I-290

Preliminary Engineering

and Environmental (Phase 1) Study

West of Mannheim Road to Racine Avenue

# Existing Roadway Operations

# Addendum #1

Extended Study Area: East of Cicero to Racine Avenue

April 2013

# Table of Contents

## LIST OF TABLES



## LIST OF FIGURES



## APPENDICES

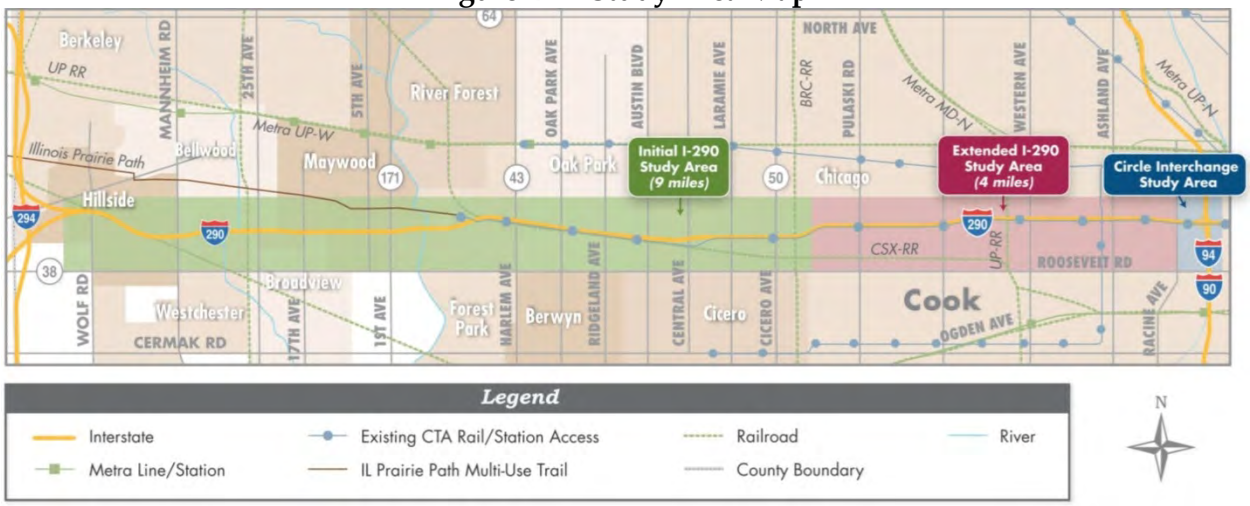
# 1.0 Introduction

This Technical Memorandum Addendum was prepared in support of the I-290 Preliminary Engineering and Environmental (Phase I) Study Existing Transportation System Performance Report, and documents the existing traffic operations along the Eisenhower Expressway (I-290) from east of Cicero Avenue to Racine Avenue in Cook County, Illinois.

# 2.0 Study Area

The I-290 Phase I study extended study area (Figure 2-1) is centered along I-290 in Cook County extending approximately 4 miles from east of Cicero Avenue to Racine Avenue.

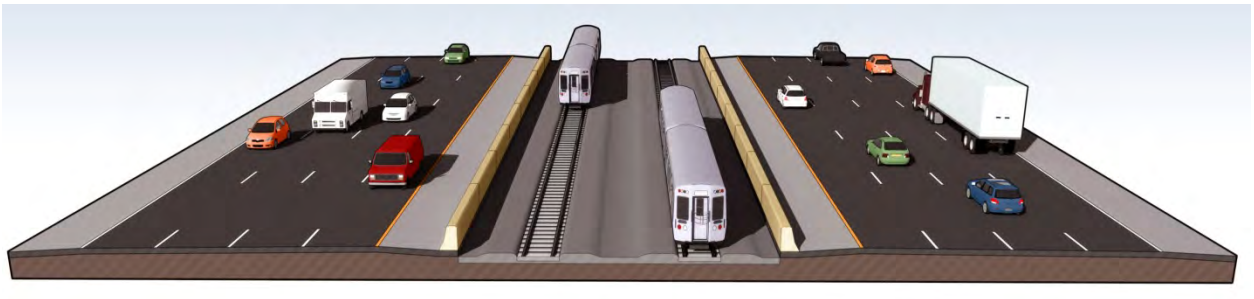
**Figure 2-1 - Study Area Map**




## 2.1 Mainline

The I-290 Eisenhower Expressway has remained almost entirely unchanged since its construction over 50 years ago. Interchanges, access ramps, and lane configurations of I-290 from east of Cicero Avenue to Racine Avenue are still in their original design. The I-290 mainline maintains an 8-lane configuration throughout the extended study area with the CTA Blue Line heavy rail transit operating in the median (**Figure 2-2**).

**Figure 2-2 - I-290 Extended Study Area Typical Section**



An existing lane diagram in **Figure 2-3** illustrates the existing mainline and ramp lane configurations in the extended study area.

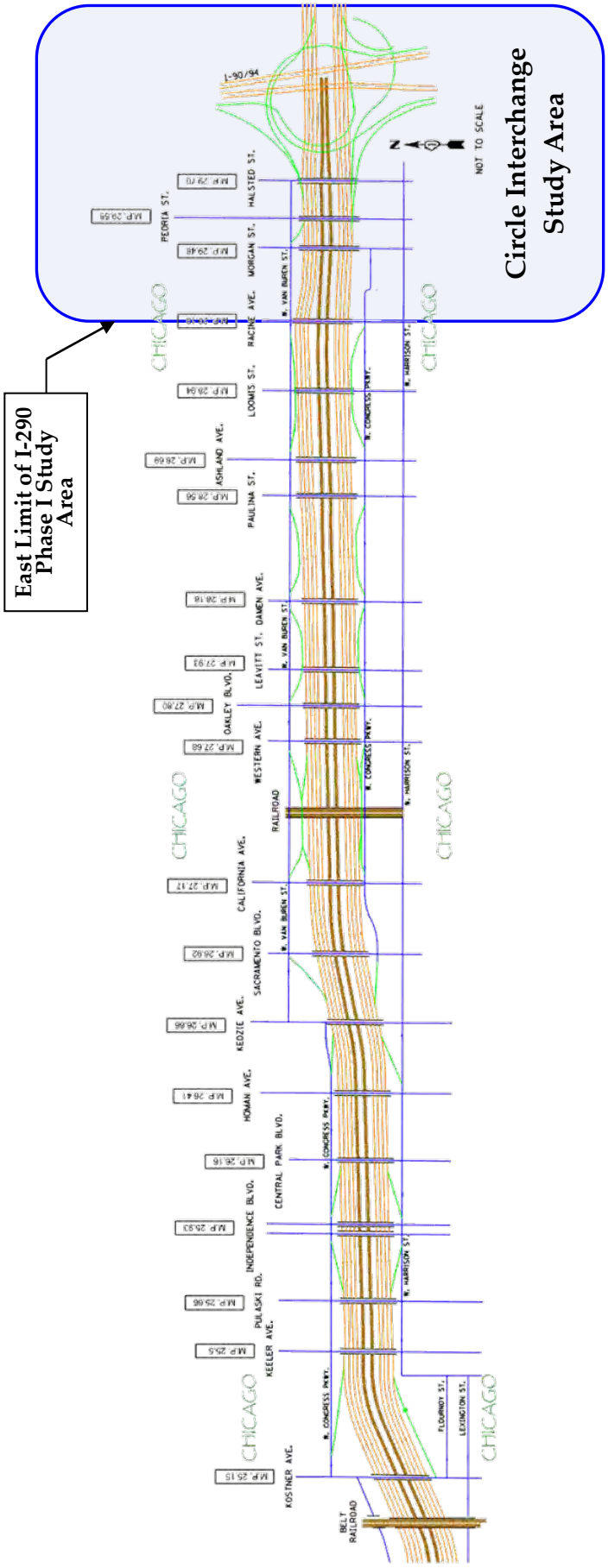



**Figure 2-3 - I-290 Extended Study Area Lane Diagram**

Traffic volumes along I-290 in the extended study area range from 186,300 to 225,700 vehicles per day with truck volumes averaging around 3% (compared to the regional expressway average truck percentage of 10%).

**Table 2-1 - I-290 Extended Study Area ADT (% Trucks)[1]**

| I-290 Location | M.P. | Dis. | # of Lanes | I-290 Mainline Volumes | | | Truck Volume | |
|---|---|---|---|---|---|---|---|---|
| | | | | WB | EB | 2-Way | 2-Way | % |
| Racine St | 19.67 | | | | | | | |
| | | 0.14 | 8 | 103,000 | 109,600 | 212,600 | 6,700 | 3.2% |
| Ashland Ave | 19.53 | | | | | | | |
| | | 0.36 | 8 | 94,400 | 98,900 | 193,300 | 6,700 | 3.5% |
| Paulina St | 19.17 | | | | | | | |
| | | 0.17 | 8 | 104,300 | 110,300 | 214,600 | 6,700 | 3.1% |
| Damen Ave | 19.00 | | | | | | | |
| | | 0.28 | 8 | 98,600 | 104,100 | 202,700 | 6,700 | 3.3% |
| Damen Ave | 18.72 | | | | | | | |
| | | 0.12 | 8 | 107,500 | 113,700 | 221,200 | 6,700 | 3.0% |
| Oakley Blvd | 18.60 | | | | | | | |
| | | 0.38 | 8 | 101,900 | 108,600 | 210,500 | 6,700 | 3.2% |
| Western Ave | 18.22 | | | | | | | |
| | | 0.29 | 8 | 110,400 | 100,800 | 211,200 | 6,700 | 3.2% |
| California Ave | 17.93 | | | | | | | |
| | | 0.50 | 8 | 99,900 | 108,600 | 208,500 | 6,700 | 3.2% |
| Sacramento Blvd | 17.43 | | | | | | | |
| | | 0.17 | 8 | 109,200 | 116,000 | 225,200 | 6,700 | 3.0% |
| Homan Ave | 17.26 | | | | | | | |
| | | 0.58 | 8 | 101,800 | 105,900 | 207,700 | 6,000 | 2.9% |
| Independence Blvd | 16.68 | | | | | | | |
| | | 0.32 | 8 | 93,800 | 95,300 | 189,100 | 6,000 | 3.2% |
| Independence Blvd | 16.36 | | | | | | | |
| | | 0.33 | 8 | 103,800 | 105,100 | 208,900 | 6,000 | 2.9% |
| Kostner | 16.03 | | | | | | | |
| | | 0.50 | 8 | 96,000 | 90,300 | 186,300 | 6,000 | 3.2% |

## 2.2 Study Area Arterials

The primary east-west parallel arterial streets near I-290 are Roosevelt Road to the south and Madison Street to the north. Roosevelt Road, located just over ½ mile to the south of I-290, is a consistent 4-lane street throughout the extended study area section with areas of on-street parking in various locations and averages between 20,100 and 24,400 vehicles per day (vpd). East of Ogden Avenue, there are medians of varying widths located along Roosevelt Road. Throughout this section, there are sections of parallel on-street parking in various locations. Madison Street, which runs parallel to I-290 about ½ mile to the north, varies from a two-lane to four lane configuration in each direction as it travels from east to west. East of Ogden Avenue, there are medians of varying widths. Within the extended study area, there are areas of on-street parallel parking in various locations. Traffic on Madison Street varies from about 8,900 to 18,300 vpd in extended study area. These arterial roads are limited in their capacity to carry additional traffic by the existing number of through lanes, and the operation of signalized intersections along their routes.

[1] 2009 IDOT & CMAP balanced traffic data

Other parallel arterial roads to the north and south of I-290 include Lake Street (approximately 1 mile to the north), North Avenue (approximately 2.4 miles to the north), and Cermak Road (approximately 1.6 miles to the south). The ADT on Lake Street is approximately 14,500 vpd through the extended study area. Along North Avenue, the ADT varies between 18,000 and 24,900 vpd. The ADT on Cermak Road varies between 13,400 and 19,100 vpd.

The principal arterial north-south routes in the extended study area of I-290 are Pulaski Road, Kedzie Avenue, Western Avenue, and Ashland Avenue. Traffic along Pulaski varies from 17,000 to 21,900. Traffic along Kedzie varies from 10,800 to 15,100. Western varies from 26,800 to 31,300 vpd near I-290. Traffic along Ashland varies from 32,000 to 33,600 vpd near I-290.

**Figure 2-4 – Extended Study Area Arterial ADTs[2] (2009)**


## 2.3 Current Mitigation Measures

To mitigate congestion, the Illinois Department of Transportation (IDOT) has a Congestion Management System (CMS) to monitor and respond to traffic events, including a traffic monitoring control center in Oak Park. Within the I-290 corridor, the CMS strategies relative to traffic operational improvements include ramp metering and traffic surveillance. The existing ramp metering and traffic monitoring equipment have been in service for over two decades. As part of the current plan to maintain traffic flow, IDOT's incident management system includes "Minute Man" patrols to provide prompt response to incidents. Variable message signs installed at various locations along I-290 are instrumental in providing motorists with advance warnings of incidents and maintenance–related lane reductions. Even with these management systems in place, mobility and capacity remains constrained due to the dense urban environment.

[2] 2007 IDOT ADT data

# 3.0 Performance Measures

This section defines basic performance measures – volume to capacity (v/c) ratio and level of service (LOS) – used in evaluating roadway operations within the extended study area. IDOT's LOS policy for urban freeways is also described in this section.

## 3.1 Volume/Capacity Ratio

A measure of how well a roadway segment is functioning is the volume to capacity ratio (v/c ratio). The volume or "v" is the number of vehicles driving on a roadway segment. The capacity portion of the equation "c" is the number of vehicles the subject roadway section can accommodate before a breakdown occurs. If the number of vehicles on a section of highway and the number of vehicles that the highway section can accommodate are the same, the v/c ratio is equal to one. Another way to view this situation is that 100% of the capacity of the roadway has been used. Once capacity is reached (v/c > 1), operations become very unstable and vehicles are operating with the minimum spacing between them in order to maintain uniform flow and vehicle speeds are highly variable. Minor disruptions within the traffic stream such as vehicles entering from ramps, disabled vehicles on the shoulder, crashes, and vehicles being ticketed (off-road) cannot be accommodated. Their occurrence will result in operations that rapidly deteriorate resulting in traffic jams, brief periods of movement and stoppages. The operational conditions of a traffic stream are measured by Level of Service (LOS).

## 3.2 Level of Service

LOS is a transportation congestion measure that represents the collective factors of speed, travel time, traffic interruption, freedom to maneuver, safety, driver comfort and convenience, and operating volume. LOS procedures from the Transportation Research Board's Highway Capacity Manual (HCM), 2010 were used to evaluate I-290 corridor traffic operations during the morning (A.M.) and evening (P.M.) peak hours. The HCM defines six levels-of-service, ranging from A to F. LOS A represents the best operating conditions and LOS F the worst. Each of these levels represents a range of operating conditions and the driver's perception of these conditions. The HCM defines the operating conditions for each level of service as follows:

**LOS A** indicates primarily free flow operation at average travel speeds. Vehicles are completely unimpeded in their ability to maneuver within the traffic stream.

**LOS B** also indicates free flow speed, although the presence of other vehicles becomes noticeable. Average travel speeds are the same as in LOS A, but drivers have less freedom to maneuver. Minor disruptions to vehicular flow will be easily absorbed

**LOS C**, the influence of traffic density on operations becomes marked. The ability to maneuver within the traffic stream is clearly affected by other vehicles. Travel speeds are affected. Minor disruptions can cause deterioration in service and queues will form behind any major traffic disruption.

**LOS D**, the ability to maneuver is severely restricted due to traffic congestion. Travel speed is reduced by the increasing traffic volume. Only minor disruptions can be absorbed without extensive queues forming and the traffic service deteriorating.

**LOS E** represents operations at capacity and very unstable. Vehicles are operating with the minimum spacing between them in order to maintain uniform flow. Minor disruptions cannot be dissipated and these occurrences will result in operations to deteriorate to LOS F

**LOS F** represents forced or breakdown flow. It occurs either when vehicles arrive at a rate greater than the rate at which they are discharged or when the forecast demand exceeds the computed capacity of a planned facility. LOS F is used to characterize both the point at which the breakdown occurs and/or the operations afterward, i.e., travel speeds are low and vehicles experience brief periods of movement and stoppages. Due to the low traffic speeds and stoppages, the measured volume during breakdown conditions will decrease.

As described above, the performance of a roadway facility is most often described in terms of LOS. It provides a common letter grade rating system, understandable to a broad range of stakeholders. However, LOS is determined based on the primary performance measure for the roadway element being evaluated. For example, the performance of a signalized intersection is measured by the amount of delay. Density is the primary performance measure for evaluating basic freeway segments and ramp junctions. The primary performance measure for evaluating freeway weaving operations is speed.

## 3.3 IDOT LOS Policy

Although I-290 is referred to as an "expressway", it is functionally classified as a freeway by IDOT. IDOT's LOS policy on freeways, as documented in Chapter 44 of the Bureau of Design and Environment (BDE) Manual, indicates that freeways in urban areas should provide for a LOS C at a minimum; however, a LOS D may be considered for a reconstruction project where existing cross section elements are left in place, with study and justification.[3]

A lower than the desired LOS for a proposed improvement may be justified to minimize impacts to communities and other resources, as well as reduce costs. It may be noted that these level of service criteria/policies (excluding "3R") are applicable to design forecast year traffic volumes 20 years beyond the study phase, and apply to new highway construction or reconstruction projects. Therefore, projected increases in traffic affect the ability of a new or reconstructed highway design to maintain a minimum LOS.

[3] IDOT Bureau of Design and Environment Manual, Figure 44-5.C, note 4.

# 4.0 Analysis Methodology

The roadway elements evaluated in the I-290 corridor traffic operations analysis include basic freeway segments, freeway ramp junctions (merge and diverge areas), and weaving sections. This section describes the roadway elements, methodology, and the measures used to analyze their performance.

## 4.1 Mainline Basic Freeway Segments

Basic freeway segments include the portions of the freeway where flow is not influenced by the merging, diverging, or weaving associated with ramp/freeway connections. The primary factors that affect operations on basic freeway segments include lane widths, lateral clearance, number of lanes, interchange density, heavy vehicles, grades and driver familiarity. The common methodology used for analyzing basic freeway segment operations is described in Chapter 11 of the HCM, 2010. The performance measure used to estimate the LOS for traffic capacity and operations on freeway segments is density in terms of passenger cars per lane per mile. The basic freeway segments within the I-290 study area were evaluated using Highway Capacity Software (HCS) Version 6.1, a computerized version of HCM, 2010. The analysis used IDOT's April 2009 traffic volumes. These volumes were obtained from I-290 automated loop count data from IDOT's Traffic Systems Center (TSC).

## 4.2 Mainline Ramp Junctions

The analysis associated with operations at ramp junctions with the freeway mainline typically involves the effects of vehicles either merging onto or diverging from the mainline. The analysis evaluates the impacts of the turbulence caused by the merging and diverging operations that occurs specifically in the two lanes adjacent to the merge/diverge point. The methodology used for analyzing freeway ramp junction operations is illustrated in Chapter 13 of the HCM, 2010. The HCM methodology defines an influence area of 1,500 feet for merging and diverging traffic (1,500 feet downstream from ramp if merging and 1,500 feet upstream from ramp if diverging). The LOS and operations at an interchange ramp junction adjacent to the freeway is dependent on the number of lanes on the freeway mainline, the number of lanes on the ramp, the volume of traffic on the mainline, specifically in the two lanes adjacent to the ramp, the volume of traffic entering or exiting at the ramp, the length of the acceleration or deceleration lanes, the side of the mainline that the ramp connects to (right or left), the free-flow speed of the mainline and ramp, and the terrain. The performance measure used to determine the LOS for ramp junctions is density. The existing ramp junctions within the I-290 study area were evaluated using HCS Version 6.1, a computerized version of HCM, 2010. The analysis was performed using April 2009 traffic volumes provided by IDOT's Traffic Systems Center.

## 4.3 Mainline Ramp Weaves

The HCM defines weaving as the crossing of two or more traffic streams traveling in the same general direction along a significant length of highway without the aid of traffic control devices, with the exception of guide signs. Weaving segments are formed when a merge area is closely followed by a diverge area within 2,500 feet, and the two are joined by an auxiliary lane. Per the HCM, segments longer than 2,500 feet exhibit characteristics similar to a basic freeway segment, and were analyzed as such in this report. For segments longer than 2,500 feet, ramp

junction analysis is used to analyze the operations for the immediate merge and diverge influence areas of the ramps. The methodology used for analyzing freeway weaving segments is described in Chapter 12 of the HCM, 2010. The most critical aspect of operations within a weaving segment is the intense lane changing maneuvers that take place within the confined length of the weaving segment. Factors that influence the operation of the weaving segment include the weaving length, the number of lanes in the weaving segment, the number of vehicles entering and exiting the weave, the freeway traffic, and the weave configuration type. The performance measure that determines LOS within weaving sections is density (passenger cars/mile/lane).

The HCM methodology identifies multiple weaving configurations. The weaving configuration applicable to the I-290 corridor through the extended project area is the one-sided ramp weave. The identifying characteristic of a one-sided ramp weave segment is that all weaving vehicles must make one lane change to complete their maneuver successfully. The weaving segments within the I-290 study area were evaluated using HCS Version 6.1, a computerized version of HCM, 2010. The analysis was performed using April 2009 traffic volumes provided by IDOT's Traffic Systems Center.

# 5.0 Operational Analysis Results

## 5.1 Existing Mainline Operations

Table 5-1 provides a comprehensive overview of the existing A.M. and P.M. peak hour mainline operations for all mainline elements analyzed (basic freeway segments, ramp junctions, and weaving segments) for east and westbound I-290 within the extended study area. As seen in the table, the entire I-290 mainline in the study area is operating at LOS D or worse during the A.M. and P.M. peak periods. This means that the facility is operating near, at, or over capacity with lower travel speeds. The existing traffic operations and LOS analysis for the individual roadway elements (basic freeway segments, ramp junctions, and weaving segments) are described in subsequent sections. The HCS output for this analysis is provided in **Appendix B**.

**Table 5-1 – Overall I-290 Mainline Peak Period LOS Summary**

| Eastbound | Analysis Type | 2009 LOS | | Westbound | Analysis Type | 2009 LOS | |
|---|---|---|---|---|---|---|---|
| | | AM | PM | | | AM | PM |
| | Segment | E | D | | Segment | F* | F* |
| Kostner Ave On-Ramp | Ramp Jnct. | E* | D | Kostner Ave Off Ramp | Ramp Jnct. | E* | F* |
| | Segment | F* | E | | Segment | D | F* |
| Independence Blvd Off-Ramp | Ramp Jnct. | E | E | Independence Blvd On Ramp | Ramp Jnct. | D* | F* |
| | Segment | E | D | | Segment | D | F* |
| Independence Blvd On-Ramp | Ramp Jnct. | D | D | Independence Blvd Off Ramp | Ramp Jnct. | D | F* |
| | Segment | E | E | | Segment | D | F* |
| Homan Ave On-Ramp | Weave | E | E | Homan Ave Off Ramp | Weave | E | F* |
| Sacramento Blvd Off Ramp | Segment | E | E | Sacramento Blvd On Ramp | Segment | D | F* |
| | Segment | E | E | | Segment | D | F* |
| Western Ave Off Ramp | Ramp Jnct. | E | D | Western Ave On Ramp | Ramp Jnct. | D* | F* |
| | Segment | E | D | | Segment | D | F* |
| California Ave On Ramp | Ramp Jnct. | D | D | California Ave Off Ramp | Ramp Jnct. | D | F* |
| | Segment | E | E | | Segment | D | F* |
| Oakley On Ramp | Weave | E | E | Oakley Ave Off Ramp | Weave | D | F* |
| Damen Ave Off Ramp | Segment | E | F* | Damen Ave On Ramp | Segment | D | F* |
| Damen Ave On Ramp | Weave | E | F* | Damen Ave Off Ramp | Weave | D | D |
| Paulina Ave Off Ramp | Segment | E | F* | Paulina Ave On Ramp | Segment | D | D |
| Ashland Ave On Ramp | Weave | E | E | Ashland Ave Off Ramp | Weave | E | E |
| Racine Ave Off Ramp | | | | Racine Ave On Ramp | | | |

Observations and speed information indicate that I-290 through the extended study area operate near, at, or over capacity conditions during AM and PM peak periods through various sections. These sections experience saturated or over saturated conditions resulting in low volumes and speeds which are not well evaluated by HCM 2010. The level of service for those sections are identified by an (*) and is noted on the HCS output in Appendix B.

Table 5-2 summarizes the proportion of the extended study area that is operating at each level of Service during the peak periods. Overall, the peak period level of service is somewhat evenly distributed across all three levels of service. However, when looking at the directional LOS, 83% (3.3 miles) of westbound I-290 in the PM peak hour (traditional commute) operates at breakdown LOS F conditions. This is due to the 4-lane to 3-lane expressway transition that occurs downstream at Austin Boulevard. For the reverse commute (westbound in the AM peak hour), traffic is generally less congested with 85% of the mainline operating at LOS D. Compared to the westbound operations, eastbound traffic experiences approximately a third of the amount of LOS F conditions. The primary cause of eastbound breakdown conditions is due to the spill back congestion related to the I-290 to I-90/94 system interchange ramps. The remaining 84% of AM and PM eastbound operations operate at LOS E or D.

**Table 5-2 - Proportion of I-290 Mainline by LOS (2009)**

| LOS | EASTBOUND | | | | WESTBOUND | | | | OVERALL Peak | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AM | | PM | | AM | | PM | | | |
| | Length | % | Length | % | Length | % | Length | % | Length | % |
| F | 2,150 | 10% | 4,447 | 22% | 1,654 | 8% | 17,376 | 83% | 25,627 | 31% |
| E | 18,498 | 90% | 11,497 | 56% | 1,528 | 7% | 650 | 3% | 32,173 | 39% |
| D | 0 | 0% | 4,704 | 23% | 17,673 | 85% | 2,829 | 14% | 25,206 | 30% |
| C | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| B | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| A | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Total | 20,648 | 100% | 20,648 | 100% | 20,855 | 100% | 20,855 | 100% | 83,006 | 100% |

Average 2010 peak period speeds were calculated by the travel demand model are presented in **Table 5-3**. For the traditional commute pattern, eastbound travel speeds are estimated at between 8.5 mph and 28.1 mph in the AM period and between 8.6 mph and 31.8 mph in the westbound direction during the PM peak. Average reverse commute speeds are over double the average traditional commute speeds with westbound speeds ranging between 37.2 mph and 53.8 mph in the AM period, and eastbound average speeds ranging between 37.2 mph and 48.7 mph in the PM period.

**Table 5-3 - I-290 Mainline Average 2010 Travel model Speeds**

| From | To | Length | Eastbound (mph) | | Westbound (mph) | |
|---|---|---|---|---|---|---|
| | | | AM | PM | AM | PM |
| Kostner Ave. Entrance | Independence Exit | 0.35 | 19.5 | 44.0 | 40.2 | 22.0 |
| Independence Exit | Independence Entrance | 0.41 | 28.1 | 51.4 | 49.6 | 31.8 |
| Independence Entrance | Homan Entrance | 0.51 | 18.1 | 45.3 | 46.0 | 19.9 |
| Homan Entrance | Sacramento Exit | 0.14 | 10.2 | 34.6 | 37.2 | 10.6 |
| Sacramento Exit | CD Road Exit | 0.55 | 15.5 | 46.3 | 47.9 | 16.8 |
| CD Road Exit | CD Road Entrance | 0.25 | 21.1 | 48.7 | 50.7 | 21.8 |
| CD Road Entrance | Oakley Entrance | 0.36 | 12.8 | 45.6 | 47.7 | 11.7 |
| Oakley Entrance | Damen Exit | 0.09 | 8.5 | 39.7 | 44.4 | 8.6 |
| Damen Exit | Damen Entrance | 0.29 | 18.5 | 45.8 | 51.3 | 16.2 |
| Damen Entrance | Paulina Exit | 0.08 | 12.0 | 37.2 | 46.5 | 8.9 |
| Paulina Exit | Ashland Entrance | 0.48 | 20.8 | 46.8 | 53.8 | 19.4 |
| Ashland Entrance | Racine Exit | 0.10 | 16.4 | 44.8 | 52.9 | 15.3 |
| | **Weighted Average Speed (mph)->** | | 18.3 | 45.8 | 47.9 | 18.9 |

### 5.1.1 Mainline Basic Freeway Segments

**Table 5-4** summarizes the results of the I-290 mainline basic freeway segment HCS analysis for the A.M. and P.M. peak hours. The results of the basic freeway segment analysis indicate that the traditional commute operations are generally worse than the reverse commute operations, operating almost entirely in LOS D and LOS E. Factors contributing to the sub-standard LOS along basic freeway segments are discussed in Section 6.2.

**Table 5-4 - I-290 Mainline Basic Freeway Segment LOS**

| Eastbound | Analysis Type | 2009 LOS | | Westbound | Analysis Type | 2009 LOS | |
|---|---|---|---|---|---|---|---|
| | | AM | PM | | | AM | PM |
| | Segment | E | D | | Segment | F* | F* |
| Kostner Ave On-Ramp | Segment | F* | E | Kostner Ave Off Ramp | Segment | D | F* |
| Independence Blvd Off-Ramp | Segment | E | D | Independence Blvd On Ramp | Segment | D | F* |
| Independence Blvd On-Ramp | Segment | E | E | Independence Blvd Off Ramp | Segment | D | F* |
| Homan Ave On-Ramp | | | | Homan Ave Off Ramp | | | |
| Sacramento Blvd Off Ramp | Segment | E | E | Sacramento Blvd On Ramp | Segment | D | F* |
| Western Ave Off Ramp | Segment | E | D | Western Ave On Ramp | Segment | D | F* |
| California Ave On Ramp | Segment | E | E | California Ave Off Ramp | Segment | D | F* |
| Oakley On Ramp | | | | Oakley Ave Off Ramp | | | |
| Damen Ave Off Ramp | Segment | E | F* | Damen Ave On Ramp | Segment | D | F* |
| Damen Ave On Ramp | | | | Damen Ave Off Ramp | | | |
| Paulina Ave Off Ramp | Segment | E | F* | Paulina Ave On Ramp | Segment | D | D |
| Ashland Ave On Ramp | | | | Ashland Ave Off Ramp | | | |

### 5.1.2 Mainline Ramp Junctions

The I-290 freeway ramp junction analysis of the A.M. and P.M. peak hours is summarized in **Table 5-5.** The results of the ramp junction analysis indicate that the ramp junction operations associated with traditional commute are generally worse than the reverse commute operations, operating almost entirely in LOS E and LOS F. Factors contributing to the sub-standard operations for ramp junctions are discussed in Section 5.1.2.

**Table 5-5 - I-290 Ramp Junction Analysis Summary**

| Eastbound | Analysis Type | 2009 LOS | | Westbound | Analysis Type | 2009 LOS | |
|---|---|---|---|---|---|---|---|
| | | AM | PM | | | AM | PM |
| Kostner Ave On-Ramp | Ramp Jnct. | E* | D | Kostner Ave Off Ramp | Ramp Jnct. | E* | F* |
| Independence Blvd Off-Ramp | Ramp Jnct. | E | E | Independence Blvd On Ramp | Ramp Jnct. | D* | F* |
| Independence Blvd On-Ramp | Ramp Jnct. | D | D | Independence Blvd Off Ramp | Ramp Jnct. | D | F* |
| Western Ave Off Ramp | Ramp Jnct. | E | D | Western Ave On Ramp | Ramp Jnct. | D* | F* |
| California Ave On Ramp | Ramp Jnct. | D | D | California Ave Off Ramp | Ramp Jnct. | D | F* |

### 5.1.3 Mainline Ramp Weaves

The results of the I-290 corridor weaving section analysis for the A.M. and P.M. peak hours is summarized **Table 5-6.** The weaving sections along I-290 in the expanded study area each include a continuous auxiliary lane connecting single lane on-ramp to a single lane off-ramp.

**Table 5-6 - Mainline Weaving Segment LOS**

| Eastbound | Analysis Type | 2009 LOS | | Westbound | Analysis Type | 2009 LOS | |
|---|---|---|---|---|---|---|---|
| | | AM | PM | | | AM | PM |
| Homan Ave On-Ramp | | | | Homan Ave Off Ramp | | | |
| Sacramento Blvd Off Ramp | Weave | E | E | Sacramento Blvd On Ramp | Weave | E | F* |
| Oakley On Ramp | | | | Oakley Ave Off Ramp | | | |
| Damen Ave Off Ramp | Weave | E | E | Damen Ave On Ramp | Weave | D | F* |
| Damen Ave On Ramp | | | | Damen Ave Off Ramp | | | |
| Paulina Ave Off Ramp | Weave | E | F* | Paulina Ave On Ramp | Weave | D | D |
| Ashland Ave On Ramp | | | | Ashland Ave Off Ramp | | | |
| Racine Ave Off Ramp | Weave | E | E | Racine Ave On Ramp | Weave | E | E |

### 5.4.1 Eastbound I-290 Weaving Sections

There are four existing weaving sections along eastbound I-290 within the extended study area. They are described here in the direction of travel:

The first eastbound weaving section is between Homan Avenue on-ramp and the Sacramento Boulevard off-ramp. The two ramps are connected by approximately 760 feet of auxiliary lane.

The second eastbound weaving section exists between the Oakley Avenue on-ramp and the Damen Avenue off-ramp. The two ramps are connected by approximately 560 feet of auxiliary lane.

The third eastbound weaving section exists between the Damen Avenue on-ramp and the Paulina Avenue off-ramp. The two ramps are connected by approximately 480 feet of auxiliary lane.

The fourth eastbound weaving section exists between the Ashland Avenue on-ramp and the Racine Avenue off-ramp. The two ramps are connected by approximately 530 feet of auxiliary lane.

### 5.4.2 Westbound I-290 Weaving Sections

There are four existing weaving sections along westbound I-290 within the extended study area. They are described here in the direction of travel:

The first westbound weaving section exists between the Racine Avenue on-ramp and the Ashland Avenue off-ramp. The two ramps are connected by approximately 650 feet of auxiliary lane.

The second westbound weaving section exists between the Paulina Avenue on-ramp and the Damen Avenue off-ramp. The two ramps are connected by approximately 425 feet of auxiliary lane.

The third westbound weaving section exists between the Damen Avenue on-ramp and the Oakley Avenue off-ramp. The two ramps are connected by approximately 560 feet of auxiliary lane.

The fourth eastbound weaving section is between the Sacramento Boulevard on-ramp and the Homan Avenue off-ramp. The two ramps are connected by approximately 880 feet of auxiliary lane.

### 5.1.4 Duration of Congestion

To determine the overall periods of congestion beyond the peak hours, the available April 2009 mainline count station traffic volume was analyzed. For the extended study area, data from the count station located nearest the center of the extended study area at Sacramento Avenue was used for both the eastbound and westbound mainline lanes. The LOS for each one-hour time period was calculated at the count station. Calculations were based on equating expressway volumes to a level of service per HCS 2010. The calculations are presented in **Appendix C**, and **Table 5-7** summarizes the results:

**Table 5-7 - I-290 Twenty Four Hour LOS (2009)**

| Time of day | @ Sacramento | |
|---|---|---|
| | East-bound | Westbound |
| 1:00 AM | A | A |
| 2:00 AM | A | A |
| 3:00 AM | A | A |
| 4:00 AM | A | A |
| 5:00 AM | A | A |
| 6:00:00 AM* | C | B |
| 7:00:00 AM* | E | D** |
| 8:00:00 AM* | E | D |
| 9:00:00 AM* | E | D |
| 10:00 AM | E | C |
| 11:00 AM | D | C |
| 12:00 PM | D | D |
| 1:00 PM | D | D |
| 2:00 PM | D | D |
| 3:00 PM | D | D |
| 4:00:00 PM* | D | E** |
| 5:00:00 PM* | D | F** |
| 6:00:00 PM* | D | F** |
| 7:00 PM | D | D |
| 8:00 PM | D | C |
| 9:00 PM | C | C |
| 10:00 PM | C | C |
| 11:00 PM | C | C |
| 12:00 AM | B | B |

* Peak Period, ** Observed Operations

Traffic data indicates that the I-290 Eisenhower Expressway experiences congested conditions (LOS D or worse) for up to fourteen hours each weekday for both eastbound and westbound lanes. The most severe congestion occurs in the westbound PM peak period (traditional commute) and is attributed to over 4 miles of congestion due to the I-290 mainline lane drop at Austin Boulevard located over three miles west. Other than this location, the 8-lane section of the extended I-290 project area does not experience the same level breakdown conditions as experienced in the six-lane section of I-290 to the west. In the eastbound direction, the poorest operations occur in the AM peak period (traditional commute) and are attributed to congestion related to the exit ramps at the I-90/94 system interchange.

## 5.2 Study Area Arterial Operations

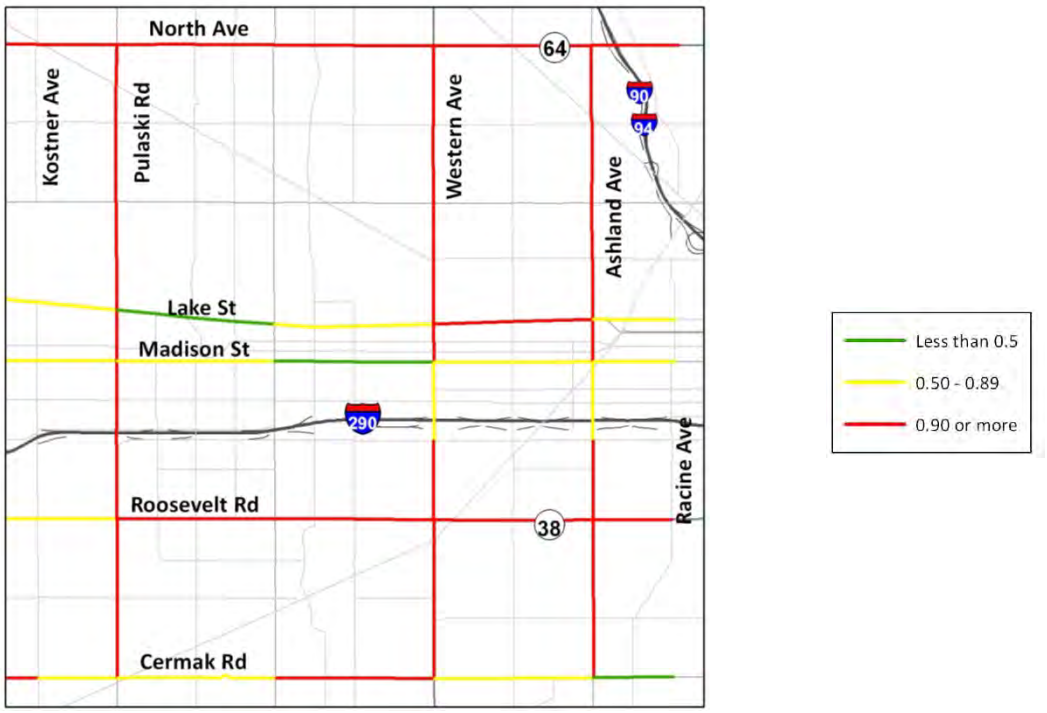
Five east-west and three north-south arterials within the extended study area were evaluated; from north to south they are: North Avenue, Lake Street, Madison Street, Roosevelt Road, and Cermak Road, and from east to west: Ashland Avenue, Western Avenue, and Pulaski Road.

To understand the operational performance, the volume to capacity ratio of arterials was examined for the average peak period in 2010. As described earlier in this document, v/c is defined as the ratio of traffic demand flow rate to the roads existing capacity, and is used as a tool to provide conceptual level picture of traffic congestion. For this analysis, the v/c ratios were classified into the following ranges;

| | |
|---|---|
| Less than 0.50 | Uncongested traffic conditions (green) |
| 0.50 to 0.90 | Congested traffic conditions (orange) |
| 0.90 and over | Very congested conditions (red) |

**Figure 5-1** shows the 2010 arterial roadway peak period analysis based on the I-290 travel model results, and **Table 5-8** provides a summary of arterial congestion levels based on length.

**Figure 5-1 - 2010 Arterial Roadway Peak Period Volume to Capacity Ratios**




In the extended study area, 39% of the east-west arterials and 92% of the north south arterials operate under very congested peak period conditions. All of North Avenue operates under very congested conditions, as does most of Roosevelt Road. **Appendix A** provides a summary of the v/c values calculation table by sub-segment.

**Table 5-8 - 2010 Arterial Peak Period Operations Summary**

| Arterial | Length | Uncongested < 0.5 | | Congested from 0.5 to 0.89 | | Very Congested 0.9 & above | |
|---|---|---|---|---|---|---|---|
| | | length | % | length | % | Length | % |
| **North Avenue** | 5.83 mi | *0.00 mi* | *0%* | *0.00 mi* | *0%* | 5.83 mi | 100% |
| **Lake Street** | 5.84 mi | 1.00 mi | 17% | 4.84 mi | 83% | *0.00 mi* | *0%* |
| **Madison Street** | 5.61 mi | 1.02 mi | 18% | 4.59 mi | 82% | *0.00 mi* | *0%* |
| **Roosevelt Road** | 5.58 mi | *0.00 mi* | *0%* | 2.03 mi | 36% | 3.55 mi | 64% |
| **Cermak Road** | 4.05 mi | 0.52 mi | 13% | 2.53 mi | 62% | 1.00 mi | 25% |
| **Total (East-West)** | 26.91 mi | 2.54 mi | 9% | 13.99 mi | 52% | 10.38 mi | 39% |
| **Pulaski Road** | 4.06 mi | *0.00 mi* | *0%* | *0.00 mi* | *0%* | 4.06 mi | 100% |
| **Western Avenue** | 4.05 mi | *0.00 mi* | *0%* | 0.51 mi | 13% | 3.54 mi | 87% |
| **Ashland Avenue** | 3.99 mi | *0.00 mi* | *0%* | 0.47 mi | 12% | 3.52 mi | 88% |
| **Total (North-South)** | 12.10 mi | *0.00 mi* | *0%* | 0.98 mi | 8% | 11.12 mi | 92% |
| **Overall** | 39.01 mi | 2.54 mi | 7% | 14.97 mi | 38% | 21.50 mi | 55% |

# 6.0 Factors Affecting Operations

The results of the traffic operations analysis of existing conditions indicate that the majority of roadway elements within the I-290 corridor are operating under congested conditions and deteriorated levels of service. Each of the various elements analyzed have different factors that affect their performance under traffic. This section identifies the primary factors that influence the performance of the major roadway elements analyzed.

## 6.1 Basic Freeway Segments

A majority of the four lane basic freeway segments along eastbound and westbound I-290 operate at LOS E or worse during both A.M. and P.M. peak hours. This deteriorated LOS may be attributed to the following factors:

- Inadequate capacity for travel demand
- Congestion that backs up due to the westbound lane drop at Austin Boulevard, which is violation of the basic number of lanes principle
- Congested eastbound operations related to the I-90/I-94 interchange/Circle interchange ramp capacity and exit volumes

Demand exceeding the available capacity is the primary factor causing congestion in the corridor. The 8-lane section of I-290 in the extended study on average carries 201,909 vehicles per day. Based on a maximum expected capacity of 180,000 vehicles per day[4], the mainline operates in excess of 12.2% of its ideal capacity. As a comparison, the 6 lane section of I-290 operates in excess of 37.6% of its ideal capacity (**Table 6-1**).

**Table 6-1 – I-290 Existing Volumes and Capcity**

| I-290 Section | Ideal Capacity | 2-way ADT Weighted Average by Length | % Over Ideal Capacity |
|---|---|---|---|
| 8 Lanes | 180,000 | 201,909 | 12.2% |
| 6 Lanes | 135,000 | 185,728 | 37.6% |

Generally, the level of service of the basic freeway segments are affected by the demand volume generally exceeding the maximum expected, or ideal capacity, resulting in less than desirable levels of service D and E. Breakdown level of service F in the basic freeway segments is directly related to congestion spill back from downstream bottleneck conditions in the westbound direction at Austin Boulevard and in the eastbound direction at the I-290 & I-90/94 system interchange ramps.

## 6.2 Ramp Junctions and Weaving

All of the ramp junctions and each of the identified weaving sections within the 4-lane section of eastbound and westbound I-290, through the extended project area operate at less than the desired LOS C. This lower performance can be attributed to the same factors as the weaving segments:

[4] From 2010 Highway Capacity Manual, Exhibit 11-17

- Inadequate capacity for travel demand
- Congestion that backs up due to the westbound lane drop at Austin Boulevard, which is violation of the basic number of lanes principle
- Congested eastbound operations related to the I-90/I-94 interchange/Circle interchange ramp capacity and exit volumes

Generally, the level of service of the ramp junctions and weaving sections are affected by the demand volume generally exceeding the maximum expected capacity, resulting in less than desirable levels of service D and E. Breakdown level of service F in ramp junctions and weaving sections is directly related to congestion spill back from downstream bottleneck conditions in the westbound direction at Austin Boulevard and in the eastbound direction at the I-290 & I-90/94 system interchange ramps.

## 6.3 Study Area Arterials

Several factors influence the operation along the parallel arterials including:

- Traffic volume: Higher traffic demand results in higher volume to capacity ratios, with congestion beginning when demand approaches the design capacity of a roadway. Breakdown conditions occur when demand exceeds capacity resulting in extremely congested conditions characterized by lower speeds, longer trip times, and longer queues.
- Number of lanes and cross-sections: Providing an adequate number of lanes, including an appropriate number of turn lanes, increases the available capacity on an arterial, allowing it to convey more traffic at lower v/c ratios. The lack of an adequate number of through and turn lanes results in higher volume to capacity ratios and greater congestion.
- The dense urban environment in which these arterials are located, constrain the opportunities to provide capacity improvements to improve operations. Adding through lanes or turn lanes would result in potential impacts to available parking, sidewalks, and buildings.
- Traffic signals: Operations along arterials are impacted by signal density (the number of traffic signals per mile). Service volumes are higher on arterials that have a lower number of traffic signals per mile. A higher number of traffic signals per mile on an arterial will result in lower travel speeds, increases in delay, queuing at intersections, congestion, and greater opportunity for crashes.
- Mainline Congestion: Congested conditions along mainline I-290 may result in the "spillover" traffic being diverted to these arterials. Similar to the mainline operations, the east-west arterials that parallel the 8-lane section of I-290 are generally less congested than compared to the parallel arterials along the six-lane section of I-290 west of Austin Boulevard.

# 7.0 Conclusion

The extended study area and 8-lane section of the I-290 Eisenhower Expressway and adjacent arterial network all experience some congestion, primarily due to demand exceeding the available capacity of the various facilities.

Although congestion in the extended study area can be attributed to the traffic demand in the corridor, two key factors contribute to the particular congestion problems in this section: the eastbound mainline lane imbalance and capacity reduction at Austin Boulevard, and congestion related to the Circle Interchange ramp volume and capacity.

The I-290 Crash Analysis for the extended study area also recognizes these two locations within the extended study area and for operational improvements to address congestion related crashes where they occur with the greatest frequency – in the eastbound direction approaching Racine Avenue, and in the westbound direction from Independence Avenue to Kostner Avenue approaching the lane drop at Austin Boulevard.

Potential operational countermeasures include eliminating the 3 lane bottleneck in the westbound direction to promote more free-flow of traffic and reduce the potential for stop and start traffic that contributes to rear end crashes. In the eastbound direction, the congestion reducing countermeasures associated with the I-290 and I90/94 system interchange are being considered by the Circle Interchange Study.

# List of References

Bureau of Design and Environment Manual, Illinois Department of Transportation, December 2002

A Policy on Geometric Design of Highways and Streets, American Association of State Highway and Transportation Officials, 2004

Highway Capacity Manual, Transportation Research Board, 2010

Chicago Metropolitan Agency for Planning, Congestion Management, Performance Management, http://www.cmap.illinois.gov/scans/

Average Daily Traffic map, Illinois Department of Transportation, December 2009, http://www.gettingaroundillinois.com/default.aspx?ql=aadt

# Appendix A

# Arterial Volume to Capacity (v/c) Calculations

| Arterial Segment | | Len. (mi) | Capacity | AADT 1 hr Vol. | v/c |
|---|---|---|---|---|---|
| **Seg** | **North Avenue** | | | | |
| 1 | Central Ave to Kostner Ave | 1.53 | 2,309 | 2,380 | 1.03 |
| 6 | Kostner to Pulaski | 0.52 | 2,052 | 2,380 | 1.16 |
| 7 | Pulaski to Kedzie | 1.00 | 2,309 | 2,390 | 1.04 |
| 8 | Kedzie to Western | 1.02 | 2,052 | 2,390 | 1.16 |
| 9 | Western to Ashland | 1.01 | 822 | 2,390 | 2.91 |
| 10 | Ashland to Racine | 0.75 | 2,284 | 2,310 | 1.01 |
| **Seg** | **Lake Street** | | | | |
| 1 | Central Ave to Kostner Ave | 1.52 | 2,136 | 1,120 | 0.52 |
| 6 | Kostner to Pulaski | 0.50 | 1,418 | 870 | 0.61 |
| 7 | Pulaski to Kedzie | 1.00 | 1,990 | 870 | 0.44 |
| 8 | Kedzie to Western | 1.02 | 1,697 | 870 | 0.51 |
| 9 | Western to Ashland | 0.99 | 972 | 870 | 0.90 |
| 10 | Ashland to Racine | 0.81 | 1,033 | 870 | 0.84 |
| **Seg** | **Madison Street** | | | | |
| 1 | Central Ave to Kostner Ave | 1.53 | 2,437 | 1,650 | 0.68 |
| 6 | Kostner to Pulaski | 0.51 | 2,437 | 1,680 | 0.69 |
| 7 | Pulaski to Kedzie | 1.01 | 1,635 | 1,065 | 0.65 |
| 8 | Kedzie to Western | 1.02 | 2,159 | 900 | 0.42 |
| 9 | Western to Ashland | 1.03 | 1,560 | 840 | 0.54 |
| 10 | Ashland to Racine | 0.51 | 1,102 | 840 | 0.76 |
| **Seg** | **Roosevelt Road** | Fixed | | | |
| 1 | Central Ave to Koster Ave | 1.53 | 2,227 | 1,847 | 0.83 |
| 6 | Kostner to Pulaski | 0.50 | 2,437 | 1,420 | 0.58 |
| 7 | Pulaski to Kedzie | 1.00 | 2,228 | 2,590 | 1.16 |
| 8 | Kedzie to Western | 1.00 | 2,106 | 2,590 | 1.23 |
| 9 | Western to Ashland | 1.01 | 2,302 | 2,590 | 1.13 |
| 10 | Ashland to Racine | 0.54 | 2,123 | 2,590 | 1.22 |
| **Seg** | **Cermak Road** | | | | |
| 1 | Kostner to Pulaski | 0.52 | 2,437 | 2,080 | 0.85 |
| 2 | Pulaski to Kedzie | 1.01 | 2,410 | 1,630 | 0.68 |
| 3 | Kedzie to Western | 1.00 | 1,617 | 1,630 | 1.01 |
| 4 | Western to Ashland | 1.00 | 1,769 | 1,090 | 0.62 |
| 5 | Ashland to Racine | 0.52 | 2,991 | 1,090 | 0.36 |

| Arterial Segment | | Len. (mi) | Capacity | AADT 1 hr Vol. | v/c |
|---|---|---|---|---|---|
| **Seg** | **Pulaski Road** | | | | |
| 1 | North to Chicago | 0.99 | 1,093 | 1,680 | 1.54 |
| 2 | Chicago to Lake | 0.69 | 1,033 | 1,740 | 1.68 |
| 3 | Lake to Madison | 0.35 | 1,080 | 1,740 | 1.61 |
| 4 | Madison to Harrison | 0.49 | 1,133 | 1,740 | 1.54 |
| 5 | Harrison to Roosevelt | 0.53 | 1,114 | 1,790 | 1.61 |
| 6 | Roosevelt to Cermak | 1.01 | 1,154 | 1,580 | 1.37 |
| **Seg** | **Western Avenue** | | | | |
| 1 | North to Chicago | 1.00 | 2,052 | 2,680 | 1.31 |
| 2 | Chicago to Lake | 0.77 | 2,022 | 2,680 | 1.33 |
| 3 | Lake to Madison | 0.25 | 2,216 | 2,680 | 1.21 |
| 4 | Madison to Harrison | 0.51 | 3,056 | 2,680 | 0.88 |
| 5 | Harrison to Roosevelt | 0.50 | 2,052 | 2,420 | 1.18 |
| 6 | Roosevelt to Cermak | 1.02 | 2,599 | 2,890 | 1.11 |
| **Seg** | **Ashland Avenue** | | | | |
| 1 | North to Chicago | 1.00 | 2,225 | 2,720 | 1.22 |
| 2 | Chicago to Lake | 0.78 | 2,052 | 2,720 | 1.33 |
| 3 | Lake to Madison | 0.24 | 2,870 | 2,720 | 0.95 |
| 4 | Madison to Harrison | 0.47 | 3,402 | 2,720 | 0.80 |
| 5 | Harrison to Roosevelt | 0.50 | 2,965 | 2,720 | 0.92 |
| 6 | Roosevelt to Cermak | 1.00 | 2,180 | 2,690 | 1.23 |

# Appendix B

# HCS Analysis Output

# B-1

# Basic Freeway Segments

# I - 290 Eastbound Segment Analysis

## Existing Conditions

HCS 2010: Basic Freeway Segments Release 6.1

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Cicero to Kostner |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 7350 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1934 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 2031 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 2031 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 53.7 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 37.8 | pc/mi/ln |
| Level of service, LOS | E | |

HCS 2010: Basic Freeway Segments Release 6.1

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Cicero to Kostner |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 6860 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1805 | v |
| Trucks and buses | 9 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.957 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1887 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1887 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 54.8 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 34.4 | pc/mi/ln |
| Level of service, LOS | D | |

HCS 2010: Basic Freeway Segments Release 6.1

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Kostner to Independence |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 7990 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 2103 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 2208 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 2208 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 50.9 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 43.4 | pc/mi/ln |
| Level of service, LOS | E | |

HCS 2010: Basic Freeway Segments Release 6.1

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Kostner to Independence |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 7590 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1997 | v |
| Trucks and buses | 9 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.957 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 2087 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 2087 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 53.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 39.4 | pc/mi/ln |
| Level of service, LOS | E | |

HCS 2010: Basic Freeway Segments Release 6.1

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Independence Off to On |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 7590 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1997 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 2097 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 2097 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 52.8 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 39.7 | pc/mi/ln |
| Level of service, LOS | E | |

HCS 2010: Basic Freeway Segments Release 6.1

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Independence Off to On |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 6720 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1768 | v |
| Trucks and buses | 9 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.957 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1848 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1848 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 54.9 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 33.6 | pc/mi/ln |
| Level of service, LOS | D | |

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Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Independence to Homan |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 8020 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 2111 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 2216 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 2216 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 50.7 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 43.7 | pc/mi/ln |
| Level of service, LOS | E | |

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E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Independence to Homan |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 7370 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1939 | v |
| Trucks and buses | 9 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.957 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 2027 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 2027 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 53.7 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 37.7 | pc/mi/ln |
| Level of service, LOS | E | |

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## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Sacramento to Western |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 7750 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 2039 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 2141 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 2141 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 52.1 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 41.1 | pc/mi/ln |
| Level of service, LOS | E | |

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## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Sacramento to Western |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 7220 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1900 | v |
| Trucks and buses | 9 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.957 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1986 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1986 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 54.1 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 36.7 | pc/mi/ln |
| Level of service, LOS | E | |

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## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Western to California |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 7250 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1908 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 2003 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 2003 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 54.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 37.1 | pc/mi/ln |
| Level of service, LOS | E | |

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## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Western to California |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 6720 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1768 | v |
| Trucks and buses | 9 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.957 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1848 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1848 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 54.9 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 33.6 | pc/mi/ln |
| Level of service, LOS | D | |

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## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | California to Oakley |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 7750 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 2039 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 2141 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 2141 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 52.1 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 41.1 | pc/mi/ln |
| Level of service, LOS | E | |

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## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | California to Oakley |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 7250 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1908 | v |
| Trucks and buses | 9 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.957 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1994 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1994 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 54.1 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 36.9 | pc/mi/ln |
| Level of service, LOS | E | |

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## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Damen Off to Damen On |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 7210 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1897 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1992 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1992 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 54.1 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 36.8 | pc/mi/ln |
| Level of service, LOS | E | |

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Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

Phone: Fax:
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## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Damen Off to Damen On |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 6920 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1821 | v |
| Trucks and buses | 9 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.957 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1903 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1903 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 54.7 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 34.8 | pc/mi/ln |
| Level of service, LOS | D | |

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E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Paulina to Ashland |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 7020 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1847 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1940 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1940 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 54.5 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 35.6 | pc/mi/ln |
| Level of service, LOS | E | |

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Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Paulina to Ashland |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 6990 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1839 | v |
| Trucks and buses | 9 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.957 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1922 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1922 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 54.6 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 35.2 | pc/mi/ln |
| Level of service, LOS | E | |

HCS 2010: Basic Freeway Segments Release 6.1

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Racine to I-90/94 Off |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 7200 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1895 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1989 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1989 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 54.1 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 36.8 | pc/mi/ln |
| Level of service, LOS | E | |

HCS 2010: Basic Freeway Segments Release 6.1

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 7/31/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 EB |
| From/To: | Racine to I-90/94 Off |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 7420 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1953 | v |
| Trucks and buses | 9 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.957 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 2041 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 2041 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 53.6 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 38.1 | pc/mi/ln |
| Level of service, LOS | E | |

# I - 290 Westbound Segment Analysis

## Existing Conditions

HCS 2010: Basic Freeway Segments Release 6.1

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | Ashland to Paulina |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 5570 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1466 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1539 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1539 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 55.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 28.0 | pc/mi/ln |
| Level of service, LOS | D | |

HCS 2010: Basic Freeway Segments Release 6.1

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | Ashland to Paulina |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 5720 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1505 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1581 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1581 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 55.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 28.7 | pc/mi/ln |
| Level of service, LOS | D | |

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Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | Damen Off to On |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 5300 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1395 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1464 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1464 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 55.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 26.6 | pc/mi/ln |
| Level of service, LOS | D | |

HCS 2010: Basic Freeway Segments Release 6.1

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | Damen Off to On |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 5850 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1539 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1616 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1616 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 55.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 29.4 | pc/mi/ln |
| Level of service, LOS | D | |

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Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | Oakley to California |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 5690 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1497 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1572 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1572 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 55.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 28.6 | pc/mi/ln |
| Level of service, LOS | D | |

HCS 2010: Basic Freeway Segments Release 6.1

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | Oakley to California |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 6360 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1674 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1757 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1757 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 55.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 31.9 | pc/mi/ln |
| Level of service, LOS | D | |

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Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | California to Western |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 5210 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1371 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1440 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1440 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 55.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 26.2 | pc/mi/ln |
| Level of service, LOS | D | |

HCS 2010: Basic Freeway Segments Release 6.1

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | California to Western |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 5940 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1563 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1641 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1641 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 55.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 29.8 | pc/mi/ln |
| Level of service, LOS | D | |

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Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | Western to Sacramento |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 5930 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1561 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1639 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1639 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 55.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 29.8 | pc/mi/ln |
| Level of service, LOS | D | |

HCS 2010: Basic Freeway Segments Release 6.1

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | Western to Sacramento |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 6570 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1729 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1815 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1815 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 55.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 33.0 | pc/mi/ln |
| Level of service, LOS | D | |

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Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | Homan to Independence |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 6110 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1608 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1688 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1688 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 55.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 30.7 | pc/mi/ln |
| Level of service, LOS | D | |

HCS 2010: Basic Freeway Segments Release 6.1

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | Homan to Independence |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 6630 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1745 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1832 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1832 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 55.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 33.3 | pc/mi/ln |
| Level of service, LOS | D | |

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Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | Independence Off to On |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 5630 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1482 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1556 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1556 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 55.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 28.3 | pc/mi/ln |
| Level of service, LOS | D | |

HCS 2010: Basic Freeway Segments Release 6.1

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | Independence Off to On |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 6160 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1621 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1702 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1702 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 55.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 30.9 | pc/mi/ln |
| Level of service, LOS | D | |

HCS 2010: Basic Freeway Segments Release 6.1

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | Independence to Kostner |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 6110 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1608 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1688 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1688 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 55.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 30.7 | pc/mi/ln |
| Level of service, LOS | D | |

HCS 2010: Basic Freeway Segments Release 6.1

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | Independence to Kostner |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 6700 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1763 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1851 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1851 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 54.9 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 33.7 | pc/mi/ln |
| Level of service, LOS | D | |

HCS 2010: Basic Freeway Segments Release 6.1

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | Kostner to Cicero |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 5470 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1439 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1511 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1511 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 55.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 27.5 | pc/mi/ln |
| Level of service, LOS | D | |

HCS 2010: Basic Freeway Segments Release 6.1

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency or Company: | PB |
| Date Performed: | 8/6/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Direction: | I-290 WB |
| From/To: | Kostner to Cicero |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Flow Inputs and Adjustments

| | | |
|---|---|---|
| Volume, V | 6100 | veh/h |
| Peak-hour factor, PHF | 0.95 | |
| Peak 15-min volume, v15 | 1605 | v |
| Trucks and buses | 10 | % |
| Recreational vehicles | 0 | % |
| Terrain type: | Level | |
| Grade | - | % |
| Segment length | - | mi |
| Trucks and buses PCE, ET | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | |
| Driver population factor, fp | 1.00 | |
| Flow rate, vp | 1686 | pc/h/ln |

## Speed Inputs and Adjustments

| | | |
|---|---|---|
| Lane width | - | ft |
| Right-side lateral clearance | - | ft |
| Total ramp density, TRD | - | ramps/mi |
| Number of lanes, N | 4 | |
| Free-flow speed: | Measured | |
| FFS or BFFS | 55.0 | mi/h |
| Lane width adjustment, fLW | - | mi/h |
| Lateral clearance adjustment, fLC | - | mi/h |
| TRD adjustment | - | mi/h |
| Free-flow speed, FFS | 55.0 | mi/h |

## LOS and Performance Measures

| | | |
|---|---|---|
| Flow rate, vp | 1686 | pc/h/ln |
| Free-flow speed, FFS | 55.0 | mi/h |
| Average passenger-car speed, S | 55.0 | mi/h |
| Number of lanes, N | 4 | |
| Density, D | 30.7 | pc/mi/ln |
| Level of service, LOS | D | |

# Appendix B

# HCS Analysis Output

---

# B-2

# Ramp Junctions

# I - 290 Eastbound Ramp Junction Analysis

## Existing Conditions

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Merge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/1/2012 |
| Analysis time period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Junction: | Kostner Ave. Entrance Ramp |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Merge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 7350 | vph |

## On Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-flow speed on ramp | 35.0 | mph |
| Volume on ramp | 640 | vph |
| Length of first accel/decel lane | 560 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent Ramp | | vph |
| Position of adjacent Ramp | | |
| Type of adjacent Ramp | | |
| Distance to adjacent Ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | Ramp | Adjacent Ramp | |
|---|---|---|---|---|
| Volume, V (vph) | 7350 | 640 | | vph |
| Peak-hour factor, PHF | 0.95 | 0.95 | | |
| Peak 15-min volume, v15 | 1934 | 168 | | v |
| Trucks and buses | 10 | 10 | | % |
| Recreational vehicles | 0 | 0 | | % |
| Terrain type: | Level | Level | | |
| Grade | % | % | % | |
| Length | mi | mi | mi | |
| Trucks and buses PCE, ET | 1.5 | 1.5 | | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | | 0.952 | 0.952 |
| Driver population factor, fP | | 1.00 | 1.00 |
| Flow rate, vp | | 8124 | 707 pcph |

## Estimation of V12 Merge Areas

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = 0.129 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 1051 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{FO}$ | 8831 | 9000 | No |
| $v_3$ or $v_{av34}$ | 3536 pc/h | (Equation 13-14 or 13-17) | |
| Is $v_3$ or $v_{av34}$ > 2700 pc/h? | | Yes | |
| Is $v_3$ or $v_{av34}$ > 1.5 $v_{12}$ /2 | | Yes | |

If yes, $v_{12A}$ = 3249 (Equation 13-15, 13-16, 13-18, or 13-19)

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12A}$ | 8831 | 4600 | No |

## Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 32.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $M_S$ = 0.486 | |
| Space mean speed in ramp influence area, | $S_R$ = 48.7 | mph |
| Space mean speed in outer lanes, | $S_O$ = 47.6 | mph |
| Space mean speed for all vehicles, | S = 48.1 | mph |

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS E, which are not adequately evaluated by the Highway Capacity Manual Method.

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Merge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/1/2012 |
| Analysis time period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Junction: | Kostner Ave. Entrance Ramp |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Merge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 6860 | vph |

## On Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-flow speed on ramp | 35.0 | mph |
| Volume on ramp | 730 | vph |
| Length of first accel/decel lane | 560 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent Ramp | | vph |
| Position of adjacent Ramp | | |
| Type of adjacent Ramp | | |
| Distance to adjacent Ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | Ramp | Adjacent Ramp | |
|---|---|---|---|---|
| Volume, V (vph) | 6860 | 730 | | vph |
| Peak-hour factor, PHF | 0.95 | 0.95 | | |
| Peak 15-min volume, v15 | 1805 | 192 | | v |
| Trucks and buses | 9 | 9 | | % |
| Recreational vehicles | 0 | 0 | | % |
| Terrain type: | Level | Level | | |
| Grade | % | % | % | |
| Length | mi | mi | mi | |
| Trucks and buses PCE, ET | 1.5 | 1.5 | | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | 0.957 | 0.957 | |
| Driver population factor, fP | 1.00 | 1.00 | |
| Flow rate, vp | 7546 | 803 | pcph |

## Estimation of V12 Merge Areas

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = 0.117 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 886 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{FO}$ | 8349 | 9000 | No |
| $v_3$ or $v_{av34}$ | 3330 pc/h | (Equation 13-14 or 13-17) | |

Is $v_3$ or $v_{av34}$ > 2700 pc/h? Yes

Is $v_3$ or $v_{av34}$ > 1.5 $v_{12}$ /2 Yes

If yes, $v_{12A}$ = 3018 (Equation 13-15, 13-16, 13-18, or 13-19)

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12A}$ | 8349 | 4600 | No |

## Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 31.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $M_S$ = 0.460 | |
| Space mean speed in ramp influence area, | $S_R$ = 49.0 | mph |
| Space mean speed in outer lanes, | $S_O$ = 48.6 | mph |
| Space mean speed for all vehicles, | $S$ = 48.8 | mph |

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Diverge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/1/2012 |
| Analysis time period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Junction: | Independence Blvd. Exit Ramp |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Diverge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 7990 | vph |

## Off Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-Flow speed on ramp | 35.0 | mph |
| Volume on ramp | 400 | vph |
| Length of first accel/decel lane | 215 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent ramp | | vph |
| Position of adjacent ramp | | |
| Type of adjacent ramp | | |
| Distance to adjacent ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | | Ramp | | Adjacent Ramp | |
|---|---|---|---|---|---|---|
| Volume, V (vph) | 7990 | | 400 | | | vph |
| Peak-hour factor, PHF | 0.95 | | 0.95 | | | |
| Peak 15-min volume, v15 | 2103 | | 105 | | | v |
| Trucks and buses | 10 | | 10 | | | % |
| Recreational vehicles | 0 | | 0 | | | % |
| Terrain type: | Level | | Level | | | |
| Grade | 0.00 | % | 0.00 | % | | % |
| Length | 0.00 | mi | 0.00 | mi | | mi |
| Trucks and buses PCE, ET | 1.5 | | 1.5 | | | |
| Recreational vehicle PCE, ER | 1.2 | | 1.2 | | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | 0.952 | 0.952 | |
| Driver population factor, fP | 1.00 | 1.00 | |
| Flow rate, vp | 8831 | 442 | pcph |

## Estimation of V12 Diverge Areas

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4100 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{Fi} = v_F$ | 8831 | 9000 | No |
| $v_{FO} = v_F - v_R$ | 8389 | 9000 | No |
| $v_R$ | 442 | 2000 | No |
| $v_3$ or $v_{av34}$ | 2365 pc/h | (Equation 13-14 or 13-17) | |

Is $v_3$ or $v_{av34}$ > 2700 pc/h? No

Is $v_3$ or $v_{av34}$ > 1.5 $v_{12}$ /2 No

If yes, $v_{12A}$ = 4100 (Equation 13-15, 13-16, 13-18, or 13-19)

## Flow Entering Diverge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12}$ | 4100 | 4400 | No |

## Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 37.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence E

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $D_S$ = 0.468 | |
| Space mean speed in ramp influence area, | $S_R$ = 48.9 | mph |
| Space mean speed in outer lanes, | $S_O$ = 55.0 | mph |
| Space mean speed for all vehicles, | S = 52.0 | mph |

# HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Diverge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/1/2012 |
| Analysis time period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Junction: | Independence Blvd. Exit Ramp |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Diverge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 7590 | vph |

## Off Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-Flow speed on ramp | 35.0 | mph |
| Volume on ramp | 870 | vph |
| Length of first accel/decel lane | 215 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent ramp | | vph |
| Position of adjacent ramp | | |
| Type of adjacent ramp | | |
| Distance to adjacent ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | | Ramp | | Adjacent Ramp | |
|---|---|---|---|---|---|---|
| Volume, V (vph) | 7590 | | 870 | | | vph |
| Peak-hour factor, PHF | 0.95 | | 0.95 | | | |
| Peak 15-min volume, v15 | 1997 | | 229 | | | v |
| Trucks and buses | 9 | | 9 | | | % |
| Recreational vehicles | 0 | | 0 | | | % |
| Terrain type: | Level | | Level | | | |
| Grade | 0.00 | % | 0.00 | % | | % |
| Length | 0.00 | mi | 0.00 | mi | | mi |
| Trucks and buses PCE, ET | 1.5 | | 1.5 | | | |
| Recreational vehicle PCE, ER | 1.2 | | 1.2 | | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | 0.957 | 0.957 | |
| Driver population factor, fP | 1.00 | 1.00 | |
| Flow rate, vp | 8349 | 957 | pcph |

## Estimation of V12 Diverge Areas

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4180 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{Fi} = v_F$ | 8349 | 9000 | No |
| $v_{FO} = v_F - v_R$ | 7392 | 9000 | No |
| $v_R$ | 957 | 2000 | No |
| $v_3$ or $v_{av34}$ | 2084 pc/h | (Equation 13-14 or 13-17) | |

Is $v_3$ or $v_{av34}$ > 2700 pc/h? No

Is $v_3$ or $v_{av34}$ > 1.5 $v_{12}$ /2 No

If yes, $v_{12A}$ = 4180 (Equation 13-15, 13-16, 13-18, or 13-19)

## Flow Entering Diverge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12}$ | 4180 | 4400 | No |

## Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 38.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence E

## Speed Estimation

Intermediate speed variable, $D_S$ = 0.514

Space mean speed in ramp influence area, $S_R$ = 48.3 mph

Space mean speed in outer lanes, $S_O$ = 56.1 mph

Space mean speed for all vehicles, S = 51.9 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Merge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/1/2012 |
| Analysis time period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Junction: | Independenc Blvd. Entrance |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Merge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 7590 | vph |

## On Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-flow speed on ramp | 35.0 | mph |
| Volume on ramp | 430 | vph |
| Length of first accel/decel lane | 490 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent Ramp | | vph |
| Position of adjacent Ramp | | |
| Type of adjacent Ramp | | |
| Distance to adjacent Ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | Ramp | Adjacent Ramp | |
|---|---|---|---|---|
| Volume, V (vph) | 7590 | 430 | | vph |
| Peak-hour factor, PHF | 0.95 | 0.95 | | |
| Peak 15-min volume, v15 | 1997 | 113 | | v |
| Trucks and buses | 10 | 10 | | % |
| Recreational vehicles | 0 | 0 | | % |
| Terrain type: | Level | Level | | |
| Grade | % | % | % | |
| Length | mi | mi | mi | |
| Trucks and buses PCE, ET | 1.5 | 1.5 | | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | 0.952 | 0.952 | |
| Driver population factor, fP | 1.00 | 1.00 | |
| Flow rate, vp | 8389 | 475 | pcph |

## Estimation of V12 Merge Areas

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = 0.158 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 1329 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{FO}$ | 8864 | 9000 | No |
| $v_3$ or $v_{av34}$ | 3530 pc/h | (Equation 13-14 or 13-17) | |
| Is $v_3$ or $v_{av34}$ > 2700 pc/h? | | Yes | |
| Is $v_3$ or $v_{av34}$ > 1.5 $v_{12}$ /2 | | Yes | |

If yes, $v_{12A}$ = 3355 (Equation 13-15, 13-16, 18, or 19)

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12A}$ | 8864 | 4600 | No |

## Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 32.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $M_S$ = 0.466 | |
| Space mean speed in ramp influence area, | $S_R$ = 48.9 | mph |
| Space mean speed in outer lanes, | $S_O$ = 47.2 | mph |
| Space mean speed for all vehicles, | $S$ = 47.9 | mph |

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Merge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/1/2012 |
| Analysis time period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Junction: | Independenc Blvd. Entrance |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Merge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 6720 | vph |

## On Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-flow speed on ramp | 35.0 | mph |
| Volume on ramp | 650 | vph |
| Length of first accel/decel lane | 490 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent Ramp | | vph |
| Position of adjacent Ramp | | |
| Type of adjacent Ramp | | |
| Distance to adjacent Ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | Ramp | Adjacent Ramp | |
|---|---|---|---|---|
| Volume, V (vph) | 6720 | 650 | | vph |
| Peak-hour factor, PHF | 0.95 | 0.95 | | |
| Peak 15-min volume, v15 | 1768 | 171 | | v |
| Trucks and buses | 9 | 9 | | % |
| Recreational vehicles | 0 | 0 | | % |
| Terrain type: | Level | Level | | |
| Grade | % | % | % | |
| Length | mi | mi | mi | |
| Trucks and buses PCE, ET | 1.5 | 1.5 | | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | 0.957 | 0.957 | |
| Driver population factor, fP | 1.00 | 1.00 | |
| Flow rate, vp | 7392 | 715 | pcph |

## Estimation of V12 Merge Areas

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = 0.128 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 949 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{FO}$ | 8107 | 9000 | No |
| $v_3$ or $v_{av34}$ | 3221 pc/h | (Equation 13-14 or 13-17) | |
| Is $v_3$ or $v_{av34}$ > 2700 pc/h? | | Yes | |
| Is $v_3$ or $v_{av34}$ > 1.5 $v_{12}$ /2 | | Yes | |

If yes, $v_{12A}$ = 2956 (Equation 13-15, 13-16, 18, or 19)

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12A}$ | 8107 | 4600 | No |

## Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 30.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $M_S$ = 0.440 | |
| Space mean speed in ramp influence area, | $S_R$ = 49.3 | mph |
| Space mean speed in outer lanes, | $S_O$ = 48.8 | mph |
| Space mean speed for all vehicles, | S = 49.0 | mph |

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Phone: Fax:
E-mail:

## Diverge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/1/2012 |
| Analysis time period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Junction: | Western Ave. Exit Ramp |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Diverge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 7750 | vph |

## Off Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-Flow speed on ramp | 35.0 | mph |
| Volume on ramp | 500 | vph |
| Length of first accel/decel lane | 230 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent ramp | | vph |
| Position of adjacent ramp | | |
| Type of adjacent ramp | | |
| Distance to adjacent ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | | Ramp | | Adjacent Ramp | |
|---|---|---|---|---|---|---|
| Volume, V (vph) | 7750 | | 500 | | | vph |
| Peak-hour factor, PHF | 0.95 | | 0.95 | | | |
| Peak 15-min volume, v15 | 2039 | | 132 | | | v |
| Trucks and buses | 10 | | 10 | | | % |
| Recreational vehicles | 0 | | 0 | | | % |
| Terrain type: | Level | | Level | | | |
| Grade | 0.00 | % | 0.00 | % | | % |
| Length | 0.00 | mi | 0.00 | mi | | mi |
| Trucks and buses PCE, ET | 1.5 | | 1.5 | | | |
| Recreational vehicle PCE, ER | 1.2 | | 1.2 | | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | 0.952 | 0.952 | |
| Driver population factor, fP | 1.00 | 1.00 | |
| Flow rate, vp | 8566 | 553 | pcph |

## Estimation of V12 Diverge Areas

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4047 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{Fi} = v_F$ | 8566 | 9000 | No |
| $v_{FO} = v_F - v_R$ | 8013 | 9000 | No |
| $v_R$ | 553 | 2000 | No |
| $v_3$ or $v_{av34}$ | 2259 pc/h | (Equation 13-14 or 13-17) | |

Is $v_3$ or $v_{av34}$ > 2700 pc/h? No

Is $v_3$ or $v_{av34}$ > 1.5 $v_{12}$ /2 No

If yes, $v_{12A}$ = 4047 (Equation 13-15, 13-16, 13-18, or 13-19)

## Flow Entering Diverge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12}$ | 4047 | 4400 | No |

## Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 37.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence E

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $D_S$ = 0.478 | |
| Space mean speed in ramp influence area, | $S_R$ = 48.8 | mph |
| Space mean speed in outer lanes, | $S_O$ = 55.4 | mph |
| Space mean speed for all vehicles, | S = 52.1 | mph |

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Diverge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/1/2012 |
| Analysis time period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Junction: | Western Ave. Exit Ramp |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Diverge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 7220 | vph |

## Off Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-Flow speed on ramp | 35.0 | mph |
| Volume on ramp | 500 | vph |
| Length of first accel/decel lane | 230 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent ramp | | vph |
| Position of adjacent ramp | | |
| Type of adjacent ramp | | |
| Distance to adjacent ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | | Ramp | | Adjacent Ramp | |
|---|---|---|---|---|---|---|
| Volume, V (vph) | 7220 | | 500 | | | vph |
| Peak-hour factor, PHF | 0.95 | | 0.95 | | | |
| Peak 15-min volume, v15 | 1900 | | 132 | | | v |
| Trucks and buses | 9 | | 9 | | | % |
| Recreational vehicles | 0 | | 0 | | | % |
| Terrain type: | Level | | Level | | | |
| Grade | 0.00 | % | 0.00 | % | | % |
| Length | 0.00 | mi | 0.00 | mi | | mi |
| Trucks and buses PCE, ET | 1.5 | | 1.5 | | | |
| Recreational vehicle PCE, ER | 1.2 | | 1.2 | | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | 0.957 | 0.957 | |
| Driver population factor, fP | 1.00 | 1.00 | |
| Flow rate, vp | 7942 | 550 | pcph |

## Estimation of V12 Diverge Areas

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3773 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{Fi} = v_F$ | 7942 | 9000 | No |
| $v_{FO} = v_F - v_R$ | 7392 | 9000 | No |
| $v_R$ | 550 | 2000 | No |
| $v_3$ or $v_{av34}$ | 2084 pc/h | (Equation 13-14 or 13-17) | |

Is $v_3$ or $v_{av34}$ > 2700 pc/h? No

Is $v_3$ or $v_{av34}$ > 1.5 $v_{12}$ /2 No

If yes, $v_{12A}$ = 3773 (Equation 13-15, 13-16, 13-18, or 13-19)

## Flow Entering Diverge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12}$ | 3773 | 4400 | No |

## Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 34.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $D_S$ = 0.478 | |
| Space mean speed in ramp influence area, | $S_R$ = 48.8 | mph |
| Space mean speed in outer lanes, | $S_O$ = 56.1 | mph |
| Space mean speed for all vehicles, | $S$ = 52.4 | mph |

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Merge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/1/2012 |
| Analysis time period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Junction: | California Ave. Entrance Ramp |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Merge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 7250 | vph |

## On Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-flow speed on ramp | 35.0 | mph |
| Volume on ramp | 500 | vph |
| Length of first accel/decel lane | 400 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent Ramp | | vph |
| Position of adjacent Ramp | | |
| Type of adjacent Ramp | | |
| Distance to adjacent Ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | Ramp | Adjacent Ramp | |
|---|---|---|---|---|
| Volume, V (vph) | 7250 | 500 | | vph |
| Peak-hour factor, PHF | 0.95 | 0.95 | | |
| Peak 15-min volume, v15 | 1908 | 132 | | v |
| Trucks and buses | 10 | 10 | | % |
| Recreational vehicles | 0 | 0 | | % |
| Terrain type: | Level | Level | | |
| Grade | % | % | % | |
| Length | mi | mi | mi | |
| Trucks and buses PCE, ET | 1.5 | 1.5 | | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | | 0.952 | 0.952 |
| Driver population factor, fP | | 1.00 | 1.00 |
| Flow rate, vp | | 8013 | 553 pcph |

## Estimation of V12 Merge Areas

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = 0.149 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 1191 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{FO}$ | 8566 | 9000 | No |
| $v_3$ or $v_{av34}$ | 3411 pc/h | (Equation 13-14 or 13-17) | |
| Is $v_3$ or $v_{av34}$ | > 2700 pc/h? | Yes | |
| Is $v_3$ or $v_{av34}$ | > 1.5 $v_{12}$ /2 | Yes | |

If yes, $v_{12A}$ = 3205 (Equation 13-15, 13-16, 18, or 19)

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12A}$ | 8566 | 4600 | No |

## Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 32.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $M_S$ = 0.460 | |
| Space mean speed in ramp influence area, | $S_R$ = 49.0 | mph |
| Space mean speed in outer lanes, | $S_O$ = 47.8 | mph |
| Space mean speed for all vehicles, | S = 48.4 | mph |

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Merge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/1/2012 |
| Analysis time period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Junction: | California Ave. Entrance Ramp |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Merge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 6720 | vph |

## On Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-flow speed on ramp | 35.0 | mph |
| Volume on ramp | 530 | vph |
| Length of first accel/decel lane | 400 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent Ramp | | vph |
| Position of adjacent Ramp | | |
| Type of adjacent Ramp | | |
| Distance to adjacent Ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | Ramp | Adjacent Ramp | |
|---|---|---|---|---|
| Volume, V (vph) | 6720 | 530 | | vph |
| Peak-hour factor, PHF | 0.95 | 0.95 | | |
| Peak 15-min volume, v15 | 1768 | 139 | | v |
| Trucks and buses | 9 | 9 | | % |
| Recreational vehicles | 0 | 0 | | % |
| Terrain type: | Level | Level | | |
| Grade | % | % | % | |
| Length | mi | mi | mi | |
| Trucks and buses PCE, ET | 1.5 | 1.5 | | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | 0.957 | 0.957 | |
| Driver population factor, fP | 1.00 | 1.00 | |
| Flow rate, vp | 7392 | 583 | pcph |

## Estimation of V12 Merge Areas

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = 0.145 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 1071 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{FO}$ | 7975 | 9000 | No |
| $v_3$ or $v_{av34}$ | 3160 pc/h | (Equation 13-14 or 13-17) | |
| Is $v_3$ or $v_{av34}$ > 2700 pc/h? | | Yes | |
| Is $v_3$ or $v_{av34}$ > 1.5 $v_{12}$ /2 | | Yes | |

If yes, $v_{12A}$ = 2956 (Equation 13-15, 13-16, 18, or 19)

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12A}$ | 7975 | 4600 | No |

## Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 30.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $M_S$ = 0.427 | |
| Space mean speed in ramp influence area, | $S_R$ = 49.4 | mph |
| Space mean speed in outer lanes, | $S_O$ = 48.8 | mph |
| Space mean speed for all vehicles, | $S$ = 49.1 | mph |

# I - 290 Westbound Ramp Junction Analysis

## Existing Conditions

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Diverge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/7/2012 |
| Analysis time period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Junction: | California Ave. Exit Ramp |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Diverge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 5690 | vph |

## Off Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-Flow speed on ramp | 35.0 | mph |
| Volume on ramp | 480 | vph |
| Length of first accel/decel lane | 265 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent ramp | | vph |
| Position of adjacent ramp | | |
| Type of adjacent ramp | | |
| Distance to adjacent ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | Ramp | Adjacent Ramp | |
|---|---|---|---|---|
| Volume, V (vph) | 5690 | 480 | | vph |
| Peak-hour factor, PHF | 0.95 | 0.95 | | |
| Peak 15-min volume, v15 | 1497 | 126 | | v |
| Trucks and buses | 10 | 10 | | % |
| Recreational vehicles | 0 | 0 | | % |
| Terrain type: | Level | Level | | |
| Grade | 0.00 % | 0.00 % | | % |
| Length | 0.00 mi | 0.00 mi | | mi |
| Trucks and buses PCE, ET | 1.5 | 1.5 | | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | 0.952 | 0.952 | |
| Driver population factor, fP | 1.00 | 1.00 | |
| Flow rate, vp | 6289 | 531 | pcph |

## Estimation of V12 Diverge Areas

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3041 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{Fi} = v_F$ | 6289 | 9000 | No |
| $v_{FO} = v_F - v_R$ | 5758 | 9000 | No |
| $v_R$ | 531 | 2000 | No |
| $v_3$ or $v_{av34}$ | 1624 pc/h | (Equation 13-14 or 13-17) | |

Is $v_3$ or $v_{av34}$ > 2700 pc/h? No

Is $v_3$ or $v_{av34}$ > 1.5 $v_{12}$ /2 No

If yes, $v_{12A}$ = 3041 (Equation 13-15, 13-16, 13-18, or 13-19)

## Flow Entering Diverge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12}$ | 3041 | 4400 | No |

## Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 28.0+ pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $D_S$ = 0.476 | |
| Space mean speed in ramp influence area, | $S_R$ = 48.8 | mph |
| Space mean speed in outer lanes, | $S_O$ = 57.9 | mph |
| Space mean speed for all vehicles, | $S$ = 53.1 | mph |

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Diverge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/7/2012 |
| Analysis time period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Junction: | California Ave. Exit Ramp |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Diverge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 6360 | vph |

## Off Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-Flow speed on ramp | 35.0 | mph |
| Volume on ramp | 420 | vph |
| Length of first accel/decel lane | 265 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent ramp | | vph |
| Position of adjacent ramp | | |
| Type of adjacent ramp | | |
| Distance to adjacent ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | | Ramp | | Adjacent Ramp | |
|---|---|---|---|---|---|---|
| Volume, V (vph) | 6360 | | 420 | | | vph |
| Peak-hour factor, PHF | 0.95 | | 0.95 | | | |
| Peak 15-min volume, v15 | 1674 | | 111 | | | v |
| Trucks and buses | 3 | | 3 | | | % |
| Recreational vehicles | 0 | | 0 | | | % |
| Terrain type: | Level | | Level | | | |
| Grade | 0.00 | % | 0.00 | % | | % |
| Length | 0.00 | mi | 0.00 | mi | | mi |
| Trucks and buses PCE, ET | 1.5 | | 1.5 | | | |
| Recreational vehicle PCE, ER | 1.2 | | 1.2 | | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | | 0.985 | 0.985 |
| Driver population factor, fP | | 1.00 | 1.00 |
| Flow rate, vp | | 6795 | 449 pcph |

## Estimation of V12 Diverge Areas

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3216 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{Fi} = v_F$ | 6795 | 9000 | No |
| $v_{FO} = v_F - v_R$ | 6346 | 9000 | No |
| $v_R$ | 449 | 2000 | No |
| $v_3$ or $v_{av34}$ | 1789 pc/h | (Equation 13-14 or 13-17) | |
| Is $v_3$ or $v_{av34}$ > 2700 pc/h? | | No | |
| Is $v_3$ or $v_{av34}$ > 1.5 $v_{12}$ /2 | | No | |

If yes, $v_{12A}$ = 3216 (Equation 13-15, 13-16, 13-18, or 13-19)

## Flow Entering Diverge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12}$ | 3216 | 4400 | No |

## Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 29.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $D_S$ = 0.468 | |
| Space mean speed in ramp influence area, | $S_R$ = 48.9 | mph |
| Space mean speed in outer lanes, | $S_O$ = 57.3 | mph |
| Space mean speed for all vehicles, | $S$ = 53.0 | mph |

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Merge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/7/2012 |
| Analysis time period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Junction: | Western Ave. Entrance Ramp |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Merge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 5210 | vph |

## On Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-flow speed on ramp | 35.0 | mph |
| Volume on ramp | 720 | vph |
| Length of first accel/decel lane | 375 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent Ramp | | vph |
| Position of adjacent Ramp | | |
| Type of adjacent Ramp | | |
| Distance to adjacent Ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | Ramp | Adjacent Ramp | |
|---|---|---|---|---|
| Volume, V (vph) | 5210 | 720 | | vph |
| Peak-hour factor, PHF | 0.95 | 0.95 | | |
| Peak 15-min volume, v15 | 1371 | 189 | | v |
| Trucks and buses | 10 | 10 | | % |
| Recreational vehicles | 0 | 0 | | % |
| Terrain type: | Level | Level | | |
| Grade | % | % | % | |
| Length | mi | mi | mi | |
| Trucks and buses PCE, ET | 1.5 | 1.5 | | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | | 0.952 | 0.952 |
| Driver population factor, fP | | 1.00 | 1.00 |
| Flow rate, vp | | 5758 | 796 pcph |

## Estimation of V12 Merge Areas

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = 0.118 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 681 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{FO}$ | 6554 | 9000 | No |
| $v_3$ or $v_{av34}$ | 2538 pc/h | (Equation 13-14 or 13-17) | |
| Is $v_3$ or $v_{av34}$ | > 2700 pc/h? | No | |
| Is $v_3$ or $v_{av34}$ | > 1.5 $v_{12}$ /2 | Yes | |

If yes, $v_{12A}$ = 2303 (Equation 13-15, 13-16, 18, or 19)

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12A}$ | 6554 | 4600 | No |

## Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 26.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $M_S$ = 0.381 | |
| Space mean speed in ramp influence area, | $S_R$ = 50.0 | mph |
| Space mean speed in outer lanes, | $S_O$ = 50.6 | mph |
| Space mean speed for all vehicles, | S = 50.3 | mph |

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS D, which are not adequately evaluated by the Highway Capacity Manual Method.

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Merge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/7/2012 |
| Analysis time period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Junction: | Western Ave. Entrance Ramp |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Merge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 5940 | vph |

## On Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-flow speed on ramp | 35.0 | mph |
| Volume on ramp | 630 | vph |
| Length of first accel/decel lane | 375 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent Ramp | | vph |
| Position of adjacent Ramp | | |
| Type of adjacent Ramp | | |
| Distance to adjacent Ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | Ramp | Adjacent Ramp | |
|---|---|---|---|---|
| Volume, V (vph) | 5940 | 630 | | vph |
| Peak-hour factor, PHF | 0.95 | 0.95 | | |
| Peak 15-min volume, v15 | 1563 | 166 | | v |
| Trucks and buses | 3 | 3 | | % |
| Recreational vehicles | 0 | 0 | | % |
| Terrain type: | Level | Level | | |
| Grade | % | % | % | |
| Length | mi | mi | mi | |
| Trucks and buses PCE, ET | 1.5 | 1.5 | | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | | 0.985 | 0.985 |
| Driver population factor, fP | | 1.00 | 1.00 |
| Flow rate, vp | | 6346 | 673 pcph |

## Estimation of V12 Merge Areas

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = 0.134 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 848 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{FO}$ | 7019 | 9000 | No |
| $v_3$ or $v_{av34}$ | 2749 pc/h | (Equation 13-14 or 13-17) | |
| Is $v_3$ or $v_{av34}$ > 2700 pc/h? | | Yes | |
| Is $v_3$ or $v_{av34}$ > 1.5 $v_{12}$ /2 | | Yes | |

If yes, $v_{12A}$ = 2538 (Equation 13-15, 13-16, 18, or 19)

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12A}$ | 7019 | 4600 | No |

## Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 27.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $M_S$ = 0.391 | |
| Space mean speed in ramp influence area, | $S_R$ = 49.9 | mph |
| Space mean speed in outer lanes, | $S_O$ = 49.9 | mph |
| Space mean speed for all vehicles, | S = 49.9 | mph |

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Diverge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/7/2012 |
| Analysis time period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Junction: | Independence Blvd. Exit Ramp |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Diverge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 6110 | vph |

## Off Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-Flow speed on ramp | 35.0 | mph |
| Volume on ramp | 480 | vph |
| Length of first accel/decel lane | 150 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent ramp | | vph |
| Position of adjacent ramp | | |
| Type of adjacent ramp | | |
| Distance to adjacent ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | | Ramp | | Adjacent Ramp | |
|---|---|---|---|---|---|---|
| Volume, V (vph) | 6110 | | 480 | | | vph |
| Peak-hour factor, PHF | 0.95 | | 0.95 | | | |
| Peak 15-min volume, v15 | 1608 | | 126 | | | v |
| Trucks and buses | 10 | | 10 | | | % |
| Recreational vehicles | 0 | | 0 | | | % |
| Terrain type: | Level | | Level | | | |
| Grade | 0.00 | % | 0.00 | % | | % |
| Length | 0.00 | mi | 0.00 | mi | | mi |
| Trucks and buses PCE, ET | 1.5 | | 1.5 | | | |
| Recreational vehicle PCE, ER | 1.2 | | 1.2 | | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | | 0.952 | 0.952 |
| Driver population factor, fP | | 1.00 | 1.00 |
| Flow rate, vp | | 6753 | 531 pcph |

## Estimation of V12 Diverge Areas

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3244 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{Fi} = v_F$ | 6753 | 9000 | No |
| $v_{FO} = v_F - v_R$ | 6222 | 9000 | No |
| $v_R$ | 531 | 2000 | No |
| $v_3$ or $v_{av34}$ | 1754 pc/h | (Equation 13-14 or 13-17) | |

Is $v_3$ or $v_{av34}$ > 2700 pc/h? No

Is $v_3$ or $v_{av34}$ > 1.5 $v_{12}$ /2 No

If yes, $v_{12A}$ = 3244 (Equation 13-15, 13-16, 13-18, or 13-19)

## Flow Entering Diverge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12}$ | 3244 | 4400 | No |

## Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 30.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $D_S$ = 0.476 | |
| Space mean speed in ramp influence area, | $S_R$ = 48.8 | mph |
| Space mean speed in outer lanes, | $S_O$ = 57.4 | mph |
| Space mean speed for all vehicles, | $S$ = 52.9 | mph |

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Diverge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/7/2012 |
| Analysis time period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Junction: | Independence Blvd. Exit Ramp |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Diverge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 6630 | vph |

## Off Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-Flow speed on ramp | 35.0 | mph |
| Volume on ramp | 470 | vph |
| Length of first accel/decel lane | 150 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent ramp | | vph |
| Position of adjacent ramp | | |
| Type of adjacent ramp | | |
| Distance to adjacent ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | | Ramp | | Adjacent Ramp | |
|---|---|---|---|---|---|---|
| Volume, V (vph) | 6630 | | 470 | | | vph |
| Peak-hour factor, PHF | 0.95 | | 0.95 | | | |
| Peak 15-min volume, v15 | 1745 | | 124 | | | v |
| Trucks and buses | 3 | | 3 | | | % |
| Recreational vehicles | 0 | | 0 | | | % |
| Terrain type: | Level | | Level | | | |
| Grade | 0.00 | % | 0.00 | % | | % |
| Length | 0.00 | mi | 0.00 | mi | | mi |
| Trucks and buses PCE, ET | 1.5 | | 1.5 | | | |
| Recreational vehicle PCE, ER | 1.2 | | 1.2 | | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | | 0.985 | 0.985 |
| Driver population factor, fP | | 1.00 | 1.00 |
| Flow rate, vp | | 7084 | 502 pcph |

## Estimation of V12 Diverge Areas

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3372 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{Fi} = v_F$ | 7084 | 9000 | No |
| $v_{FO} = v_F - v_R$ | 6582 | 9000 | No |
| $v_R$ | 502 | 2000 | No |
| $v_3$ or $v_{av34}$ | 1856 pc/h | (Equation 13-14 or 13-17) | |

Is $v_3$ or $v_{av34}$ > 2700 pc/h? No

Is $v_3$ or $v_{av34}$ > 1.5 $v_{12}$ /2 No

If yes, $v_{12A}$ = 3372 (Equation 13-15, 13-16, 13-18, or 13-19)

## Flow Entering Diverge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12}$ | 3372 | 4400 | No |

## Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 31.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $D_S$ = 0.473 | |
| Space mean speed in ramp influence area, | $S_R$ = 48.8 | mph |
| Space mean speed in outer lanes, | $S_O$ = 57.0 | mph |
| Space mean speed for all vehicles, | $S$ = 52.8 | mph |

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Merge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/7/2012 |
| Analysis time period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Junction: | Independence Blvd. Entrance |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Merge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 5630 | vph |

## On Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-flow speed on ramp | 35.0 | mph |
| Volume on ramp | 480 | vph |
| Length of first accel/decel lane | 630 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent Ramp | | vph |
| Position of adjacent Ramp | | |
| Type of adjacent Ramp | | |
| Distance to adjacent Ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | Ramp | Adjacent Ramp | |
|---|---|---|---|---|
| Volume, V (vph) | 5630 | 480 | | vph |
| Peak-hour factor, PHF | 0.95 | 0.95 | | |
| Peak 15-min volume, v15 | 1482 | 126 | | v |
| Trucks and buses | 10 | 10 | | % |
| Recreational vehicles | 0 | 0 | | % |
| Terrain type: | Level | Level | | |
| Grade | % | % | % | |
| Length | mi | mi | mi | |
| Trucks and buses PCE, ET | 1.5 | 1.5 | | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | | 0.952 | 0.952 |
| Driver population factor, fP | | 1.00 | 1.00 |
| Flow rate, vp | | 6223 | 531 pcph |

## Estimation of V12 Merge Areas

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = 0.151 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 942 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{FO}$ | 6754 | 9000 | No |
| $v_3$ or $v_{av34}$ | 2640 pc/h | (Equation 13-14 or 13-17) | |
| Is $v_3$ or $v_{av34}$ | > 2700 pc/h? | No | |
| Is $v_3$ or $v_{av34}$ | > 1.5 $v_{12}$ /2 | Yes | |

If yes, $v_{12A}$ = 2489 (Equation 13-15, 13-16, 13-18, or 13-19)

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12A}$ | 6754 | 4600 | No |

## Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 24.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $M_S$ = 0.357 | |
| Space mean speed in ramp influence area, | $S_R$ = 50.4 | mph |
| Space mean speed in outer lanes, | $S_O$ = 50.1 | mph |
| Space mean speed for all vehicles, | S = 50.2 | mph |

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS D, which are not adequately evaluated by the Highway Capacity Manual Method.

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Merge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/7/2012 |
| Analysis time period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Junction: | Independence Blvd. Entrance |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Merge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 6160 | vph |

## On Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-flow speed on ramp | 35.0 | mph |
| Volume on ramp | 540 | vph |
| Length of first accel/decel lane | 630 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent Ramp | | vph |
| Position of adjacent Ramp | | |
| Type of adjacent Ramp | | |
| Distance to adjacent Ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | Ramp | Adjacent Ramp | |
|---|---|---|---|---|
| Volume, V (vph) | 6160 | 540 | | vph |
| Peak-hour factor, PHF | 0.95 | 0.95 | | |
| Peak 15-min volume, v15 | 1621 | 142 | | v |
| Trucks and buses | 3 | 3 | | % |
| Recreational vehicles | 0 | 0 | | % |
| Terrain type: | Level | Level | | |
| Grade | % | % | % | |
| Length | mi | mi | mi | |
| Trucks and buses PCE, ET | 1.5 | 1.5 | | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | 0.985 | 0.985 | |
| Driver population factor, fP | 1.00 | 1.00 | |
| Flow rate, vp | 6581 | 577 | pcph |

## Estimation of V12 Merge Areas

$L_{EQ}$ = (Equation 13-6 or 13-7)

$P_{FM}$ = 0.146 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 959 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{FO}$ | 7158 | 9000 | No |
| $v_3$ or $v_{av34}$ | 2811 pc/h | (Equation 13-14 or 13-17) | |
| Is $v_3$ or $v_{av34}$ | > 2700 pc/h? | Yes | |
| Is $v_3$ or $v_{av34}$ | > 1.5 $v_{12}$ /2 | Yes | |

If yes, $v_{12A}$ = 2632 (Equation 13-15, 13-16, 13-18, or 13-19)

## Flow Entering Merge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12A}$ | 7158 | 4600 | No |

## Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 26.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $M_S$ = 0.373 | |
| Space mean speed in ramp influence area, | $S_R$ = 50.1 | mph |
| Space mean speed in outer lanes, | $S_O$ = 49.7 | mph |
| Space mean speed for all vehicles, | S = 49.9 | mph |

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Diverge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/7/2012 |
| Analysis time period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Junction: | Kostner Ave. Exit Ramp |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Diverge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 6110 | vph |

## Off Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-Flow speed on ramp | 35.0 | mph |
| Volume on ramp | 640 | vph |
| Length of first accel/decel lane | 267 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent ramp | | vph |
| Position of adjacent ramp | | |
| Type of adjacent ramp | | |
| Distance to adjacent ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | | Ramp | | Adjacent Ramp | |
|---|---|---|---|---|---|---|
| Volume, V (vph) | 6110 | | 640 | | | vph |
| Peak-hour factor, PHF | 0.95 | | 0.95 | | | |
| Peak 15-min volume, v15 | 1608 | | 168 | | | v |
| Trucks and buses | 10 | | 10 | | | % |
| Recreational vehicles | 0 | | 0 | | | % |
| Terrain type: | Level | | Level | | | |
| Grade | 0.00 | % | 0.00 | % | | % |
| Length | 0.00 | mi | 0.00 | mi | | mi |
| Trucks and buses PCE, ET | 1.5 | | 1.5 | | | |
| Recreational vehicle PCE, ER | 1.2 | | 1.2 | | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | | 0.952 | 0.952 |
| Driver population factor, fP | | 1.00 | 1.00 |
| Flow rate, vp | | 6753 | 707 pcph |

## Estimation of V12 Diverge Areas

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3343 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{Fi} = v_F$ | 6753 | 9000 | No |
| $v_{FO} = v_F - v_R$ | 6046 | 9000 | No |
| $v_R$ | 707 | 2000 | No |
| $v_3$ or $v_{av34}$ | 1705 pc/h | (Equation 13-14 or 13-17) | |

Is $v_3$ or $v_{av34}$ > 2700 pc/h? No

Is $v_3$ or $v_{av34}$ > 1.5 $v_{12}$ /2 No

If yes, $v_{12A}$ = 3343 (Equation 13-15, 13-16, 13-18, or 13-19)

## Flow Entering Diverge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12}$ | 3343 | 4400 | No |

## Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 30.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $D_S$ = 0.492 | |
| Space mean speed in ramp influence area, | $S_R$ = 48.6 | mph |
| Space mean speed in outer lanes, | $S_O$ = 57.6 | mph |
| Space mean speed for all vehicles, | S = 52.8 | mph |

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS E, which are not adequately evaluated by the Highway Capacity Manual Method.

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

## Diverge Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date performed: | 8/7/2012 |
| Analysis time period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Junction: | Kostner Ave. Exit Ramp |
| Jurisdiction: | IDOT |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Freeway Data

| | | |
|---|---|---|
| Type of analysis | Diverge | |
| Number of lanes in freeway | 4 | |
| Free-flow speed on freeway | 55.0 | mph |
| Volume on freeway | 6700 | vph |

## Off Ramp Data

| | | |
|---|---|---|
| Side of freeway | Right | |
| Number of lanes in ramp | 1 | |
| Free-Flow speed on ramp | 35.0 | mph |
| Volume on ramp | 600 | vph |
| Length of first accel/decel lane | 267 | ft |
| Length of second accel/decel lane | | ft |

## Adjacent Ramp Data (if one exists)

| | | |
|---|---|---|
| Does adjacent ramp exist? | No | |
| Volume on adjacent ramp | | vph |
| Position of adjacent ramp | | |
| Type of adjacent ramp | | |
| Distance to adjacent ramp | | ft |

## Conversion to pc/h Under Base Conditions

| Junction Components | Freeway | | Ramp | | Adjacent Ramp | |
|---|---|---|---|---|---|---|
| Volume, V (vph) | 6700 | | 600 | | | vph |
| Peak-hour factor, PHF | 0.95 | | 0.95 | | | |
| Peak 15-min volume, v15 | 1763 | | 158 | | | v |
| Trucks and buses | 3 | | 3 | | | % |
| Recreational vehicles | 0 | | 0 | | | % |
| Terrain type: | Level | | Level | | | |
| Grade | 0.00 | % | 0.00 | % | | % |
| Length | 0.00 | mi | 0.00 | mi | | mi |
| Trucks and buses PCE, ET | 1.5 | | 1.5 | | | |
| Recreational vehicle PCE, ER | 1.2 | | 1.2 | | | |

| | | | |
|---|---|---|---|
| Heavy vehicle adjustment, fHV | | 0.985 | 0.985 |
| Driver population factor, fP | | 1.00 | 1.00 |
| Flow rate, vp | | 7158 | 641 pcph |

## Estimation of V12 Diverge Areas

$L_{EQ}$ = (Equation 13-12 or 13-13)

$P_{FD}$ = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3482 pc/h

## Capacity Checks

| | Actual | Maximum | LOS F? |
|---|---|---|---|
| $v_{Fi} = v_F$ | 7158 | 9000 | No |
| $v_{FO} = v_F - v_R$ | 6517 | 9000 | No |
| $v_R$ | 641 | 2000 | No |
| $v_3$ or $v_{av34}$ | 1838 pc/h | (Equation 13-14 or 13-17) | |
| Is $v_3$ or $v_{av34}$ > 2700 pc/h? | | No | |
| Is $v_3$ or $v_{av34}$ > 1.5 $v_{12}$ /2 | | No | |

If yes, $v_{12A}$ = 3482 (Equation 13-15, 13-16, 13-18, or 13-19)

## Flow Entering Diverge Influence Area

| | Actual | Max Desirable | Violation? |
|---|---|---|---|
| $v_{12}$ | 3482 | 4400 | No |

## Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 31.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

## Speed Estimation

| | | |
|---|---|---|
| Intermediate speed variable, | $D_S$ = 0.486 | |
| Space mean speed in ramp influence area, | $S_R$ = 48.7 | mph |
| Space mean speed in outer lanes, | $S_O$ = 57.1 | mph |
| Space mean speed for all vehicles, | $S$ = 52.7 | mph |

Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

# Appendix B

# HCS Analysis Output

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# B-3

# Weaving Sections

# I - 290 Eastbound Weaving Analysis

## Existing Conditions

HCS 2010: Freeway Weaving Release 6.1

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date Performed: | 8/2/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Weaving Location: | Homan Ent. to Sacramento Ex. |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Inputs

| | | |
|---|---|---|
| Segment Type | Freeway | |
| Weaving configuration | One-Sided | |
| Number of lanes, N | 5 | ln |
| Weaving segment length, LS | 758 | ft |
| Freeway free-flow speed, FFS | 55 | mi/h |
| Minimum segment speed, SMIN | 15 | mi/h |
| Freeway maximum capacity, cIFL | 2250 | pc/h/ln |
| Terrain type | Level | |
| Grade | 0.00 | % |
| Length | 0.00 | mi |

### Conversion to pc/h Under Base Conditions

| | Volume Components | | | | |
|---|---|---|---|---|---|
| | VFF | VRF | VFR | VRR | |
| Volume, V | 7467 | 290 | 560 | 0 | veh/h |
| Peak hour factor, PHF | 0.95 | 0.95 | 0.95 | 0.95 | |
| Peak 15-min volume, v15 | 1965 | 76 | 147 | 0 | |
| Trucks and buses | 10 | 10 | 10 | 0 | % |
| Recreational vehicles | 0 | 0 | 0 | 0 | % |
| Trucks and buses PCE, ET | 1.5 | 1.5 | 1.5 | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | 1.2 | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | 0.952 | 0.952 | 1.000 | |
| Driver population adjustment, fP | 1.00 | 1.00 | 1.00 | 1.00 | |
| Flow rate, v | 8253 | 321 | 619 | 0 | pc/h |

| | | |
|---|---|---|
| Volume ratio, VR | 0.102 | |

### Configuration Characteristics

| | | |
|---|---|---|
| Number of maneuver lanes, NWL | 2 | ln |
| Interchange density, ID | 1.00 | int/mi |
| Minimum RF lane changes, LCRF | 1 | lc/pc |
| Minimum FR lane changes, LCFR | 1 | lc/pc |
| Minimum RR lane changes, LCRR | | lc/pc |
| Minimum weaving lane changes, LCMIN | 940 | lc/h |
| Weaving lane changes, LCW | 1303 | lc/h |
| Non-weaving vehicle index, INW | 626 | |
| Non-weaving lane change, LCNW | 1148 | lc/h |
| Total lane changes, LCALL | 2451 | lc/h |

### Weaving and Non-Weaving Speeds

| | |
|---|---|
| Weaving intensity factor, W | 0.570 |

| | | |
|---|---|---|
| Average weaving speed, SW | 40.5 | mi/h |
| Average non-weaving speed, SNW | 39.4 | mi/h |

Weaving Segment Speed, Density, Level of Service and Capacity

| | | |
|---|---|---|
| Weaving segment speed, S | 39.5 | mi/h |
| Weaving segment density, D | 46.5 | pc/mi/ln |
| Level of service, LOS | E | |
| Weaving segment v/c ratio | 0.903 | |
| Weaving segment flow rate, v | 9193 | pc/h |
| Weaving segment capacity, cW | 9695 | veh/h |

Limitations on Weaving Segments

If limit reached, see note.

| | Minimum | Maximum | Actual | Note |
|---|---|---|---|---|
| Weaving length (ft) | 300 | 3561 | 758 | a,b |
| | | Maximum | Analyzed | |
| Density-based capacty, cIWL (pc/h/ln) | | 2250 | 2036 | c |
| | | Maximum | Analyzed | |
| v/c ratio | | 1.00 | 0.903 | d |

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."
c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
d. Volumes exceed the weaving segment capacity. The level of service is F.

HCS 2010: Freeway Weaving Release 6.1

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date Performed: | 8/2/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Weaving Location: | Homan Ent. to Sacramento Ex. |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Inputs

| | | |
|---|---|---|
| Segment Type | Freeway | |
| Weaving configuration | One-Sided | |
| Number of lanes, N | 5 | ln |
| Weaving segment length, LS | 758 | ft |
| Freeway free-flow speed, FFS | 55 | mi/h |
| Minimum segment speed, SMIN | 15 | mi/h |
| Freeway maximum capacity, cIFL | 2250 | pc/h/ln |
| Terrain type | Level | |
| Grade | 0.00 | % |
| Length | 0.00 | mi |

## Conversion to pc/h Under Base Conditions

| | Volume Components | | | | |
|---|---|---|---|---|---|
| | VFF | VRF | VFR | VRR | |
| Volume, V | 6680 | 540 | 690 | 0 | veh/h |
| Peak hour factor, PHF | 0.95 | 0.95 | 0.95 | 0.95 | |
| Peak 15-min volume, v15 | 1758 | 142 | 182 | 0 | |
| Trucks and buses | 9 | 9 | 9 | 0 | % |
| Recreational vehicles | 0 | 0 | 0 | 0 | % |
| Trucks and buses PCE, ET | 1.5 | 1.5 | 1.5 | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | 1.2 | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.957 | 0.957 | 0.957 | 1.000 | |
| Driver population adjustment, fP | 1.00 | 1.00 | 1.00 | 1.00 | |
| Flow rate, v | 7348 | 594 | 759 | 0 | pc/h |

| | | |
|---|---|---|
| Volume ratio, VR | 0.155 | |

## Configuration Characteristics

| | | |
|---|---|---|
| Number of maneuver lanes, NWL | 2 | ln |
| Interchange density, ID | 1.00 | int/mi |
| Minimum RF lane changes, LCRF | 1 | lc/pc |
| Minimum FR lane changes, LCFR | 1 | lc/pc |
| Minimum RR lane changes, LCRR | | lc/pc |
| Minimum weaving lane changes, LCMIN | 1353 | lc/h |
| Weaving lane changes, LCW | 1716 | lc/h |
| Non-weaving vehicle index, INW | 557 | |
| Non-weaving lane change, LCNW | 962 | lc/h |
| Total lane changes, LCALL | 2678 | lc/h |

## Weaving and Non-Weaving Speeds

| | |
|---|---|
| Weaving intensity factor, W | 0.612 |

| | | |
|---|---|---|
| Average weaving speed, SW | 39.8 | mi/h |
| Average non-weaving speed, SNW | 36.9 | mi/h |

Weaving Segment Speed, Density, Level of Service and Capacity

| | | |
|---|---|---|
| Weaving segment speed, S | 37.3 | mi/h |
| Weaving segment density, D | 46.6 | pc/mi/ln |
| Level of service, LOS | E | |
| Weaving segment v/c ratio | 0.872 | |
| Weaving segment flow rate, v | 8701 | pc/h |
| Weaving segment capacity, cW | 9545 | veh/h |

Limitations on Weaving Segments

If limit reached, see note.

| | Minimum | Maximum | Actual | Note |
|---|---|---|---|---|
| Weaving length (ft) | 300 | 4086 | 758 | a,b |
| | | Maximum | Analyzed | |
| Density-based capacty, cIWL (pc/h/ln) | | 2250 | 1995 | c |
| | | Maximum | Analyzed | |
| v/c ratio | | 1.00 | 0.872 | d |

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."
c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
d. Volumes exceed the weaving segment capacity. The level of service is F.

HCS 2010: Freeway Weaving Release 6.1

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date Performed: | 8/2/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Weaving Location: | Oakley Ent. to Damen Ex. |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Inputs

| | | |
|---|---|---|
| Segment Type | Freeway | |
| Weaving configuration | One-Sided | |
| Number of lanes, N | 5 | ln |
| Weaving segment length, LS | 557 | ft |
| Freeway free-flow speed, FFS | 55 | mi/h |
| Minimum segment speed, SMIN | 15 | mi/h |
| Freeway maximum capacity, cIFL | 2250 | pc/h/ln |
| Terrain type | Level | |
| Grade | 0.00 | % |
| Length | 0.00 | mi |

## Conversion to pc/h Under Base Conditions

| | Volume Components | | | | |
|---|---|---|---|---|---|
| | VFF | VRF | VFR | VRR | |
| Volume, V | 6780 | 430 | 970 | 0 | veh/h |
| Peak hour factor, PHF | 0.95 | 0.95 | 0.95 | 0.95 | |
| Peak 15-min volume, v15 | 1784 | 113 | 255 | 0 | |
| Trucks and buses | 10 | 10 | 10 | 0 | % |
| Recreational vehicles | 0 | 0 | 0 | 0 | % |
| Trucks and buses PCE, ET | 1.5 | 1.5 | 1.5 | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | 1.2 | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | 0.952 | 0.952 | 1.000 | |
| Driver population adjustment, fP | 1.00 | 1.00 | 1.00 | 1.00 | |
| Flow rate, v | 7494 | 475 | 1072 | 0 | pc/h |
| Volume ratio, VR | | 0.171 | | | |

## Configuration Characteristics

| | | |
|---|---|---|
| Number of maneuver lanes, NWL | 2 | ln |
| Interchange density, ID | 1.00 | int/mi |
| Minimum RF lane changes, LCRF | 1 | lc/pc |
| Minimum FR lane changes, LCFR | 1 | lc/pc |
| Minimum RR lane changes, LCRR | | lc/pc |
| Minimum weaving lane changes, LCMIN | 1547 | lc/h |
| Weaving lane changes, LCW | 1819 | lc/h |
| Non-weaving vehicle index, INW | 417 | |
| Non-weaving lane change, LCNW | 883 | lc/h |
| Total lane changes, LCALL | 2702 | lc/h |

## Weaving and Non-Weaving Speeds

| | |
|---|---|
| Weaving intensity factor, W | 0.786 |

| | | |
|---|---|---|
| Average weaving speed, SW | 37.4 | mi/h |
| Average non-weaving speed, SNW | 35.2 | mi/h |

Weaving Segment Speed, Density, Level of Service and Capacity

| | | |
|---|---|---|
| Weaving segment speed, S | 35.5 | mi/h |
| Weaving segment density, D | 50.9 | pc/mi/ln |
| Level of service, LOS | E | |
| Weaving segment v/c ratio | 0.919 | |
| Weaving segment flow rate, v | 9041 | pc/h |
| Weaving segment capacity, cW | 9371 | veh/h |

Limitations on Weaving Segments

If limit reached, see note.

| | Minimum | Maximum | Actual | Note |
|---|---|---|---|---|
| Weaving length (ft) | 300 | 4243 | 557 | a,b |
| | | Maximum | Analyzed | |
| Density-based capacty, cIWL (pc/h/ln) | | 2250 | 1968 | c |
| | | Maximum | Analyzed | |
| v/c ratio | | 1.00 | 0.919 | d |

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."
c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
d. Volumes exceed the weaving segment capacity. The level of service is F.

HCS 2010: Freeway Weaving Release 6.1

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date Performed: | 8/2/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Weaving Location: | Oakley Ent. to Damen Ex. |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Inputs

| | | |
|---|---|---|
| Segment Type | Freeway | |
| Weaving configuration | One-Sided | |
| Number of lanes, N | 5 | ln |
| Weaving segment length, LS | 557 | ft |
| Freeway free-flow speed, FFS | 55 | mi/h |
| Minimum segment speed, SMIN | 15 | mi/h |
| Freeway maximum capacity, cIFL | 2250 | pc/h/ln |
| Terrain type | Level | |
| Grade | 0.00 | % |
| Length | 0.00 | mi |

### Conversion to pc/h Under Base Conditions

| | Volume Components | | | | |
|---|---|---|---|---|---|
| | VFF | VRF | VFR | VRR | |
| Volume, V | 6530 | 390 | 720 | 0 | veh/h |
| Peak hour factor, PHF | 0.95 | 0.95 | 0.95 | 0.95 | |
| Peak 15-min volume, v15 | 1718 | 103 | 189 | 0 | |
| Trucks and buses | 9 | 9 | 9 | 0 | % |
| Recreational vehicles | 0 | 0 | 0 | 0 | % |
| Trucks and buses PCE, ET | 1.5 | 1.5 | 1.5 | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | 1.2 | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.957 | 0.957 | 0.957 | 1.000 | |
| Driver population adjustment, fP | 1.00 | 1.00 | 1.00 | 1.00 | |
| Flow rate, v | 7183 | 429 | 792 | 0 | pc/h |

Volume ratio, VR 0.145

### Configuration Characteristics

| | | |
|---|---|---|
| Number of maneuver lanes, NWL | 2 | ln |
| Interchange density, ID | 1.00 | int/mi |
| Minimum RF lane changes, LCRF | 1 | lc/pc |
| Minimum FR lane changes, LCFR | 1 | lc/pc |
| Minimum RR lane changes, LCRR | | lc/pc |
| Minimum weaving lane changes, LCMIN | 1221 | lc/h |
| Weaving lane changes, LCW | 1493 | lc/h |
| Non-weaving vehicle index, INW | 400 | |
| Non-weaving lane change, LCNW | 819 | lc/h |
| Total lane changes, LCALL | 2312 | lc/h |

### Weaving and Non-Weaving Speeds

Weaving intensity factor, W 0.695

| | | |
|---|---|---|
| Average weaving speed, SW | 38.6 | mi/h |
| Average non-weaving speed, SNW | 38.1 | mi/h |

Weaving Segment Speed, Density, Level of Service and Capacity

| | | |
|---|---|---|
| Weaving segment speed, S | 38.2 | mi/h |
| Weaving segment density, D | 44.0 | pc/mi/ln |
| Level of service, LOS | E | |
| Weaving segment v/c ratio | 0.845 | |
| Weaving segment flow rate, v | 8404 | pc/h |
| Weaving segment capacity, cW | 9512 | veh/h |

Limitations on Weaving Segments

If limit reached, see note.

| | Minimum | Maximum | Actual | Note |
|---|---|---|---|---|
| Weaving length (ft) | 300 | 3985 | 557 | a,b |
| | | Maximum | Analyzed | |
| Density-based capacty, cIWL (pc/h/ln) | | 2250 | 1988 | c |
| | | Maximum | Analyzed | |
| v/c ratio | | 1.00 | 0.845 | d |

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."
c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
d. Volumes exceed the weaving segment capacity. The level of service is F.

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Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date Performed: | 8/2/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Weaving Location: | Damen Ent. to Paulina Ex. |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Inputs

| | | |
|---|---|---|
| Segment Type | Freeway | |
| Weaving configuration | One-Sided | |
| Number of lanes, N | 5 | ln |
| Weaving segment length, LS | 480 | ft |
| Freeway free-flow speed, FFS | 55 | mi/h |
| Minimum segment speed, SMIN | 15 | mi/h |
| Freeway maximum capacity, cIFL | 2250 | pc/h/ln |
| Terrain type | Level | |
| Grade | 0.00 | % |
| Length | 0.00 | mi |

## Conversion to pc/h Under Base Conditions

| | Volume Components | | | | |
|---|---|---|---|---|---|
| | VFF | VRF | VFR | VRR | |
| Volume, V | 6610 | 410 | 600 | 0 | veh/h |
| Peak hour factor, PHF | 0.95 | 0.95 | 0.95 | 0.95 | |
| Peak 15-min volume, v15 | 1739 | 108 | 158 | 0 | |
| Trucks and buses | 10 | 10 | 10 | 0 | % |
| Recreational vehicles | 0 | 0 | 0 | 0 | % |
| Trucks and buses PCE, ET | 1.5 | 1.5 | 1.5 | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | 1.2 | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | 0.952 | 0.952 | 1.000 | |
| Driver population adjustment, fP | 1.00 | 1.00 | 1.00 | 1.00 | |
| Flow rate, v | 7306 | 453 | 663 | 0 | pc/h |

Volume ratio, VR 0.133

## Configuration Characteristics

| | | |
|---|---|---|
| Number of maneuver lanes, NWL | 2 | ln |
| Interchange density, ID | 1.00 | int/mi |
| Minimum RF lane changes, LCRF | 1 | lc/pc |
| Minimum FR lane changes, LCFR | 1 | lc/pc |
| Minimum RR lane changes, LCRR | | lc/pc |
| Minimum weaving lane changes, LCMIN | 1116 | lc/h |
| Weaving lane changes, LCW | 1344 | lc/h |
| Non-weaving vehicle index, INW | 351 | |
| Non-weaving lane change, LCNW | 802 | lc/h |
| Total lane changes, LCALL | 2146 | lc/h |

## Weaving and Non-Weaving Speeds

Weaving intensity factor, W 0.737

| | | |
|---|---|---|
| Average weaving speed, SW | 38.0 | mi/h |
| Average non-weaving speed, SNW | 38.9 | mi/h |

Weaving Segment Speed, Density, Level of Service and Capacity

| | | |
|---|---|---|
| Weaving segment speed, S | 38.8 | mi/h |
| Weaving segment density, D | 43.5 | pc/mi/ln |
| Level of service, LOS | E | |
| Weaving segment v/c ratio | 0.846 | |
| Weaving segment flow rate, v | 8422 | pc/h |
| Weaving segment capacity, cW | 9486 | veh/h |

Limitations on Weaving Segments

If limit reached, see note.

| | Minimum | Maximum | Actual | Note |
|---|---|---|---|---|
| Weaving length (ft) | 300 | 3858 | 480 | a,b |
| | | Maximum | Analyzed | |
| Density-based capacty, cIWL (pc/h/ln) | | 2250 | 1992 | c |
| | | Maximum | Analyzed | |
| v/c ratio | | 1.00 | 0.846 | d |

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."
c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
d. Volumes exceed the weaving segment capacity. The level of service is F.

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## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date Performed: | 8/2/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Weaving Location: | Damen Ent. to Paulina Ex. |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Inputs

| | | |
|---|---|---|
| Segment Type | Freeway | |
| Weaving configuration | One-Sided | |
| Number of lanes, N | 5 | ln |
| Weaving segment length, LS | 480 | ft |
| Freeway free-flow speed, FFS | 55 | mi/h |
| Minimum segment speed, SMIN | 15 | mi/h |
| Freeway maximum capacity, cIFL | 2250 | pc/h/ln |
| Terrain type | Level | |
| Grade | 0.00 | % |
| Length | 0.00 | mi |

## Conversion to pc/h Under Base Conditions

| | Volume Components | | | | |
|---|---|---|---|---|---|
| | VFF | VRF | VFR | VRR | |
| Volume, V | 6390 | 600 | 530 | 0 | veh/h |
| Peak hour factor, PHF | 0.95 | 0.95 | 0.95 | 0.95 | |
| Peak 15-min volume, v15 | 1682 | 158 | 139 | 0 | |
| Trucks and buses | 9 | 9 | 9 | 0 | % |
| Recreational vehicles | 0 | 0 | 0 | 0 | % |
| Trucks and buses PCE, ET | 1.5 | 1.5 | 1.5 | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | 1.2 | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.957 | 0.957 | 0.957 | 1.000 | |
| Driver population adjustment, fP | 1.00 | 1.00 | 1.00 | 1.00 | |
| Flow rate, v | 7029 | 660 | 583 | 0 | pc/h |
| Volume ratio, VR | | 0.150 | | | |

## Configuration Characteristics

| | | |
|---|---|---|
| Number of maneuver lanes, NWL | 2 | ln |
| Interchange density, ID | 1.00 | int/mi |
| Minimum RF lane changes, LCRF | 1 | lc/pc |
| Minimum FR lane changes, LCFR | 1 | lc/pc |
| Minimum RR lane changes, LCRR | | lc/pc |
| Minimum weaving lane changes, LCMIN | 1243 | lc/h |
| Weaving lane changes, LCW | 1471 | lc/h |
| Non-weaving vehicle index, INW | 337 | |
| Non-weaving lane change, LCNW | 745 | lc/h |
| Total lane changes, LCALL | 2216 | lc/h |

## Weaving and Non-Weaving Speeds

| | | |
|---|---|---|
| Weaving intensity factor, W | 0.756 | |

| | | |
|---|---|---|
| Average weaving speed, SW | 37.8 | mi/h |
| Average non-weaving speed, SNW | 38.1 | mi/h |

Weaving Segment Speed, Density, Level of Service and Capacity

| | | |
|---|---|---|
| Weaving segment speed, S | 38.1 | mi/h |
| Weaving segment density, D | 43.5 | pc/mi/ln |
| Level of service, LOS | E | |
| Weaving segment v/c ratio | 0.836 | |
| Weaving segment flow rate, v | 8272 | pc/h |
| Weaving segment capacity, cW | 9464 | veh/h |

Limitations on Weaving Segments

If limit reached, see note.

| | Minimum | Maximum | Actual | Note |
|---|---|---|---|---|
| Weaving length (ft) | 300 | 4034 | 480 | a,b |
| | | Maximum | Analyzed | |
| Density-based capacty, cIWL (pc/h/ln) | | 2250 | 1978 | c |
| | | Maximum | Analyzed | |
| v/c ratio | | 1.00 | 0.836 | d |

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."
c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
d. Volumes exceed the weaving segment capacity. The level of service is F.

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Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

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## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date Performed: | 8/2/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Weaving Location: | Ashland Ent. to Racine Ex. |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Inputs

| | | |
|---|---|---|
| Segment Type | Freeway | |
| Weaving configuration | One-Sided | |
| Number of lanes, N | 5 | ln |
| Weaving segment length, LS | 530 | ft |
| Freeway free-flow speed, FFS | 55 | mi/h |
| Minimum segment speed, SMIN | 15 | mi/h |
| Freeway maximum capacity, cIFL | 2250 | pc/h/ln |
| Terrain type | Level | |
| Grade | 0.00 | % |
| Length | 0.00 | mi |

## Conversion to pc/h Under Base Conditions

| | Volume Components | | | | |
|---|---|---|---|---|---|
| | VFF | VRF | VFR | VRR | |
| Volume, V | 6610 | 590 | 410 | 0 | veh/h |
| Peak hour factor, PHF | 0.95 | 0.95 | 0.95 | 0.95 | |
| Peak 15-min volume, v15 | 1739 | 155 | 108 | 0 | |
| Trucks and buses | 10 | 10 | 10 | 0 | % |
| Recreational vehicles | 0 | 0 | 0 | 0 | % |
| Trucks and buses PCE, ET | 1.5 | 1.5 | 1.5 | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | 1.2 | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | 0.952 | 0.952 | 1.000 | |
| Driver population adjustment, fP | 1.00 | 1.00 | 1.00 | 1.00 | |
| Flow rate, v | 7306 | 652 | 453 | 0 | pc/h |

Volume ratio, VR 0.131

## Configuration Characteristics

| | | |
|---|---|---|
| Number of maneuver lanes, NWL | 2 | ln |
| Interchange density, ID | 1.00 | int/mi |
| Minimum RF lane changes, LCRF | 1 | lc/pc |
| Minimum FR lane changes, LCFR | 1 | lc/pc |
| Minimum RR lane changes, LCRR | | lc/pc |
| Minimum weaving lane changes, LCMIN | 1105 | lc/h |
| Weaving lane changes, LCW | 1362 | lc/h |
| Non-weaving vehicle index, INW | 387 | |
| Non-weaving lane change, LCNW | 829 | lc/h |
| Total lane changes, LCALL | 2191 | lc/h |

## Weaving and Non-Weaving Speeds

Weaving intensity factor, W 0.693

| | | |
|---|---|---|
| Average weaving speed, SW | 38.6 | mi/h |
| Average non-weaving speed, SNW | 39.0 | mi/h |

Weaving Segment Speed, Density, Level of Service and Capacity

| | | |
|---|---|---|
| Weaving segment speed, S | 38.9 | mi/h |
| Weaving segment density, D | 43.2 | pc/mi/ln |
| Level of service, LOS | E | |
| Weaving segment v/c ratio | 0.843 | |
| Weaving segment flow rate, v | 8411 | pc/h |
| Weaving segment capacity, cW | 9505 | veh/h |

Limitations on Weaving Segments

If limit reached, see note.

| | Minimum | Maximum | Actual | Note |
|---|---|---|---|---|
| Weaving length (ft) | 300 | 3847 | 530 | a,b |
| | | Maximum | Analyzed | |
| Density-based capacty, cIWL (pc/h/ln) | | 2250 | 1996 | c |
| | | Maximum | Analyzed | |
| v/c ratio | | 1.00 | 0.843 | d |

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."
c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
d. Volumes exceed the weaving segment capacity. The level of service is F.

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Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date Performed: | 8/2/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 EB |
| Weaving Location: | Ashland Ent. to Racine Ex. |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Inputs

| | | |
|---|---|---|
| Segment Type | Freeway | |
| Weaving configuration | One-Sided | |
| Number of lanes, N | 5 | ln |
| Weaving segment length, LS | 530 | ft |
| Freeway free-flow speed, FFS | 55 | mi/h |
| Minimum segment speed, SMIN | 15 | mi/h |
| Freeway maximum capacity, cIFL | 2250 | pc/h/ln |
| Terrain type | Level | |
| Grade | 0.00 | % |
| Length | 0.00 | mi |

### Conversion to pc/h Under Base Conditions

| | Volume Components | | | | |
|---|---|---|---|---|---|
| | VFF | VRF | VFR | VRR | |
| Volume, V | 6510 | 910 | 480 | 0 | veh/h |
| Peak hour factor, PHF | 0.95 | 0.95 | 0.95 | 0.95 | |
| Peak 15-min volume, v15 | 1713 | 239 | 126 | 0 | |
| Trucks and buses | 9 | 9 | 9 | 0 | % |
| Recreational vehicles | 0 | 0 | 0 | 0 | % |
| Trucks and buses PCE, ET | 1.5 | 1.5 | 1.5 | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | 1.2 | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.957 | 0.957 | 0.957 | 1.000 | |
| Driver population adjustment, fP | 1.00 | 1.00 | 1.00 | 1.00 | |
| Flow rate, v | 7161 | 1001 | 528 | 0 | pc/h |

Volume ratio, VR 0.176

### Configuration Characteristics

| | | |
|---|---|---|
| Number of maneuver lanes, NWL | 2 | ln |
| Interchange density, ID | 1.00 | int/mi |
| Minimum RF lane changes, LCRF | 1 | lc/pc |
| Minimum FR lane changes, LCFR | 1 | lc/pc |
| Minimum RR lane changes, LCRR | | lc/pc |
| Minimum weaving lane changes, LCMIN | 1529 | lc/h |
| Weaving lane changes, LCW | 1786 | lc/h |
| Non-weaving vehicle index, INW | 380 | |
| Non-weaving lane change, LCNW | 799 | lc/h |
| Total lane changes, LCALL | 2585 | lc/h |

### Weaving and Non-Weaving Speeds

Weaving intensity factor, W 0.789

| | | |
|---|---|---|
| Average weaving speed, SW | 37.4 | mi/h |
| Average non-weaving speed, SNW | 35.6 | mi/h |

Weaving Segment Speed, Density, Level of Service and Capacity

| | | |
|---|---|---|
| Weaving segment speed, S | 35.9 | mi/h |
| Weaving segment density, D | 48.4 | pc/mi/ln |
| Level of service, LOS | E | |
| Weaving segment v/c ratio | 0.886 | |
| Weaving segment flow rate, v | 8690 | pc/h |
| Weaving segment capacity, cW | 9388 | veh/h |

Limitations on Weaving Segments

If limit reached, see note.

| | Minimum | Maximum | Actual | Note |
|---|---|---|---|---|
| Weaving length (ft) | 300 | 4292 | 530 | a,b |
| | | Maximum | Analyzed | |
| Density-based capacty, cIWL (pc/h/ln) | | 2250 | 1962 | c |
| | | Maximum | Analyzed | |
| v/c ratio | | 1.00 | 0.886 | d |

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."
c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
d. Volumes exceed the weaving segment capacity. The level of service is F.

# I - 290 Westbound Weaving Analysis

## Existing Conditions

HCS 2010: Freeway Weaving Release 6.1

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date Performed: | 8/7/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Weaving Location: | Racine Ent. to Ashland Ex. |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Inputs

| | | |
|---|---|---|
| Segment Type | Freeway | |
| Weaving configuration | One-Sided | |
| Number of lanes, N | 5 | ln |
| Weaving segment length, LS | 650 | ft |
| Freeway free-flow speed, FFS | 55 | mi/h |
| Minimum segment speed, SMIN | 15 | mi/h |
| Freeway maximum capacity, cIFL | 2250 | pc/h/ln |
| Terrain type | Level | |
| Grade | 0.00 | % |
| Length | 0.00 | mi |

## Conversion to pc/h Under Base Conditions

| | Volume Components | | | | |
|---|---|---|---|---|---|
| | VFF | VRF | VFR | VRR | |
| Volume, V | 4830 | 740 | 900 | 0 | veh/h |
| Peak hour factor, PHF | 0.95 | 0.95 | 0.95 | 0.95 | |
| Peak 15-min volume, v15 | 1271 | 195 | 237 | 0 | |
| Trucks and buses | 10 | 10 | 10 | 0 | % |
| Recreational vehicles | 0 | 0 | 0 | 0 | % |
| Trucks and buses PCE, ET | 1.5 | 1.5 | 1.5 | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | 1.2 | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | 0.952 | 0.952 | 1.000 | |
| Driver population adjustment, fP | 1.00 | 1.00 | 1.00 | 1.00 | |
| Flow rate, v | 5338 | 818 | 995 | 0 | pc/h |
| Volume ratio, VR | | 0.254 | | | |

## Configuration Characteristics

| | | |
|---|---|---|
| Number of maneuver lanes, NWL | 2 | ln |
| Interchange density, ID | 1.00 | int/mi |
| Minimum RF lane changes, LCRF | 1 | lc/pc |
| Minimum FR lane changes, LCFR | 1 | lc/pc |
| Minimum RR lane changes, LCRR | | lc/pc |
| Minimum weaving lane changes, LCMIN | 1813 | lc/h |
| Weaving lane changes, LCW | 2131 | lc/h |
| Non-weaving vehicle index, INW | 347 | |
| Non-weaving lane change, LCNW | 489 | lc/h |
| Total lane changes, LCALL | 2620 | lc/h |

## Weaving and Non-Weaving Speeds

| | | |
|---|---|---|
| Weaving intensity factor, W | 0.679 | |

| | | |
|---|---|---|
| Average weaving speed, SW | 38.8 | mi/h |
| Average non-weaving speed, SNW | 35.1 | mi/h |

Weaving Segment Speed, Density, Level of Service and Capacity

| | | |
|---|---|---|
| Weaving segment speed, S | 36.0 | mi/h |
| Weaving segment density, D | 39.8 | pc/mi/ln |
| Level of service, LOS | E | |
| Weaving segment v/c ratio | 0.755 | |
| Weaving segment flow rate, v | 7151 | pc/h |
| Weaving segment capacity, cW | 9016 | veh/h |

Limitations on Weaving Segments

If limit reached, see note.

| | Minimum | Maximum | Actual | Note |
|---|---|---|---|---|
| Weaving length (ft) | 300 | 5091 | 650 | a,b |
| | | Maximum | Analyzed | |
| Density-based capacty, cIWL (pc/h/ln) | | 2250 | 1910 | c |
| | | Maximum | Analyzed | |
| v/c ratio | | 1.00 | 0.755 | d |

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."
c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
d. Volumes exceed the weaving segment capacity. The level of service is F.

HCS 2010: Freeway Weaving Release 6.1

Phone: Fax:
E-mail:

## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date Performed: | 8/7/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Weaving Location: | Racine Ent. to Ashland Ex. |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Inputs

| | | |
|---|---|---|
| Segment Type | Freeway | |
| Weaving configuration | One-Sided | |
| Number of lanes, N | 5 | ln |
| Weaving segment length, LS | 650 | ft |
| Freeway free-flow speed, FFS | 55 | mi/h |
| Minimum segment speed, SMIN | 15 | mi/h |
| Freeway maximum capacity, cIFL | 2250 | pc/h/ln |
| Terrain type | Level | |
| Grade | 0.00 | % |
| Length | 0.00 | mi |

## Conversion to pc/h Under Base Conditions

| | Volume Components | | | | |
|---|---|---|---|---|---|
| | VFF | VRF | VFR | VRR | |
| Volume, V | 4910 | 810 | 500 | 0 | veh/h |
| Peak hour factor, PHF | 0.95 | 0.95 | 0.95 | 0.95 | |
| Peak 15-min volume, v15 | 1292 | 213 | 132 | 0 | |
| Trucks and buses | 10 | 10 | 10 | 0 | % |
| Recreational vehicles | 0 | 0 | 0 | 0 | % |
| Trucks and buses PCE, ET | 1.5 | 1.5 | 1.5 | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | 1.2 | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | 0.952 | 0.952 | 1.000 | |
| Driver population adjustment, fP | 1.00 | 1.00 | 1.00 | 1.00 | |
| Flow rate, v | 5427 | 895 | 553 | 0 | pc/h |
| Volume ratio, VR | | 0.211 | | | |

## Configuration Characteristics

| | | |
|---|---|---|
| Number of maneuver lanes, NWL | 2 | ln |
| Interchange density, ID | 1.00 | int/mi |
| Minimum RF lane changes, LCRF | 1 | lc/pc |
| Minimum FR lane changes, LCFR | 1 | lc/pc |
| Minimum RR lane changes, LCRR | | lc/pc |
| Minimum weaving lane changes, LCMIN | 1448 | lc/h |
| Weaving lane changes, LCW | 1766 | lc/h |
| Non-weaving vehicle index, INW | 353 | |
| Non-weaving lane change, LCNW | 507 | lc/h |
| Total lane changes, LCALL | 2273 | lc/h |

## Weaving and Non-Weaving Speeds

| | |
|---|---|
| Weaving intensity factor, W | 0.607 |

| | | |
|---|---|---|
| Average weaving speed, SW | 39.9 | mi/h |
| Average non-weaving speed, SNW | 38.0 | mi/h |

Weaving Segment Speed, Density, Level of Service and Capacity

| | | |
|---|---|---|
| Weaving segment speed, S | 38.4 | mi/h |
| Weaving segment density, D | 35.8 | pc/mi/ln |
| Level of service, LOS | E | |
| Weaving segment v/c ratio | 0.707 | |
| Weaving segment flow rate, v | 6875 | pc/h |
| Weaving segment capacity, cW | 9257 | veh/h |

Limitations on Weaving Segments

If limit reached, see note.

| | Minimum | Maximum | Actual | Note |
|---|---|---|---|---|
| Weaving length (ft) | 300 | 4645 | 650 | a,b |
| | | Maximum | Analyzed | |
| Density-based capacty, cIWL (pc/h/ln) | | 2250 | 1944 | c |
| | | Maximum | Analyzed | |
| v/c ratio | | 1.00 | 0.707 | d |

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."
c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
d. Volumes exceed the weaving segment capacity. The level of service is F.

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## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date Performed: | 8/7/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Weaving Location: | Paulina Ent. to Damen Ex. |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Inputs

| | | |
|---|---|---|
| Segment Type | Freeway | |
| Weaving configuration | One-Sided | |
| Number of lanes, N | 5 | ln |
| Weaving segment length, LS | 425 | ft |
| Freeway free-flow speed, FFS | 55 | mi/h |
| Minimum segment speed, SMIN | 15 | mi/h |
| Freeway maximum capacity, cIFL | 2250 | pc/h/ln |
| Terrain type | Level | |
| Grade | 0.00 | % |
| Length | 0.00 | mi |

## Conversion to pc/h Under Base Conditions

| | Volume Components | | | | |
|---|---|---|---|---|---|
| | VFF | VRF | VFR | VRR | |
| Volume, V | 4850 | 450 | 720 | 0 | veh/h |
| Peak hour factor, PHF | 0.95 | 0.95 | 0.95 | 0.95 | |
| Peak 15-min volume, v15 | 1276 | 118 | 189 | 0 | |
| Trucks and buses | 10 | 10 | 10 | 0 | % |
| Recreational vehicles | 0 | 0 | 0 | 0 | % |
| Trucks and buses PCE, ET | 1.5 | 1.5 | 1.5 | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | 1.2 | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | 0.952 | 0.952 | 1.000 | |
| Driver population adjustment, fP | 1.00 | 1.00 | 1.00 | 1.00 | |
| Flow rate, v | 5361 | 497 | 796 | 0 | pc/h |
| Volume ratio, VR | | 0.194 | | | |

## Configuration Characteristics

| | | |
|---|---|---|
| Number of maneuver lanes, NWL | 2 | ln |
| Interchange density, ID | 1.00 | int/mi |
| Minimum RF lane changes, LCRF | 1 | lc/pc |
| Minimum FR lane changes, LCFR | 1 | lc/pc |
| Minimum RR lane changes, LCRR | | lc/pc |
| Minimum weaving lane changes, LCMIN | 1293 | lc/h |
| Weaving lane changes, LCW | 1483 | lc/h |
| Non-weaving vehicle index, INW | 228 | |
| Non-weaving lane change, LCNW | 372 | lc/h |
| Total lane changes, LCALL | 1855 | lc/h |

## Weaving and Non-Weaving Speeds

| | | |
|---|---|---|
| Weaving intensity factor, W | 0.723 | |

| | | |
|---|---|---|
| Average weaving speed, SW | 38.2 | mi/h |
| Average non-weaving speed, SNW | 39.3 | mi/h |

Weaving Segment Speed, Density, Level of Service and Capacity

| | | |
|---|---|---|
| Weaving segment speed, S | 39.1 | mi/h |
| Weaving segment density, D | 34.0 | pc/mi/ln |
| Level of service, LOS | D | |
| Weaving segment v/c ratio | 0.686 | |
| Weaving segment flow rate, v | 6654 | pc/h |
| Weaving segment capacity, cW | 9238 | veh/h |

Limitations on Weaving Segments

If limit reached, see note.

| | Minimum | Maximum | Actual | Note |
|---|---|---|---|---|
| Weaving length (ft) | 300 | 4478 | 425 | a,b |
| | | Maximum | Analyzed | |
| Density-based capacty, cIWL (pc/h/ln) | | 2250 | 1940 | c |
| | | Maximum | Analyzed | |
| v/c ratio | | 1.00 | 0.686 | d |

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."
c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
d. Volumes exceed the weaving segment capacity. The level of service is F.

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## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date Performed: | 8/7/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Weaving Location: | Paulina Ent. to Damen Ex. |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Inputs

| | | |
|---|---|---|
| Segment Type | Freeway | |
| Weaving configuration | One-Sided | |
| Number of lanes, N | 5 | ln |
| Weaving segment length, LS | 425 | ft |
| Freeway free-flow speed, FFS | 55 | mi/h |
| Minimum segment speed, SMIN | 15 | mi/h |
| Freeway maximum capacity, cIFL | 2250 | pc/h/ln |
| Terrain type | Level | |
| Grade | 0.00 | % |
| Length | 0.00 | mi |

## Conversion to pc/h Under Base Conditions

| | Volume Components | | | | |
|---|---|---|---|---|---|
| | VFF | VRF | VFR | VRR | |
| Volume, V | 5330 | 520 | 390 | 0 | veh/h |
| Peak hour factor, PHF | 0.95 | 0.95 | 0.95 | 0.95 | |
| Peak 15-min volume, v15 | 1403 | 137 | 103 | 0 | |
| Trucks and buses | 10 | 10 | 10 | 0 | % |
| Recreational vehicles | 0 | 0 | 0 | 0 | % |
| Trucks and buses PCE, ET | 1.5 | 1.5 | 1.5 | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | 1.2 | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | 0.952 | 0.952 | 1.000 | |
| Driver population adjustment, fP | 1.00 | 1.00 | 1.00 | 1.00 | |
| Flow rate, v | 5891 | 575 | 431 | 0 | pc/h |
| Volume ratio, VR | | 0.146 | | | |

## Configuration Characteristics

| | | |
|---|---|---|
| Number of maneuver lanes, NWL | 2 | ln |
| Interchange density, ID | 1.00 | int/mi |
| Minimum RF lane changes, LCRF | 1 | lc/pc |
| Minimum FR lane changes, LCFR | 1 | lc/pc |
| Minimum RR lane changes, LCRR | | lc/pc |
| Minimum weaving lane changes, LCMIN | 1006 | lc/h |
| Weaving lane changes, LCW | 1196 | lc/h |
| Non-weaving vehicle index, INW | 250 | |
| Non-weaving lane change, LCNW | 481 | lc/h |
| Total lane changes, LCALL | 1677 | lc/h |

## Weaving and Non-Weaving Speeds

| | | |
|---|---|---|
| Weaving intensity factor, W | 0.668 | |

| | | |
|---|---|---|
| Average weaving speed, SW | 39.0 | mi/h |
| Average non-weaving speed, SNW | 41.1 | mi/h |

Weaving Segment Speed, Density, Level of Service and Capacity

| | | |
|---|---|---|
| Weaving segment speed, S | 40.8 | mi/h |
| Weaving segment density, D | 33.8 | pc/mi/ln |
| Level of service, LOS | D | |
| Weaving segment v/c ratio | 0.698 | |
| Weaving segment flow rate, v | 6897 | pc/h |
| Weaving segment capacity, cW | 9414 | veh/h |

Limitations on Weaving Segments

If limit reached, see note.

| | Minimum | Maximum | Actual | Note |
|---|---|---|---|---|
| Weaving length (ft) | 300 | 3990 | 425 | a,b |
| | | Maximum | Analyzed | |
| Density-based capacty, cIWL (pc/h/ln) | | 2250 | 1977 | c |
| | | Maximum | Analyzed | |
| v/c ratio | | 1.00 | 0.698 | d |

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."
c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
d. Volumes exceed the weaving segment capacity. The level of service is F.

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## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date Performed: | 8/7/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Weaving Location: | Damen Ent. to Oakley Ex. |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Inputs

| | | |
|---|---|---|
| Segment Type | Freeway | |
| Weaving configuration | One-Sided | |
| Number of lanes, N | 5 | ln |
| Weaving segment length, LS | 560 | ft |
| Freeway free-flow speed, FFS | 55 | mi/h |
| Minimum segment speed, SMIN | 15 | mi/h |
| Freeway maximum capacity, cIFL | 2250 | pc/h/ln |
| Terrain type | Level | |
| Grade | 0.00 | % |
| Length | 0.00 | mi |

## Conversion to pc/h Under Base Conditions

| | Volume Components | | | | |
|---|---|---|---|---|---|
| | VFF | VRF | VFR | VRR | |
| Volume, V | 5000 | 690 | 300 | 0 | veh/h |
| Peak hour factor, PHF | 0.95 | 0.95 | 0.95 | 0.95 | |
| Peak 15-min volume, v15 | 1316 | 182 | 79 | 0 | |
| Trucks and buses | 10 | 10 | 10 | 0 | % |
| Recreational vehicles | 0 | 0 | 0 | 0 | % |
| Trucks and buses PCE, ET | 1.5 | 1.5 | 1.5 | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | 1.2 | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | 0.952 | 0.952 | 1.000 | |
| Driver population adjustment, fP | 1.00 | 1.00 | 1.00 | 1.00 | |
| Flow rate, v | 5526 | 763 | 332 | 0 | pc/h |
| Volume ratio, VR | | 0.165 | | | |

## Configuration Characteristics

| | | |
|---|---|---|
| Number of maneuver lanes, NWL | 2 | ln |
| Interchange density, ID | 1.00 | int/mi |
| Minimum RF lane changes, LCRF | 1 | lc/pc |
| Minimum FR lane changes, LCFR | 1 | lc/pc |
| Minimum RR lane changes, LCRR | | lc/pc |
| Minimum weaving lane changes, LCMIN | 1095 | lc/h |
| Weaving lane changes, LCW | 1369 | lc/h |
| Non-weaving vehicle index, INW | 309 | |
| Non-weaving lane change, LCNW | 479 | lc/h |
| Total lane changes, LCALL | 1848 | lc/h |

## Weaving and Non-Weaving Speeds

| | |
|---|---|
| Weaving intensity factor, W | 0.580 |

| | | |
|---|---|---|
| Average weaving speed, SW | 40.3 | mi/h |
| Average non-weaving speed, SNW | 40.8 | mi/h |

Weaving Segment Speed, Density, Level of Service and Capacity

| | | |
|---|---|---|
| Weaving segment speed, S | 40.7 | mi/h |
| Weaving segment density, D | 32.5 | pc/mi/ln |
| Level of service, LOS | D | |
| Weaving segment v/c ratio | 0.671 | |
| Weaving segment flow rate, v | 6621 | pc/h |
| Weaving segment capacity, cW | 9395 | veh/h |

Limitations on Weaving Segments

If limit reached, see note.

| | Minimum | Maximum | Actual | Note |
|---|---|---|---|---|
| Weaving length (ft) | 300 | 4185 | 560 | a,b |
| | | Maximum | Analyzed | |
| Density-based capacty, cIWL (pc/h/ln) | | 2250 | 1973 | c |
| | | Maximum | Analyzed | |
| v/c ratio | | 1.00 | 0.671 | d |

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."
c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
d. Volumes exceed the weaving segment capacity. The level of service is F.

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## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date Performed: | 8/7/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Weaving Location: | Damen Ent. to Oakley Ex. |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Inputs

| | | |
|---|---|---|
| Segment Type | Freeway | |
| Weaving configuration | One-Sided | |
| Number of lanes, N | 5 | ln |
| Weaving segment length, LS | 560 | ft |
| Freeway free-flow speed, FFS | 55 | mi/h |
| Minimum segment speed, SMIN | 15 | mi/h |
| Freeway maximum capacity, cIFL | 2250 | pc/h/ln |
| Terrain type | Level | |
| Grade | 0.00 | % |
| Length | 0.00 | mi |

## Conversion to pc/h Under Base Conditions

| | Volume Components | | | | |
|---|---|---|---|---|---|
| | VFF | VRF | VFR | VRR | |
| Volume, V | 5570 | 790 | 280 | 0 | veh/h |
| Peak hour factor, PHF | 0.95 | 0.95 | 0.95 | 0.95 | |
| Peak 15-min volume, v15 | 1466 | 208 | 74 | 0 | |
| Trucks and buses | 10 | 10 | 10 | 0 | % |
| Recreational vehicles | 0 | 0 | 0 | 0 | % |
| Trucks and buses PCE, ET | 1.5 | 1.5 | 1.5 | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | 1.2 | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | 0.952 | 0.952 | 1.000 | |
| Driver population adjustment, fP | 1.00 | 1.00 | 1.00 | 1.00 | |
| Flow rate, v | 6156 | 873 | 309 | 0 | pc/h |
| Volume ratio, VR | | 0.161 | | | |

## Configuration Characteristics

| | | |
|---|---|---|
| Number of maneuver lanes, NWL | 2 | ln |
| Interchange density, ID | 1.00 | int/mi |
| Minimum RF lane changes, LCRF | 1 | lc/pc |
| Minimum FR lane changes, LCFR | 1 | lc/pc |
| Minimum RR lane changes, LCRR | | lc/pc |
| Minimum weaving lane changes, LCMIN | 1182 | lc/h |
| Weaving lane changes, LCW | 1456 | lc/h |
| Non-weaving vehicle index, INW | 345 | |
| Non-weaving lane change, LCNW | 609 | lc/h |
| Total lane changes, LCALL | 2065 | lc/h |

## Weaving and Non-Weaving Speeds

| | |
|---|---|
| Weaving intensity factor, W | 0.633 |

| | | |
|---|---|---|
| Average weaving speed, SW | 39.5 | mi/h |
| Average non-weaving speed, SNW | 39.4 | mi/h |

Weaving Segment Speed, Density, Level of Service and Capacity

| | | |
|---|---|---|
| Weaving segment speed, S | 39.5 | mi/h |
| Weaving segment density, D | 37.2 | pc/mi/1n |
| Level of service, LOS | E | |
| Weaving segment v/c ratio | 0.743 | |
| Weaving segment flow rate, v | 7338 | pc/h |
| Weaving segment capacity, cW | 9410 | veh/h |

Limitations on Weaving Segments

If limit reached, see note.

| | Minimum | Maximum | Actual | Note |
|---|---|---|---|---|
| Weaving length (ft) | 300 | 4142 | 560 | a,b |
| | | Maximum | Analyzed | |
| Density-based capacty, cIWL (pc/h/ln) | | 2250 | 1976 | c |
| | | Maximum | Analyzed | |
| v/c ratio | | 1.00 | 0.743 | d |

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."
c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
d. Volumes exceed the weaving segment capacity. The level of service is F.

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Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

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## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date Performed: | 8/7/2012 |
| Analysis Time Period: | AM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Weaving Location: | Sacramento Ent. to Homan Ex. |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Inputs

| | | |
|---|---|---|
| Segment Type | Freeway | |
| Weaving configuration | One-Sided | |
| Number of lanes, N | 5 | ln |
| Weaving segment length, LS | 878 | ft |
| Freeway free-flow speed, FFS | 55 | mi/h |
| Minimum segment speed, SMIN | 15 | mi/h |
| Freeway maximum capacity, cIFL | 2250 | pc/h/ln |
| Terrain type | Level | |
| Grade | 0.00 | % |
| Length | 0.00 | mi |

## Conversion to pc/h Under Base Conditions

| | Volume Components | | | | |
|---|---|---|---|---|---|
| | VFF | VRF | VFR | VRR | |
| Volume, V | 5500 | 610 | 430 | 0 | veh/h |
| Peak hour factor, PHF | 0.95 | 0.95 | 0.95 | 0.95 | |
| Peak 15-min volume, v15 | 1447 | 161 | 113 | 0 | |
| Trucks and buses | 10 | 10 | 10 | 0 | % |
| Recreational vehicles | 0 | 0 | 0 | 0 | % |
| Trucks and buses PCE, ET | 1.5 | 1.5 | 1.5 | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | 1.2 | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | 0.952 | 0.952 | 1.000 | |
| Driver population adjustment, fP | 1.00 | 1.00 | 1.00 | 1.00 | |
| Flow rate, v | 6079 | 674 | 475 | 0 | pc/h |
| Volume ratio, VR | | 0.159 | | | |

## Configuration Characteristics

| | | |
|---|---|---|
| Number of maneuver lanes, NWL | 2 | ln |
| Interchange density, ID | 1.00 | int/mi |
| Minimum RF lane changes, LCRF | 1 | lc/pc |
| Minimum FR lane changes, LCFR | 1 | lc/pc |
| Minimum RR lane changes, LCRR | | lc/pc |
| Minimum weaving lane changes, LCMIN | 1149 | lc/h |
| Weaving lane changes, LCW | 1557 | lc/h |
| Non-weaving vehicle index, INW | 534 | |
| Non-weaving lane change, LCNW | 765 | lc/h |
| Total lane changes, LCALL | 2322 | lc/h |

## Weaving and Non-Weaving Speeds

| | |
|---|---|
| Weaving intensity factor, W | 0.487 |

| | | |
|---|---|---|
| Average weaving speed, SW | 41.9 | mi/h |
| Average non-weaving speed, SNW | 39.8 | mi/h |

Weaving Segment Speed, Density, Level of Service and Capacity

| | | |
|---|---|---|
| Weaving segment speed, S | 40.1 | mi/h |
| Weaving segment density, D | 36.0 | pc/mi/ln |
| Level of service, LOS | E | |
| Weaving segment v/c ratio | 0.722 | |
| Weaving segment flow rate, v | 7228 | pc/h |
| Weaving segment capacity, cW | 9533 | veh/h |

Limitations on Weaving Segments

If limit reached, see note.

| | Minimum | Maximum | Actual | Note |
|---|---|---|---|---|
| Weaving length (ft) | 300 | 4121 | 878 | a,b |
| | | Maximum | Analyzed | |
| Density-based capacty, cIWL (pc/h/ln) | | 2250 | 2002 | c |
| | | Maximum | Analyzed | |
| v/c ratio | | 1.00 | 0.722 | d |

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."
c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
d. Volumes exceed the weaving segment capacity. The level of service is F.

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Phone: Fax:
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## Operational Analysis

| | |
|---|---|
| Analyst: | RCT |
| Agency/Co.: | PB |
| Date Performed: | 8/7/2012 |
| Analysis Time Period: | PM Peak Hour |
| Freeway/Dir of Travel: | I-290 WB |
| Weaving Location: | Sacramento Ent. to Homan Ex. |
| Analysis Year: | Exist. 2009 |
| Description: | I-290 Phase 1 Study |

## Inputs

| | | |
|---|---|---|
| Segment Type | Freeway | |
| Weaving configuration | One-Sided | |
| Number of lanes, N | 5 | ln |
| Weaving segment length, LS | 878 | ft |
| Freeway free-flow speed, FFS | 55 | mi/h |
| Minimum segment speed, SMIN | 15 | mi/h |
| Freeway maximum capacity, cIFL | 2250 | pc/h/ln |
| Terrain type | Level | |
| Grade | 0.00 | % |
| Length | 0.00 | mi |

### Conversion to pc/h Under Base Conditions

| | Volume Components | | | | |
|---|---|---|---|---|---|
| | VFF | VRF | VFR | VRR | |
| Volume, V | 6070 | 560 | 500 | 0 | veh/h |
| Peak hour factor, PHF | 0.95 | 0.95 | 0.95 | 0.95 | |
| Peak 15-min volume, v15 | 1597 | 147 | 132 | 0 | |
| Trucks and buses | 10 | 10 | 10 | 0 | % |
| Recreational vehicles | 0 | 0 | 0 | 0 | % |
| Trucks and buses PCE, ET | 1.5 | 1.5 | 1.5 | 1.5 | |
| Recreational vehicle PCE, ER | 1.2 | 1.2 | 1.2 | 1.2 | |
| Heavy vehicle adjustment, fHV | 0.952 | 0.952 | 0.952 | 1.000 | |
| Driver population adjustment, fP | 1.00 | 1.00 | 1.00 | 1.00 | |
| Flow rate, v | 6709 | 619 | 553 | 0 | pc/h |

Volume ratio, VR 0.149

### Configuration Characteristics

| | | |
|---|---|---|
| Number of maneuver lanes, NWL | 2 | ln |
| Interchange density, ID | 1.00 | int/mi |
| Minimum RF lane changes, LCRF | 1 | lc/pc |
| Minimum FR lane changes, LCFR | 1 | lc/pc |
| Minimum RR lane changes, LCRR | | lc/pc |
| Minimum weaving lane changes, LCMIN | 1172 | lc/h |
| Weaving lane changes, LCW | 1580 | lc/h |
| Non-weaving vehicle index, INW | 589 | |
| Non-weaving lane change, LCNW | 895 | lc/h |
| Total lane changes, LCALL | 2475 | lc/h |

### Weaving and Non-Weaving Speeds

Weaving intensity factor, W 0.512

| | | |
|---|---|---|
| Average weaving speed, SW | 41.5 | mi/h |
| Average non-weaving speed, SNW | 39.0 | mi/h |

Weaving Segment Speed, Density, Level of Service and Capacity

| | | |
|---|---|---|
| Weaving segment speed, S | 39.3 | mi/h |
| Weaving segment density, D | 40.1 | pc/mi/ln |
| Level of service, LOS | E | |
| Weaving segment v/c ratio | 0.784 | |
| Weaving segment flow rate, v | 7881 | pc/h |
| Weaving segment capacity, cW | 9571 | veh/h |

Limitations on Weaving Segments

If limit reached, see note.

| | Minimum | Maximum | Actual | Note |
|---|---|---|---|---|
| Weaving length (ft) | 300 | 4019 | 878 | a,b |
| | | Maximum | Analyzed | |
| Density-based capacty, cIWL (pc/h/ln) | | 2250 | 2010 | c |
| | | Maximum | Analyzed | |
| v/c ratio | | 1.00 | 0.784 | d |

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."
c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
d. Volumes exceed the weaving segment capacity. The level of service is F.

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Speed and volume conditions occuring in the field indicate over-saturated conditions indicative of LOS F, which are not adequately evaluated by the Highway Capacity Manual Method.

# Appendix C

# I-290 Count Station Hourly LOS

# Mainline Periods of Congestion

## I-290 Eastbound

| SACR4LCS | April 2009 Loop Count Data | | | |
|---|---|---|---|---|
| Time | 3-Day Ave. Volume | LOS Calc. | Over-saturated LOS | LOS |
| 01:00 | 1326 | A | | A |
| 02:00 | 838 | A | | A |
| 03:00 | 723 | A | | A |
| 04:00 | 762 | A | | A |
| 05:00 | 1273 | A | | A |
| 06:00* | 4157 | C | | C |
| 07:00* | 7438 | E | | E |
| 08:00* | 7563 | E | | E |
| 09:00* | 7617 | E | | E |
| 10:00 | 7199 | E | | E |
| 11:00 | 6219 | D | | D |
| 12:00 | 5786 | D | | D |
| 13:00 | 5759 | D | | D |
| 14:00 | 5794 | D | | D |
| 15:00 | 6086 | D | | D |
| 16:00* | 6061 | D | | D |
| 17:00* | 6235 | D | | D |
| 18:00* | 6647 | D | | D |
| 19:00 | 6604 | D | | D |
| 20:00 | 5346 | D | | D |
| 21:00 | 4210 | C | | C |
| 22:00 | 4264 | C | | C |
| 23:00 | 3604 | C | | C |
| 00:00 | 2494 | B | | B |
| **Total** | **114,005** | | | |

* Peak Period

** LOS observed data - CMAP Congestion Scan

| 3-lane Segment | | | 4-lane Segment | | |
|---|---|---|---|---|---|
| LOS* | | Volumes | LOS* | | Volumes |
| A | < | 1644 | A | < | 2192 |
| B | < | 2689 | B | < | 3585 |
| C | < | 3883 | C | < | 5178 |
| D | < | 5194 | D | < | 6926 |
| E | < | 6109 | E | < | 8145 |
| F | >= | 6109 | F | >= | 8145 |

Note:
*3/4-lane Segment
Lane Width = 12'
Right Shoulder Clearance = 6'
Interchange Density: 1 per mile
Base Free-flow Speed: 55 mph
PHF = 0.95
%HV = 10

SOURCE: HCS 2010 Freeways Version 6.1

## I-290 Westbound

| SACR4LCS | April 2009 Loop Count Data | | | |
|---|---|---|---|---|
| **Time** | 3-Day Ave. Volume | LOS Calc. | Over-saturated LOS | LOS |
| 01:00 | 1640 | A | | **A** |
| 02:00 | 1119 | A | | **A** |
| 03:00 | 745 | A | | **A** |
| 04:00 | 755 | A | | **A** |
| 05:00 | 1206 | A | | **A** |
| 06:00* | 2731 | B | | **B** |
| 07:00* | 5104 | C | D** | **D** |
| 08:00* | 6325 | D | | **D** |
| 09:00* | 5491 | D | | **D** |
| 10:00 | 4907 | C | | **C** |
| 11:00 | 5060 | C | | **C** |
| 12:00 | 5298 | D | | **D** |
| 13:00 | 5749 | D | | **D** |
| 14:00 | 6098 | D | | **D** |
| 15:00 | 6701 | D | | **D** |
| 16:00* | 6140 | D | E** | **D** |
| 17:00* | 5807 | D | F** | **D** |
| 18:00* | 6427 | D | F** | **D** |
| 19:00 | 6211 | D | | **D** |
| 20:00 | 5147 | C | | **C** |
| 21:00 | 4665 | C | | **C** |
| 22:00 | 4740 | C | | **C** |
| 23:00 | 4909 | C | | **C** |
| 00:00 | 3193 | B | | **B** |
| **Total** | **106,167** | | | |

* Peak Period

** LOS observed data - CMAP Congestion Scan

| 3-lane Segment | | | 4-lane Segment | | |
|---|---|---|---|---|---|
| LOS* | | Volumes | LOS* | | Volumes |
| A | < | 1644 | A | < | 2192 |
| B | < | 2689 | B | < | 3585 |
| C | < | 3883 | C | < | 5178 |
| D | < | 5194 | D | < | 6926 |
| E | < | 6109 | E | < | 8145 |
| F | >= | 6109 | F | >= | 8145 |

Note:
*3/4-lane Segment
Lane Width = 12'
Right Shoulder Clearance = 6'
Interchange Density: 1 per mile
Base Free-flow Speed: 55 mph
PHF = 0.95
%HV = 10

SOURCE: HCS 2010 Freeways Version 6.1