<td>58.61</td>
<td>4294.25</td>
</tr>
<tr>
<td>10600 S (PM peak southbound)</td>
<td>2495.33</td>
<td>1938</td>
<td>77.67</td>
<td>2859.67</td>
</tr>
</tbody>
</table>

5. Conclusion

From the overall analysis it can be concluded that the HOV lanes carry much more persons and less vehicles at all the locations. The AVO numbers show that the throughput for the HOV lanes is more than double than the GP lanes. Also, it could be seen that for all the locations the PM peak person throughput was much higher than the AM peak except only at 2700 S. The NCHRP report 414 ‘HOV Systems Manual” recommends that a minimum of 400-800 vehicles per hour per lane (vphpl) is needed for most HOV facilities and from this study we observe that the vphpl volume is much higher than the required standards. Overall it can be concluded that the HOV facility on the I-15 in Salt Lake Valley region is very efficient and contributes to travel time savings and higher person throughput.
Volume & Throughput @ 3900 south: AM – PM peak Analysis
Volume & Throughput @ 4900 south: AM – PM peak Analysis

**Figure 5.** Volume-15 min profile @ 4900 S on I-15 N (AM Peak northbound)

**Figure 6.** Volume-15 min profile @ 4900 S on I-15 S (PM Peak southbound)

**Figure 7.** AM peak HOV & GP Lane (Volume & Throughput) @ 4900 S on I-15 N

**Figure 8.** PM peak HOV & GP Lane (Volume & Throughput) @ 4900 S on I-15 N
Figure 9. Volume-15 min profile @ 2700 S on I-15 N (AM Peak northbound)

Figure 10. AM peak HOV & GP Lane (Volume & Throughput) @ 2700 S on I-15 N

Volume & Throughput @ 2700 south: AM peak Analysis (northbound) only
Volume & Throughput @ 10600 south: PM peak Analysis (southbound) only