Appendix H.6 - Level of Service Analysis

A level of service (LOS) analysis was performed for the Kennedy Interchange and Ohio River bridge crossings using the 2010 Highway Capacity Manual1 (HCM) and related 2010 Highway Capacity Software (HCS). The summaries of LOS results are shown here in Tables H.6-1 and H.6-2. The actual HCS reports have been included at the end of the section. The LOS results were reported in Chapters 2 and 3 of the FSEIS within Figure 2.2-7 and Table 3.3-4 respectively, as well as Table A.5-4 in Appendix A.5. Table 3.3-4 and Table A.5-4 present the worst-case bridge crossing LOS out of northbound in the AM peak hour, southbound in the AM peak hour, northbound in the PM peak hour, and southbound in the PM peak hour for each bridge under each alternative. These worst-case values are presented in Table H.6-2 in bold.

As part of the Louisville – Southern Indiana Ohio River Bridges (LSIORB) Project a Time-of-Day (TOD) travel demand model was developed (see Appendix H.2 and Appendix H.3 for more information). The TOD model produced the freeway segment volumes used in the HCS analysis (see Appendix H.1 for more details of the traffic volume forecasts). Several key assumptions were made regarding freeway operations as inputs to the HCS.

Peak-Hour Factor (PHF)

Within the HCS analysis, PHF is used to convert an average hourly traffic volume to a peak 15-minute flow rate. The 15-minute flow rate is used as the basis for most procedures of the HCS, including freeway analysis. Segment-specific 15-minute count data was not available to calculate PHFs. The HCM (page 11-13) points out that freeway PHFs typically range from 0.85 to 0.98. For this analysis a PHF of 0.92 was used. As part of the LSIORB Project, intersection turning movement volumes were collected at ramp terminals and other intersections adjacent to the Kennedy Interchange. Although not completely correlated to the freeway segments, these turning movement volumes were collected in 15-minute intervals and indicate that a PHF of 0.92 is reflective of local traffic conditions.

Free-Flow Speed (FFS)

Conducting an LOS analysis of freeway segments requires a value of FFS. The HCM directs that the FFS can be determined from field measurement or estimated based on physical roadway characteristics. In the absence of actual field-measured speeds, an initial approach taken to estimate the FFS based on physical characteristics indicated values through the Kennedy Interchange ranging from 67 to 69 miles per hour (mph). Notwithstanding the flexibility provided in estimating the FFS based on physical roadway characteristics, the HCM freeway analysis methodologies best reflect operations within more standardized interstate corridors. Given the complex nature of the Kennedy

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Interchange it was reasoned that these estimates likely exceeded realistic FFS expectations.

Under a separate context, a FFS study was conducted in support of statewide travel demand modeling efforts in Indiana\(^2\). For the speed study, the surveyed locations were all located in Southern Indiana. Many of the locations were along interstate roadways including I-64. The conclusions of the study identified a free-flow speed of 60 mph for a typical urban 2-lane interstate with a posted speed of 55 mph. For 4-, 6- and 8-lane facilities, a free-flow speed of 64 mph was identified. As required for a statewide travel demand model, these estimates represented conditions along a typical interstate segment. Again, given the complex nature of the Kennedy Interchange it seemed that 64 mph was also likely higher than the expected FFS.

Given the aforementioned reasoning and the 55 mph speed limit in the Kennedy Interchange, an assumed FFS of 60 mph was used for the LOS analysis throughout the Kennedy Interchange and Ohio River bridge crossings. The exceptions to using the 60 mph FFS assumption included:

- I-265 East End Bridge - Given the relatively isolated nature of the I-265 East End Bridge, the HCS analysis was conducted using a FFS of 65 mph.
- Clark Memorial Bridge – The Clark Memorial Bridge was analyzed with HCS using the multilane lane highway methodology, which best reflects the configuration of the bridge and the approaches to it. The analysis was conducted using a 45 mph FFS based on the following.
  - The Clark Memorial Bridge and the approaches to it total over one mile of uninterrupted roadway. Given the functional characteristics of the bridge and its approaches the segment was analyzed using the HCS multilane highway methodology. For the multilane highway methodology, the calculations internally force the analysis to use the closest of four speed-flow curves: 45 mph, 50 mph, 55 mph, or 60 mph. The 45 mph FFS was used as it is closest to the posted speed limit of 35 mph on the Clark Memorial Bridge.
- I-71 Southbound between I-65 Off and I-64 On - The southbound segment of I-71 between the exit to I-65 northbound and the entrance from I-64 eastbound was analyzed using a FFS of 55 mph. The decision was made based on the presence of a 35 mph posted advisory speed limit for this segment of the interchange.

**Heavy Vehicle Percentages**

The percentage of heavy vehicles in the traffic stream for each freeway segment was estimated by the TOD model for the 2030 No-Action, the 2030 FEIS Selected, 2030 Modified Selected, 2030 East End and 2030 Downtown bridge-scenarios. For the 2010 analysis, heavy vehicle percentages were available for the Ohio River bridge crossings and Kennedy interchange from vehicle classification ground counts.

Table H.6-1
Kennedy Interchange 2010 and 2030 No-Action Level of Service (LOS) Summary

<table>
<thead>
<tr>
<th>Mainline</th>
<th>2010 AM Peak Hour</th>
<th>2010 PM Peak Hour</th>
<th>2030 AM Peak Hour</th>
<th>2030 PM Peak Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-65 Northbound</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Muhammad Ali Blvd. On to I-64/I-71 Off*</td>
<td>B</td>
<td>E</td>
<td>B</td>
<td>F</td>
</tr>
<tr>
<td>Between I-64/I-71 Off to I-64/I-71 On</td>
<td>B</td>
<td>D</td>
<td>B</td>
<td>E</td>
</tr>
<tr>
<td>Between I-64/I-71 On to Court Ave. Off (Kennedy Bridge)</td>
<td>B</td>
<td>D</td>
<td>C</td>
<td>E</td>
</tr>
<tr>
<td>1-65 Southbound</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Market Off to I-64 Off (Kennedy Bridge)</td>
<td>D</td>
<td>C</td>
<td>F</td>
<td>D</td>
</tr>
<tr>
<td>Between I-64 Off to I-64/I-71 On</td>
<td>C</td>
<td>C</td>
<td>F</td>
<td>D</td>
</tr>
<tr>
<td>Between I-64/I-71 On to Jefferson St. Off*</td>
<td>E</td>
<td>B</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>1-64 Eastbound</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West of I-65 Off</td>
<td>C</td>
<td>D</td>
<td>D</td>
<td>E</td>
</tr>
<tr>
<td>Between River Rd. On to I-71NB Off</td>
<td>C</td>
<td>E</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>Between I-65 On to Story Ave. Off*</td>
<td>C</td>
<td>C</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>Between Story Ave. Off to Mellwood Ave. On</td>
<td>C</td>
<td>D</td>
<td>D</td>
<td>E</td>
</tr>
<tr>
<td>1-64 Westbound</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Mellwood Ave. Off to Story Ave. On</td>
<td>D</td>
<td>C</td>
<td>F</td>
<td>E</td>
</tr>
<tr>
<td>Between Story Ave. On to I-65 Off*</td>
<td>C</td>
<td>B</td>
<td>E</td>
<td>D</td>
</tr>
<tr>
<td>Between I-71SB On to I-65 On</td>
<td>D</td>
<td>C</td>
<td>F</td>
<td>E</td>
</tr>
<tr>
<td>Between I-65 On to 3rd St. Off*</td>
<td>C</td>
<td>B</td>
<td>E</td>
<td>D</td>
</tr>
<tr>
<td>West of 3rd St. Off</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>1-71 Northbound</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between I-64WB Off to I-65SB On</td>
<td>A</td>
<td>C</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Between I-65SB On to I-64EB Off*</td>
<td>D</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Between I-64EB On to Zorn Ave. Off</td>
<td>C</td>
<td>E</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>1-71 Southbound</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Zorn Ave. On to I-64WB Off</td>
<td>E</td>
<td>C</td>
<td>F</td>
<td>E</td>
</tr>
<tr>
<td>Between I-64WB Off to I-64WB On</td>
<td>C</td>
<td>B</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Between I-64WB On to I-65NB Off*</td>
<td>F</td>
<td>D</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Between I-65NB Off to I-64EB On</td>
<td>D</td>
<td>A</td>
<td>D</td>
<td>B</td>
</tr>
</tbody>
</table>

* Analyzed as a weaving segment.
Table H.6-2
2030 Ohio River Bridge Crossings Level of Service (LOS) Summary

<table>
<thead>
<tr>
<th>River Crossing</th>
<th>Period/Direction</th>
<th>No-Action</th>
<th>FEIS Selected</th>
<th>Modified Selected</th>
<th>East End Only</th>
<th>Downtown Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-64 Sherman Minton Bridge</td>
<td>A.M. Peak Westbound</td>
<td>B</td>
<td>B</td>
<td>C</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>A.M. Peak Eastbound</td>
<td>F</td>
<td>D</td>
<td>E</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>P.M. Peak Westbound</td>
<td>F</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td></td>
<td>P.M. Peak Eastbound</td>
<td>C</td>
<td>C</td>
<td>D</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>US-31 Clark Memorial Bridge</td>
<td>A.M. Peak Northbound</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>A.M. Peak Southbound</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>P.M. Peak Northbound</td>
<td>C</td>
<td>C</td>
<td>D*</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>P.M. Peak Southbound</td>
<td>B</td>
<td>B</td>
<td>C</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>I-65 John F. Kennedy Memorial Bridge</td>
<td>A.M. Peak Northbound</td>
<td>C</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>A.M. Peak Southbound</td>
<td>F</td>
<td>D</td>
<td>C</td>
<td>F</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>P.M. Peak Northbound</td>
<td>E</td>
<td>C</td>
<td>C</td>
<td>E</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>P.M. Peak Southbound</td>
<td>D</td>
<td>B</td>
<td>B</td>
<td>D</td>
<td>C</td>
</tr>
<tr>
<td>I-265 East End Bridge</td>
<td>A.M. Peak Northbound</td>
<td>C</td>
<td>D</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A.M. Peak Southbound</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P.M. Peak Northbound</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P.M. Peak Southbound</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Bold LOS** - Indicates the lowest level of service by direction and time period which was reported in Chapter 3 Table 3.3-4 and Table A.5-4 in Appendix A.5.

* Under the Modified Selected Alternative the Clark Memorial Bridge is LOS D. LOS is based on density in passenger cars per mile per lane (pcpmpl). The upper boundary for density for LOS C is 26 pcpmpl. For the multilane highway analysis the calculated density was 26.7 pcpmpl. This is equivalent to about 60 vehicles out of the P.M. peak northbound 2,200 vehicles forecasted.

The HCS reports have been assembled together in nine groups:

1. 2010 A.M. peak hour Kennedy Interchange including the Kennedy Bridge (LOS reported in Figure 2.2-7).
2. 2010 P.M. peak hour Kennedy Interchange including the Kennedy Bridge (LOS reported in Figure 2.2-7).
3. 2030 No-Action A.M. peak hour Kennedy Interchange including the Kennedy Bridge (LOS reported in Figure 2.2-7).
4. 2030 No-Action P.M. peak hour Kennedy Interchange including the Kennedy Bridge (LOS reported in Figure 2.2-7).
5. 2030 No-Action A.M. and P.M. peak hours for the Sherman Minton Bridge and Clark Memorial Bridge (LOS reported in Table 3.3-4).
6. 2030 FEIS Selected A.M. and P.M. peak hours for the Sherman Minton Bridge, Clark Memorial Bridge, Kennedy Bridge and East End Bridge (LOS reported in Table 3.3-4).
7. 2030 Modified Selected A.M. and P.M. peak hours for the Sherman Minton Bridge, Clark Memorial Bridge, Kennedy Bridge and East End Bridge (LOS reported in Table 3.3-4).
8. 2030 East End A.M. and P.M. peak hours for the Sherman Minton Bridge, Clark Memorial Bridge, Kennedy Bridge and East End Bridge (LOS reported in Table A.5-4).
9. 2030 Downtown A.M. and P.M. peak hours for the Sherman Minton Bridge, Clark Memorial Bridge and Kennedy Bridge (LOS reported in Table A.5-4).

Note: For the multilane highway analysis of the Clark Memorial Bridge, Direction 1 is northbound and Direction 2 is southbound.
# Basic Freeway Segments Worksheet

## General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: AM Peak Hour
- **Project Description**: Ohio River Bridges Project

## Site Information
- **Highway/Direction of Travel**: I-65 Northbound
- **Between**: I-64 Off and I-64
- **From/To**: On
- **Jurisdiction**: 11-4.1
- **Analysis Year**: 2010

## Flow Inputs
- **Volume, V**: 1400 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: veh/h
- **Peak-Hr Direction Prop, D**: veh/h
- **DDHV = AADT x K x D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 17
- **%RVs, P_R**: 0
- **General Terrain: Level**
- **Grade % Length mi**:
  - **Up/Down %**:

## Calculate Flow Adjustments
- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( E_R = 1.2 \)
- \( f_{HV} = \frac{141 + P_T(E_T - 1) + P_R(E_R - 1)}{0.922} \)

## Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

## Calc Speed Adj and FFS
- **TRD Adjustment**: mph
- **FFS**: 60.0 mph

## LOS and Performance Measures

### Operational (LOS)
- \( v_p = \frac{(V or DDHV) \times (PHF \times N \times f_{HV})}{S \times f_p} \) pc/h/ln
- \( S = 60.0 \) mph
- \( D = v_p / S \) pc/mi/ln

### Design (N)
- **LOS**: Required Number of Lanes, N

## Glossary
- **N**: Number of lanes
- **S**: Speed
- **V**: Hourly volume
- **D**: Density
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume
- **FFS**: Free-flow speed
- **BFFS**: Base free-flow speed

## Factor Location
- **E_R - Exhibits**: 11-10, 11-12
- **f_LW - Exhibit**: 11-8
- **E_T - Exhibits**: 11-10, 11-11, 11-13
- **f_LC - Exhibit**: 11-9
- **f_p - Page**: 11-18
- **TRD - Page**: 11-11
- **LOS, S, FFS, v_p - Exhibits**: 11-2, 11-3

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2/24/2012
**BASIC FREEWAY SEGMENTS WORKSHEET**

### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: AM Peak Hour
- **Project Description**: Ohio River Bridges Project

### Site Information
- **Highway/Direction of Travel**: I-65 Northbound
- **From/To**: Between I-64 On and Court Off
- **Jurisdiction**: 11-5.1
- **Analysis Year**: 2010

### Flow Inputs
- **Volume, V**: 3250 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %Trucks and Buses, PT 10
- **Peak-Hr Direction Prop, D**: %RVs, PR 0
- **DDHV = AADT x K x D**: veh/h

### Calculate Flow Adjustments
- **fp**: 1.00
- **ET**: 1.5
- **E_R**: 1.2
- **f_{HV} = \{(1+PT)(ET - 1) + PR(E_R - 1)\}0.952**

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 4
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

### Calc Speed Adj and FFS
- **f_{LW}**: mph
- **f_{LC}**: mph
- **TRD Adjustment**: mph
- **FFS**: 60.0 mph

### LOS and Performance Measures
- **Operational (LOS)**
  - \( v_p = \left(\frac{V \text{ or } DDHV}{PHF \times N \times f_{HV}}\right) 927 \text{ pc/h/ln} \)
  - \( S = 60.0 \text{ mph} \)
  - \( D = \frac{v_p}{S} = 15.4 \text{ pc/mi/ln} \)
  - **LOS**: B

### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

### Design (N)
- **Design LOS**
- **Design (N)**
- **Required Number of Lanes, N**

### Factor Location
- **E_R - Exhibits 11-10, 11-12**
- **f_{LW} - Exhibit 11-8**
- **E_T - Exhibits 11-10, 11-11, 11-13**
- **f_{LC} - Exhibit 11-9**
- **f_p - Page 11-18**
- **TRD - Page 11-11**
- **LOS, S, FFS, v_p - Exhibits 11-2, 11-3**
# Basic Freeway Worksheet

## General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: AM Peak Hour
- **Project Description**: Ohio River Bridges Project

## Site Information
- **Highway/Direction of Travel**: I-65 Southbound
- **From/To**: Btw Market St Off and I-64
- **Jurisdiction**: Analysis Year - 2010

## Flow Inputs
- **Volume, V**: 4500 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: veh/h
- **Peak-Hr Direction Prop, D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, PT**: 16
- **%RVs, PR**: 0
- **General Terrain**: Level
- **Grade %**: Up/Down %

## Calculate Flow Adjustments
- **f_p**: 1.00
- **E_R**: 1.2
- **E_T**: 1.5
- **f_HV = 1/(1 + p_(T)(E_T - 1) + p_(R)(E_R - 1))**: 0.926

## Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

## LOS and Performance Measures

### Operational (LOS)
- **v_p = (V or DDHV) / [(PHF x N x f_HV) x f_p]**: pc/h/ln
- **S**: 59.5 mph
- **D = v_p / S**: pc/mi/ln
- **LOS**:

### Design (N)
- **Design LOS**:
- **Design LOS**:
- **Required Number of Lanes, N**:

## Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume
- **S**: Speed
- **D**: Density
- **FFS**: Free-flow speed
- **BFFS**: Base free-flow speed
- **E_R**: Exhibits 11-10, 11-12
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_p**: Page 11-18
- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3

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2/24/2012
# BASIC FREEWAY WORKSHEET

## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: AM Peak Hour
- **Project Description**: Ohio River Bridges Project

### Site Information
- **Highway/Direction of Travel**: I-65 Southbound
- **From/To**: Between I-64 Off and I-64
- **Jurisdiction**: Analysis Year 2010

### Flow Inputs
- **Volume, V**: 2450 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**:
- **Peak-Hr Direction Prop, D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 21
- **%RVs, P_R**: 0
- **General Terrain**: Level
- **Grade**: %
- **Length**: mi
- **Up/Down %**:

### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_R**: 1.2
- **E_T**: 1.5
- **f_{HV} = \frac{1}{[1 + P_T(E_T - 1) + P_R(E_R - 1)]} 0.905**

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/MI
- **FFS (measured)**: 60.0 mph
- **Base free-flow speed, BFFS**: mph

### LOS and Performance Measures

#### Operational (LOS)
- **v_p = (V or DDHV) / (PHF x N x f_{HV})**: pc/h/ln
- **S**: 60.0 mph
- **D = v_p / S**: 24.5 pc/MI/ln
- **LOS**: C

#### Design (N)
- **v_p = (V or DDHV) / (PHF x N x f_{HV})**: pc/h/ln
- **S**: mph
- **D = v_p / S**: pc/MI/ln
- **Required Number of Lanes, N**:

### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

### Factor Location
- **E_R**: Exhibits 11-10, 11-12
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_p**: Page 11-18
- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3

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2/24/2012
## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: AM Peak Hour
- **Project Description**: Ohio River Bridges Project

### Site Information
- **Highway/Direction of Travel**: I-64 Eastbound
- **From/To**: West of Kennedy Interchange
- **Jurisdiction**: 21-1.1
- **Analysis Year**: 2010

### Flow Inputs
- **Volume, V**: 3350 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: veh/h
- **Peak-Hr Direction Prop, D**: AADT x K x D
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 7%
- **%RVs, P_R**: 0%
- **General Terrain**: Level
- **Grade**: %
- **Length**: mi
- **Up/Down %**:

### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_R**: 1.2
- **f_{HV} = \frac{1}{4} + \frac{P_T}{E_T - 1} + \frac{P_R}{E_R - 1} \times 0.966**

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

### Speed Inputs
- **Calc Speed Adj and FFS**
  - **f_{LVW}**
  - **m**
  - **f_{LC}**
  - **m**
  - **TRD Adjustment**
  - **mph**
  - **FFS**
  - **60.0 mph**

### LOS and Performance Measures
- **Operational (LOS)**
  - **v_p = \frac{(V or DDHV)}{(PHF x N x f_{HV})} \times f_p**
  - **pc/h/ln**
  - **S**: 60.0 mph
  - **D = \frac{v_p}{S}**
  - **pc/mi/ln**
  - **LOS**

### Design (N)
- **Design LOS**
  - **Design (N)**
  - **Required Number of Lanes, N**

### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

### Factor Location
- **E_R**: Exhibits 11-10, 11-12
- **f_{LVW}**: Exhibit 11-8
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_{LC}**: Exhibit 11-9
- **f_p**: Page 11-18
- **TRD**: Page 11-11
- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3

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2/24/2012
## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information

<table>
<thead>
<tr>
<th>Analyst</th>
<th>Adams</th>
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<tbody>
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<td>Agency or Company</td>
<td>Parsons</td>
</tr>
<tr>
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<td>11/7/11</td>
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<td>AM Peak Hour</td>
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<td>Project Description</td>
<td>Ohio River Bridges</td>
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### Site Information

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<th>Highway/Direction of Travel</th>
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<tbody>
<tr>
<td>From/To</td>
<td>Between I-65 Off and River</td>
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<td>Jurisdiction</td>
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<td>Analysis Year</td>
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### Flow Inputs

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<th>Volume, V (veh/h)</th>
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<tr>
<td>AADT (veh/day)</td>
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</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K (veh/h)</td>
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<tr>
<td>Peak-Hr Direction Prop, D (veh/h)</td>
<td></td>
</tr>
<tr>
<td>DDHV = AADT x K x D (veh/h)</td>
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<tr>
<td>Peak-Hour Factor, PHF</td>
<td>0.92</td>
</tr>
<tr>
<td>%Trucks and Buses, P_T</td>
<td>8</td>
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<tr>
<td>%RVs, P_R</td>
<td>0</td>
</tr>
<tr>
<td>General Terrain Level</td>
<td></td>
</tr>
</tbody>
</table>

### Calculate Flow Adjustments

| f_p | 1.00 |
| E_R | 1.2  |
| E_T | 1.5  |

### Speed Inputs

| Lane Width (ft) |      |
| Rt-Side Lat. Clearance (ft) |      |
| Number of Lanes, N | 2 |
| Total Ramp Density, TRD (ramps/mi) |      |
| FFS (measured) (mph) | 60.0 |
| Base free-flow Speed, BFFS (mph) |      |

### Calc Speed Adj and FFS

| f_{LW} | mph |
| f_{LC} | mph |
| TRD Adjustment |      |
| FFS | 60.0 mph |

### LOS and Performance Measures

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
<th>Design (N)</th>
</tr>
</thead>
</table>

### Glossary

<table>
<thead>
<tr>
<th>N - Number of lanes</th>
<th>S - Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>V - Hourly volume</td>
<td>D - Density</td>
</tr>
<tr>
<td>v_p - Flow rate</td>
<td>FFS - Free-flow speed</td>
</tr>
<tr>
<td>LOS - Level of service</td>
<td>BFFS - Base free-flow speed</td>
</tr>
<tr>
<td>DDHV - Directional design hour volume</td>
<td></td>
</tr>
</tbody>
</table>

### Factor Location

<p>| E_R - Exhibits 11-10, 11-12 | f_{LW} - Exhibit 11-8 |
| E_T - Exhibits 11-10, 11-11, 11-13 | f_{LC} - Exhibit 11-9 |
| f_p - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, v_p - Exhibits 11-2, 11-3 |</p>
<table>
<thead>
<tr>
<th><strong>BASIC FREEWAY SEGMENTS WORKSHEET</strong></th>
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</thead>
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<tr>
<td><strong>General Information</strong></td>
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<tr>
<td>Analyst</td>
</tr>
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<td>Agency or Company</td>
</tr>
<tr>
<td>Date Performed</td>
</tr>
<tr>
<td>Analysis Time Period</td>
</tr>
<tr>
<td>Project Description</td>
</tr>
<tr>
<td>Oper.(LOS)</td>
</tr>
<tr>
<td>Flow Inputs</td>
</tr>
<tr>
<td>Volume, V</td>
</tr>
<tr>
<td>AADT</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
</tr>
<tr>
<td>Calculate Flow Adjustments</td>
</tr>
<tr>
<td>f_p</td>
</tr>
<tr>
<td>E_T</td>
</tr>
<tr>
<td>Speed Inputs</td>
</tr>
<tr>
<td>Lane Width</td>
</tr>
<tr>
<td>Rt-Side Lat. Clearance</td>
</tr>
<tr>
<td>Number of Lanes, N</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
</tr>
<tr>
<td>FFS (measured)</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
</tr>
<tr>
<td>Calc Speed Adj and FFS</td>
</tr>
<tr>
<td>Lane Width</td>
</tr>
<tr>
<td>Rt-Side Lat. Clearance</td>
</tr>
<tr>
<td>TRD Adjustment</td>
</tr>
<tr>
<td>FFS (measured)</td>
</tr>
<tr>
<td>LOS and Performance Measures</td>
</tr>
<tr>
<td>Operational (LOS)</td>
</tr>
<tr>
<td>v_p = (V or DDHV) / (PHF x N x f_{HV}1272)</td>
</tr>
<tr>
<td>S = 60.0 mph</td>
</tr>
<tr>
<td>LOS = v_p / S</td>
</tr>
<tr>
<td>N - Number of lanes</td>
</tr>
<tr>
<td>V - Hourly volume</td>
</tr>
<tr>
<td>v_p - Flow rate</td>
</tr>
<tr>
<td>LOS - Level of service</td>
</tr>
<tr>
<td>DDHV - Directional design hour volume</td>
</tr>
</tbody>
</table>

**Glossary**

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume

**Factor Location**

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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2/24/2012
# BASIC FREEWAY SEGMENTS WORKSHEET

**General Information**
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/30/11
- **Analysis Time Period**: AM Peak Hour

**Site Information**
- **Highway/Direction of Travel**: I-64 Eastbound
- **From/To**: Btw Story Off & Mellwood
- **Jurisdiction**: 21-6.1
- **Analysis Year**: 2010

**Project Description**: Ohio River Bridges Project

## Flow Inputs

<table>
<thead>
<tr>
<th>Volume, V</th>
<th>2600 veh/h</th>
<th>Peak-Hour Factor, PHF</th>
<th>0.92</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADT</td>
<td>veh/day</td>
<td>%Trucks and Buses, P_T</td>
<td>7</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td>%RVs, P_R</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
<td>General Terrain: Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>veh/h</td>
<td>Grade % Length mi</td>
<td></td>
</tr>
</tbody>
</table>

## Calculate Flow Adjustments

<table>
<thead>
<tr>
<th>( f_p )</th>
<th>1.00</th>
<th>( E_R )</th>
<th>1.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>( E_T )</td>
<td>1.5</td>
<td>( f_{HV} ) = ( 1/{1+P_T(1-E_T-1) + P_R(E_R-1)} )</td>
<td>0.966</td>
</tr>
</tbody>
</table>

## Speed Inputs

<table>
<thead>
<tr>
<th>Lane Width</th>
<th>ft</th>
<th>Calc Speed Adj and FFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
<td>( f_{LW} )</td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>2</td>
<td>( f_C )</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
<td>TRD Adjustment</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>60.0 mph</td>
<td>FFS</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
<td>60.0</td>
</tr>
</tbody>
</table>

## LOS and Performance Measures

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
<th>Design (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV}^{1462}) )</td>
<td>Design LOS</td>
</tr>
<tr>
<td>S</td>
<td>60.0 mph</td>
</tr>
<tr>
<td>D = ( v_p / S )</td>
<td>24.4 pc/mi/ln</td>
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<tr>
<td>LOS</td>
<td>C</td>
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</table>

## Glossary

<table>
<thead>
<tr>
<th>N - Number of lanes</th>
<th>V - Hourly volume</th>
<th>v_p - Flow rate</th>
<th>LOS - Level of service</th>
<th>DDHV - Directional design hour volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>S - Speed</td>
<td>D - Density</td>
<td>FFS - Free-flow speed</td>
<td>BFFS - Base free-flow speed</td>
<td></td>
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</tbody>
</table>

**Factor Location**
- \( E_R \) - Exhibits 11-10, 11-12
- \( f_{LW} \) - Exhibit 11-8
- \( E_T \) - Exhibits 11-10, 11-11, 11-13
- \( f_C \) - Exhibit 11-9
- \( f_p \) - Page 11-18
- TRD - Page 11-11
- LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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2/24/2012
# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/30/11
- **Analysis Time Period**: AM Peak Hour
- **Project Description**: Ohio River Bridges Project

## Site Information
- **Highway/Direction of Travel**: I-64 Westbound
- **From/To**: Btw Mellwood Off and Story
- **Jurisdiction**: 22-1.1
- **Analysis Year**: 2010

## Flow Inputs
- **Volume, V**: 3250 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: veh/h
- **Peak-Hr Direction Prop, D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 4%
- **%RVs, P_R**: 0%
- **General Terrain**: Level
- **Grade**: %
- **Length**: mi

## Calculate Flow Adjustments
- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( f_{HV} = \frac{1}{(1 + P_T (E_T - 1) + P_R (E_R - 1))} \times 0.980 \)

## Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow speed, BFFS**: mph

## Calc Speed Adj and FFS
- **f_LW**: mph
- **f_LC**: mph
- **TRD Adjustment**: mph
- **FFS**: 60.0 mph

## LOS and Performance Measures
- **Operational (LOS)**
  - \( v_p = \frac{(V \times DDHV)}{(PHF \times N \times f_{HV})} \times 1802 \) pc/h/ln
  - \( S_p = 59.3 \) mph
  - \( D = \frac{v_p}{S} \times 30.4 \) pc/mi/ln

- **Design (N)**
  - **Design LOS**
  - **Required Number of Lanes, N**

## Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

**Factor Location**
- **E_R**: Exhibits 11-10, 11-12
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_p**: Page 11-18
- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3

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2/24/2012
### BASIC FREEWAY SEGMENTS WORKSHEET

#### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: AM Peak Hour
- **Project Description**: Ohio River Bridges Project

#### Site Information
- **Highway/Direction of Travel**: I-64 Westbound
- **From/To**: Between I-71 On and I65
- **Jurisdiction**: 22-4.1
- **Analysis Year**: 2010

#### Flow Inputs
- **Volume, V**: 3600 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: veh/h
- **Peak-Hr Direction Prop, D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 3
- **%RVs, P_R**: 0
- **General Terrain**: Level
- **Grade %**:
- **Length mi**:
- **Up/Down %**:

#### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_T**: 1.5
- **E_R**: 1.2

#### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

#### Calc Speed Adj and FFS
- **f_LW**: mph
- **f_LC**: mph
- **TRD Adjustment**: mph
- **FFS**: 60.0 mph

#### LOS and Performance Measures
- **Operational (LOS)**
- **Design (N)**

#### Glossary
- **N** - Number of lanes
- **V** - Hourly volume
- **v_p** - Flow rate
- **LOS** - Level of service
- **DDHV** - Directional design hour volume

#### Factor Location
- **E_R** - Exhibits 11-10, 11-12
- **f_LW** - Exhibit 11-8
- **E_T** - Exhibits 11-10, 11-11, 11-13
- **f_LC** - Exhibit 11-9
- **f_p** - Page 11-18
- **TRD** - Page 11-11
- **LOS, S, FFS, v_p** - Exhibits 11-2, 11-3

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### BASIC FREEWAY WORKSHEET

#### General Information
- Analyst: Adams
- Agency or Company: Parsons
- Date Performed: 11/7/11
- Analysis Time Period: AM Peak Hour
- Project Description: Ohio River Bridges Project

#### Site Information
- Highway/Direction of Travel: I-64 Westbound
- From/To: West of Third Street
- Jurisdiction: 22-6.1
- Analysis Year: 2010

#### Flow Inputs

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<tr>
<th>Parameter</th>
<th>Value</th>
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<tr>
<td>Volume, V</td>
<td>2750</td>
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<tr>
<td>AADT</td>
<td>veh/day</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td></td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
<td></td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>veh/h</td>
</tr>
<tr>
<td>Peak-Hour Factor, PHF</td>
<td>0.92</td>
</tr>
<tr>
<td>%Trucks and Buses, P_T</td>
<td>5</td>
</tr>
<tr>
<td>%RVs, P_R</td>
<td>0</td>
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<tr>
<td>General Terrain:</td>
<td>Level</td>
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<tr>
<td>Grade</td>
<td></td>
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<tr>
<td>Length</td>
<td></td>
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<tr>
<td>Up/Down %</td>
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#### Calculate Flow Adjustments

\[
\begin{align*}
f_p & = 1.00 \\
E_T & = 1.5 \\
E_R & = 1.2 \\
f_{HV} = \frac{1}{1+P_T(E_T\cdot 1) + P_R(E_R\cdot 1)} & = 0.976
\end{align*}
\]

#### Speed Inputs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Lane Width</td>
<td>ft</td>
</tr>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>3</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>60.0</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
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</tbody>
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#### Calc Speed Adj and FFS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>f_{LV}</td>
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</tr>
<tr>
<td>f_{LC}</td>
<td></td>
</tr>
<tr>
<td>TRD Adjustment</td>
<td></td>
</tr>
<tr>
<td>FFS</td>
<td>60.0</td>
</tr>
<tr>
<td>mph</td>
<td></td>
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</table>

#### LOS and Performance Measures

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational (LOS)</td>
<td></td>
</tr>
<tr>
<td>Design (N)</td>
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</tr>
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</table>

#### Glossary

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>N</td>
<td>Number of lanes</td>
</tr>
<tr>
<td>V</td>
<td>Hourly volume</td>
</tr>
<tr>
<td>v_p</td>
<td>Flow rate</td>
</tr>
<tr>
<td>LOS</td>
<td>Level of service</td>
</tr>
<tr>
<td>DDHV</td>
<td>Directional design hour volume</td>
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#### Factor Location

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Reference</th>
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<tbody>
<tr>
<td>S</td>
<td>E_R - Exhibits 11-10, 11-12</td>
</tr>
<tr>
<td>D</td>
<td>E_T - Exhibits 11-10, 11-11, 11-13</td>
</tr>
<tr>
<td>LOS</td>
<td>f_{p} - Page 11-18</td>
</tr>
<tr>
<td>LOS</td>
<td>LOS, S, FFS, v_p - Exhibits 11-2,</td>
</tr>
<tr>
<td></td>
<td>11-3</td>
</tr>
<tr>
<td></td>
<td>f_{LV} - Exhibit 11-8</td>
</tr>
<tr>
<td></td>
<td>f_{LC} - Exhibit 11-9</td>
</tr>
<tr>
<td></td>
<td>TRD - Page 11-11</td>
</tr>
</tbody>
</table>

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### BASIC FREEWAY SEGMENTS WORKSHEET

**General Information**
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: AM Peak Hour
- **Project Description**: Ohio River Bridges Project

**Site Information**
- **Highway/Direction of Travel**: I-71 Northbound
- **From/To**: Btw I-64WB Off and I-65SB
- **Jurisdiction**: 31-1.1
- **Analysis Year**: 2010

**Flow Inputs**
- **Volume, V**: 1150 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: veh/h
- **DDHV = AADT × K × D**: veh/h
- **Peak-Hr Direction Prop, D**: %Trucks and Buses, \( P_T \)
- **%RVs, \( P_R \)**: 0
- **General Terrain**: Level
- **Grade**: %
- **Length**: mi
- **Up/Down %**:

**Calculate Flow Adjustments**
- \( f_p = 1.00 \)
- \( E_T = 1.5 \)

**Speed Inputs**
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

**Calc Speed Adj and FFS**
- \( f_{LV} \)
- \( f_{LC} \)
- **FFS**: 60.0 mph

**LOS and Performance Measures**
- **Operational (LOS)**
- **Design (N)**

**Glossary**
- **V**: Hourly volume
- **D**: Density
- **\( f_p \)**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

**Factor Location**
- \( E_R \): Exhibits 11-10, 11-12
- \( f_{LV} \): Exhibit 11-8
- \( E_T \): Exhibits 11-10, 11-11, 11-13
- \( f_{LC} \): Exhibit 11-9
- \( f_p \): Page 11-18
- **TRD**: Page 11-11
- **LOS, S, FFS, \( v_p \)**: Exhibits 11-2, 11-3
## Basic Freeway Segments Worksheet

### General Information
- Analyst: Adams
- Agency or Company: Parsons
- Date Performed: 11/7/11
- Analysis Time Period: AM Peak Hour
- Project Description: Ohio River Bridges Project

### Site Information
- Highway/Direction of Travel: I-71 Northbound
- From/To: Btw I64EB On & Zorn Off
- Jurisdiction: 31-4.1
- Analysis Year: 2010

### Flow Inputs
- Volume, V: 2200 veh/h
- AADT: veh/day
- Peak-Hr Prop. of AADT, K
- Peak-Hr Direction Prop, D
- DDHV = AADT x K x D veh/h
- Peak-Hour Factor, PHF: 0.92
- %Trucks and Buses, PT: 8
- %RVs, PR: 0
- General Terrain: Level
- Grade % Length mi
- Up/Down %

### Calculate Flow Adjustments
- \( f_p \): 1.00
- \( E_T \): 1.5
- \( E_R \): 1.2
- \( E_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} \): 0.962

### Speed Inputs
- Lane Width: ft
- Rt-Side Lat. Clearance: ft
- Number of Lanes, N: 2
- Total Ramp Density, TRD: ramps/mi
- FFS (measured): 60.0 mph
- Base free-flow Speed, BFFS: mph

### Speed Adjustments and FFS
- \( f_{LV} \): mph
- \( f_{LC} \): mph
- TRD Adjustment: mph
- FFS: 60.0 mph

### LOS and Performance Measures
- Operational (LOS)
  - \( v_p = \frac{(V or DDHV)}{(PHF x N x f_{HV}} \times f_p \)
    - pc/h/ln
  - S: 60.0 mph
  - D: \( v_p / S \)
    - pc/mi/ln
  - LOS: C

### Design (N)
- Design LOS
- Design (N)
  - \( v_p = \frac{(V or DDHV)}{(PHF x N x f_{HV}} \times f_p \)
    - pc/h/ln
  - S: mph
  - D: \( v_p / S \)
    - pc/mi/ln
  - Required Number of Lanes, N

### Glossary
- N: Number of lanes
- V: Hourly volume
- \( v_p \): Flow rate
- LOS: Level of service
- DDHV: Directional design hour volume

### Factor Location
- \( E_R \): Exhibits 11-10, 11-12
- \( f_{LV} \): Exhibit 11-8
- \( E_T \): Exhibits 11-10, 11-11, 11-13
- \( f_{LC} \): Exhibit 11-9
- \( f_p \): Page 11-18
- TRD: Page 11-11
- LOS, S, FFS, \( v_p \): Exhibits 11-2, 11-3

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BASIC FREEWAY SEGMENTS WORKSHEET

### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: AM Peak Hour
- **Project Description**: Ohio River Bridges Project

### Site Information
- **Highway/Direction of Travel**: I-71 Southbound
- **From/To**: Btw Zorn On & I64 WB Off
- **Jurisdiction**: 32-1.1
- **Analysis Year**: 2010

### Flow Inputs
- **Volume, V**: 3800 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %
- **Peak-Hr Direction Prop, D**: %
- **DDHV = AADT x K x D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 4
- **%RVs, P_R**: 0
- **General Terrain**: Level
- **Grade % Length mi Up/Down %**

### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_T**: 1.5
- **E_R**: 1.2
- **f_HV = 1/(1 + P_T(E_T - 1) + P_R(E_R - 1))**: 0.980

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

### Calc Speed Adj and FFS
- **f_LW**: mph
- **f_LC**: mph
- **TRD Adjustment**: mph
- **FFS**: 60.0 mph

### LOS and Performance Measures
- **Operational (LOS)**
  - **V_p = (V or DDHV) / (PHF x N x f_HV)**:
  - **S**: 55.3 mph
  - **D = V_p / S**: 38.1 pc/mi/ln
  - **LOS**: E

### Design (N)
- **Design LOS**

### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **D**: Density
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

### Factor Location
- **E_R - Exhibits 11-10, 11-12**
- **f_LW - Exhibit 11-8**
- **E_T - Exhibits 11-10, 11-11, 11-13**
- **f_LC - Exhibit 11-9**
- **f_p - Page 11-18**
- **TRD - Page 11-11**
- **LOS, S, FFS, v_p - Exhibits 11-2, 11-3**

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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

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<tr>
<th>Analyst</th>
<th>Adams</th>
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<tbody>
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<td>Parsons</td>
</tr>
<tr>
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<td>11/7/11</td>
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<tr>
<td>Analysis Time Period</td>
<td>AM Peak Hour</td>
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<td>Project Description</td>
<td>Ohio River Bridges Project</td>
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## Site Information

<table>
<thead>
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<th>Highway/Direction of Travel</th>
<th>I-71 Southbound</th>
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</thead>
<tbody>
<tr>
<td>From/To</td>
<td>Btw I-54WB Off and I-64WB On</td>
</tr>
<tr>
<td>Jurisdiction</td>
<td>32-2.1</td>
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<td>Analysis Year</td>
<td>2010</td>
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## Flow Inputs

<table>
<thead>
<tr>
<th>Volume, V (veh/h)</th>
<th>2350</th>
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</thead>
<tbody>
<tr>
<td>AADT (veh/day)</td>
<td></td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K (veh/h)</td>
<td></td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D (veh/h)</td>
<td></td>
</tr>
<tr>
<td>DDHV = AADT x K x D (veh/h)</td>
<td></td>
</tr>
<tr>
<td>Peak-Hour Factor, PHF</td>
<td>0.92</td>
</tr>
<tr>
<td>%Trucks and Buses, P_T</td>
<td>3</td>
</tr>
<tr>
<td>%RVs, P_R</td>
<td>0</td>
</tr>
<tr>
<td>General Terrain</td>
<td>Level</td>
</tr>
<tr>
<td>Grade</td>
<td>% Length</td>
</tr>
<tr>
<td>Up/Down %</td>
<td></td>
</tr>
</tbody>
</table>

## Calculate Flow Adjustments

| f_p | 1.00 |
| E_T | 1.5  |
| f_HV = \frac{1}{(1 + P_T(E_T - 1) + P_R(E_R - 1))}0.985 |

## Speed Inputs

<table>
<thead>
<tr>
<th>Lane Width (ft)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rt-Side Lat. Clearance (ft)</td>
<td></td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>2</td>
</tr>
<tr>
<td>Total Ramp Density, TRD (ramps/mi)</td>
<td></td>
</tr>
<tr>
<td>FFS (measured) (mph)</td>
<td>60.0</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS (mph)</td>
<td></td>
</tr>
<tr>
<td>f_LW</td>
<td></td>
</tr>
<tr>
<td>f_C</td>
<td></td>
</tr>
<tr>
<td>TRD Adjustment (mph)</td>
<td></td>
</tr>
<tr>
<td>FFS</td>
<td>60.0</td>
</tr>
</tbody>
</table>

## LOS and Performance Measures

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
<th>Design (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>v_p = (V or DDHV) / (PHF x N x f_HV)</td>
<td>Design LOS</td>
</tr>
<tr>
<td>x f_p )</td>
<td></td>
</tr>
<tr>
<td>S = 60.0 mph</td>
<td></td>
</tr>
<tr>
<td>D = v_p / S</td>
<td></td>
</tr>
<tr>
<td>LOS</td>
<td>C</td>
</tr>
<tr>
<td>v_p = (V or DDHV) / (PHF x N x f_HV)</td>
<td>pc/h/ln</td>
</tr>
<tr>
<td>x f_p )</td>
<td></td>
</tr>
<tr>
<td>S = 60.0 mph</td>
<td></td>
</tr>
<tr>
<td>D = v_p / S</td>
<td></td>
</tr>
<tr>
<td>LOS</td>
<td>C</td>
</tr>
</tbody>
</table>

## Glossary

<table>
<thead>
<tr>
<th>N - Number of lanes</th>
<th>S - Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>V - Hourly volume</td>
<td>D - Density</td>
</tr>
<tr>
<td>v_p - Flow rate</td>
<td>FFS - Free-flow speed</td>
</tr>
<tr>
<td>LOS - Level of service</td>
<td>BFFS - Base free-flow speed</td>
</tr>
<tr>
<td>DDHV - Directional design hour volume</td>
<td></td>
</tr>
</tbody>
</table>

## Factor Location

<table>
<thead>
<tr>
<th>E_R - Exhibits 11-10, 11-12</th>
<th>f_LW - Exhibit 11-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>E_T - Exhibits 11-10, 11-11, 11-13</td>
<td>f_C - Exhibit 11-9</td>
</tr>
<tr>
<td>f_p - Page 11-18</td>
<td>TRD - Page 11-11</td>
</tr>
<tr>
<td>LOS, S, FFS, v_p - Exhibits 11-2, 11-3</td>
<td></td>
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### BASIC FREEWAY SEGMENTS WORKSHEET

#### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: AM Peak Hour
- **Project Description**: Ohio River Bridges Project

#### Site Information
- **Highway/Direction of Travel**: I-71 Southbound
- **From/To**: Btw I65NB Off & I64EB On
- **Jurisdiction**: 32-4.1
- **Analysis Year**: 2010

#### Flow Inputs
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Volume, V</td>
<td>2700 veh/h</td>
</tr>
<tr>
<td>AADT</td>
<td>veh/day</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td></td>
</tr>
<tr>
<td>Peak-Hr Direction Prop. D</td>
<td></td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>veh/h</td>
</tr>
</tbody>
</table>

#### Peak-Hour Factor
- PHF: 0.92
- %Trucks and Buses, P_T: 4
- %RVs, P_R: 0

#### General Terrain
- Level

#### Calculate Flow Adjustments
- \( f_p = 1.00 \)
- \( E_R = 1.2 \)
- \( f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} = 0.980 \)

#### Speed Inputs
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Lane Width</td>
<td>ft</td>
</tr>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>2</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>55.0 mph</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
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</tbody>
</table>

#### Calc Speed Adj and FFS
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f_{LV} )</td>
<td>mph</td>
</tr>
<tr>
<td>( f_{LC} )</td>
<td>mph</td>
</tr>
<tr>
<td>TRD Adjustment</td>
<td>mph</td>
</tr>
<tr>
<td>FFS</td>
<td>55.0 mph</td>
</tr>
</tbody>
</table>

#### LOS and Performance Measures
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational (LOS)</td>
<td></td>
</tr>
<tr>
<td>( v_p = \frac{(V \text{ or } DDHV)}{(PHF \times N \times f_{HV}} \times f_p )</td>
<td>1497 pc/h/ln</td>
</tr>
<tr>
<td>( x f_p )</td>
<td>55.0 mph</td>
</tr>
<tr>
<td>( S )</td>
<td>27.2 pc/mi/ln</td>
</tr>
<tr>
<td>( D = \frac{v_p}{S} )</td>
<td></td>
</tr>
<tr>
<td>LOS</td>
<td></td>
</tr>
</tbody>
</table>

#### Design (N)
- Design LOS
- Required Number of Lanes, \( N \)

#### Glossary
- \( N \): Number of lanes
- \( V \): Hourly volume
- \( v_p \): Flow rate
- LOS: Level of service
- DDHV: Directional design hour volume
- S: Speed
- D: Density
- FFS: Free-flow speed
- BFFS: Base free-flow speed

---

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## General Information

<table>
<thead>
<tr>
<th>Analyst</th>
<th>Adams</th>
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<tbody>
<tr>
<td>Agency/Company</td>
<td>Parsons</td>
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<tr>
<td>Date Performed</td>
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<tr>
<td>Analysis Time Period</td>
<td>AM Peak Hour</td>
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<td>Freeway/Dir of Travel</td>
<td>I-65 Northbound 11-3.1</td>
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<tr>
<td>Weaving Segment Location</td>
<td>Btw Ali On &amp; 164/171 Off</td>
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<tr>
<td>Analysis Year</td>
<td>2010</td>
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## Site Information

| Project Description | Ohio River Bridges Project |

## Inputs

<table>
<thead>
<tr>
<th>Weaving configuration</th>
<th>One-Sided</th>
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<tbody>
<tr>
<td>Weaving number of lanes, N</td>
<td>4</td>
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<tr>
<td>Weaving segment length, L_S</td>
<td>2100 ft</td>
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<tr>
<td>Freeway free-flow speed, FFS</td>
<td>60 mph</td>
</tr>
<tr>
<td>Segment type</td>
<td>Freeway</td>
</tr>
<tr>
<td>Freeway minimum speed, S_MIN</td>
<td>50</td>
</tr>
<tr>
<td>Freeway maximum capacity, C_FF</td>
<td>2300</td>
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</tbody>
</table>

## Conversions to pc/h Under Base Conditions

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_HV</th>
<th>f_P</th>
<th>V (pc/h)</th>
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</thead>
<tbody>
<tr>
<td>V_FF</td>
<td>1100</td>
<td>0.92</td>
<td>20</td>
<td>0</td>
<td>1.2</td>
<td>0.909</td>
<td>1.00</td>
<td>1315</td>
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<tr>
<td>V_RF</td>
<td>1400</td>
<td>0.92</td>
<td>6</td>
<td>0</td>
<td>1.2</td>
<td>0.971</td>
<td>1.00</td>
<td>1567</td>
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<td>V_FR</td>
<td>300</td>
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<td>9</td>
<td>0</td>
<td>1.2</td>
<td>0.957</td>
<td>1.00</td>
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<td>V_REL</td>
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<td>20</td>
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<td>1.2</td>
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<tr>
<td>V_HV</td>
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<td>V = 3662</td>
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<td></td>
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<td></td>
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## Configuration Characteristics

| Minimum maneuver lanes, N_WL | 3 lc |
| Interchange density, ID | 2.50 int/mi |
| Minimum RF lane changes, LC_FF | 2 lc/pc |
| Minimum FR lane changes, LC_FR | 0 lc/pc |
| Minimum RR lane changes, LC_RR | 1 lc/pc |
| Minimum weaving lane changes, LC_MIN | 682 lc/h |
| Weaving lane changes, LC_W | 1403 lc/h |
| Non-weaving lane changes, LC_NW | 729 lc/h |
| Total lane changes, LC_ALL | 2132 lc/h |
| Non-weaving vehicle index, I_NW | 0.229 |

## Weaving Segment Speed, Density, Level of Service, and Capacity

| Weaving segment flow rate, v | 3662 pc/h |
| Weaving segment capacity, c_w | 6107 veh/h |
| Weaving segment wc ratio | 0.545 |
| Weaving segment density, D | 16.9 pc/miln |
| Level of Service, LOS | B |
| Weaving intensity factor, W | 0.229 |
| Weaving segment speed, S | 54.3 mph |
| Average weaving speed, S | 58.1 mph |
| Average non-weaving speed, S_NW | 50.7 mph |
| Maximum weaving length, L_MAX | 6507 ft |

## Notes

a. 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".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".
# Ohio River Bridges Project

## FREEWAY WEAVING WORKSHEET

### General Information

<table>
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<tr>
<th>Analyst</th>
<th>Adams</th>
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<td>Parsons</td>
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<tr>
<td>Analysis Time Period</td>
<td>AM Peak Hour</td>
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<table>
<thead>
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<tbody>
<tr>
<td>Freeway/Dir of Travel</td>
</tr>
<tr>
<td>Weaving Segment Location</td>
</tr>
<tr>
<td>Analysis Year</td>
</tr>
</tbody>
</table>

### Project Description

Ohio River Bridges Project

## Inputs

- **Weaving configuration**: One-Sided
- **Weaving number of lanes, N**: 4
- **Weaving segment length, Lg**: 2175 ft
- **Freeway free-flow speed, FFS**: 60 mph

### Conversions to pc/h Under Base Conditions

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>ET</th>
<th>ER</th>
<th>fm</th>
<th>fp</th>
<th>v (pc/h)</th>
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<td>V_FF</td>
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<td>30</td>
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<td>V_MW</td>
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<td>V_W</td>
<td>3304</td>
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## Configuration Characteristics

- **Minimum maneuver lanes, N_{WL}**: 3 lanes
- **Interchange density, ID**: 2.70 int/mi
- **Minimum RF lane changes, L_{RF}**: 0 lane/pc
- **Minimum FR lane changes, L_{FR}**: 2 lane/pc
- **Minimum RR lane changes, L_{RR}**: lane/pc

### Weaving Segment Speed, Density, Level of Service, and Capacity

- **Weaving segment flow rate, v**: 6577 pc/h
- **Weaving segment capacity, c_w**: 6058 veh/h
- **Weaving segment v/c ratio**: 0.944
- **Weaving segment density, D**: 35.5 pc/mil

<table>
<thead>
<tr>
<th>Speed Characteristics</th>
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<tbody>
<tr>
<td>Weaving intensity factor, W</td>
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<tr>
<td>Weaving segment speed, S</td>
</tr>
<tr>
<td>Average weaving speed, S_w</td>
</tr>
<tr>
<td>Average non-weaving speed, S_{nw}</td>
</tr>
<tr>
<td>Maximum weaving length, L_{MAX}</td>
</tr>
</tbody>
</table>

## Notes

a. 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".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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**Ohio River Bridges Project**

**FREEWAY WEAVING WORKSHEET**

<table>
<thead>
<tr>
<th>General Information</th>
<th>Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyst</td>
<td>Adams</td>
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<tr>
<td>Agency/Company</td>
<td>Parsons</td>
</tr>
<tr>
<td>Date Performed</td>
<td>10/28/2011</td>
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<tr>
<td>Analysis Time Period</td>
<td>AM Peak Hour</td>
</tr>
<tr>
<td>Freeway/Dir of Travel</td>
<td>I-64 Eastbound 21-5.1</td>
</tr>
<tr>
<td>Weaving Segment Location</td>
<td>Btw I-65 On &amp; Story Off</td>
</tr>
<tr>
<td>Analysis Year</td>
<td>2010</td>
</tr>
</tbody>
</table>

**Project Description** Ohio River Bridges Project

**Inputs**

- Weaving configuration: Two-Sided
- Weaving number of lanes, N: 3
- Weaving segment length, L_{w}: 1425ft
- Freeway free-flow speed, FFS: 60 mph

**Conversions to pc/h Under Base Conditions**

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_{rv}</th>
<th>f_p</th>
<th>v (pc/h)</th>
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</thead>
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<td>V_{FF}</td>
<td>1210</td>
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<td>6</td>
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<td>V_{W}</td>
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</table>

**Configuration Characteristics**

- Minimum maneuver lanes, N_{ML}: 0 lc
- Interchange density, ID: 2.00 int/mi
- Minimum RF lane changes, LC_{RF}: lc/pc
- Minimum FR lane changes, LC_{FR}: lc/pc
- Minimum RR lane changes, LC_{RR}: 2 lc/pc

**Weaving Segment Speed, Density, Level of Service, and Capacity**

- Weaving segment flow rate, v: 3359 pc/h
- Weaving segment capacity, c_{w}: 5598 veh/h
- Weaving segment v/c ratio: 0.583
- Weaving segment density, D: 21.7 pc/miln
- Level of Service, LOS: C

**Notes**

4. 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".

2. For volumes that exceed the weaving segment capacity, the level of service is "F".
Ohio River Bridges Project

**FREEWAY WEAVING WORKSHEET**

### General Information
- Analyst: Adams
- Agency/Company: Parsons
- Date Performed: 10/28/2011
- Analysis Time Period: AM Peak Hour
- Project Description: Ohio River Bridges Project

### Site Information
- Freeway/Dir of Travel: I-64 Westbound 22-2.1
- Weaving Segment Location: Blw Story On & I-65 Off
- Analysis Year: 2010

### Inputs
- Weaving configuration: Two-Sided
- Weaving number of lanes, N: 3
- Weaving segment length, L_g: 1600ft (500m)
- Freeway free-flow speed, FFS: 60 mph (100 km/h)

### Conversions to pc/h Under Base Conditions

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>I_VW</th>
<th>f_p</th>
<th>V (pc/h)</th>
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</thead>
<tbody>
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<td>1400</td>
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<td>0</td>
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<td>1.2</td>
<td>0.976</td>
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<td>3</td>
<td>0</td>
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<td>1.2</td>
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<td>V_NW</td>
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### Configuration Characteristics
- Minimum maneuver lanes, Nwl: 0
- Minimum weaving lane changes, Lcw: 455 lcf/h
- Weaving lane changes, Lcw: 744 lcf/h
- Non-weaving lane changes, Lcw: 1099 lcf/h
- Total lane changes, Lal: 1843 lcf/h
- Non-weaving vehicle index, Ivw: 0.253

### Weaving Segment Speed, Density, Level of Service, and Capacity
- Weaving segment flow rate, v: 4160 pc/h
- Weaving intensity factor, W: 0.253
- Weaving segment capacity, c: 5749 veh/h
- Average weaving speed, Sw: 58.0 mph
- Weaving segment v/c ratio: 0.713
- Average non-weaving speed, Snw: 50.1 mph
- Weaving segment density, D: 27.5 pc/mi/ln
- Maximum weaving length, Lmax: 6339 ft

### Notes
- a. 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".
- b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Ohio River Bridges Project

**FREEROWAY WEAVING WORKSHEET**

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<td>Parsons</td>
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<tr>
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<td>I-64 Westbound 22-5.1</td>
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<td></td>
<td>Weaving Segment Location</td>
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<td></td>
<td>Btw I-65 On &amp; 3rd Off</td>
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<td></td>
<td>Analysis Year</td>
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<td>2010</td>
</tr>
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**Project Description**: Ohio River Bridges Project

**Inputs**

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<th>Weaving configuration</th>
<th>Two-Sided</th>
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</thead>
<tbody>
<tr>
<td>Weaving number of lanes, N</td>
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<tr>
<td>Weaving segment length, L_w</td>
<td>1425 ft</td>
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<tr>
<td>Freeway free-flow speed, FFS</td>
<td>60 mph</td>
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</tbody>
</table>

**Conversions to pc/h Under Base Conditions**

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_R</th>
<th>f_M</th>
<th>f_o</th>
<th>V (pc/h)</th>
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</tbody>
</table>

**Configuration Characteristics**

| N_WL | Minimum maneuver lanes, N_WL | 0 lc |
| ID   | Interchange density, ID      | 1.80 int/mi |
| LC_RF| Minimum RF lane changes, LC_RF | 1 lc/pc |
| LC_FR| Minimum FR lane changes, LC_FR | 1 lc/pc |
| LC_RR| Minimum RR lane changes, LC_RR | 1 lc/pc |

**Minimum weaving lane changes, LC_MN**: 382 lc/h
**Weaving lane changes, LC_W**: 859 lc/h
**Non-weaving lane changes, LC_NW**: 949 lc/h
**Total lane changes, LC_ALL**: 1808 lc/h
**Non-weaving vehicle index, f_M**: 0.273

**Weaving Segment Speed, Density, Level of Service, and Capacity**

<table>
<thead>
<tr>
<th>V (pc/h)</th>
<th>Weaving intensity factor, W</th>
<th>0.273</th>
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</thead>
<tbody>
<tr>
<td>Weaving segment flow rate, v</td>
<td>4978 pc/h</td>
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<tr>
<td>Weaving segment capacity, c_w</td>
<td>7477 veh/h</td>
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<tr>
<td>Weaving segment v/c ratio</td>
<td>0.850</td>
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<tr>
<td>Weaving segment density, D</td>
<td>24.1 pc/mi/ln</td>
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</tr>
<tr>
<td>Level of Service, LOS</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Maximum weaving length, L_MAX</td>
<td>6447 ft</td>
<td></td>
</tr>
</tbody>
</table>

**Notes**

1. 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".
2. For volumes that exceed the weaving segment capacity, the level of service is "F".

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**Ohio River Bridges Project**

## FREETWAY WEAVING WORKSHEET

### General Information

<table>
<thead>
<tr>
<th>Analyst</th>
<th>Adams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency/Company</td>
<td>Parsons</td>
</tr>
<tr>
<td>Date Performed</td>
<td>10/28/2011</td>
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<tr>
<td>Analysis Time Period</td>
<td>AM Peak Hour</td>
</tr>
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### Site Information

<table>
<thead>
<tr>
<th>Freeway/Dir of Travel</th>
<th>I-71 Northbound 31-2.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaving Segment Location</td>
<td>Btw I-65S3 On &amp; I-64EB Off</td>
</tr>
<tr>
<td>Analysis Year</td>
<td>2010</td>
</tr>
</tbody>
</table>

### Project Description

**Ohio River Bridges Project**

### Inputs

- **Weaving configuration**: Two-Sided
- **Weaving number of lanes, N**: 2
- **Weaving segment length, Ls**: 220 ft
- **Freeway free-flow speed, FFS**: 60 mph

### Conversions to pc/h Under Base Conditions

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<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_hv</th>
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<th>V (pc/h)</th>
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</thead>
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### Configuration Characteristics

| Minimum maneuver lanes, N_WM | 0 l/c |
| Interchange density, ID | 2.30 int/mi |
| Minimum RF lane changes, LC_RF | l/c/pc |
| Minimum FR lane changes, LC_FR | l/c/pc |
| Minimum RR lane changes, LC_RR | l/c/pc |

### Minimum weaving lane changes, LC_MN

1103 l/c

### Weaving Segment Speed, Density, Level of Service, and Capacity

| Weaving segment flow rate, v | 3316 pc/h |
| Weaving capacity, c_w | 3482 veh/h |
| Weaving segment w/c ratio | 0.934 |
| Weaving segment density, D | 34.6 pc/mi/ln |
| Average weaving speed, S_w | 47.9 mph |
| Average non-weaving speed, S_NW | 58.0 mph |
| Maximum weaving length, L_MAX | 9069 ft |

### Notes

a. 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".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".
## General Information

<table>
<thead>
<tr>
<th>Analyst</th>
<th>Adams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency/Company</td>
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<tr>
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<td>AM Peak Hour</td>
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<tr>
<td>Freeway/Dir of Travel</td>
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<tr>
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<tr>
<td>Analysis Year</td>
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### Inputs

- Weaving configuration: Two-Sided
- Weaving number of lanes, N: 2 lanes
- Weaving segment length, L_s: 1480 ft
- Freeway free-flow speed, FFS: 60 mph
- Freeway minimum speed, S_{MN}: 50 mph
- Freeway maximum capacity, C_{FPL}: 2300 veh/Anh

### Conversions to pc/h Under Base Conditions

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_1</th>
<th>E_R</th>
<th>f_{HV}</th>
<th>f_p</th>
<th>v (pc/h)</th>
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</thead>
<tbody>
<tr>
<td>V_{RF}</td>
<td>1610</td>
<td>0.92</td>
<td>2</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.990</td>
<td>1.00</td>
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<tr>
<td>V_{RF}</td>
<td>740</td>
<td>0.92</td>
<td>6</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.971</td>
<td>1.00</td>
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<tr>
<td>V_{FR}</td>
<td>1090</td>
<td>0.92</td>
<td>6</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.971</td>
<td>1.00</td>
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<tr>
<td>V_{RR}</td>
<td>510</td>
<td>0.92</td>
<td>2</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.990</td>
<td>1.00</td>
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<tr>
<td>V_{NW}</td>
<td>3816</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>V_w</td>
<td>574</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VR</td>
<td>0.131</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Configuration Characteristics

- Minimum maneuver lanes, N_{WL}: 0 lane
- Interchange density, ID: 220 in/ti/mi
- Minimum RF lane changes, L_{CRF}: 0 lane/pc
- Minimum FR lane changes, L_{CFR}: 0 lane/pc
- Minimum RR lane changes, L_{CRR}: 1 lane/pc

### Weaving Segment Speed, Density, Level of Service, and Capacity

- Weaving segment flow rate, v: 4390 pc/h
- Weaving segment capacity, c_w: 3723 veh/h
- Weaving segment v/c ratio: 1.167
- Level of Service, LOS: F

### Notes

a. 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".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".
### BASIC FREEWAY SEGMENTS WORKSHEET

#### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: PM Peak Hour
- **Project Description**: Ohio River Bridges Project

#### Site Information
- **Highway/Direction of Travel**: I-65 Northbound
- **From/To**: Between I-64 Off and I-64
- **Jurisdiction**: 11-4.1
- **Analysis Year**: 2010

#### Flow Inputs
- **Volume, V**: 3000 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %Trucks and Buses, P_T
- **Peak-Hr Direction Prop, D**: %RVs, P_R
- **DDHV = AADT x K x D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 22
- **%RVs, P_R**: 0

#### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_T**: 1.5
- **f_HV = \frac{1}{1+(P_T / P_R)}**: 0.901

#### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

#### LOS and Performance Measures
- **LOS and Performance Measures**

#### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

### Site Specification
- **Oper.(LOS)**
- **Des.(N)**
- **Planning Data**

---

**Calc Speed Adj and FFS**

- **Calc Speed Adj**
  - **f_LW**: mph
  - **f_LC**: mph

- **FFS**: 60.0 mph
- **TRD Adjustment**: mph

---

**Design (N)**

- **Design LOS**
  - **v_p**: pc/h/ln
  - **D**: pc/mi/ln

- **LOS**: pc/h/ln

---

**Factor Location**

- **E_R**: Exhibits 11-10, 11-12
- **f_LW**: Exhibit 11-8
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_LC**: Exhibit 11-9
- **f_p**: Page 11-18
- **TRD**: Page 11-11
- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3
**BASIC FREEWAY SEGMENTS WORKSHEET**

### General Information

<table>
<thead>
<tr>
<th>Analyst</th>
<th>Adams</th>
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<td>Parsons</td>
</tr>
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<td>PM Peak Hour</td>
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### Site Information

<table>
<thead>
<tr>
<th>Highway/Direction of Travel</th>
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<tbody>
<tr>
<td>From/To</td>
<td>Between I-64 On and Off</td>
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<tr>
<td>Jurisdiction</td>
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<tr>
<td>Analysis Year</td>
<td>2010</td>
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### Flow Inputs

<table>
<thead>
<tr>
<th>Volume, V</th>
<th>5350 veh/h</th>
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<tr>
<td>AADT</td>
<td>veh/day</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td>%Trucks and Buses, P_T</td>
</tr>
<tr>
<td>%RVs, P_R</td>
<td>0</td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>veh/h</td>
</tr>
</tbody>
</table>

### Calculate Flow Adjustments

\[
f_p = 1.00 \quad E_R = 1.2 \quad f_{HV} = \frac{1}{1 + \frac{P_T(E_R - 1)}{P_R(E_R - 1)}} 0.926
\]

### Speed Inputs

<table>
<thead>
<tr>
<th>Lane Width</th>
<th>ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rl-Side Lat. Clearance</td>
<td>ft</td>
</tr>
<tr>
<td>Number of Lanes</td>
<td>4</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>60.0 mph</td>
</tr>
<tr>
<td>BFFS</td>
<td>mph</td>
</tr>
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### Speed Adj and FFS

<table>
<thead>
<tr>
<th>Calc Speed Adj and FFS</th>
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<tbody>
<tr>
<td>( f_{LW} )</td>
</tr>
<tr>
<td>( f_{LC} )</td>
</tr>
<tr>
<td>TRD Adjustment</td>
</tr>
<tr>
<td>FFS</td>
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### LOS and Performance Measures

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
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</thead>
<tbody>
<tr>
<td>( v_p = \frac{(V \text{ or DDHV})}{(PHF \times N \times f_{HV})} \times f_p )</td>
</tr>
<tr>
<td>( S )</td>
</tr>
<tr>
<td>( D = \frac{v_p}{S} )</td>
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<tr>
<td>LOS</td>
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### Design (N)

<table>
<thead>
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<th>Design (N)</th>
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<tbody>
<tr>
<td>Design LOS</td>
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<tr>
<td>( v_p = \frac{(V \text{ or DDHV})}{(PHF \times N \times f_{HV})} \times f_p )</td>
</tr>
<tr>
<td>( S )</td>
</tr>
<tr>
<td>( D = \frac{v_p}{S} )</td>
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<tr>
<td>Required Number of Lanes, N</td>
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### Glossary

<table>
<thead>
<tr>
<th>N - Number of lanes</th>
</tr>
</thead>
<tbody>
<tr>
<td>V - Hourly volume</td>
</tr>
<tr>
<td>( v_p ) - Flow rate</td>
</tr>
<tr>
<td>LOS - Level of service</td>
</tr>
<tr>
<td>DDHV - Directional design hour volume</td>
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### Factor Location

<table>
<thead>
<tr>
<th>E_R - Exhibits 11-10, 11-12</th>
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<tbody>
<tr>
<td>f_{LW} - Exhibit 11-8</td>
</tr>
<tr>
<td>E_T - Exhibits 11-10, 11-11, 11-13</td>
</tr>
<tr>
<td>f_{LC} - Exhibit 11-9</td>
</tr>
<tr>
<td>f_p - Page 11-18</td>
</tr>
<tr>
<td>TRD - Page 11-11</td>
</tr>
<tr>
<td>LOS, S, FFS, ( v_p ) - Exhibits 11-2, 11-3</td>
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2/24/2012
**BASIC FREEWAY SEGMENTS WORKSHEET**

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<td>Parsons</td>
</tr>
<tr>
<td>Date Performed</td>
<td>11/7/11</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>PM Peak Hour</td>
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<td>Project Description</td>
<td>Ohio River Bridges Project</td>
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<td>Highway/Direction of Travel</td>
<td>I-65 Southbound Btw Market St Off and I-64</td>
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<td>From/To</td>
<td>Off</td>
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<td>Analysis Year</td>
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<table>
<thead>
<tr>
<th>Flow Inputs</th>
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<tbody>
<tr>
<td>Volume, V</td>
<td>3400 veh/h</td>
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<tr>
<td>AADT</td>
<td>veh/day</td>
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<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td>%Trucks and Buses, P_T</td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
<td>%RVs, P_R</td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>veh/h</td>
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<table>
<thead>
<tr>
<th>Calculate Flow Adjustments</th>
<th></th>
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<tbody>
<tr>
<td>f_p</td>
<td>1.00</td>
</tr>
<tr>
<td>E_R</td>
<td>1.5</td>
</tr>
<tr>
<td>E_T</td>
<td>1.5</td>
</tr>
<tr>
<td>f_{HV} = 1/(1+P_T(E_T-1) + P_R(E_R-1))</td>
<td>0.881</td>
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<table>
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<tr>
<th>Speed Inputs</th>
<th>Calc Speed Adj and FFS</th>
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<tbody>
<tr>
<td>Lane Width</td>
<td>ft</td>
<td>f_{LW} mph</td>
</tr>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
<td>f_{LC} mph</td>
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<td>Number of Lanes, N</td>
<td>3</td>
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<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
<td>TRD Adjustment</td>
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<tr>
<td>FFS (measured)</td>
<td>60.0 mph</td>
<td>FFS</td>
</tr>
<tr>
<td>Base free-flow speed, BFFS</td>
<td>mph</td>
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<table>
<thead>
<tr>
<th>LOS and Performance Measures</th>
<th>Design (N)</th>
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<tbody>
<tr>
<td>Operational (LOS)</td>
<td>Design LOS</td>
<td>v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) pc/h/ln</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x f_p) pc/h/ln</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D = v_p / S pc/mi/ln</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LOS C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Design (N)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Design LOS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) pc/h/ln</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x f_p) pc/h/ln</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D = v_p / S pc/mi/ln</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Required Number of Lanes, N</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Glossary</th>
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<tbody>
<tr>
<td>N - Number of lanes</td>
<td>S - Speed</td>
</tr>
<tr>
<td>V - Hourly volume</td>
<td>D - Density</td>
</tr>
<tr>
<td>v_p - Flow rate</td>
<td>FFS - Free-flow speed</td>
</tr>
<tr>
<td>LOS - Level of service</td>
<td>BFFS - Base free-flow speed</td>
</tr>
<tr>
<td>DDHV - Directional design hour volume</td>
<td></td>
</tr>
</tbody>
</table>

**Factor Location**

- E_R - Exhibits 11-10, 11-12
- f_LW - Exhibit 11-8
- E_T - Exhibits 11-10, 11-11, 11-13
- f_{LC} - Exhibit 11-9
- f_p - Page 11-18
- TRD - Page 11-11
- LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: PM Peak Hour
- **Project Description**: Ohio River Bridges Project

### Site Information
- **Highway/Direction of Travel**: I-65 Southbound
- **Between**: I-64 Off and I-64 On
- **Jurisdiction**: 12-5.1
- **Analysis Year**: 2010

### Flow Inputs
- **Volume, V**: 1800 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %Trucks and Buses, P_T
- **Peak-Hr Direction Prop, D**: %RVs, P_R
- **DDHV = AADT x K x D**: veh/h

### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_T**: 1.5
- **E_R**: 1.2
- **f_{HV} = \frac{1}{4} (1 + P_T (E_T - 1) + P_R (E_R - 1))**: 0.889

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

### Calc Speed Adj and FFS
- **f_{LW}**: mph
- **f_{LC}**: mph
- **TRD Adjustment**: mph
- **FFS**: 60.0 mph

### LOS and Performance Measures
- **V_p = (V or DDHV) / (PHF x N x f_{HV})**: pc/h/in
- **D = V_p / S**: pc/mi/in

### Design (N)
- **Design LOS**:
- **Design N**:
- **Required Number of Lanes, N**

### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **V_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

### Factor Location
- **E_R**: Exhibits 11-10, 11-12
- **f_{LW}**: Exhibit 11-8
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_{LC}**: Exhibit 11-9
- **f_p**: Page 11-18
- **TRD**: Page 11-11
- **LOS, S, FFS, V_p**: Exhibits 11-2, 11-3

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2/24/2012
# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: PM Peak Hour
- **Project Description**: Ohio River Bridges Project

## Site Information
- **Highway/Direction of Travel**: I-64 Eastbound
- **From/To**: West of Kennedy
- **Jurisdiction**: 21-1.1
- **Analysis Year**: 2010

## Flow Inputs
- **Volume, V**: 4200 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: veh/h
- **Peak-Hr Direction Prop, D**: veh/h
- **Peak-Hr Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 6
- **%RVs, P_R**: 0
- **General Terrain**: Level
- **Grade % Length mi**: Up/Down %

## Calculate Flow Adjustments
- \( f_p = 1.00 \)
- \( E_R = 1.2 \)
- \( f_{HV} = \frac{1}{1+P_T(E_T - 1) + P_R(E_R - 1)} \times 0.971 \)

## Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

## Speed Adj and FFS
- **Calc Speed Adj**: mph
- **FFS**: mph

## LOS and Performance Measures
- **LOS and Performance Measures**: Required Number of Lanes, N
- **Operational (LOS)**
  - \( v_p = \frac{(V \text{ or } DDHV)}{(PHF \times N \times f_{HV}} \times f_p) \)
  - \( S \) = 60.0 mph
  - \( D = \frac{v_p}{S} \)
  - \( D = \frac{v_p}{S} \)
  - \( LOS \)

## Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume
- **S**: Speed
- **D**: Density
- **FFS**: Free-flow speed

## Factor Location
- **E_R - Exhibits 11-10, 11-12**: f_LW - Exhibit 11-8
- **E_T - Exhibits 11-10, 11-11, 11-13**: f_LC - Exhibit 11-9
- **f_p - Page 11-18**: TRD - Page 11-11
- **LOS, S, FFS, v_p - Exhibits 11-2, 11-3**: HCS 2010™ Version 6.1

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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information
- **Analyst:** Adams
- **Agency or Company:** Parsons
- **Date Performed:** 11/7/11
- **Analysis Time Period:** PM Peak Hour
- **Project Description:** Ohio River Bridges

## Site Information
- **Highway/Direction of Travel:** I-64 Eastbound
- **From/To:** Between I-55 Off and River
- **Jurisdiction:** 21-2.1
- **Analysis Year:** 2010

## Flow Inputs
- **Volume, V:** 2950 veh/h
- **AADT:** veh/day
- **Peak-Hr Prop. of AADT, K:**
- **Peak-Hr Direction Prop, D:** veh/h
- **Peak-Hour Factor, PHF:** 0.92
- **%Trucks and Buses, P_T:** 7
- **%RVs, P_R:** 0
- **General Terrain:** Level
- **Grade:** %
- **Length:** mi
- **Up/Down %:**

## Calculate Flow Adjustments
- **f_p:** 1.00
- **E_T:** 1.5
  - **f_HV = 1/(1+P_T(E_T - 1) + P_R(E_R - 1))/0.966**
- **E_R:** 1.2

## Speed Inputs
- **Lane Width:** ft
  - **f_LW:** mph
- **Rt-Side Lat. Clearance:** ft
  - **f_LC:** mph
- **Number of Lanes, N:** 2 ramps/mi
  - **TRD Adjustment:** mph
- **Total Ramp Density, TRD:**
  - **FFS (measured):** 60.0 mph
  - **FFS:** mph
  - **BFFS:** mph

## LOS and Performance Measures
- **Operational (LOS):**
  - **Design (N):**
- **v_p = (V or DDHV) / (PHF x N x f_HV)**
  - **v_p = (V or DDHV) / (PHF x N x f_HV)**
  - **v_p:** pc/h/ln
  - **S:** 59.9 mph
  - **D:** 27.7 pc/mi/ln
  - **LOS:**

## Glossary
- **N:** Number of lanes
- **V:** Hourly volume
- **V_p:** Flow rate
- **LOS:** Level of service
- **DDHV:** Directional design hour volume

## Factor Location
- **E_R:** Exhibits 11-10, 11-12
- **f_LW:** Exhibit 11-8
- **E_T:** Exhibits 11-10, 11-11, 11-13
- **f_LC:** Exhibit 11-9
- **f_p:** Page 11-18
- **TRD:** Page 11-11
- **LOS, S, FFS, v_p:** Exhibits 11-2, 11-3

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**BASIC FREEWAY SEGMENTS WORKSHEET**

<table>
<thead>
<tr>
<th><strong>General Information</strong></th>
<th><strong>Site Information</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyst</td>
<td>Adams</td>
</tr>
<tr>
<td>Agency or Company</td>
<td>Highway/Direction of Travel I-64 Eastbound</td>
</tr>
<tr>
<td>Date Performed</td>
<td>Parsons</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>From/To Between River On and I-71</td>
</tr>
<tr>
<td>Project Description</td>
<td>11/7/11</td>
</tr>
<tr>
<td></td>
<td>Jurisdiction</td>
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<tr>
<td></td>
<td>Analysis Year</td>
</tr>
<tr>
<td></td>
<td>Ohio River Bridges Project</td>
</tr>
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<table>
<thead>
<tr>
<th><strong>Flow Inputs</strong></th>
<th><strong>Oper. (LOS)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume, V (veh/h)</td>
<td>3800</td>
</tr>
<tr>
<td>AADT (veh/day)</td>
<td>Peak-Hour Factor, PHF 0.92</td>
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<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td>%Trucks and Buses, P_T 5</td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
<td>%RVs, P_R 0</td>
</tr>
<tr>
<td>DDHV = AADT x K x D (veh/h)</td>
<td>General Terrain: Level</td>
</tr>
<tr>
<td></td>
<td>Grade % Length mi Up/Down %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Calculate Flow Adjustments</strong></th>
<th><strong>Des. (N)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>f_p</td>
<td>1.00</td>
</tr>
<tr>
<td>E_T</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>$f_{HV} = \frac{1}{1+P_T(E_T - 1) + P_R(E_R - 1)} \times 0.976$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Speed Inputs</strong></th>
<th><strong>Calc Speed Adj and FFS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane Width (ft)</td>
<td>TRD Adjustment</td>
</tr>
<tr>
<td>Rt-Side Lat. Clearance (ft)</td>
<td>f_LW</td>
</tr>
<tr>
<td>Number of Lanes, N (2)</td>
<td>f_LC</td>
</tr>
<tr>
<td>Total Ramp Density, TRD (ramps/mi)</td>
<td></td>
</tr>
<tr>
<td>FFS (measured) (mph)</td>
<td>FFS</td>
</tr>
<tr>
<td>Base free-flow Speed, mph</td>
<td>60.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>LOS and Performance Measures</strong></th>
<th><strong>Design (N)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational (LOS)</td>
<td>Design LOS</td>
</tr>
<tr>
<td>$v_p = \frac{(V \text{ or } DDHV)}{(PHF \times N \times f_{LW}^{2117}}$</td>
<td>$v_p = \frac{(V \text{ or } DDHV)}{(PHF \times N \times f_{HV}}$</td>
</tr>
<tr>
<td>S (55.1 mph)</td>
<td>$S$</td>
</tr>
<tr>
<td>D = $v_p / S$</td>
<td>$D = v_p / S$</td>
</tr>
<tr>
<td>LOS</td>
<td>Required Number of Lanes, N</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Glossary</strong></th>
<th><strong>Factor Location</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>N - Number of lanes</td>
<td>E_R - Exhibits 11-10, 11-12</td>
</tr>
<tr>
<td>V - Hourly volume</td>
<td>$f_{LW}$ - Exhibit 11-8</td>
</tr>
<tr>
<td>$v_p$ - Flow rate</td>
<td>$E_T$ - Exhibits 11-10, 11-11, 11-13</td>
</tr>
<tr>
<td>LOS - Level of service</td>
<td>$f_p$ - Page 11-18</td>
</tr>
<tr>
<td>DDHV - Directional design hour volume</td>
<td>TRD - Page 11-11</td>
</tr>
</tbody>
</table>

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# BASIC FREEWAY SEGMENTS WORKSHEET

<table>
<thead>
<tr>
<th>General Information</th>
<th>Site Information</th>
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</thead>
<tbody>
<tr>
<td>Analyst</td>
<td>Adams</td>
</tr>
<tr>
<td>Agency or Company</td>
<td>Parsons</td>
</tr>
<tr>
<td>Date Performed</td>
<td>11/7/11</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>PM Peak Hour</td>
</tr>
<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project</td>
</tr>
<tr>
<td></td>
<td>Highway/Direction of Travel I-64 Eastbound From/To East of Story Avenue Jurisdiction 21-6.1 Analysis Year 2010</td>
</tr>
<tr>
<td>Oper.(LOS)</td>
<td>Des.(N)</td>
</tr>
</tbody>
</table>

## Flow Inputs

<table>
<thead>
<tr>
<th>Volume, V</th>
<th>3400 veh/h</th>
<th>Peak-Hour Factor, PHF</th>
<th>0.92</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADT</td>
<td>veh/day</td>
<td>%Trucks and Buses, PT</td>
<td>5</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td>%RVs, PR</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
<td>General Terrain:</td>
<td>Level</td>
<td></td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>veh/h</td>
<td>Grade</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Calculate Flow Adjustments

\[
E_R = 1.2 \\
E_T = 1.5 \\
f_{HV} = \frac{1}{\frac{1}{1+P_T(E_T - 1)} + P_R(E_R - 1)} = 0.976
\]

## Speed Inputs

<table>
<thead>
<tr>
<th>Lane Width</th>
<th>ft</th>
<th>FFS (measured)</th>
<th>mph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
<td>TRD Adjustment</td>
<td>mph</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>60.0</td>
<td>FFS</td>
<td>60.0 mph</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Calc Speed Adj and FFS

<table>
<thead>
<tr>
<th>Lane Width</th>
<th>ft</th>
<th>FFS (measured)</th>
<th>mph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
<td>TRD Adjustment</td>
<td>mph</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>60.0</td>
<td>FFS</td>
<td>60.0 mph</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## LOS and Performance Measures

Operational (LOS)

\[
v_p = \frac{(V \text{ or DDHV})}{(PHF \times N \times f_{HV} \times f_p)} \]

\[
v_p = \frac{(V \text{ or DDHV})}{(PHF \times N \times f_{HV} \times f_p)} \]

\[
x = \frac{1894}{\text{pc/h/ln}} \]

\[
S = 58.4 \text{ mph} \]

\[
D = \frac{v_p}{S} = 32.4 \text{ pc/mi/ln} \]

LOS = \[
D = \frac{v_p}{S} = 32.4 \text{ pc/mi/ln} \]

Required Number of Lanes, N

## Glossary

<table>
<thead>
<tr>
<th>N - Number of lanes</th>
<th>S - Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>V - Hourly volume</td>
<td>D - Density</td>
</tr>
<tr>
<td>v_p - Flow rate</td>
<td>FFS - Free-flow speed</td>
</tr>
<tr>
<td>LOS - Level of service</td>
<td>BFFS - Base free-flow speed</td>
</tr>
<tr>
<td>DDHV - Directional design hour volume</td>
<td></td>
</tr>
</tbody>
</table>

## Factor Location

<table>
<thead>
<tr>
<th>E_R - Exhibits 11-10, 11-12</th>
<th>f_{HV} - Exhibit 11-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>E_T - Exhibits 11-10, 11-11, 11-13</td>
<td>f_{LC} - Exhibit 11-9</td>
</tr>
<tr>
<td>f_p - Page 11-18</td>
<td>TRD - Page 11-11</td>
</tr>
<tr>
<td>LOS, S, FFS, v_p - Exhibits 11-2, 11-3</td>
<td></td>
</tr>
</tbody>
</table>

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2/24/2012
# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: PM Peak Hour
- **Project Description**: Ohio River Bridges Project

## Site Information
- **Highway/Direction of Travel**: I-64 Westbound
- **From/To**: East of Story Avenue
- **Jurisdiction**: 22-1.1
- **Analysis Year**: 2010

## Flow Inputs
- **Volume, V**: 2250 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**:
- **Peak-Hr Direction Prop, D**: veh/h

## Calculate Flow Adjustments
- \( f_p \) = 1.00
- \( E_T \) = 1.5

## Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph

## LOS and Performance Measures
- **Operational (LOS)**
  - \( v_p \) = \( \frac{(V \text{ or } DDHV)}{(PHF \times N \times f_{HV} \times f_{p})} \)
  - \( S \) = 60.0 mph
  - \( D = v_p / S \)

## Glossary
- **N** - Number of lanes
- **V** - Hourly volume
- **v_p** - Flow rate
- **LOS** - Level of service
- **DDHV** - Directional design hour volume

## Factor Location
- **E_T** - Exhibits 11-10, 11-11, 11-13
- **f_{LC}** - Exhibit 11-9
- **f_{P}** - Page 11-18
- **LOS, S, FFS, v_p** - Exhibits 11-2, 11-3
# BASIC FREeways WORKSHEET

## General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: PM Peak Hour
- **Project Description**: Ohio River Bridges Project
- **Highway/Direction of Travel**: I-64 Westbound
- **From/To**: Between I-71 On and I65
- **Jurisdiction**: 22-4.1
- **Analysis Year**: 2010

## Site Information
- **Peak-Hour Factor, PHF**: 0.92
- **Trucks and Buses, P_T**: 8
- **%RVs, P_R**: 0
- **General Terrain**: Level
- **Grade %**: Up/Down %

## Flow Inputs
- **Volume, V**: 2700 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: veh/h
- **Peak-Hr Direction Prop, D**: D
- **DDHV = AADT x K x D**: veh/h

## Calculate Flow Adjustments

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>f_p</td>
<td>1.00</td>
</tr>
<tr>
<td>E_T</td>
<td>1.5</td>
</tr>
<tr>
<td>E_R</td>
<td>1.2</td>
</tr>
<tr>
<td>F_HV</td>
<td>0.962</td>
</tr>
</tbody>
</table>

## Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

## Calc Speed Adj and FFS
- **f_LW**: mph
- **f_LC**: mph
- **TRD Adjustment**: mph
- **FFS**: 60.0 mph

## LOS and Performance Measures
- **Operational (LOS)**
  - **v_p = (V or DDHV) / (PHF x N x f_HV)**: pc/h/ln
  - **S**: 60.0 mph
  - **D = v_p / S**: 25.4 pc/mi/ln
- **LOS**: C

## Design (N)
- **Design (N)**
- **Design LOS**

## Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

## Factor Location
- **E_R - Exhibits 11-10, 11-12**: f_LW - Exhibit 11-8
- **E_T - Exhibits 11-10, 11-11, 11-13**: f_LC - Exhibit 11-9
- **f_p - Page 11-18**: TRD - Page 11-11
- **LOS, S, FFS, v_p - Exhibits 11-2, 11-3**

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2/24/2012
# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: PM Peak Hour
- **Project Description**: Ohio River Bridges Project

## Site Information
- **Highway/Direction of Travel**: I-64 Westbound
- **From/To**: West of Third Street
- **Jurisdiction**: 22-6.1
- **Analysis Year**: 2010

## Flow Inputs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Volume, V</td>
<td>3300 veh/h</td>
</tr>
<tr>
<td>AADT</td>
<td>veh/day</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td>%</td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
<td>veh/h</td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>veh/h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak-Hour Factor, PHF</td>
<td>0.92</td>
</tr>
<tr>
<td>%Trucks and Buses, pT</td>
<td>6</td>
</tr>
<tr>
<td>%RVs, pR</td>
<td>0</td>
</tr>
<tr>
<td>General Terrain</td>
<td>Level</td>
</tr>
<tr>
<td>Grade</td>
<td>%</td>
</tr>
<tr>
<td>Length</td>
<td>mi</td>
</tr>
<tr>
<td>Up/Down</td>
<td>%</td>
</tr>
</tbody>
</table>

## Calculate Flow Adjustments

- f_p = 1.00
- E_R = 1.2
- \[ f_{HV} = \frac{1}{f_p + E_T (f_{AC} - 1) + E_R (f_{AC} - 1)} \]

## Speed Inputs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane Width</td>
<td>ft</td>
</tr>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>3</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>mph</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
</tr>
</tbody>
</table>

## Calc Speed Adj and FFS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>f_LW</td>
<td>mph</td>
</tr>
<tr>
<td>f_LC</td>
<td>mph</td>
</tr>
<tr>
<td>TRD Adjustment</td>
<td>mph</td>
</tr>
<tr>
<td>FFS</td>
<td>60.0 mph</td>
</tr>
</tbody>
</table>

## LOS and Performance Measures

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational (LOS)</td>
<td></td>
</tr>
<tr>
<td>( v_p = \frac{V \times DDHV}{(PHF \times N \times f_{HV})} )</td>
<td>pc/h/ln</td>
</tr>
<tr>
<td>S</td>
<td>60.0 mph</td>
</tr>
<tr>
<td>D = ( \frac{v_p}{S} )</td>
<td>20.5 pc/mi/ln</td>
</tr>
<tr>
<td>LOS</td>
<td>C</td>
</tr>
</tbody>
</table>

## Design (N)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Design LOS</td>
<td></td>
</tr>
<tr>
<td>Design ( v_p = \frac{V \times DDHV}{(PHF \times N \times f_{HV})} )</td>
<td>pc/h/ln</td>
</tr>
<tr>
<td>S</td>
<td>mph</td>
</tr>
<tr>
<td>D = ( \frac{v_p}{S} )</td>
<td>pc/hi/ln</td>
</tr>
<tr>
<td>Required Number of Lanes, N</td>
<td></td>
</tr>
</tbody>
</table>

## Glossary

- N - Number of lanes
- V - Hourly volume
- \( v_p \) - Flow rate
- LOS - Level of service
- DDHV - Directional design hour volume
- S - Speed
- D - Density
- FFS - Free-flow speed
- BFFS - Base free-flow speed

## Factor Location

- \( E_R \) - Exhibits 11-10, 11-12
- \( f_{LW} \) - Exhibit 11-8
- \( E_T \) - Exhibits 11-10, 11-11, 11-13
- \( f_{LC} \) - Exhibit 11-9
- \( f_p \) - Page 11-18
- TRD - Page 11-11
- LOS, S, FFS, \( v_p \) - Exhibits 11-2, 11-3

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2/24/2012
# BASIC FREEWAY WORKSHEET

## GENERAL INFORMATION

**Analyst:** Adams  
**Agency or Company:** Parsons  
**Date Performed:** 11/7/11  
**Analysis Time Period:** PM Peak Hour  
**Project Description:** Ohio River Bridges Project

## SITE INFORMATION

**Highway/Direction of Travel:** I-71 Northbound  
**From/To:** Btw I-64WB Off and I-65 SB  
**Jurisdiction:** 31-1.1  
**Analysis Year:** 2010

---

## FLOW INPUTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume, V</td>
<td>2300 veh/h</td>
</tr>
<tr>
<td>AADT</td>
<td>veh/day</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td>%RVs, P_R</td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
<td>General Terrain: Level</td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>veh/h</td>
</tr>
</tbody>
</table>

### Calculate Flow Adjustments

- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( E_R = 1.2 \)
- \( f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} \times 0.980 \)

### Speed Inputs

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane Width</td>
<td>ft</td>
</tr>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>2</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>60.0 mph</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
</tr>
</tbody>
</table>

### Calc Speed Adj and FFS

- \( f_{LW} \)
- \( f_L C \)
- \( TRD \) Adjustment
- \( FFS \) 60.0 mph

## LOS AND PERFORMANCE MEASURES

### Operational (LOS)

\[
V_p = \left( \frac{V \text{ or DDHV}}{PHF \times N \times f_{HV}} \right) x f_p \text{ pc/h/ln} \\
S = 60.0 \text{ mph} \\
D = \frac{V_p}{S} \text{ pc/mi/ln} \\
LOS = C \\
\]

### Design (N)

- Design LOS
- Required Number of Lanes, N

---

## GLOSSARY

- **N**: Number of lanes  
- **V**: Hourly volume  
- **v_p**: Flow rate  
- **LOS**: Level of service  
- **DDHV**: Directional design hour volume

---

## FACTOR LOCATION

- \( E_R \): Exhibits 11-10, 11-12  
- \( f_{LW} \): Exhibit 11-8  
- \( E_T \): Exhibits 11-10, 11-11, 11-13  
- \( f_L C \): Exhibit 11-9  
- \( f_p \): Page 11-18  
- TRD: Page 11-11  
- LOS, S, FFS, \( v_p \): Exhibits 11-2, 11-3

---

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**Generated:** 2/24/2012 4:07 PM
### BASIC FREEWAY SEGMENTS WORKSHEET

#### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: PM Peak Hour
- **Project Description**: Ohio River Bridges Project

#### Site Information
- **Highway/Direction of Travel**: I-71 Northbound
- **From/To**: Btw I64EB On & Zorn Off
- **Jurisdiction**: 31-4.1
- **Analysis Year**: 2010

#### Flow Inputs
- **Volume, V**: 3750 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %
- **Peak-Hr Direction Prop, D**: %
- **DDHV = AADT x K x D**: veh/h

#### Calculate Flow Adjustments

\[
E_R = 1.2 \\
E_T = 1.5 \\
f_{HV} = \frac{1}{f_p (1 + P_T (E_T - 1) + P_R (E_R - 1))} 0.976
\]

#### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph

#### Calc Speed Adj and FFS
- **f_{LVW}**
- **f_{LC}**
- **TRD Adjustment**
- **FFS**

#### LOS and Performance Measures

#### Design (N)

#### Glossary

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Hourly volume</td>
</tr>
<tr>
<td>v_p</td>
<td>Flow rate</td>
</tr>
<tr>
<td>LOS</td>
<td>Level of service</td>
</tr>
<tr>
<td>DDHV</td>
<td>Directional design hour volume</td>
</tr>
</tbody>
</table>

### Factor Location

- **E_R**: Exhibits 11-10, 11-12
- **f_{LVW}**: Exhibit 11-8
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_{LC}**: Exhibit 11-9
- **f_p**: Page 11-18
- **TRD**: Page 11-11

- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3

---

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HCS 2010™ Version 6.1 Generated: 24/02/2012 4:07 PM
# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

<table>
<thead>
<tr>
<th>Artist</th>
<th>Adams</th>
</tr>
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<tr>
<td>Agency or Company</td>
<td>Parsons</td>
</tr>
<tr>
<td>Date Performed</td>
<td>11/7/11</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>PM Peak Hour</td>
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<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project</td>
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## Site Information

<table>
<thead>
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<th>Highway/Direction of Travel</th>
<th>I-71 Southbound</th>
</tr>
</thead>
<tbody>
<tr>
<td>From/To</td>
<td>Btw Zorn On &amp; I64WB Off</td>
</tr>
<tr>
<td>Jurisdiction</td>
<td>32-1.1</td>
</tr>
<tr>
<td>Analysis Year</td>
<td>2010</td>
</tr>
</tbody>
</table>

## Flow Inputs

| Volume, V               | 2500 veh/h    |
| AADT                    | veh/day       |
| Peak-Hr Prop. of AADT, K| %Trucks and Buses, P_T |
| Peak-Hr Direction Prop, D| %RVs, P_R    |
| DDHV = AADT x K x D    | veh/h         |

### Calculate Flow Adjustments

| f_p          | 1.00       |
| f_T          | 1.5        |

### Speed Inputs

<table>
<thead>
<tr>
<th>Lane Width</th>
<th>ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>2</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>60.0 mph</td>
</tr>
</tbody>
</table>

## LOS and Performance Measures

### Operational (LOS)

\[
\begin{align*}
V_p &= \left( \frac{V \times DDHV}{PHF \times L \times f_{HV} \times f_p} \right) \\
S &= \left( \frac{60.0}{23.3} \right) \\
D &= \left( \frac{23.3}{60.0} \right)
\end{align*}
\]

### Design (N)

#### Design LOS

<table>
<thead>
<tr>
<th>V_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)</th>
<th>pc/h/ln</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>mph</td>
</tr>
<tr>
<td>D = v_p / S</td>
<td>pc/mi/ln</td>
</tr>
<tr>
<td>LOS</td>
<td></td>
</tr>
</tbody>
</table>

## Glossary

- **N** - Number of lanes
- **V** - Hourly volume
- **V_p** - Flow rate
- **LOS** - Level of service
- **DDHV** - Directional design hour volume
- **S** - Speed
- **D** - Density
- **f_p** - Exhibit 11-10, 11-12
- **f_{HV}** - Exhibit 11-9
- **LOS** - Exhibit 11-12, 11-3
- **FFS** - Free-flow speed
- **BFFS** - Base free-flow speed
- **E_R** - Exhibit 11-10, 11-12
- **E_T** - Exhibit 11-10, 11-11, 11-13
- **f_{LC}** - Exhibit 11-9
- **TRD** - Page 11-11

## Factor Location

- **E_R** - Exhibits 11-10, 11-12
- **E_T** - Exhibits 11-10, 11-11, 11-13
- **f_{LC}** - Exhibit 11-9
- **TRD** - Page 11-11
- **LOS, S, FFS, V_p** - Exhibits 11-2, 11-3

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# BASIC FREEWAY WORKSHEET

## General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: PM Peak Hour

## Site Information
- **Highway/Direction of Travel**: I-71 Southbound
- **From/To**: Btw I-64WB Off and I-64WB
- **Jurisdiction**: 32-2.1
- **Analysis Year**: 2010

## Project Description
- **Project**: Ohio River Bridges Project

## Flow Inputs
- **Volume, V**: 1450 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %Trucks and Buses, PT
- **Peak-Hr Direction Prop, D**: %RVs, PR
- **DDHV = AADT x K x D**: veh/h

## Calculate Flow Adjustments
- **E_R**: 1.2
- **f_p**: 1.00
- **E_T**: 1.5
- **f_HV = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]**: 0.976

## Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

## LOS and Performance Measures
- **Operational (LOS)**
  - \( v_p = \frac{(V \text{ or } \text{DDHV}) \times f_p}{(PHF \times N \times f_{HV})^{0.8}} \) pc/h/ln
  - \( S = 60.0 \) mph
  - \( D = \frac{v_p}{S} \) pc/mi/ln
  - **LOS**

## Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

## Design (N)
- **Design (N)**
- **Design LOS**

## Factor Location
- **E_R**: Exhibits 11-10, 11-12
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_p**: Page 11-18
- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3
## Basic Freeway Segments Worksheet

### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 11/7/11
- **Analysis Time Period**: PM Peak Hour
- **Project Description**: Ohio River Bridges Project

### Site Information
- **Highway/Direction of Travel**: I-71 Southbound
- **From/To**: I-85NB Off & I-64EB On
- **Jurisdiction**: 32-4.1
- **Analysis Year**: 2010

### Flow Inputs
- **Volume, V**: 800 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %
- **Peak-Hr Direction Prop, D**: %
- **DDHV = AADT x K x D**: veh/h
  - **Peak-Hour Factor, PHF**: 0.92
  - **%Trucks and Buses, P_T**: 6
  - **%RVs, P_R**: 0
  - **General Terrain**: Level
  - **Grade**: %
  - **Length**: mi
  - **Up/Down %**:

### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_R**: 1.2
- **E_T**: 1.5
- **f_HV = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]**: 0.971

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 55.0 mph
- **Base free-flow Speed, BFFS**: mph

### Calc Speed Adj and FFS
- **f_LW**: mph
- **f_LC**: mph
- **TRD Adjustment**: mph
- **FFS**: 55.0 mph

### LOS and Performance Measures
- **Operational (LOS)**
  - **v_p = (V or DDHV) / (PHF x N x f_HV x f_p)**: pc/h/ln
  - **S**: 55.0 mph
  - **D = v_p / S**: pc/mi/ln
  - **LOS**: A

### Glossary
- **N - Number of lanes**
- **V - Hourly volume**
- **v_p - Flow rate**
- **LOS - Level of service**
- **DDHV - Directional design hour volume**

### Design (N)
- **Required Number of Lanes, N**

### Factor Location
- **E_R - Exhibits 11-10, 11-12**
- **E_T - Exhibits 11-10, 11-11, 11-13**
- **f_LW - Exhibit 11-8**
- **f_LC - Exhibit 11-9**
- **Page 11-18**
- **TRD - Page 11-11**

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2/24/2012
Ohio River Bridges Project

**FREeway weaving WORKSHEET**

### General Information
- **Analyst:** Adams
- **Agency/Company:** Parsons
- **Date Performed:** 10/28/2011
- **Analysis Time Period:** PM Peak Hour

### Site Information
- **Freeway/Dir of Travel:** I-65 Northbound 11-3.1
- **Weaving Segment Location:** Btw All On & I64/I71 Off
- **Analysis Year:** 2010

### Project Description
- **Ohio River Bridges Project**

### Inputs
- **Weaving configuration:** One-Sided
- **Weaving number of lanes, N:** 4
- **Weaving segment length, Ls:** 2100 ft
- **Freeway free-flow speed, FFS:** 60 mph

### Segment type
- **Freeway minimum speed, S_{MIN}**
- **Freeway maximum capacity, C_{FRL}**
- **Terrain type:** Level

### Conversions to pc/h Under Base Conditions

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_{HV}</th>
<th>f_p</th>
<th>v (pc/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{FF}</td>
<td>1900</td>
<td>0.92</td>
<td>33</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.858</td>
<td>1.00</td>
</tr>
<tr>
<td>V_{RF}</td>
<td>2000</td>
<td>0.92</td>
<td>3</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.985</td>
<td>1.00</td>
</tr>
<tr>
<td>V_{RR}</td>
<td>1100</td>
<td>0.92</td>
<td>3</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.985</td>
<td>1.00</td>
</tr>
<tr>
<td>V_{NW}</td>
<td>1200</td>
<td>0.92</td>
<td>33</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.858</td>
<td>1.00</td>
</tr>
<tr>
<td>V_{W}</td>
<td>3730</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V =</td>
<td></td>
</tr>
<tr>
<td>VR</td>
<td>3421</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Configuration Characteristics
- **Minimum maneuver lanes, N_{WL}**
- **Interchange density, ID:** 3 lc
- **Minimum RF lane changes, LC_{RF}**
- **Minimum FR lane changes, LC_{FR}**
- **Minimum RR lane changes, LC_{RR}**

### Minimum weaving lane changes, LC_{MN}
- 2428 lc/h

### Weaving lane changes, LC_{W}
- 3149 lc/h

### Non-weaving lane changes, LC_{MN}
- 2521 lc/h

### Total lane changes, LC_{ALL}
- 5670 lc/h

### Non-weaving vehicle index, I_{NW}
- 0.495

### Weaving Segment Speed, Density, Level of Service, and Capacity
- **Weaving segment flow rate, v:** 7151 pc/h
- **Weaving segment capacity, c_w:** 6280 veh/h
- **Weaving segment v/c ratio:** 0.977
- **Weaving segment density, D:** 42.6 pc/mi/ln

### Weaving intensity factor, W
- 0.495

### Weaving segment speed, S
- 42.0 mph

### Average weaving speed, S
- 56.7 mph

### Average non-weaving speed, S_{NW}
- 33.9 mph

### Maximum weaving length, L_{MAX}
- 6009 ft

### Notes
- a. 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."
- b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Ohio River Bridges Project

FREEWAY WEAVING WORKSHEET

General Information

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<tr>
<th>Analyst</th>
<th>Adams</th>
<th>Freeway/Dir of Travel</th>
<th>I-65 Southbound 12-6.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency/Company</td>
<td>Parsons</td>
<td>Weaving Segment Location</td>
<td>Btw I54/I71 On &amp; Jefferson Off</td>
</tr>
<tr>
<td>Date Performed</td>
<td>10/28/2011</td>
<td>Analysis Year</td>
<td>2010</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>PM Peak Hour</td>
<td></td>
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</tr>
</tbody>
</table>

Project Description | Ohio River Bridges Project

Inputs

<table>
<thead>
<tr>
<th>Weaving configuration</th>
<th>One-Sided</th>
<th>Segment type</th>
<th>Freeway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaving number of lanes, N</td>
<td>4</td>
<td>Freeway minimum speed, $S_{MW}$</td>
<td>50</td>
</tr>
<tr>
<td>Weaving segment length, $l_s$</td>
<td>2175 ft</td>
<td>Freeway maximum capacity, $C_{FL}$</td>
<td>2300</td>
</tr>
<tr>
<td>Freeway free-flow speed, FFS</td>
<td>60 mph</td>
<td>Terrain type</td>
<td>Level</td>
</tr>
</tbody>
</table>

Conversions to pc/h Under Base Conditions

| $V_{FF}$ | 1550 | PHF | 0.92 | Truck (%) | 32 | RV (%) | 0 | $E_1$ | 1.5 | $E_R$ | 1.2 | $f_{HR}$ | 0.862 | $f_p$ | 1.00 | $V$ (pc/h) | 1954 |
| $V_{RF}$ | 250  | 0.92 | 4    | 0        | 1.5 | 1.2 | 0.980 | 1.00 | 277 |
| $V_{FR}$ | 1200 | 0.92 | 4    | 0        | 1.5 | 1.2 | 0.980 | 1.00 | 1330 |
| $V_{RR}$ | 200  | 0.92 | 32   | 0        | 1.5 | 1.2 | 0.862 | 1.00 | 1954 |
| $V_{NW}$ | 2176 |      |      |          |     |     |      | 3783 |
| $V_{W}$  | 1607 |      |      |          |     |     |      |      |
| $VR$     | 425  |      |      |          |     |     |      |      |

Configuration Characteristics

| Minimum maneuver lanes, $N_{WL}$ | 3 | Minimum weaving lane changes, $L_{C_{MIN}}$ | 554 l/c/h |
| Interchange density, ID | 2.70 int/mi | Weaving lane changes, $L_{C_{W}}$ | 1324 l/c/h |
| Minimum RF lane changes, $L_{C_{RF}}$ | 0 l/c | Non-weaving lane changes, $L_{C_{NW}}$ | 857 l/c/h |
| Minimum FR lane changes, $L_{C_{FR}}$ | 2 l/c | Total lane changes, $L_{C_{ALL}}$ | 2181 l/c/h |
| Minimum RR lane changes, $L_{C_{RR}}$ | l/c | Non-weaving vehicle index, $I_{NW}$ | 0.226 |

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, $v$ | 3783 pc/h | Weaving intensity factor, $W$ | 0.226 |
Weaving segment capacity, $c_w$ | 7083 veh/h | Weaving segment speed, $S_w$ | 54.1 mph |
Weaving segment v/c ratio | 0.460 | Average weaving speed, $S_{AV}$ | 58.2 mph |
Weaving segment density, $D$ | 17.5 pc/mi/h | Average non-weaving speed, $S_{NW}$ | 51.5 mph |
Level of Service, LOS | B | Maximum weaving length, $L_{MAX}$ | 5395 ft |

Notes

a. 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".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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<tr>
<th><strong>General Information</strong></th>
<th><strong>Site Information</strong></th>
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<tbody>
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<td><strong>Analyst</strong></td>
<td>Adams</td>
</tr>
<tr>
<td><strong>Agency/Company</strong></td>
<td>Parsons</td>
</tr>
<tr>
<td><strong>Date Performed</strong></td>
<td>10/28/2011</td>
</tr>
<tr>
<td><strong>Analysis Time Period</strong></td>
<td>PM Peak Hour</td>
</tr>
<tr>
<td><strong>Freeway/Dir of Travel</strong></td>
<td>I-64 Eastbound 21-5.1</td>
</tr>
<tr>
<td><strong>Weaving Segment Location</strong></td>
<td>Blw I-65 On &amp; Story Off</td>
</tr>
<tr>
<td><strong>Analysis Year</strong></td>
<td>2010</td>
</tr>
</tbody>
</table>

**Project Description** Ohio River Bridges Project

**Inputs**

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<thead>
<tr>
<th><strong>Weaving configuration</strong></th>
<th>Two-Sided</th>
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<tbody>
<tr>
<td><strong>Weaving number of lanes, N</strong></td>
<td>3</td>
</tr>
<tr>
<td><strong>Weaving segment length, L_s</strong></td>
<td>1425ft</td>
</tr>
<tr>
<td><strong>Freeway free-flow speed, FFS</strong></td>
<td>60 mph</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Segment type</strong></th>
<th>Freeway</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Freeway minimum speed, S_{MN}</strong></td>
<td>50</td>
</tr>
<tr>
<td><strong>Freeway maximum capacity, C_{FL}</strong></td>
<td>2300</td>
</tr>
<tr>
<td><strong>Terrain type</strong></td>
<td>Level</td>
</tr>
</tbody>
</table>

**Conversions to pc/h Under Base Conditions**

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_{hv}</th>
<th>f_p</th>
<th>V (pc/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{FF}</td>
<td>1860</td>
<td>0.92</td>
<td>5</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.976</td>
<td>1.00</td>
</tr>
<tr>
<td>V_{RF}</td>
<td>190</td>
<td>0.92</td>
<td>1</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.955</td>
<td>1.00</td>
</tr>
<tr>
<td>V_{FR}</td>
<td>1540</td>
<td>0.92</td>
<td>6</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.971</td>
<td>1.00</td>
</tr>
<tr>
<td>V_{RR}</td>
<td>160</td>
<td>0.92</td>
<td>5</td>
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**Configuration Characteristics**

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<th>Minimum maneuver lanes, N_{WL}</th>
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<tr>
<td>Interchange density, ID</td>
<td>2.00 int/mi</td>
</tr>
<tr>
<td>Minimum RF lane changes, L_{RF}</td>
<td>2 lc/pc</td>
</tr>
<tr>
<td>Minimum FR lane changes, L_{FR}</td>
<td>2 lc/pc</td>
</tr>
<tr>
<td>Minimum RR lane changes, L_{RR}</td>
<td>2 lc/pc</td>
</tr>
</tbody>
</table>

| Minimum weaving lane changes, L_{C_{MN}} | 350 lc/h |
| Weaving lane changes, L_{C_{W}} | 634 lc/h |
| Non-weaving lane changes, L_{C_{NW}} | 1019 lc/h |
| Total lane changes, L_{C_{ALL}} | 1653 lc/h |
| Non-weaving vehicle index, I_{NW} | 0.254 |

**Weaving Segment Speed, Density, Level of Service, and Capacity**

| Weaving segment flow rate, v | 4179 pc/h |
| Weaving segment capacity, c_{w} | 5681 veh/h |
| Weaving segment v/c ratio | 0.718 |
| Weaving segment density, D | 27.3 pc/mil |
| Level of Service, LOS | C |

| Weaving intensity factor, W | 0.254 |
| Weaving segment speed, S | 51.1 mph |
| Average weaving speed, S_{w} | 58.0 mph |
| Average non-weaving speed, S_{NW} | 50.8 mph |
| Maximum weaving length, L_{MAX} | 6117 ft |

**Notes**

a. 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".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".
**Ohio River Bridges Project**

### FREEWAY WEAVING WORKSHEET

#### General Information

<table>
<thead>
<tr>
<th>Analyst</th>
<th>Adams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency/Company</td>
<td>Parsons</td>
</tr>
<tr>
<td>Date Performed</td>
<td>10/28/2011</td>
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<tr>
<td>Analysis Time Period</td>
<td>PM Peak Hour</td>
</tr>
<tr>
<td>Freeway/Dir of Travel</td>
<td>I-64 Westbound 22-2.1</td>
</tr>
<tr>
<td>Weaving Segment Location</td>
<td>Btw Story On &amp; I-65 Off</td>
</tr>
<tr>
<td>Analysis Year</td>
<td>2010</td>
</tr>
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#### Project Description
Ohio River Bridges Project

#### Inputs

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<thead>
<tr>
<th>Weaving configuration</th>
<th>Two-Sided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaving number of lanes, N</td>
<td>3</td>
</tr>
<tr>
<td>Weaving segment length, L₃</td>
<td>1600ft</td>
</tr>
<tr>
<td>Freeway free-flow speed, FFS</td>
<td>60 mph</td>
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<tr>
<td>Segment type</td>
<td>Freeway</td>
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<tr>
<td>Freeway minimum speed, Sₘᵦ</td>
<td>50</td>
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<tr>
<td>Freeway maximum capacity, Cᵢₑ</td>
<td>2300</td>
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<tr>
<td>Terrain type</td>
<td>Level</td>
</tr>
</tbody>
</table>

#### Conversions to pc/h Under Base Conditions

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>Eₜ</th>
<th>Eᵣ</th>
<th>fₑ</th>
<th>fᵢ</th>
<th>V (pc/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_FF</td>
<td>1375</td>
<td>0.92</td>
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<td>V_FR</td>
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<td>1.5</td>
<td>1.2</td>
<td>0.955</td>
<td>1.00</td>
</tr>
<tr>
<td>V_RR</td>
<td>175</td>
<td>0.92</td>
<td>7</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.966</td>
<td>1.00</td>
</tr>
<tr>
<td>V_NW</td>
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<td></td>
<td>V = 3063</td>
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<tr>
<td>V_W</td>
<td>194</td>
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</tbody>
</table>

#### Configuration Characteristics

| Minimum maneuver lanes, Nᵦᵪ | 0 lc |
| Interchange density, ID | 1.80 in/mi |
| Minimum RF lane changes, LCᵦᵦ | lc/pc |
| Minimum FR lane changes, LCᵦᵦ | lc/pc |
| Minimum RR lane changes, LCᵦᵦ | 2 lc/pc |
| Minimum weaving lane changes, LCᵦᵦ | 388 lc/h |
| Weaving lane changes, LCᵦᵦ | 676 lc/h |
| Non-weaving lane changes, LCᵦᵦ | 880 lc/h |
| Total lane changes, LCᵦᵦ | 1556 lc/h |
| Non-weaving vehicle index, Iᵦᵦ | 0.221 |

#### Weaving Segment Speed, Density, Level of Service, and Capacity

| Weaving segment flow rate, v | 3063 pc/h |
| Weaving segment capacity, Cᵦ | 5620 veh/h |
| Weaving segment w/c ratio | 0.527 |
| Weaving segment density, D | 19.4 pc/mi/ln |
| Level of Service, LOS | B |
| Weaving intensity factor, W | 0.221 |
| Weaving segment speed, S | 52.6 mph |
| Average weaving speed, Sᵦ | 58.2 mph |
| Average non-weaving speed, Sᵦᵦ | 52.3 mph |
| Maximum weaving length, Lᵦᵦ | 6319 ft |

#### Notes

a. 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".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".
# Freeway Weaving Worksheet

**Ohio River Bridges Project**

## Freeway Weaving Worksheet

<table>
<thead>
<tr>
<th>General Information</th>
<th>Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyst</td>
<td>Freeway/Dir of Travel</td>
</tr>
<tr>
<td>Agency/Company</td>
<td>I-64 Westbound 22-5.1</td>
</tr>
<tr>
<td>Date Performed</td>
<td>Weaving Segment Location</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>Blw I-65 On &amp; 3rd Off</td>
</tr>
<tr>
<td></td>
<td>Analysis Year</td>
</tr>
<tr>
<td></td>
<td>2010</td>
</tr>
</tbody>
</table>

**Inputs**

- **Weaving configuration**: Two-Sided
- **Weaving number of lanes, N**: 4
- **Weaving segment length, Ls**: 1425 ft
- **Freeway free-flow speed, FFS**: 60 mph

- **Segment type**: Freeway
- **Freeway minimum speed, SMN**: 50
- **Freeway maximum capacity, CFNL**: 2300
- **Terrain type**: Level

## Conversions to pc/h Under Base Conditions

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_HV</th>
<th>f_P</th>
<th>V (pc/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2340</td>
<td>0.92</td>
<td>8</td>
<td>0</td>
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<td>360</td>
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<td>1.00</td>
<td>2645</td>
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<td>4' 01</td>
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<td>V = 4255</td>
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<td>VR 0.036</td>
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</table>

## Configuration Characteristics

- **Minimum maneuver lanes, NML**: 3
- **Minimum weaving lane changes, LCMN**: 154 lc/h
- **Weaving lane changes, LCW**: 631 lc/h
- **Non-weaving lane changes, LCMN**: 847 lc/h
- **Total lane changes, LCA**: 1478 lc/h
- **Non-weaving vehicle index, I_W**: 0.233

## Weaving Segment Speed, Density, Level of Service, and Capacity

- **Weaving segment flow rate, v**: 4255 pc/h
- **Weaving intensity factor, W**: 0.233
- **Weaving segment capacity, C_W**: 7481 veh/h
- **Average weaving speed, s_w**: 53.9 mph
- **Average non-weaving speed, s_W**: 58.1 mph
- **Maximum weaving length, l_MAX**: 6063 ft

### Notes

a. 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".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".
Ohio River Bridges Project

**FREeway WEAVING WORKSHEET**

<table>
<thead>
<tr>
<th>General Information</th>
<th>Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyst</td>
<td>Adams</td>
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<td>Agency/Company</td>
<td>Parsons</td>
</tr>
<tr>
<td>Date Performed</td>
<td>10/28/2011</td>
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<tr>
<td>Analysis Time Period</td>
<td>PM Peak Hour</td>
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<td></td>
<td>Freeway/Dir of Travel</td>
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<td>1-71 Northbound 31-2.1</td>
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<td></td>
<td>Weaving Segment Location</td>
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<tr>
<td></td>
<td>Btw I65SB On &amp; I64EB Off</td>
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<td></td>
<td>Analysis Year</td>
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**Project Description** Ohio River Bridges Project

**Inputs**

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<th>Input Parameter</th>
<th>Value</th>
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<tr>
<td>Weaving segment length, L_s</td>
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<tr>
<td>Freeway free-flow speed, FFS</td>
<td>60 mph</td>
</tr>
<tr>
<td>Segment type</td>
<td>Freeway</td>
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<tr>
<td>Freeway minimum speed, S_MN</td>
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<tr>
<td>Freeway maximum capacity, C_Fl</td>
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</tr>
<tr>
<td>Terrain type</td>
<td>Level</td>
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**Conversions to pc/h Under Base Conditions**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_HV</th>
<th>f_P</th>
<th>V (pc/h)</th>
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**Configuration Characteristics**

<table>
<thead>
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<th>Characteristic</th>
<th>Value</th>
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<tr>
<td>Minimum FR lane changes, L_CFR</td>
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<tr>
<td>Minimum RR lane changes, L_CRR</td>
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<tr>
<td>Minimum weaving lane changes, L_CMN</td>
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<tr>
<td>Weaving lane changes, L_CW</td>
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<tr>
<td>Non-weaving lane changes, L_CNW</td>
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<tr>
<td>Total lane changes, L_CA</td>
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</tr>
<tr>
<td>Non-weaving vehicle index, L_NV</td>
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</tr>
</tbody>
</table>

**Weaving Segment Speed, Density, Level of Service, and Capacity**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
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<td>4125 pc/h</td>
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<tr>
<td>Weaving segment v/c ratio</td>
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<td>Weaving segment density, D</td>
<td>pc/ml/h</td>
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<tr>
<td>Level of Service, LOS</td>
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<tr>
<td>Weaving intensity factor, W</td>
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<tr>
<td>Average weaving speed, S_w</td>
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<tr>
<td>Average non-weaving speed, S_NW</td>
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</tr>
<tr>
<td>Maximum weaving length, L_MAX</td>
<td>7417 ft</td>
</tr>
</tbody>
</table>

**Notes**

a. 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".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Ohio River Bridges Project

**FREEWAY WEAVING WORKSHEET**

<table>
<thead>
<tr>
<th>General Information</th>
<th>Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyst</td>
<td>Freeway/Dir of Travel</td>
</tr>
<tr>
<td>Agency/Company</td>
<td>I-71 Southbound 32-3.1</td>
</tr>
<tr>
<td>Date Performed</td>
<td>Weaving Segment Location</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>Btw I64WB On &amp; I65NB Off</td>
</tr>
<tr>
<td></td>
<td>Analysis Year</td>
</tr>
<tr>
<td></td>
<td>2010</td>
</tr>
</tbody>
</table>

Project Description: Ohio River Bridges Project

**Inputs**

- Weaving configuration: Two-Sided
- Weaving number of lanes, N: 2
- Weaving segment length, L: 1480 ft
- Freeway free-flow speed, FFS: 60 mph

<table>
<thead>
<tr>
<th>Segment type</th>
<th>Freeway minimum speed, S_{MIN}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50</td>
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<table>
<thead>
<tr>
<th>Terrain type</th>
<th>Freeway maximum capacity, C_{FL}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2300</td>
</tr>
</tbody>
</table>

**Conversions to pc/h Under Base Conditions**

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_{HV}</th>
<th>f_D</th>
<th>v (pc/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{FF}</td>
<td>460</td>
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<td>6</td>
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<td>1.5</td>
<td>1.2</td>
<td>0.971</td>
<td>1.00</td>
</tr>
<tr>
<td>V_{RF}</td>
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<td>7</td>
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<td>1.2</td>
<td>0.966</td>
<td>1.00</td>
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<td>V_{FR}</td>
<td>340</td>
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<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.971</td>
<td>1.00</td>
</tr>
<tr>
<td>V_{RR}</td>
<td>710</td>
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<td>1.5</td>
<td>1.2</td>
<td>0.971</td>
<td>1.00</td>
</tr>
</tbody>
</table>

V_{NW} 2010

V_{W} 826

VR 0.291

**Configuration Characteristics**

- Minimum maneuver lanes, N_{WL}: 0 lane
- Interchange density, ID: 2.20 in/mi
- Minimum RF lane changes, L_{RF}: 1c/pc
- Minimum FR lane changes, L_{RF}: 1c/pc
- Minimum RR lane changes, L_{RR}: 1c/pc

<table>
<thead>
<tr>
<th></th>
<th>Minimum weaving lane changes, L_{C_{MIN}}</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>826 lcf/h</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Weaving lane changes, L_{Cw}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>962 lcf/h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Non-weaving lane changes, L_{C_{NW}}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>831 lcf/h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Total lane changes, L_{C_{ALL}}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1793 lcf/h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Non-weaving vehicle index, I_{NW}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.263</td>
</tr>
</tbody>
</table>

**Weaving Segment Speed, Density, Level of Service, and Capacity**

- Weaving segment flow rate, ν: 2836 pc/h
- Weaving segment capacity, c_{w}: 3406 veh/h
- Weaving segment v/c ratio: 0.808
- Weaving segment density, D: 28.4 pc/mi/ln

<table>
<thead>
<tr>
<th></th>
<th>Weaving intensity factor, W</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.263</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Weaving segment speed, S</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>49.9 mph</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Average weaving speed, S_{W}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>57.9 mph</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Average non-weaving speed, S_{NW}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>47.2 mph</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Maximum weaving length, L_{MAX}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8622 ft</td>
</tr>
</tbody>
</table>

**Notes**

- Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merges and Diverge Segments".
- For volumes that exceed the weaving segment capacity, the level of service is "F".
# BASIC FREEWAY SEGMENTS WORKSHEET

<table>
<thead>
<tr>
<th>General Information</th>
<th>Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyst</td>
<td>Tony Lewis</td>
</tr>
<tr>
<td>Agency or Company</td>
<td>KTA</td>
</tr>
<tr>
<td>Date Performed</td>
<td>9/15/2011</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>AM</td>
</tr>
<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flow Inputs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume, V</td>
<td>1600 veh/h</td>
</tr>
<tr>
<td>AADT</td>
<td>veh/day</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td></td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
<td></td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>veh/h</td>
</tr>
</tbody>
</table>

### Calculate Flow Adjustments

\[
f_p = 1.00 \\
E_T = 1.5 \\
f_{HV} = \frac{1}{1 + P_T (E_T - 1) + P_R (E_R - 1)} = 0.966
\]

### Speed Inputs

<table>
<thead>
<tr>
<th>Lane Width</th>
<th>ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>2</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>60.0 mph</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
</tr>
</tbody>
</table>

### LOS and Performance Measures

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(v_p = \frac{(V \times DDHV)}{(PHF \times N \times f_{HV})} \times f_p)</td>
<td>900 pc/h/ln</td>
</tr>
<tr>
<td>S</td>
<td>60.0 mph</td>
</tr>
<tr>
<td>D = (v_p / S)</td>
<td>15.0 pc/mi/ln</td>
</tr>
<tr>
<td>LOS</td>
<td>B</td>
</tr>
</tbody>
</table>

### Design (N)

<table>
<thead>
<tr>
<th>Design (N)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Design LOS</td>
<td></td>
</tr>
<tr>
<td>(v_p = \frac{(V \times DDHV)}{(PHF \times N \times f_{HV})} \times f_p)</td>
<td>pc/h/ln</td>
</tr>
<tr>
<td>S</td>
<td>mph</td>
</tr>
<tr>
<td>D = (v_p / S)</td>
<td>pc/mi/ln</td>
</tr>
<tr>
<td>Required Number of Lanes, N</td>
<td></td>
</tr>
</tbody>
</table>

### Glossary

| N | Number of lanes |
| V | Hourly volume |
| \(v_p\) | Flow rate |
| LOS | Level of service |
| DDHV | Directional design hour volume |
| S | Speed |
| D | Density |
| BFFS | Base free-flow speed |
| FFS | Free-flow speed |

### Factor Location

| E_R | Exhibits 11-10, 11-12 |
| \(f_{LV}\) | Exhibit 11-8 |
| E_T | Exhibits 11-10, 11-11, 11-13 |
| \(f_{LC}\) | Exhibit 11-9 |
| \(f_p\) | Page 11-18 |
| TRD | Page 11-11 |
| LOS, S, FFS, \(v_p\) | Exhibits 11-2, 11-3 |

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# BASIC FREEWAY WORKSHEET

## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information

<table>
<thead>
<tr>
<th>Analyst</th>
<th>Tony Lewis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency or Company</td>
<td>KTA</td>
</tr>
<tr>
<td>Date Performed</td>
<td>9/15/2011</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>AM</td>
</tr>
<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project</td>
</tr>
</tbody>
</table>

### Site Information

| Highway/Direction of Travel | I-65 NB Mainline |
| From/To                     | North of I-64/71 On |
| Jurisdiction                | analysis        |
| Analysis Year               | 2030 No Build   |

### Flow Inputs

| Volume, V | 3900 veh/h |
| AADT      | veh/day    |
| Peak-Hr Prop. of AADT, K | %Trucks and Buses, P_T |
| Peak-Hr Direction Prop, D | %RVs, P_R |
| DDHV = AADT x K x D | veh/h |

### Calculate Flow Adjustments

| f_p | 1.00 |
| E_T | 1.5  |
| E_R | 1.2  |
| \( f_{HV} = \frac{1}{1+f_p(E_T-1)+f_R(E_R-1)} \) | 0.952 |

### Speed Inputs

| Lane Width | ft |
| Rt-Side Lat. Clearance | ft |
| Number of Lanes, N | 4 |
| Total Ramp Density, TRD | ramps/mi |
| FFS (measured) | 60.0 mph |
| Base free-flow Speed, BFSS | mph |

### Calc Speed Adj and FFS

| f_LW | mph |
| f_LC | mph |
| TRD Adjustment | mph |
| FFS | 60.0 mph |

### LOS and Performance Measures

### Design (N)

### Operational (LOS)

| \( v_p = \frac{(V \text{ or } DDHV)}{(PHF \times N \times f_{HV})} \) | pc/h/in |
| \( S = 60.0 \) mph | pc/h/in |
| \( D = v_p / S \) | pc/mi/in |
| LOS | C |

### Glossary

<table>
<thead>
<tr>
<th>N - Number of lanes</th>
<th>S - Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>V - Hourly volume</td>
<td>D - Density</td>
</tr>
<tr>
<td>( v_p ) - Flow rate</td>
<td>FFS - Free-flow speed</td>
</tr>
<tr>
<td>LOS - Level of service</td>
<td>BFSS - Base free-flow speed</td>
</tr>
<tr>
<td>DDHV - Directional design hour volume</td>
<td></td>
</tr>
</tbody>
</table>

### Factor Location

| E_R - Exhibits 11-10, 11-12 | \( f_{LV} \) - Exhibit 11-8 |
| E_T - Exhibits 11-10, 11-11, 11-13 | \( f_{LC} \) - Exhibit 11-9 |
| \( f_p \) - Page 11-18 | TRD - Page 11-11 |
| LOS, S, FFS, \( v_p \) - Exhibits 11-2, 11-3 | |

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## Basic Freeway Segments Worksheet

### General Information
- **Analyst**: Tony Lewis
- **Agency or Company**: KTA
- **Date Performed**: 9/15/2011
- **Analysis Time Period**: AM

### Site Information
- **Highway/Direction of Travel**: I-66 SB Mainline
- **From/To**: North of I-64/71 Off
- **Jurisdiction**: 
- **Analysis Year**: 2030 No Build
- **Project Description**: Ohio River Bridges Project

### Flow Inputs
- **Volume, V**: 7700 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: \%
- **Peak-Hr Direction Prop, D**: veh/h
- **DDHV = AADT x K x D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 11
- **%RVs, P_R**: 0

### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_R**: 1.2
- **f_{HV} = 1/(f_p + P_T/10 + P_R) = 0.948**

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

### LOS and Performance Measures
- **Operational (LOS)**
- **LOS**
- **Design (N)**

### Glossary
- **N** - Number of lanes
- **V** - Hourly volume
- **v_p** - Flow rate
- **LOS** - Level of service
- **DDHV** - Directional design hour volume

### Factor Location
- **E_R** - Exhibits 11-10, 11-12
- **f_{LVW}** - Exhibit 11-8
- **E_T** - Exhibits 11-10, 11-11, 11-13
- **f_{LC}** - Exhibit 11-9
- **f_p** - Page 11-18
- **D** - pc/h/ln
- **TRD** - Page 11-11
- **LOS, S, FFS, v_p** - Exhibits 11-2, 11-3

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### Basic Freeway Segments Worksheet

#### General Information
- Analyst: Tony Lewis
- Agency or Company: KTA
- Date Performed: 9/15/2011
- Analysis Time Period: AM
- Project Description: Ohio River Bridges Project

#### Site Information
- Highway/Direction of Travel: I-65 SB Mainline
- From/To: Btw I-64/71 Off and I-64/71 On
- Jurisdiction: Analysis Year: 2030 No Build

#### Flow Inputs
- Volume, V: 4100 veh/h
- AADT: 4100 veh/day
- Peak-Hr Prop. of AADT, K: 
- Peak-Hr Direction Prop, D: 
- DDHV = AADT x K x D: 4100 veh/h

#### Calculate Flow Adjustments
- \( f_p \): 1.00
- \( E_T \): 1.5
- \( E_R \): 1.2
- \( f_{HV} = \frac{1}{1 + P_T (E_T - 1) + P_R (E_R - 1)} \): 0.948

#### Speed Inputs
- Lane Width: 12 ft
- Rt-Side Lat. Clearance: 12 ft
- Number of Lanes, N: 2
- Total Ramp Density, TRD: ramps/mi
- FFS (measured): 60.0 mph
- Base free-flow Speed, BFFS: mph

#### LOS and Performance Measures

#### Design (N)
- Design LOS

#### Glossary
- N - Number of lanes
- V - Hourly volume
- \( v_p \) - Flow rate
- LOS - Level of service
- DDHV - Directional design hour volume

#### Factor Location
- \( E_R \) - Exhibits 11-10, 11-12
- \( f_LW \) - Exhibit 11-8
- \( E_T \) - Exhibits 11-10, 11-11, 11-13
- \( f_{LC} \) - Exhibit 11-9
- \( f_p \) - Page 11-18
- TRD - Page 11-11
- LOS, S, FFS, \( v_p \) - Exhibits 11-2, 11-3
## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information
- **Analyst**: Tony Lewis
- **Agency or Company**: KTA
- **Date Performed**: 9/15/2011
- **Analysis Time Period**: AM
- **Project Description**: Ohio River Bridge Project

### Site Information
- **Highway/Direction of Travel**: I-64 EB Mainline
- **From/To**: West of I-65 Off
- **Jurisdiction**: 2030 No Build
- **Analysis Year**: 2030 No Build

### Flow Inputs
- **Volume, V**: 4600 veh/h
- **AADT**: 4600 veh/day
- **Peak-Hr Prop. of AADT, K**: 80
- **Peak-Hr Direction Prop, D**: 80
- **DDHV = AADT x K x D**: 1200 veh/h

### Calculate Flow Adjustments
- **f_0**: 0.92
- **E_R**: 1.2
- **f_HV = f_0 + E_R**: 0.962

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/ft
- **FFS (measured)**: 60.0 mph

### LOS and Performance Measures
- **Operational (LOS)**
  - \( v_p = \frac{(V \text{ or DDHV})}{(\text{PHF} \times N \times f_{HV})} \)
  - \( S = \frac{v_p}{D} = 29.0 \text{ pc/mi/ln} \)

### Design (N)
- **Design LOS**
  - \( v_p = \frac{(V \text{ or DDHV})}{(\text{PHF} \times N \times f_{HV})} \)
  - \( S = \frac{v_p}{D} = 29.0 \text{ pc/mi/ln} \)

### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

### Factor Location
- **E_R**: Exhibits 11-10, 11-12
- **f_{LVW}**: Exhibit 11-8
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_{LC}**: Exhibit 11-9
- **f_p**: Page 11-18
- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3
## BASIC FREEWAY SECTIONS WORKSHEET

### General Information
- **Analyst**: Tony Lewis
- **Agency or Company**: KTA
- **Date Performed**: 9/15/2011
- **Analysis Time Period**: AM
- **Project Description**: Ohio River Bridges Project
- **Highway/Direction of Travel**: I-64 EB Mainline Btw River Rd. On and I-71
- **Jurisdiction**: From/To
- **Analysis Year**: 2030

### Site Information
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 7
- **%RVs, P_R**: 0
- **General Terrain**: Level
- **Grade**: %
- **Length**: mi

### Flow Inputs
- **Volume, V**: 3200 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: 
- **Peak-Hr Direction Prop, D**: veh/h

### Calculate Flow Adjustments
- \( f_p = 1.00 \)
- \( E_{TR} = 1.5 \)

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFSS**: mph

### LOS and Performance Measures
- **Operational (LOS)**
  - \( v_p = \frac{(V \text{ or } DDHV)}{(PHF \times N \times f_{ph})} \times f_p \)
  - \( S \) = \( v_p \) / \( S \)
  - \( D = v_p / S \)

### Design (N)
- **Design LOS**
  - \( v_p = \frac{(V \text{ or } DDHV)}{(PHF \times N \times f_{ph})} \)
  - \( S \) = \( v_p \) / \( S \)
  - \( D = v_p / S \)

### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **\( v_p \)**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume
- **S**: Speed
- **D**: Density

### Factor Location
- **\( E_R \)**: Exhibits 11-10, 11-12
- **\( f_{lw} \)**: Exhibit 11-8
- **\( E_p \)**: Exhibits 11-10, 11-11, 11-13
- **\( f_{lc} \)**: Exhibit 11-9
- **\( f_p \)**: Page 11-18
- **TRD**: Page 11-11
- **LOS, S, FFS, \( v_p \)**: Exhibits 11-2, 11-3

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2/6/2012
## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information
- **Analyst**: Tony Lewis
- **Agency or Company**: KTA
- **Date Performed**: 9/15/2011
- **Analysis Time Period**: AM
- **Project Description**: Ohio River Bridges Project
- **Highway/Direction of Travel**: I-64 EB Mainline
- **From/To**: Btw Story Off and Mell. On
- **Jurisdiction**: Analysis Year 2030 No build

### Site Information
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, PT**: 10
- **%RVs, PR**: 0
- **General Terrain, Level**:
- **Grade %**:
- **Length mi**:
- **Up/Down %**:

### Flow Inputs
- **Volume, V**: 3500 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: veh/h
- **Peak-Hr Direction Prop, D**:
- **DDHV = AADT x K x D**: veh/h

### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_T**: 1.5
- **f_{HV} = \frac{1}{f_p f_L W f_T}\right) + f_R (f_E - 1) = 0.952

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFSS**: mph

### Calc Speed Adj and FFS
- **f_{LW}**: mph
- **f_{LC}**: mph
- **f_{HV}**: mph
- **TRD Adjustment**: mph
- **FFS**: 60.0 mph

### LOS and Performance Measures

#### Operational (LOS)
- **v_p = (V or DDHV) / (PHF x N x f_{HV})**: pc/h/ln
- **S**: 57.1 mph
- **D = v_p / S**: pc/mi/ln

#### Design (N)
- **Design LOS**
- **v_p = (V or DDHV) / (PHF x N x f_{HV})**: pc/h/ln
- **S**: mph
- **D = v_p / S**: pc/mi/ln
- **Required Number of Lanes, N**

### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

### Factor Location
- **E_R**: Exhibits 11-10, 11-12
- **f_{LW}**: Exhibit 11-8
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_{LC}**: Exhibit 11-9
- **f_p**: Page 11-18
- **TRD**: Page 11-11
- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3
## Basic Freeway Segments Worksheet

### General Information
- **Analyst:** Tony Lewis
- **Agency or Company:** KFA
- **Date Performed:** 9/15/2011
- **Analysis Time Period:** AM
- **Project Description:** Ohio River Bridges Project

### Site Information
- **Highway/Direction of Travel:** I-64 WB Mainline
- **From/To:** Blw Mell. Off and Story On
- **Jurisdiction:**
- **Analysis Year:** 2030 No Build

### Flow Inputs
- **Volume, V:** 4100 veh/h
- **AADT:** veh/day
- **Peak-Hr Prop. of AADT, K:**
- **Peak-Hr Direction Prop, D:** veh/h
- **DDHV = AADT x K x D:**

### Calculate Flow Adjustments
- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( E_R = 1.2 \)
- \( f_{HV} = 1 + f_p(E_T + 1) + P_T(E_R + 1) \) 0.962

### Speed Inputs
- **Lane Width:**
- **Rt-Side Lat. Clearance:** ft
- **Number of Lanes, N:** 2
- **Total Ramp Density, TRD:** ramps/mi
- **FFS (measured):** 60.0 mph
- **Base-freeflow Speed, BFFS:** mph

### LOS and Performance Measures
- **Operational (LOS):**
  - \( v_p = \frac{(V \times DDHV)}{(PHF \times N \times f_{HV})} \)
  - \( x f_p \)
  - \( S \) mph
  - \( D = \frac{v_p}{S} \)
  - \( F \)

### Glossary
- **N:** Number of lanes
- **V:** Hourly volume
- **v_p:** Flow rate
- **LOS:** Level of service
- **DDHV:** Directional design hour volume

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### BASIC FREEWAY SEGMENTS WORKSHEET

#### General Information
- **Analyst**: Tony Lewis
- **Agency or Company**: KTA
- **Date Performed**: 9/15/2011
- **Analysis Time Period**: AM
- **Project Description**: Ohio River Bridges Project

#### Site Information
- **Highway/Direction of Travel**: I-64 WB Mainline
- **From/To**: Btw I-71 On and I-65 On
- **Jurisdiction**: Analysis Year
- **Analysis Year**: 2030 No Build

#### Flow Inputs
- **Volume, V**: 4300 veh/h
- **Peak-Hour Prop. of AADT, K**: veh/day
- **Peak-Hr Direction Prop, D**: veh/h
- **AADT**: 5
- **%Trucks and Buses, PT**: 0
- **%RVs, PR**: Level
- **General Terrain**: Up/Down %

#### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_T**: 1.5
- **f_HV = 1/(1 + PT(E_T - 1) + PR(E_R - 1))**: 0.976

#### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

#### LOS and Performance Measures

#### Speed Adjust and FFS
- **f_LW**: mph
- **f_RC**: mph
- **TRD Adjustment**: mph
- **FFS**: 60.0 mph

#### Design (N)
- **Design (N)**
- **Design LOS**
- **v_p = (V or DDHV) / (PHF x N x f_HV)**
- **pc/h/ln**
- **= (PHF x N x f_HV)**
- **pc/h/ln**
- **= S mph**
- **= D = v_p / S pc/mi/ln**
- **Required Number of Lanes, N**

#### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume
- **S**: Speed
- **D**: Density
- **FFS**: Free-flow speed
- **BFFS**: Base free-flow speed
- **E_R**: Exhibits 11-10, 11-12
- **f_LW**: Exhibit 11-8
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_RC**: Exhibit 11-9
- **f_p**: Page 11-18
- **TRD**: Page 11-11
- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3
# BASIC FREEWAY WORKSHEET

## BASIC FREEWAY SEGMENTS WORKSHEET

<table>
<thead>
<tr>
<th><strong>General Information</strong></th>
<th><strong>Site Information</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyst</td>
<td>Tony Lewis</td>
</tr>
<tr>
<td>Agency or Company</td>
<td>KTA</td>
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<tr>
<td>Date Performed</td>
<td>12/12/2011</td>
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<td>AM</td>
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<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project</td>
</tr>
</tbody>
</table>

### Oper.(LOS) | Des.(N) | Planning Data

## Flow Inputs

| Volume, V | 4300 veh/h |
| AADT | veh/day |
| Peak-Hr Prop. of AADT, K | |
| Peak-Hr Direction Prop, D | |
| DDHV = AADT x K x D | veh/h |

### Calculate Flow Adjustments

| $f_p$ | 1.00 |
| $E_T$ | 1.5 |
| $E_R$ | 1.2 |

### Speed Inputs

| Lane Width | ft |
| Rt.-Side Lat. Clearance | ft |
| Number of Lanes, N | 3 |
| Total Ramp Density, TRD | ramps/mi |
| FFS (measured) | 60.0 mph |
| Base free-flow Speed, BFFS | mph |

### LOS and Performance Measures

### Design (N)

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
<th>Design (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV})$</td>
<td>Design LOS</td>
</tr>
<tr>
<td>$x f_p$</td>
<td>pc/h/ln</td>
</tr>
<tr>
<td>$S$</td>
<td>60.0 mph</td>
</tr>
<tr>
<td>$D = v_p / S$</td>
<td>pc/mi/ln</td>
</tr>
<tr>
<td>LOS</td>
<td>D</td>
</tr>
</tbody>
</table>

## Glossary

- **N** - Number of lanes
- **V** - Hourly volume
- **$v_p$** - Flow rate
- **LOS** - Level of service
- **DDHV** - Directional design hour volume

## Factor Location

- $E_R$ - Exhibits 11-10, 11-12
- $f_{LV}$ - Exhibit 11-8
- $E_T$ - Exhibits 11-10, 11-11, 11-13
- $f_p$ - Page 11-18
- TRD - Page 11-11
- LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3
# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information
- **Analyst:** Tony Lewis
- **Agency or Company:** KTA
- **Data Performed:** 9/15/2011
- **Analysis Time Period:** AM
- **Project Description:** Ohio River Bridges Project

## Site Information
- **Highway/Direction of Travel:** I-71 NB Mainline
- **From/To:** Btw 1-64 WB Off and I-65
- **Jurisdiction:** SB On
- **Analysis Year:** 2030 No Build

## Flow Inputs
- **Volume, V:** 1200 veh/h
- **AADT:** veh/day
- **Peak-Hr Prop. of AADT, K:** %
- **Peak-Hr Direction Prop, D:** %
- **DDHV = AADT x K x D:** veh/h
- **Peak-Hour Factor, PHF:** 0.92
- **%Trucks and Buses, P_T:** 4
- **%RVs, P_R:** 0
- **General Terrain:** Level
- **Grade:** %
- **Length:** mi
- **Up/Down %**

## Calculate Flow Adjustments
- **f_p:** 1.00
- **E_T:** 1.5
- **E_R:** 1.2
- **f_{HV} = \frac{1}{(1 + P_T(E_T - 1) + P_R(E_R - 1))}** 0.980

## Speed Inputs
- **Lane Width:** ft
- **Rt-Side Lat. Clearance:** ft
- **Number of Lanes, N:** 2
- **Total Ramp Density, TRD:** ramps/mi
- **FFS (measured):** 60.0 mph
- **Base free-flow speed, BFFS:** mph

## Calc Speed Adj and FFS
- **f_{LW}:** mph
- **f_{LC}:** mph
- **TRD Adjustment:** mph
- **FFS:** 60.0 mph

## LOS and Performance Measures
- **Operational (LOS):**
  - **v_p = \frac{(V \text{ or DDHV})}{(\text{PHF} \times N \times f_{HV})}** pc/h/ln
  - **S:** 60.0 mph
  - **D:** 11.1 pc/mln/ln
  - **LOS:** B

## Design (N)
- **Design LOS:**
  - **v_p = \frac{(V \text{ or DDHV})}{(\text{PHF} \times N \times f_{HV})}** pc/h/ln
  - **S:** mph
  - **D:** pc/mln/ln

## Glossary
- **N:** Number of lanes
- **V:** Hourly volume
- **v_p:** Flow rate
- **LOS:** Level of service
- **DDHV:** Directional design hour volume

## Factor Location
- **E_R - Exhibits 11-10, 11-12**
- **f_{LW} - Exhibit 11-8**
- **E_T - Exhibits 11-10, 11-11, 11-13**
- **f_{LC} - Exhibit 11-9**
- **f_p - Page 11-18**
- **TRD - Page 11-11**
- **LOS, S, FFS, v_p - Exhibits 11-2, 11-3**

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HCS 2010™ Version 6.1 Generated: 2/6/2012 12:40 PM
## BASIC FREEWAY WORKSHEET

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<td>Analysis Year</td>
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<td></td>
<td>Des.(N)</td>
</tr>
<tr>
<td></td>
<td>Planning Data</td>
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</tbody>
</table>

### Flow Inputs

- **Volume, V**: 2800 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: K
- **Peak-Hr Direction Prop, D**: D
- **DDHV = AADT x K x D**: veh/h

- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 7
- **%RVs, P_R**: 0
- **General Terrain**: Level
- **Grade**: %
- **Length**: mi
- **Up/Down %**:

### Calculate Flow Adjustments

- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( f_{HV} = \frac{1}{(1 + P_T(E_T - 1) + P_R(E_R - 1))} = 0.966 \)
- \( E_R = 1.2 \)

### Speed Inputs

- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

### Calc Speed Adj and FFS

- **Calc Speed Adj**: mph
- **FFS**: 60.0 mph

### LOS and Performance Measures

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
<th>Design (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( v_p = \frac{(V \text{ or } DDHV)}{(PHF \times N \times f_{HV})} )</td>
<td>Design LOS</td>
</tr>
<tr>
<td>( x f_p )</td>
<td>( v_p = \frac{(V \text{ or } DDHV)}{(PHF \times N \times f_{HV})} )</td>
</tr>
<tr>
<td>1575 pc/h/ln</td>
<td>pc/h/ln</td>
</tr>
<tr>
<td>( S )</td>
<td>( S )</td>
</tr>
<tr>
<td>60.0 mph</td>
<td>mph</td>
</tr>
<tr>
<td>( D = \frac{v_p}{S} )</td>
<td>( D = \frac{v_p}{S} )</td>
</tr>
<tr>
<td>26.3 pc/mi/ln</td>
<td>pc/mi/ln</td>
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<tr>
<td>LOS</td>
<td>Required Number of Lanes, N</td>
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</table>

### Glossary

- **N** - Number of lanes
- **V** - Hourly volume
- **v_p** - Flow rate
- **LOS** - Level of service
- **DDHV** - Directional design hour volume

### Factor Location

- **E_R** - Exhibits 11-10, 11-12
- **f_LW** - Exhibit 11-8
- **E_T** - Exhibits 11-10, 11-11, 11-13
- **f LC** - Exhibit 11-9
- **f_p** - Page 11-18
- **TRD** - Page 11-11
- **LOS, S, FFS, v_p** - Exhibits 11-2, 11-3

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# BASIC FREEWAY WORKSHEET

## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information
- **Analyst**: Tony Lewis
- **Agency or Company**: KTA
- **Date Performed**: 9/15/2011
- **Analysis Time Period**: AM

### Site Information
- **Highway/Direction of Travel**: I-71 SB Mainline
- **From/To**: North of I-64 Off
- **Jurisdiction**: 
- **Analysis Year**: 2030 No Build

### Project Description
- **Oper.(LOS)**
- **Des.(N)**
- **Planning Data**

### Flow Inputs
- **Volume, V**: 4500 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %
- **Peak-Hr Direction Prop, D**: %
- **DDHV = AADT x K x D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 5
- **%RVs, P_R**: 0
- **General Terrain**: Level
- **Grade % Length mi**: Up/Down %

### Calculate Flow Adjustments
- **E_R**: 1.2
- **f_HV = 1/(1+P_T(E_T - 1) + P_R(E_R - 1))**: 0.976

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

### Calc Speed Adj and FFS
- **f_LW**: mph
- **f_LC**: mph
- **TRD Adjustment**: mph
- **FFS**: 60.0 mph

### LOS and Performance Measures
- **Operational (LOS)**
- **Design (N)**

### Glossary

<table>
<thead>
<tr>
<th>N</th>
<th>Number of lanes</th>
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<tbody>
<tr>
<td>V</td>
<td>Hourly volume</td>
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<tr>
<td>v_p</td>
<td>Flow rate</td>
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<td>LOS</td>
<td>Level of service</td>
</tr>
<tr>
<td>DDHV</td>
<td>Directional design hour volume</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>S</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>Density</td>
</tr>
<tr>
<td>F</td>
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### Factor Location

<table>
<thead>
<tr>
<th>E_R</th>
<th>Exhibits 11-10, 11-12</th>
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</thead>
<tbody>
<tr>
<td>f_LW</td>
<td>Exhibit 11-8</td>
</tr>
<tr>
<td>E_T</td>
<td>Exhibits 11-10, 11-11, 11-13</td>
</tr>
<tr>
<td>f_LC</td>
<td>Exhibit 11-9</td>
</tr>
<tr>
<td>f_p</td>
<td>Page 11-18</td>
</tr>
<tr>
<td>TRD</td>
<td>Page 11-11</td>
</tr>
<tr>
<td>LOS, S, FFS, v_p</td>
<td>Exhibits 11-2, 11-3</td>
</tr>
</tbody>
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HCS 2010™ Version 6.1  Generated: 2/6/2012  12:41 PM
# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information
- Analyst: Tony Lewis
- Agency or Company: KTA
- Date Performed: 9/15/2011
- Analysis Time Period: AM
- Project Description: Ohio River Bridges Project

## Site Information
- Highway/Direction of Travel: I-71 SB Mainline
- From/To: Btw I-64 Off and I-64 On
- Jurisdiction: 
- Analysis Year: 2030 No Build

## Flow Inputs
- Volume, V: 2700 veh/h
- AADT: veh/day
- Peak-Hr Prop. of AADT, K: 
- Peak-Hr Direction Prop, D: 
- DDHV = AADT x K x D: veh/h
- Peak-Hour Factor, PHF: 0.92
- %Trucks and Buses, PT: 5
- %RVs, PR: 0
- General Terrain: Level
- Grade: %
- Length: mi
- Up/Down %:

## Calculate Flow Adjustments
- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( f_{HV} = \frac{1}{1 + f_p (E_T - 1) + P_R (E_T - 1)} = 0.976 \)

## Speed Inputs
- Lane Width: ft
- Rt-Side Lat. Clearance: ft
- Number of Lanes, N: 2
- Total Ramp Density, TRD: ramps/mi
- FFS (measured): 60.0 mph
- Base free-flow Speed, BFFS: mph

## Calc Speed Adj and FFS
- \( f_{LV} \)
- \( f_{LC} \)
- TRD Adjustment: mph
- FFS: 60.0 mph

## LOS and Performance Measures
- Operational (LOS)
- \( V_p = \frac{(V \text{ or DDHV})}{(PHF \times N \times f_{HV}) \times f_p} \)
- \( S \)
- \( D = \frac{v_p}{S} \)
- LOS:

## Design (N)
- Design LOS
- Design (N)
- Required Number of Lanes, N

## Glossary
- N - Number of lanes
- V - Hourly volume
- \( v_p \) - Flow rate
- LOS - Level of service
- DDHV - Directional design hour volume
- S - Speed
- D - Density
- FFS - Free-flow speed
- BFFS - Base free-flow speed

## Factor Location
- \( E_R \) - Exhibits 11-10, 11-12
- \( f_{LV} \) - Exhibit 11-8
- \( E_T \) - Exhibits 11-10, 11-11, 11-13
- \( f_{LC} \) - Exhibit 11-9
- \( f_p \) - Page 11-18
- LOS, S, FFS, \( v_p \) - Exhibits 11-2, 11-3
- TRD - Page 11-11

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# Basic Freeway Segments Worksheet

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<td>Project Description</td>
<td>Ohio River Bridges Project</td>
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<table>
<thead>
<tr>
<th>Flow Inputs</th>
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<tbody>
<tr>
<td>Volume, V</td>
<td>3300 veh/h</td>
</tr>
<tr>
<td>AADT</td>
<td>veh/day</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
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<tr>
<td>Peak-Hr Direction Prop, D</td>
<td></td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>veh/h</td>
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<tr>
<td></td>
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<table>
<thead>
<tr>
<th>Calculate Flow Adjustments</th>
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<tbody>
<tr>
<td>f_p</td>
<td>1.00</td>
</tr>
<tr>
<td>E_T</td>
<td>1.5</td>
</tr>
<tr>
<td>E_R</td>
<td>1.2</td>
</tr>
<tr>
<td>f_{HV} = 1(1+P_T(E_T - 1) + P_R(E_R - 1))</td>
<td>0.976</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Speed Inputs</th>
<th>Calc Speed Adj and FFS</th>
</tr>
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<tbody>
<tr>
<td>Lane Width</td>
<td>ft</td>
</tr>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
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<tr>
<td>Number of Lanes, N</td>
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<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/MI</td>
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<tr>
<td>FFS (measured)</td>
<td>55.0 mph</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td>f_LW</td>
<td>mph</td>
</tr>
<tr>
<td>f_LC</td>
<td>mph</td>
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<tr>
<td>TRD Adjustment</td>
<td>mph</td>
</tr>
<tr>
<td>FFS</td>
<td>55.0 mph</td>
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<table>
<thead>
<tr>
<th>LOS and Performance Measures</th>
<th>Design (N)</th>
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</thead>
<tbody>
<tr>
<td>Operational (LOS)</td>
<td>Design LOS</td>
</tr>
<tr>
<td>v_p = (V or DDHV) / (PHF x N x f_{HV}^{1838})</td>
<td>pc/h/ln</td>
</tr>
<tr>
<td>x f_p</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>55.0 mph</td>
</tr>
<tr>
<td>D = v_p / S</td>
<td>pc/mil/ln</td>
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<tr>
<td>D</td>
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<table>
<thead>
<tr>
<th>Glossary</th>
<th>Factor Location</th>
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<tbody>
<tr>
<td>N - Number of lanes</td>
<td>S - Speed</td>
</tr>
<tr>
<td>V - Hourly volume</td>
<td>D - Density</td>
</tr>
<tr>
<td>v_p - Flow rate</td>
<td>FFS - Free-flow speed</td>
</tr>
<tr>
<td>LOS - Level of service</td>
<td>BFFS - Base free-flow speed</td>
</tr>
<tr>
<td>DDHV - Directional design hour volume</td>
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Design LOS:

- Exhibits 11-10, 11-12
- f_{LV} - Exhibit 11-8

- Exhibits 11-10, 11-11, 11-13
- f_{LC} - Exhibit 11-9

- Page 11-18
- TRD - Page 11-11

- LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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# Freeway Weaving Worksheet

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## Site Information

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<th>I-85 NB</th>
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<tbody>
<tr>
<td>Weaving Segment Location</td>
<td>Btw All On and I-64/71 Off</td>
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<tr>
<td>Analysis Year</td>
<td>2030 No Build</td>
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</table>

## Project Description
Ohio River Bridge Project

## Inputs

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<th>Weaving configuration</th>
<th>One-Sided</th>
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<tbody>
<tr>
<td>Weaving number of lanes, N</td>
<td>4</td>
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<tr>
<td>Weaving segment length, L_s</td>
<td>2300 ft</td>
</tr>
<tr>
<td>Freeway free-flow speed, FFS</td>
<td>60 mph</td>
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## Conversions to pc/h Under Base Conditions

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<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_RV</th>
<th>f_P</th>
<th>V (pc/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_FF</td>
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<td>0.92</td>
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<td>1.2</td>
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<td>1.2</td>
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## Configuration Characteristics

| Minimum maneuver lanes, N_WL | 2 lc |
| Interchange density, ID       | 2.50 int/mi |
| Minimum RF lane changes, L_CRF | 2 lc/pc |
| Minimum FR lane changes, L_CFR | 0 lc/pc |
| Minimum RR lane changes, L_CRR | lc/pc |

## Freeway Segment Speed, Density, Level of Service, and Capacity

| Weaving segment flow rate, v | 3820 pc/h |
| Weaving segment capacity, c_w | 5321 veh/h |
| Weaving segment v/c ratio    | 0.684 |
| Weaving segment density, D   | 18.9 pc/mi/ln |
| Level of Service, LOS        | B       |

## Notes
- 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".
- For volumes that exceed the weaving segment capacity, the level of service is "F".
# Ohio River Bridge Project

## Freeway Weaving Worksheet

### General Information

<table>
<thead>
<tr>
<th>Analyst</th>
<th>KTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date Performed</td>
<td>10/26/2011</td>
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<tr>
<td>Analysis Time Period</td>
<td>AM</td>
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### Site Information

<table>
<thead>
<tr>
<th>Freeway/Dir of Travel</th>
<th>I-65 SB</th>
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</thead>
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<tr>
<td>Weaving Segment Location</td>
<td>Btw I-64/7 On and Jeffers Rd Off</td>
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<tr>
<td>Analysis Year</td>
<td>2030 No Build</td>
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### Project Description
Ohio River Bridge Project

### Inputs

<table>
<thead>
<tr>
<th>Weaving configuration</th>
<th>One-Sided</th>
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</thead>
<tbody>
<tr>
<td>Weaving number of lanes, N</td>
<td>4</td>
</tr>
<tr>
<td>Weaving segment length, Lw</td>
<td>2200 ft</td>
</tr>
<tr>
<td>Freeway free-flow speed, FFS</td>
<td>60 mph</td>
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</tbody>
</table>

### Segment Details

- **Segment Type**
  - Freeway
  - Freeway minimum speed, Smn | 50 |
  - Freeway maximum capacity, C_{pl} | 2300 |
  - Terrain type | Level |

### Conversions to pc/h Under Base Conditions

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_{nv}</th>
<th>f_p</th>
<th>v (pc/h)</th>
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</thead>
<tbody>
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<td>V_{FF}</td>
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<td>1.2</td>
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<td>V_{FR}</td>
<td>2476</td>
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<td>V_{NW}</td>
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<td>V_{R}</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Configuration Characteristics

- **Minimum maneuver lanes, N_{WL}** | 2 |
- **Interchange density, ID** | 2.70 Int/mi |
- **Minimum RF lane changes, L_{cR}** | 2 lpc |
- **Minimum FR lane changes, L_{cF}** | 0 lpc |
- **Minimum RR lane changes, L_{cR}** | 2 lpc |
- **Minimum weaving lane changes, L_{cMN}** | 2 lpc |

### Weaving Segment Speed, Density, Level of Service, and Capacity

| Weaving segment flow rate, v | 9037 pc/h |
| Weaving segment capacity, c_{w} | 4277 veh/h |
| Weaving segment v/c ratio | 2.061 pc/mi/ln |
| Weaving segment density, D | F |

### Weaving Lane Changes

- Weaving intensity factor, W
- Weaving segment speed, S
- Average weaving speed, S_{av}
- Average non-weaving speed, S_{nw}
- Maximum weaving length, L_{max}

### Notes

a. 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".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".
# Freeway Weaving Worksheet

## General Information

- **Analyst**: KTA
- **Date Performed**: 12/13/2011
- **Analysis Time Period**: AM
- **Freeway/Dir of Travel**: I-64 EB
- **Weaving Segment Location**: Blw I-71 On and Story Off
- **Analysis Year**: 2030 No Build

## Project Description

Ohio River Bridge Project

## Inputs

- **Weaving configuration**: Two-Sided
- **Weaving number of lanes, N**: 3
- **Weaving segment length, Lc**: 1475 ft
- **Freeway free-flow speed, FFS**: 60 mph

## Conversions to pc/h Under Base Conditions

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_NW</th>
<th>f_P</th>
<th>V (pc/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_FF</td>
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<td>7</td>
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</table>

## Configuration Characteristics

- **Minimum maneuver lanes, N_WL**: 0
- **Interchange density, ID**: 2.00 Int/mi
- **Minimum RF lane changes, LC_RF**: 1 pc
- **Minimum FR lane changes, LC_FR**: 1 pc
- **Minimum RR lane changes, LC_RR**: 2 pc

## Minimum weaving lane changes, LC_MIN: 1114 pc/h

### Weaving Lane Changes

- **LC_W**: 1404 pc/h
- **LC_NW**: 1010 pc/h
- **LC_ALL**: 2414 pc/h

### Non-Weaving Vehicle Index, I_NW: 0.333

## Weaving Segment Speed, Density, Level of Service, and Capacity

- **Weaving segment flow rate, v**: 4382 pc/h
- **Weaving segment capacity, c_w**: 5455 veh/h
- **Weaving segment v/c ratio**: 0.776
- **Weaving segment density, D**: 31.6 pc/mi/ln

<table>
<thead>
<tr>
<th>W</th>
<th>0.333</th>
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<tbody>
<tr>
<td>S</td>
<td>46.2 mph</td>
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<tr>
<td>S_w</td>
<td>57.5 mph</td>
</tr>
<tr>
<td>S_NW</td>
<td>45.0 mph</td>
</tr>
</tbody>
</table>

**Maximum weaving length, L_MAX**: 6937 ft

## Notes

- a. 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".
- b. For volumes that exceed the weaving segment capacity, the level of service is "F".
## Ohio River Bridge Project

### Freeway Weaving Worksheet

#### General Information
- **Analyst**
- **Agency/Company** KTA
- **Date Performed** 10/26/2011
- **Analysis Time Period** AM

#### Site Information
- **Freeway/Dir of Travel** I-64 WB
- **Weaving Segment Location** Btw Story On and I-65 Off
- **Analysis Year** 2030 No Build

#### Project Description
Ohio River Bridge Project

#### Inputs
- **Weaving configuration** Two-Sided
- **Weaving number of lanes, N** 3
- **Weaving segment length, L_s** 1600 ft or 60 mph
- **Freeway free-flow speed, FFS**

#### Conversions to pc/h Under Base Conditions

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_iW</th>
<th>f_p</th>
<th>V (pc/h)</th>
</tr>
</thead>
<tbody>
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<td>0</td>
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<td>1.2</td>
<td>0.985</td>
<td>1.00</td>
</tr>
<tr>
<td>V_NW</td>
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<td></td>
<td>V = 5196</td>
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</table>

### Configuration Characteristics
- **Minimum maneuver lanes, N_wL** 0 LC
- **Interchange density, ID** 1.80 Int/mi
- **Minimum RF lane changes, Lc_RF** 1 LC
- **Minimum FR lane changes, Lc_FR** 1 LC
- **Minimum RR lane changes, Lc_RR** 2 LC

**Minimum weaving lane changes, Lc_MIN** 668 LC/h

**Weaving lane changes, Lc_w** 956 LC/h

**Weaving lane changes, Lc_NW** 1520 LC/h

**Total lane changes, Lc_ALL** 2476 LC/h

**Non-weaving vehicle index, i_NW** 0.319

### Weaving Segment Speed, Density, Level of Service, and Capacity
- **Weaving segment flow rate, v** 5196 pc/h
- **Weaving segment capacity, c_w** 5728 veh/h
- **Weaving segment v/c ratio** 0.894
- **Weaving segment density, D** 38.5 pc/mi/ln
- **Level of Service, LOS** E

**Weaving intensity factor, W** 0.319

**Weaving segment speed, S** 47.4 mph

**Average weaving speed, S_w** 57.6 mph

**Average non-weaving speed, S_NW** 46.9 mph

**Maximum weaving length, L_max** 6328 ft

### Notes
- 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".
- For volumes that exceed the weaving segment capacity, the level of service is "F".

---

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2/22/2012
Ohio River Bridge Project

**General Information**

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<th>Analyst</th>
<th>Agency/Company</th>
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<th>Analysis Time Period</th>
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**Site Information**

<table>
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<th>Freeway/Direc of Travel</th>
<th>I-64 WB</th>
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<tbody>
<tr>
<td>Weaving Segment Location</td>
<td>Bow I-65 On and 3rd Off</td>
</tr>
<tr>
<td>Analysis Year</td>
<td>2030 No Build</td>
</tr>
</tbody>
</table>

**Project Description**

Ohio River Bridge Project

**Inputs**

<table>
<thead>
<tr>
<th>Weaving configuration</th>
<th>Two-Sided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaving number of lanes, N</td>
<td>4</td>
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<tr>
<td>Weaving segment length, Ls</td>
<td>1466ft</td>
</tr>
<tr>
<td>Freeway free-flow speed, FFS</td>
<td>60 mph</td>
</tr>
</tbody>
</table>

**Conversions to pc/h Under Base Conditions**

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_RV</th>
<th>f_p</th>
<th>V (pc/h)</th>
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<tbody>
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**Configuration Characteristics**

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<th>Minimum maneuver lanes</th>
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<tbody>
<tr>
<td>ID</td>
<td>Interchange density</td>
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<tr>
<td>LCF</td>
<td>Minimum RF lane changes</td>
<td>1 lc/pc</td>
</tr>
<tr>
<td>LCRF</td>
<td>Minimum FR lane changes</td>
<td>1 lc/pc</td>
</tr>
<tr>
<td>LCRRR</td>
<td>Minimum RR lane changes</td>
<td>1 lc/pc</td>
</tr>
</tbody>
</table>

**Weaving Segment Speed, Density, Level of Service, and Capacity**

| Weaving segment flow rate, v | 6723 pc/h |
| Weaving segment capacity, c_w | 7427 veh/h |
| Weaving segment v/c ratio | 0.887 |
| Weaving segment density, D | 35.3 pc/m/l |

Weaving intensity factor, W: 0.423
Weaving segment speed, S: 47.6 mph
Average weaving speed, S_NW: 57.0 mph
Average non-weaving speed, S_NW: 46.6 mph
Maximum weaving length, L_MAX: 6711 ft

**Notes**

a. 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".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".
**General Information**

<table>
<thead>
<tr>
<th>Analyst</th>
<th>KTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency/Company</td>
<td>KTA</td>
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<tr>
<td>Date Performed</td>
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<table>
<thead>
<tr>
<th>Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeway/Dir of Travel</td>
</tr>
<tr>
<td>Weaving Segment Location</td>
</tr>
<tr>
<td>Analysis Year</td>
</tr>
</tbody>
</table>

**Project Description**
Ohio River Bridge Project

**Inputs**

<table>
<thead>
<tr>
<th>Weaving configuration</th>
<th>Two-Sided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaving number of lanes, N</td>
<td>2</td>
</tr>
<tr>
<td>Weaving segment length, L&lt;sub&gt;s&lt;/sub&gt;</td>
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<tr>
<td>Freeway free-flow speed, FFS</td>
<td>60 mph</td>
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<table>
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<th>Segment type</th>
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<td>Freeway maximum capacity, C&lt;sub&gt;FL&lt;/sub&gt;</td>
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</tr>
<tr>
<td>Terrain type</td>
<td>Level</td>
</tr>
</tbody>
</table>

**Conversions to pc/h Under Base Conditions**

| V<sub>FF</sub> | 354 | 0.92 | 5 | 0 | 1.5 | 1.2 | 0.976 | 1.00 | 394 |
| V<sub>RF</sub> | 846 | 0.92 | 5 | 0 | 1.5 | 1.2 | 0.976 | 1.00 | 943 |
| V<sub>FR</sub> | 1960 | 0.92 | 2 | 0 | 1.5 | 1.2 | 0.990 | 1.00 | 2152 |
| V<sub>RR</sub> | 441 | 0.92 | 5 | 0 | 1.5 | 1.2 | 0.976 | 1.00 | 394 |
| V<sub>NW</sub> | 3489 |
| V<sub>W</sub> | 494 |
| VR | 0.122 |

**Configuration Characteristics**

| Minimum maneuver lanes, N<sub>WL</sub> | 0 lane |
| Interchange density, ID | 2.30 Int/mi |
| Minimum RF lane changes, L<sub>CRF</sub> | lc/pc |
| Minimum FR lane changes, L<sub>CFR</sub> | lc/pc |
| Minimum RR lane changes, L<sub>CRR</sub> | 1 lc/pc |

| Minimum weaving lane changes, L<sub>C</sub><sub>MIN</sub> | lc/h |
| Weaving lane changes, L<sub>C</sub><sub>W</sub> | lc/h |
| Non-weaving lane changes, L<sub>CNW</sub> | lc/h |
| Total lane changes, L<sub>C</sub><sub>ALL</sub> | lc/h |
| Non-weaving vehicle index, l<sub>NW</sub> | |

**Weaving Segment Speed, Density, Level of Service, and Capacity**

| Weaving segment flow rate, v | 3973 pc/h |
| Weaving segment capacity, c<sub>W</sub> | 3789 veh/h |
| Weaving segment v/c ratio | 1.023 |
| Weaving segment density, D | pc/mln |
| Level of Service, LOS | F |

| Weaving intensity factor, W |
| Weaving segment speed, S |
| Average weaving speed, S<sub>W</sub> |
| Average non-weaving speed, S<sub>NW</sub> |
| Maximum weaving length, L<sub>MAX</sub> | 6985 ft |

**Notes**

a. 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".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".
# Freeway Weaving Worksheet

## General Information
- **Analyst**: KTA
- **Date Performed**: 10/26/2011
- **Analysis Time Period**: AM

## Site Information
- **Freeway/Dir of Travel**: I-71 SB
- **Weaving Segment Location**: Bow I-64 On and I-65 NB Off
- **Analysis Year**: 2030 No Build

## Project Description
- **Ohio River Bridge Project**

### Inputs
- **Weaving configuration**: Two-Sided
- **Weaving number of lanes, N**: 2
- **Weaving segment length, Lw**: 1500 ft
- **Freeway free-flow speed, FFS**: 60 mph
- **Segment type**: Freeway
- **Freeway minimum speed, S_w**: 50 mph
- **Freeway maximum capacity, C氟**: 2300 veh/h
- **Terrain type**: Level

### Conversions to pc/h Under Base Conditions

<table>
<thead>
<tr>
<th></th>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_R</th>
<th>f_R</th>
<th>V (pc/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_FF</td>
<td>2032</td>
<td>0.92</td>
<td>1</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.995</td>
<td>1.00</td>
<td>2220</td>
</tr>
<tr>
<td>V_RF</td>
<td>688</td>
<td>0.92</td>
<td>4</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.980</td>
<td>1.00</td>
<td>741</td>
</tr>
<tr>
<td>V_FR</td>
<td>910</td>
<td>0.92</td>
<td>1</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.995</td>
<td>1.00</td>
<td>994</td>
</tr>
<tr>
<td>V_RR</td>
<td>1290</td>
<td>0.92</td>
<td>1</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.995</td>
<td>1.00</td>
<td>2220</td>
</tr>
<tr>
<td>V_NW</td>
<td>3955</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>1451</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VR</td>
<td>0.268</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Configuration Characteristics
- **Minimum maneuver lanes, N_WL**: 0 lane
- **Minimum weaving lane changes, LCM_W**: 0 pc
- **Weaving lane changes, LCW**: 2.20 veh/mi
- **Non-Weaving lane changes, LCNW**: 1车道
- **Total lane changes, LCA**: 1车道
- **Non-Weaving vehicle index, lw**: 1车道

### Weaving Segment Speed, Density, Level of Service, and Capacity
- **Weaving segment flow rate, v**: 5406 pc/h
- **Weaving segment capacity, CW**: 3530 veh/h
- **Average weaving speed, SW**: 1.524 mph
- **Average non-weaving speed, SW**
- **Maximum weaving length, L_MAX**: 8379 ft

### Notes
- a. 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".
- b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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2/22/2012
# BASIC FREEWAY WORKSHEET

## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information

<table>
<thead>
<tr>
<th>Analyst</th>
<th>Tony Lewis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency or Company</td>
<td>KTA</td>
</tr>
<tr>
<td>Date Performed</td>
<td>9/15/2011</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>PM</td>
</tr>
<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project</td>
</tr>
</tbody>
</table>

### Site Information

<table>
<thead>
<tr>
<th>Highway/Direction of Travel</th>
<th>I-65 NB Mainline</th>
</tr>
</thead>
<tbody>
<tr>
<td>From/To</td>
<td>Btw I-64/71 Off and I-64/71 On</td>
</tr>
<tr>
<td>Jurisdiction</td>
<td></td>
</tr>
<tr>
<td>Analysis Year</td>
<td>2030 No Build</td>
</tr>
</tbody>
</table>

### Flow Inputs

<table>
<thead>
<tr>
<th>Volume, V</th>
<th>3800 veh/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADT</td>
<td>veh/day</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td></td>
</tr>
<tr>
<td>Peak-Hr Direction Prop., D</td>
<td></td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>veh/h</td>
</tr>
</tbody>
</table>

| Peak-Hour Factor, PHF | 0.92 |
| Trucks and Buses, P_T | 20  |
| RVs, P_R               | 0   |

### Calculate Flow Adjustments

<table>
<thead>
<tr>
<th>f_p</th>
<th>1.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>E_T</td>
<td>1.5</td>
</tr>
</tbody>
</table>

\[ f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} \times 0.909 \]

### Speed Inputs

<table>
<thead>
<tr>
<th>Lane Width</th>
<th>ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td></td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>2</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>60.0 mph</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
</tr>
</tbody>
</table>

### Speeds and Performance Measures

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( v_p = \frac{V \times DDHV}{PHF \times N \times f_{HV}} \times f_p )</td>
<td>pc/h/ln</td>
</tr>
<tr>
<td>S</td>
<td>51.8 mph</td>
</tr>
<tr>
<td>D = ( \frac{v_p}{S} )</td>
<td>43.9 pc/mi/ln</td>
</tr>
<tr>
<td>LOS</td>
<td>E</td>
</tr>
</tbody>
</table>

### Design (N)

<table>
<thead>
<tr>
<th>Design (N)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Design LOS</td>
<td></td>
</tr>
<tr>
<td>( v_p = \frac{V \times DDHV}{PHF \times N \times f_{HV}} \times f_p )</td>
<td>pc/h/ln</td>
</tr>
<tr>
<td>S</td>
<td></td>
</tr>
<tr>
<td>D = ( \frac{v_p}{S} )</td>
<td></td>
</tr>
<tr>
<td>LOS</td>
<td></td>
</tr>
</tbody>
</table>

### Glossary

<table>
<thead>
<tr>
<th>N</th>
<th>Number of lanes</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Hourly volume</td>
</tr>
<tr>
<td>( v_p )</td>
<td>Flow rate</td>
</tr>
<tr>
<td>LOS</td>
<td>Level of service</td>
</tr>
<tr>
<td>DDHV</td>
<td>Directional design hour volume</td>
</tr>
</tbody>
</table>

### Factor Location

| \( E_R \)          | Exhibits 11-10, 11-12 |
| f_p                 | Exhibit 11-8         |
| \( E_T \)          | Exhibits 11-10, 11-11, 11-13 |
| f_p                 | Exhibit 11-9         |
| TRD                 | Page 11-11           |
| LOS, S, FFS, \( v_p \) | Exhibits 11-2, 11-3 |

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### BASIC FREEWAY WORKSHEET

#### General Information
- **Analyst:** Tony Lewis
- **Agency or Company:** KTA
- **Date Performed:** 9/15/2011
- **Analysis Time Period:** PM
- **Flow Inputs:**
  - **Volume, V:** 7500 veh/h
  - **AADT:** veh/day
  - **Peak-Hr Prop. of AADT, K:** veh/h
  - **Peak-Hr Direction Prop, D:**
  - **DDHV = AADT x K x D:** veh/h

#### Site Information
- **Highway/Direction of Travel:** I-65 NB Mainline
- **From/To:** North of I-64/71 On
- **Jurisdiction:** Analysis Year: 2030 No Build

#### Project Description
- **Ohio River Bridges Project**

#### Calculate Flow Adjustments
- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( E_R = 1.2 \)
- \( f_{HV} = \frac{1}{1 + f_p} \left( E_T \cdot \frac{f_p}{E_R} - 1 \right) = 0.930 \)

#### Speed Inputs
- **Lane Width:** ft
- **Rt-Side Lat. Clearance:** ft
- **Number of Lanes, N:** 4
- **Total Ramp Density, TRD:** ramps/ft
- **FFS (measured):** 60.0 mph
- **Base free-flow speed, BFFS:** mph

#### LOS and Performance Measures
- **Operational (LOS):**
  - \( v_p = \frac{(V \text{ or } DDHV) \times f_{HV}}{(PHF + N \times f_{HV})} \) pc/h/ln
  - \( S = 53.7 \) mph
  - \( D = \frac{v_p}{S} \) pc/mi/ln
  - **LOS:**

#### Glossary
- **N:** Number of lanes
- **V:** Hourly volume
- **\( f_p \):** Flow rate
- **LOS:** Level of service
- **DDHV:** Directional design hour volume

#### Factor Location
- **Design (N):**
  - **Design LOS:**
  - \( v_p = \frac{(V \text{ or } DDHV) \times f_{HV}}{(PHF + N \times f_{HV})} \) pc/h/ln
  - \( S = \) mph
  - \( D = \frac{v_p}{S} \) pc/mi/ln
  - **Required Number of Lanes, N**

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# BASIC FREEWAY WORKSHEET

## Basic Freeway Segments Worksheet

### General Information
- **Analyst**: Tony Lewis
- **Agency or Company**: KTA
- **Date Performed**: 9/15/2011
- **Analysis Time Period**: PM
- **Project Description**: Ohio River Bridges Project

### Site Information
- **Highway/Direction of Travel**: I-65 SB Mainline
- **From/To**: North of I-64/71 Off
- **Jurisdiction**: Analysis Year
- **Analysis Year**: 2030 No Build

<table>
<thead>
<tr>
<th>Flow Inputs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume, V</td>
<td>4800 veh/h</td>
</tr>
<tr>
<td>AADT</td>
<td>veh/day</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td>%Trucks and Buses, P_T</td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
<td>%RVs, P_R</td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>veh/h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Calculate Flow Adjustments</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>f_p</td>
<td>1.00</td>
</tr>
<tr>
<td>E_T</td>
<td>1.5</td>
</tr>
<tr>
<td>f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}</td>
<td>0.905</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Speed Inputs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane Width</td>
<td>ft</td>
</tr>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>3</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>60.0 mph</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
</tr>
</tbody>
</table>

### LOS and Performance Measures

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
<th>Design (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( v_p = \frac{(V \text{ or DDHV})}{(PHF \times N \times f_{HV})} \times f_p )</td>
<td>( v_p = \frac{(V \text{ or DDHV})}{(PHF \times N \times f_{HV})} \times f_p )</td>
</tr>
<tr>
<td>S</td>
<td>mph</td>
</tr>
<tr>
<td>D = \frac{v_p}{S}</td>
<td>pc/ml/in</td>
</tr>
<tr>
<td>LOS</td>
<td>pc/ml/in</td>
</tr>
</tbody>
</table>

### Glossary

- **N**: Number of lanes
- **V**: Hourly volume
- **V_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

### Factor Location

- **E_R - Exhibits 11-10, 11-12**
- **f_{LV} - Exhibit 11-8**
- **E_T - Exhibits 11-10, 11-11, 11-13**
- **f_{LC} - Exhibit 11-9**
- **f_p - Page 11-18**
- **TRD - Page 11-11**
- **LOS, S, FFS, v_p - Exhibits 11-2, 11-3**

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file:C:\Documents and Settings\76429\Local Settings\Temp\f2k93.tmp 2/7/2012
## Basic Freeway Segments Worksheet

### General Information
- **Analyst**: Tony Lewis
- **Agency or Company**: KTA
- **Date Performed**: 9/15/2011
- **Analysis Time Period**: PM
- **Jurisdiction**: Ohio River Bridges Project
- **Project Description**: Btw I-64/71 Off and I-64/71
- **Highway/Direction of Travel**: I-65 SB Mainline
- **From/To**: On
- **Analysis Year**: 2030 No Build

### Site Information
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, PT**: 25
- **%RVs, PR**: 0
- **General Terrain**: Level
- **Grade**: Up/Down %

### Flow Inputs
- **Volume, V**: 2600 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: veh/h
- **Peak-Hr Direction Prop, D**: veh/h
- **DDHV = AADT x K x D**: veh/h

### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_T**: 1.5
- **E_R**: 1.2
- **f_{HV} = 1/(1+p_{T}(E_{T} - 1) + P_{R}(E_{R} - 1))**: 0.889

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFSS**: mph

### LOS and Performance Measures
- **V_p = (V or DDHV) / (PHF x N x f_{HV} x f_{p})**
- **S**: 60.0 mph
- **D = V_p / S**: 26.5 pc/mi/ln
- **LOS**: D

### Design (N)
- **Design (N)**
- **Design LOS**
- **V_p = (V or DDHV) / (PHF x N x f_{HV} x f_{p})**
- **S**: mph
- **D = V_p / S**: pc/mi/ln
- **LOS**: Required Number of Lanes, N

### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **V_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

### Factor Location
- **E_R**: Exhibits 11-10, 11-12
- **f_{LV}**: Exhibit 11-8
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_{LC}**: Exhibit 11-9
- **f_p**: Page 11-18
- **TRD**: Page 11-11
- **LOS, S, FFS, V_p**: Exhibits 11-2, 11-3
## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information
- **Analyst**: Tony Lewis
- **Agency or Company**: KTA
- **Date Performed**: 9/15/2011
- **Analysis Time Period**: PM
- **Project Description**: Ohio River Bridge Project
- **Highway/Direction of Travel**: I-64 EB Mainline
- **From/To**: West of I-65 Off
- **Jurisdiction**: Analysis Year: 2030 No Build

### Site Information

<table>
<thead>
<tr>
<th>Flow Inputs</th>
<th>Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume, V</td>
<td>5600 veh/h</td>
</tr>
<tr>
<td>AADT</td>
<td>veh/day</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td>%Trucks and Buses, $P_T$</td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
<td>%RVs, $P_R$</td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>General Terrain: Level</td>
</tr>
</tbody>
</table>

### Calculate Flow Adjustments

$$f_p = 1.00$$ $$E_R = 1.2$$

$$f_{HV} = \frac{1}{f_1 + f_2} = \frac{1}{f_{HV}(E_R - 1) + f_{R}(E_R - 1)} = 0.962$$

### Speed Inputs

<table>
<thead>
<tr>
<th>Lane Width</th>
<th>ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>3</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>60.0 mph</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
</tr>
</tbody>
</table>

### Calc Speed Adj and FFS

<table>
<thead>
<tr>
<th>$f_{LW}$</th>
<th>mph</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f_{LC}$</td>
<td>mph</td>
</tr>
<tr>
<td>TRD Adjustment</td>
<td></td>
</tr>
<tr>
<td>FFS</td>
<td>60.0 mph</td>
</tr>
</tbody>
</table>

### LOS and Performance Measures

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
<th>Design (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV}) = 2110$</td>
<td>Design LOS</td>
</tr>
<tr>
<td>$S = 55.3$ mph</td>
<td></td>
</tr>
<tr>
<td>$D = v_p / S = 38.2$ pc/mi/ln</td>
<td></td>
</tr>
<tr>
<td>LOS</td>
<td>E</td>
</tr>
</tbody>
</table>

### Glossary

| N  | Number of lanes |
| V  | Hourly volume |
| $v_p$ | Flow rate |
| LOS | Level of service |
| DDHV | Directional design hour volume |

### Factor Location

<table>
<thead>
<tr>
<th>$E_R$</th>
<th>Exhibits 11-10, 11-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f_{LW}$</td>
<td>Exhibit 11-8</td>
</tr>
<tr>
<td>$E_p$</td>
<td>Exhibits 11-10, 11-11, 11-13</td>
</tr>
<tr>
<td>$f_{LC}$</td>
<td>Exhibit 11-9</td>
</tr>
<tr>
<td>$f_p$</td>
<td>Page 11-18</td>
</tr>
<tr>
<td>TRD</td>
<td>Page 11-11</td>
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2/7/2012
### BASIC FREEWAY SEGMENTS WORKSHEET

#### General Information
- Analyst: Tony Lewis
- Agency or Company: KTA
- Date Performed: 9/15/2011
- Analysis Time Period: PM
- Project Description: Ohio River Bridges Project

#### Site Information
- Highway/Direction of Travel: I-64 EB Mainline
- From/To: Btw River Rd. On and I-71 off
- Jurisdiction: 
- Analysis Year: 2030 No Build

#### Flow Inputs
- Volume, V: 4400 veh/h
- AADT: veh/day
- Peak-Hr Prop. of AADT, K
- Peak-Hr Direction Prop, D
- DDHV = AADT x K x D veh/h
- Peak-Hour Factor, PHF: 0.92
- %Trucks and Buses, P_T: 6%
- %RVs, P_R: 0%

#### Calculate Flow Adjustments
- \( f_p \): 1.00
- \( E_T \): 1.5
  - \( f_{HV} = \frac{1}{1 + P_T (f_T - 1) + P_R (E_R - 1)} \) 0.971

#### Speed Inputs
- Lane Width: ft
- Rt-Side Lat. Clearance: ft
- Number of Lanes, N: 2
- Total Ramp Density, TRD ramps/mi
- FFS (measured): 60.0 mph
- Base free-flow Speed, BFSS: mph

#### Calc Speed Adj and FFS
- \( f_{LV} \) mph
- \( f_{LC} \) mph
- TRD Adjustment mph
- FFS mph

#### LOS and Performance Measures
- Operational (LOS)
  - \( v_p = \frac{(V \text{ or } DDHV)}{(PHF \times N \times f_{HV}} \text{ pc/h/ln} \)
  - \( x f_p \)
  - S mph
  - D = \( v_p / S \) pc/mi/ln
  - LOS

#### Design (N)
- Design LOS
  - \( v_p = \frac{(V \text{ or } DDHV)}{(PHF \times N \times f_{HV}} \text{ pc/h/ln} \)
  - S mph
  - D = \( v_p / S \) pc/mi/ln
  - Required Number of Lanes, N

#### Glossary
- N - Number of lanes
- V - Hourly Volume
- \( v_p \) - Flow rate
- LOS - Level of service
- DDHV - Directional design hour volume

#### Factor Location
- \( E_R \) - Exhibits 11-10, 11-12
- \( f_{LV} \) - Exhibit 11-8
- \( E_T \) - Exhibits 11-10, 11-11, 11-13
- \( f_{LC} \) - Exhibit 11-9
- \( f_p \) - Page 11-18
- TRD - Page 11-11
- LOS, S, FFS, \( v_p \) - Exhibits 11-2, 11-3

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### BASIC FREEWAY SECTIONS WORKSHEET

#### General Information
- **Analyst:** Tony Lewis
- **Agency or Company:** KTA
- **Date Performed:** 9/15/2011
- **Analysis Time Period:** PM
- **Project Description:** Ohio River Bridges Project

#### Site Information
- **Highway/Direction of Travel:** I-64 EB Mainline
- **From/To:** Btw Story Off and Mell. On
- **Jurisdiction:**
- **Analysis Year:** 2030 No build

#### Flow Inputs
- **Volume, V:** 3800 veh/h
- **AADT:** veh/day
- **Peak-Hr Prop. of AADT, K:**
- **Peak-Hr Direction Prop, D:**
- **DDHV = AADT x K x D:** veh/h

#### Calculate Flow Adjustments
- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( \frac{1}{1+P_T(E_T - 1) + P_R(E_R - 1)} = 0.957 \)

#### Speed Inputs
- **Lane Width:** ft
- **Rt-Side Lat. Clearance:** ft
- **Number of Lanes, N:** 2
- **Total Ramp Density, TRD:** ramps/mi
- **FFS (measured):** 60.0 mph
- **Base free-flow speed, BFFS:** mph

#### Speed Adj and FFS
- \( f_{LW} \)
- \( f_{LC} \)
- **FFS:** 60.0 mph

#### LOS and Performance Measures
- **Operational (LOS):**
  \( v_p = \frac{(V \times DDHV)}{(PHF \times N \times f_{HV} \times f_p)} \) pc/h/ln
- **S:** 54.3 mph
- **D = v_p / S:** 39.7 pc/mi/ln
- **LOS:**

#### Glossary
- **N:** Number of lanes
- **V:** Hourly volume
- **V_p:** Flow rate
- **LOS:** Level of service
- **DDHV:** Directional design hour volume

#### Design (N)
- **Design (N):**
- **Design LOS:
  \( v_p = \frac{(V \times DDHV)}{(PHF \times N \times f_{HV} \times f_p)} \) pc/h/ln
  \( S \) mph
  \( D = v_p / S \) pc/mi/ln
- **Required Number of Lanes, N**

#### Factor Location
- **E_R - Exhibits 11-10, 11-12:**
- **f_{LW} - Exhibit 11-8:**
- **E_p - Exhibits 11-10, 11-11, 11-13:**
- **f_{LC} - Exhibit 11-9:**
- **f_p - Page 11-18:**
- **TRD - Page 11-11:**
- **LOS, S, FFS, v_p - Exhibits 11-2, 11-3**

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2/7/2012
# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information
- **Analyst:** Tony Lewis
- **Agency or Company:** KTA
- **Date Performed:** 9/15/2011
- **Analysis Time Period:** PM
- **Project Description:** Ohio River Bridges Project
- **Highway/Direction of Travel:** I-64 WB Mainline
- **From/To:** Btw Mell, Off and Story On
- **Jurisdiction:**
- **Analysis Year:** 2030 No Build

## Site Information

## Flow Inputs
- **Volume, V:** 3800 veh/h
- **AADT:** veh/day
- **Peak-Hr Prop. of AADT, K:**
- **Peak-Hr Direction Prop, D:**
- **DDHV = AADT x K x D:** veh/h
- **Peak-Hour Factor, PHF:** 0.92
- **%Trucks and Buses, P_T:** 10
- **%RVs, P_R:** 0
- **General Terrain:** Level
- **Grade:** %
- **Length:** mi
- **Up/Down %**

## Calculate Flow Adjustments
- \( f_p \) = 1.00
- \( E_T \) = 1.5
- \( f_{HV} = \frac{1}{1+P_R(E_T - 1) + P_T(E_T - 1)} \) = 0.952

## Speed Inputs
- **Lane Width:** ft
- **Rt-Side Lat. Clearance:** ft
- **Number of Lanes, N:** 2
- **Total Ramp Density, TRD:** ramps/mi
- **FFS (measured):** 60.0 mph
- **Base free-flow Speed, BFFS:** mph

## Speed Speed Adj and FFS
- \( f_{LW} \)
- \( f_{LC} \)

## LOS and Performance Measures
- **Operational (LOS):**
- \( v_p = \frac{(V \text{ or } DDHV)}{(PHF \times N \times f_{HV}^{2168})} \) pc/h/ln
- \( S \) = 54.1 mph
- \( D = \frac{v_p}{S} \) pc/mi/ln
- **LOS:**

## Design (N)
- **Design (N):**
- **Required Number of Lanes, N:**

## Glossary
- **N - Number of lanes**
- **S - Speed**
- **V - Hourly volume**
- **D - Density**
- **V_p - Flow rate**
- **LOS - Level of service**
- **DDHV - Directional design hour volume**

## Factor Location
- **E_R - Exhibits 11-10, 11-12**
- **f_{LW} - Exhibit 11-B**
- **E_T - Exhibits 11-10, 11-11, 11-13**
- **f_{LC} - Exhibit 11-9**
- **f_p - Page 11-18**
- **TRD - Page 11-11**
- **LOS, S, FFS, v_p - Exhibits 11-2, 11-3**
**BASIC FREEWAY WORKSHEET**

### General Information
- **Analyst:** Tony Lewis
- **Agency or Company:** KTA
- **Date Performed:** 9/15/2011
- **Analysis Time Period:** PM
- **Project Description:** Ohio River Bridges Project
- **Highway/Direction of Travel:** I-64 WB Mainline
- **From/To:** Btw I-71 On and I-65 On
- **Jurisdiction:**
- **Analysis Year:** 2030 No Build

### Flow Inputs
- **Volume, V:** 4000 veh/h
- **AADT:** veh/day
- **Peak-Hr Prop. of AADT, K:** veh/h
- **Peak-Hr Direction Prop, D:** %
- **DDHV = AADT x K x D:** veh/h
- **Peak-Hour Factor, PHF:** 0.92
- **%Trucks and Buses, P_T:** 9
- **%RVs, P_R:** 0
- **Grade:** %
- **Length:** mi
- **General Terrain:** Level
- **Up/Down %:**

### Calculate Flow Adjustments
- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( f_{HV} = \frac{1}{\left(1 + P_T f_T - 1\right) + P_R f_R \left(1 - 1\right)} = 0.957 \)
- \( E_R = 1.2 \)

### Speed Inputs
- **Lane Width:** ft
- **Rt-Side Lat. Clearance:** ft
- **Number of Lanes, N:** 2
- **Total Ramp Density, TRD:** ramps/mi
- **FFS (measured):** 60.0 mph
- **Base-free-flow Speed:** mph
- **Calc Speed Adj and FFS**
- \( f_{LW} \)
- \( f_{LC} \)
- **TRD Adjustment:** mpg
- **FFS:** 60.0 mph

### LOS and Performance Measures
- **Operational (LOS)**
  - \( v_p = \frac{(V \text{ or DDHV})}{\text{PHF} \times N \times f_{HV} \times f_p} \)
  - pc/h/ln
  - pc/h/ln
  - mph
  - S
  - mph
  - mph
  - D
  - pc/mi/ln
  - pc/mi/ln
  - LOS

### Glossary
- **N - Number of lanes**
- **S - Speed**
- **V - Hourly volume**
- **D - Density**
- **V_p - Flow rate**
- **FFS - Free-flow speed**
- **LOS - Level of service**
- **BFFS - Base free-flow speed**
- **DDHV - Directional design hour volume**

### Factor Location
- **E_R - Exhibits 11-10, 11-12**
- **f_{LW} - Exhibit 11-8**
- **E_T - Exhibits 11-10, 11-11, 11-13**
- **f_{LC} - Exhibit 11-9**
- **f_p - Page 11-18**
- **TRD - Page 11-11**
- **LOS, S, FFS, v_p - Exhibits 11-2, 11-3**

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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information
- **Analyst**: Tony Lewis
- **Agency or Company**: KTA
- **Date Performed**: 12/12/2011
- **Analysis Time Period**: PM
- **Project Description**: Ohio River Bridges Project
- **Highway/Direction of Travel**: I-64 WB Mainline
- **From/To**: West of 3rd Off
- **Jurisdiction**: Analysis Year: 2030 No Build

## Site Information

### Flow Inputs
- **Volume, V**: 4900 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %
- **Peak-Hr Direction Prop, D**: %
- **DDHV = AADT x K x D**: veh/h

### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_T**: 1.5
- **E_R**: 1.2
- **fHV = 1/[(1 + P_T(E_T - 1) + P_R(E_R - 1))]** 0.957

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/MI
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

### LOS and Performance Measures
- **v_p = (V or DDHV) / (PHF x N x fHV)** 1855 pc/h/ln
- **S**: 58.8 mph
- **D = v_p / S**: 31.5 pc/MI/ln

### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **V_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

### Factor Location
- **E_R - Exhibits 11-10, 11-12**: f_LW - Exhibit 11-8
- **E_T - Exhibits 11-10, 11-11, 11-13**: f_LC - Exhibit 11-9
- **f_p - Page 11-18**: TRD - Page 11-11
- **LOS, S, FFS, V_p - Exhibits 11-2, 11-3**
# BASIC FREEWAY WORKSHEET

## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information
- **Analyst:** Tony Lewis
- **Agency or Company:** KTA
- **Date Performed:** 9/15/2011
- **Analysis Time Period:** PM
- **Project Description:** Ohio River Bridges Project

### Site Information
- **Highway/Direction of Travel:** I-71 NB Mainline
- **From/To:** Btw 1-64 WB Off and I-65 SB On
- **Jurisdiction:**
- **Analysis Year:** 2030 No Build

### Analysis
- **Oper.(LOS):**
- **Des.(N):**
- **Planning Data:**

### Flow Inputs
- **Volume, \( V \):** 2700 veh/h
- **AADT:** veh/day
- **Peak-Hr Prop. of AADT, \( K \):**
- **Peak-Hr Direction Prop, \( D \):**
- **DDHV = AADT \times K \times D:** veh/h

### Peak-Hour Factor, \( PHF \):** 0.92

### %Trucks and Buses, \( P_T \):** 5

### %RVs, \( P_R \):** 0

### General Terrain:**
- **Length:** mi
- **Up/Down %:**

### Calculate Flow Adjustments
- **\( E_R \):** 1.2

### Speed Inputs
- **Lane Width:** ft
- **Rt-Side Lat. Clearance:** ft
- **Number of Lanes, \( N \):** 2
- **Total Ramp Density, \( TRD \):** ramps/mi
- **FFS (measured):** 60.0 mph
- **Base free-flow Speed:** mph

### Speed Adjustment and FFS
- **Calc Speed Adj:** mph
- **FFS Adjustment:** mph
- **LOS and Performance Measures:**
- **Operational (LOS):**
- **Design (N):**

### Glossary
- **N:** Number of lanes
- **V:** Hourly volume
- **\( V_p \):** Flow rate
- **LOS:** Level of service
- **DDHV:** Directional design hour volume
- **S:** Speed
- **D:** Density
- **FFS:** Free-flow speed
- **BFFS:** Base free-flow speed
- **E_R:** Exhibits 11-10, 11-12, 11-13
- **\( f_{LW} \):** Exhibit 11-8
- **\( f_{L_C} \):** Exhibit 11-9
- **\( f_p \):** Page 11-18
- **TRD:** Page 11-11
- **LOS, S, FFS:** Exhibits 11-2, 11-3

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# Basic Freeway Segments Worksheet

**General Information**

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<tr>
<th>Analyst</th>
<th>Tony Lewis</th>
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<tr>
<td>Agency or Company</td>
<td>KTA</td>
</tr>
<tr>
<td>Date Performed</td>
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<td>Analysis Time Period</td>
<td>PM</td>
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**Project Description**

- Ohio River Bridges Project

**Site Information**

- Highway/Direction of Travel: I-71 NB Mainline
- From/To: North of I-64 On

**Flow Inputs**

- Volume, \( V \): 4600 veh/h
- AADT: veh/day
- Peak-Hr Prop. of AADT, \( K \):
- Peak-Hr Direction Prop, \( D \):
- \( DDHV = AADT \times K \times D \): veh/h

**Calculate Flow Adjustments**

- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( E_R = 1.2 \)
- \( f_{HV} = \frac{1}{1 + (P_T(E_T - 1) + P_R(E_R - 1))} = 0.976 \)

**Speed Inputs**

- Lane Width: ft
- Rt-Side Lat. Clearance: ft
- Number of Lanes, \( N \): 2
- Total Ramp Density, \( TRD \): ramps/mi
- FFS (measured): 60.0 mph
- Base free-flow Speed, \( BFFS \): mph

**Calc Speed Adj and FFS**

- \( f_{LW} \)
- \( f_{LC} \)
- TRD Adjustment: mph
- FFS: 60.0 mph

**LOS and Performance Measures**

**Operational (LOS)**

- \( v_p = \frac{(V or DDHV)}{(PHF \times N \times f_{HV})} \times f_p \)
- \( S = \frac{v_p}{S} \)
- \( D = v_p / S \)
- \( LOS = F \)

**Design (N)**

- Design LOS
- \( v_p = \frac{(V or DDHV)}{(PHF \times N \times f_{HV})} \times f_p \)
- \( S = \)
- \( D = v_p / S \)
- Required Number of Lanes, \( N \)

**Glossary**

- **N**: Number of lanes
- **V**: Hourly volume
- **V_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume
- **S**: Speed
- **D**: Density
- **BFFS**: Base free-flow speed

**Factor Location**

- \( E_R \): Exhibits 11-10, 11-12
- \( f_{LW} \): Exhibit 11-8
- \( E_p \): Exhibits 11-10, 11-11, 11-13
- \( f_{LC} \): Exhibit 11-9
- \( f_p \): Page 11-18
- TRD: Page 11-11
- LOS, S, FFS, \( v_p \): Exhibits 11-2, 11-3

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### BASIC FREEWAY SEGMENTS WORKSHEET

#### General Information

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<th>Site Information</th>
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<td>Analyst</td>
<td>Highway/Direction of Travel I-71 SB Mainline</td>
</tr>
<tr>
<td>Agency or Company</td>
<td>From/To</td>
</tr>
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<td>Date Performed</td>
<td>Jurisdiction</td>
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<td>Analysis Time Period</td>
<td>Analysis Year</td>
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<td>2030 No Build</td>
</tr>
<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project</td>
</tr>
</tbody>
</table>

#### Flow Inputs

| Volume, V               | 3700 veh/h
|-------------------------|-------------------------------------------|
| AADT                    | veh/day
| Peak-Hr Prop. of AADT, K| %Trucks and Buses, P_T
|                         | %RVs, P_R
|                         | General Terrain: Level
| DDHV = AADT x K x D     | Grade % Length mi

#### Calculate Flow Adjustments

| f_p                     | 1.00
|-------------------------|-------------------------------------------|
| f_T                     | 1.5
| E_R                     | 1.2
| f_HV                    | 1/1 + P_T (E_T - 1) + P_R (E_R - 1) 0.966 |

#### Speed Inputs

| Lane Width              | ft
|----------------------------|-------------------------------------------|
| Rt-Side Lat. Clearance  | ft
| Number of Lanes, N       | 2
| Total Ramp Density, TRD  | ramps/mi
| FFS (measured)           | 60.0 mph
| Base free-flow Speed, BFFS| mph

#### Calc Speed Adj and FFS

| f_LW                    | mph
|-------------------------|-------------------------------------------|
| f_LC                    | mph
| TRD Adjustment          | mph
| FFS                     | 60.0 mph

#### LOS and Performance Measures

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
<th>Design (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>v_p = (V or DDHV) / (PHF x N x f_HV) 2081 pc/h/ln</td>
<td></td>
</tr>
<tr>
<td>x f_p)</td>
<td></td>
</tr>
</tbody>
</table>
| S                       | 55.8 mph
| D = v_p / S             | 37.3 pc/mi/ln
| LOS                     | E                                           |

#### Glossary

| N - Number of lanes     | S - Speed
| V - Hourly volume       | D - Density
| v_p - Flow rate         | FFS - Free-flow speed
| LOS - Level of service  | BFFS - Base free-flow speed
| DDHV - Directional design hour volume | E_R - Exhibits 11-10, 11-12
|                                   | f_LW - Exhibit 11-8
|                                   | E_T - Exhibits 11-10, 11-11, 11-13
|                                   | f_LC - Exhibit 11-9
|                                   | f_p - Page 11-18
|                                   | TRD - Page 11-11
|                                   | LOS, S, FFS, v_p - Exhibits 11-2, 11-3 |
# BASIC FREEWAY WORKSHEET

## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information
- **Analyst**: Tony Lewis
- **Agency or Company**: KTA
- **Date Performed**: 9/15/2011
- **Analysis Time Period**: PM
- **Project Description**: Ohio River Bridges Project

### Site Information
- **Highway/Direction of Travel**: I-71 SB Mainline
- **From/To**: Btw I-64 Off and I-64 On
- **Jurisdiction**: Analysis Year 2030 No Build

### Flow Inputs
- **Volume, V**: 2100 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %Trucks and Buses, \( P_T \)
- **Peak-Hr Direction Prop, D**: %RVs, \( P_R \)
- **DDHV = AADT x K x D**: veh/h

### Calculate Flow Adjustments
- \( f_p \) = 1.00
- \( E_T \) = 1.5

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

### LOS and Performance Measures

### Design (N)
- **Design LOS**
- **Design (N)**

### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

### Factor Location
- **E_R**: Exhibits 11-10, 11-12
- **f_LW**: Exhibit 11-8
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_LC**: Exhibit 11-9
- **f_p**: Page 11-18
- **TRD**: Page 11-11
- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3

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2/7/2012
**BASIC FREEWAY SEGMENTS WORKSHEET**

### General Information

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<th>Analyst</th>
<th>Tony Lewis</th>
<th>Site Information</th>
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<tr>
<td>Agency or Company</td>
<td>KTA</td>
<td>Highway/Direction of Travel I-71 SB Mainline</td>
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<td>9/15/2011</td>
<td>From/To: Btw I-65 NB Off and I-64 EB On</td>
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<td>Jurisdiction: Analysis Year 2030 No Build</td>
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<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project</td>
<td>Oper.(LOS)</td>
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### Flow Inputs

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<th>Volume, V</th>
<th>1700 veh/h</th>
<th>Peak-Hour Factor, PHF</th>
<th>0.92</th>
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<td>veh/day</td>
<td>%Trucks and Buses, P_T</td>
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<td>Peak-Hr Direction Prop, D</td>
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<td>DDHV = AADT x K x D</td>
<td>veh/h</td>
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<td>%</td>
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### Calculate Flow Adjustments

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<th>f_p</th>
<th>1.00</th>
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<th>1.2</th>
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<tr>
<td>E_T</td>
<td>1.5</td>
<td>f_{HV} = 1/(1+P_T(E_T - 1) + P_R(E_R - 1)) 0.980</td>
<td></td>
</tr>
</tbody>
</table>

### Speed Inputs

<table>
<thead>
<tr>
<th>Lane Width</th>
<th>ft</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
<td></td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
<td></td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>55.0 mph</td>
<td></td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
<td></td>
</tr>
</tbody>
</table>

### Calc Speed Adj and FFS

<table>
<thead>
<tr>
<th>f_{lw}</th>
<th>mph</th>
<th>f_{LC}</th>
<th>mph</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRD Adjustment</td>
<td>mph</td>
<td>FFS</td>
<td>55.0 mph</td>
</tr>
</tbody>
</table>

### LOS and Performance Measures

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_p = (V or DDHV) / (PHF x N x f_{HV})</td>
</tr>
<tr>
<td>x f_p</td>
</tr>
<tr>
<td>S</td>
</tr>
<tr>
<td>D = V_p / S</td>
</tr>
<tr>
<td>LOS</td>
</tr>
</tbody>
</table>

### Design (N)

<table>
<thead>
<tr>
<th>Design (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design LOS</td>
</tr>
<tr>
<td>V_p = (V or DDHV) / (PHF x N x f_{HV})</td>
</tr>
<tr>
<td>x f_p</td>
</tr>
<tr>
<td>S</td>
</tr>
<tr>
<td>D = V_p / S</td>
</tr>
<tr>
<td>Required Number of Lanes, N</td>
</tr>
</tbody>
</table>

### Glossary

<table>
<thead>
<tr>
<th>N - Number of lanes</th>
<th>S - Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>V - Hourly volume</td>
<td>D - Density</td>
</tr>
<tr>
<td>V_p - Flow rate</td>
<td>FFS - Free-flow speed</td>
</tr>
<tr>
<td>LOS - Level of service</td>
<td>BFFS - Base free-flow speed</td>
</tr>
<tr>
<td>DDHV - Directional design hour volume</td>
<td></td>
</tr>
</tbody>
</table>

### Factor Location

<table>
<thead>
<tr>
<th>E_R - Exhibits 11-10, 11-12</th>
<th>f_{lw} - Exhibit 11-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>E_T - Exhibits 11-10, 11-11, 11-13</td>
<td>f_{LC} - Exhibit 11-9</td>
</tr>
<tr>
<td>f_p - Page 11-18</td>
<td>TRD - Page 11-11</td>
</tr>
<tr>
<td>LOS, S, FFS, V_p - Exhibits 11-2, 11-3</td>
<td></td>
</tr>
</tbody>
</table>

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Ohio River Bridge Project

**FREeway Weaving Worksheet**

<table>
<thead>
<tr>
<th>General Information</th>
<th>Site Information</th>
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<tbody>
<tr>
<td>Analyst</td>
<td>Tony Lewis</td>
</tr>
<tr>
<td>Agency/Company</td>
<td>KTA</td>
</tr>
<tr>
<td>Date Performed</td>
<td>10/26/2011</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>PM</td>
</tr>
<tr>
<td>Freeway/Dir of Travel</td>
<td>I-65 NB</td>
</tr>
<tr>
<td>Weaving Segment Location</td>
<td>Btw All On and I-64/71 Off</td>
</tr>
<tr>
<td>Analysis Year</td>
<td>2030 No Build</td>
</tr>
</tbody>
</table>

**Project Description** Ohio River Bridge Project

**Inputs**

- **Weaving configuration**: One-Sided
- **Weaving number of lanes, N**: 4
- **Weaving segment length, Ls**: 2300 ft
- **Freeway free-flow speed, FFS**: 60 mph

**Conversions to pc/h Under Base Conditions**

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_RV</th>
<th>f_P</th>
<th>V (pc/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_FF</td>
<td>3603</td>
<td>0.92</td>
<td>0</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.971</td>
<td>1.00</td>
</tr>
<tr>
<td>V_RF</td>
<td>997</td>
<td>0.92</td>
<td>2</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.990</td>
<td>1.00</td>
</tr>
<tr>
<td>V_FR</td>
<td>2018</td>
<td>0.92</td>
<td>3</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.985</td>
<td>1.00</td>
</tr>
<tr>
<td>V_RR</td>
<td>1082</td>
<td>0.92</td>
<td>6</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.971</td>
<td>1.00</td>
</tr>
<tr>
<td>V_NW</td>
<td>5216</td>
<td>0.92</td>
<td>6</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V_P</td>
<td>3321</td>
<td>0.92</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V_R</td>
<td>0.389</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Configuration Characteristics**

| Minimum maneuver lanes, N_WIL | 2 lc |
| Interchange density, ID | 2.50 int/mi |
| Minimum RF lane changes, LCF | 2 lc/pc |
| Minimum FR lane changes, LCF | 0 lc/pc |
| Minimum RR lane changes, LCF | lc/pc |

**Weaving Segment Speed, Density, Level of Service, and Capacity**

| Weaving segment flow rate, V | 8537 pcf/h |
| Weaving segment capacity, C_W | 5990 veh/h |
| Weaving segment V/C ratio | 1.384 |
| Level of Service, LOS | F |

**Notes**

- a. 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".
- b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Ohio River Bridge Project

**FREEROY WEAVING WORKSHEET**

### General Information

<table>
<thead>
<tr>
<th>Analyst</th>
<th>Agency/Company</th>
<th>KTA</th>
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</thead>
<tbody>
<tr>
<td>Date Performed</td>
<td>10/26/2011</td>
<td>PM</td>
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### Site Information

<table>
<thead>
<tr>
<th>Freeway/Dir of Travel</th>
<th>I-65 SB</th>
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<tr>
<td>Weaving Segment Location</td>
<td>Btw I-64/7 On and Jefferson Of</td>
</tr>
<tr>
<td>Analysis Year</td>
<td>2030 No Build</td>
</tr>
</tbody>
</table>

**Inputs**

- **Weaving configuration**: One-Sided
- **Weaving number of lanes, N**: 4
- **Weaving segment length, L_s**: 2200 ft
- **Freeway free-flow speed, FFS**: 60 mph

**Conversions to pc/h Under Base Conditions**

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_NV</th>
<th>f_P</th>
<th>V (pc/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_FF</td>
<td>1500</td>
<td>0.92</td>
<td>10</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.952</td>
<td>1.00</td>
</tr>
<tr>
<td>V_RF</td>
<td>1100</td>
<td>0.92</td>
<td>5</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.976</td>
<td>1.00</td>
</tr>
<tr>
<td>V_FR</td>
<td>1401</td>
<td>0.92</td>
<td>3</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.985</td>
<td>1.00</td>
</tr>
<tr>
<td>V_RR</td>
<td>1069</td>
<td>0.92</td>
<td>10</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.952</td>
<td>1.00</td>
</tr>
<tr>
<td>V_NW</td>
<td>2919</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V =</td>
</tr>
<tr>
<td>V_W</td>
<td>2772</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VR</td>
<td>0.487</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Configuration Characteristics**

- **Minimum maneuver lanes, N_{WL}**: 2 lc
- **Interchange density, ID**: 2.70 Int/mi
- **Minimum RF lane changes, L_{RF}**: 0 lc/pc
- **Minimum FR lane changes, L_{FR}**: 2 lc/pc
- **Minimum RR lane changes, L_{RR}**: 0 lc/pc

**Weaving Segment Speed, Density, Level of Service, and Capacity**

| Weaving segment flow rate, v | 5691 pc/h |
| Weaving segment capacity, c_w | 4693 veh/h |
| Weaving segment vc ratio | 1.155 |
| Weaving segment density, D | pc/mln |
| Level of Service, LOS | F |

**Notes**

- a. 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".
- b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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# Freeway Weaving Worksheet

## Ohio River Bridge Project

### General Information
- **Analyst**:
- **Agency/Company**: KTA
- **Date Performed**: 12/13/2011
- **Analysis Time Period**: PM

### Project Description
- **Project**: Ohio River Bridge Project

### Site Information
- **Freeway/Dir of Travel**: I-84 EB
- **Weaving Segment Location**: Btw I-71 On and Story Off
- **Analysis Year**: 2030 No Build

### Inputs
- **Weaving configuration**: Two-Sided
- **Weaving number of lanes, N**: 3
- **Weaving segment length, L_s**: 1475 ft
- **Freeway free-flow speed, FFS**: 60 mph

### Freeway Parameters
- **Freeway minimum speed, S_{MN}**: 50 mph
- **Freeway maximum capacity, C_{FL}**: 2300 pc/h
- **Terrain type**: Level

### Conversions to pc/h Under Base Conditions

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>t_nv</th>
<th>f_0</th>
<th>v (pc/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_FF</td>
<td>2215</td>
<td>0.92</td>
<td>5</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.976</td>
<td>1.00</td>
</tr>
<tr>
<td>V_RF</td>
<td>185</td>
<td>0.92</td>
<td>5</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.976</td>
<td>1.00</td>
</tr>
<tr>
<td>V_FR</td>
<td>1615</td>
<td>0.92</td>
<td>5</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.976</td>
<td>1.00</td>
</tr>
<tr>
<td>V_RR</td>
<td>285</td>
<td>0.92</td>
<td>5</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.976</td>
<td>1.00</td>
</tr>
<tr>
<td>V_NW</td>
<td>4473</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V = 4800</td>
</tr>
<tr>
<td>V_W</td>
<td>327</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VR</td>
<td>0.068</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Configuration Characteristics
- **Minimum maneuver lanes, N_{WL}**: 0 lane
- **Interchange density, ID**: 2.00 in/mi
- **Minimum RF lane changes, L_{CF}**: 0 pc
- **Minimum FR lane changes, L_{CF}**: 0 pc
- **Minimum RR lane changes, L_{RR}**: 2 pc

### Minimum Weaving Lane Changes, L_{MN}
- **LC_{MN}**: 654 pc/h

### Weaving Lane Changes, LC_{W}
- **LC_{W}**: 944 pc/h

### Non-Weaving Lane Changes, LC_{NW}
- **LC_{NW}**: 1189 pc/h

### Total Lane Changes, LC_{ALL}
- **LC_{ALL}**: 2133 pc/h

### Non-Weaving Vehicle Index, I_{NW}
- **I_{NW}**: 0.302

### Weaving Segment Speed, Density, Level of Service, and Capacity
- **Weaving segment flow rate, v**: 4800 pc/h
- **Weaving segment capacity, c_{w}**: 5637 veh/h
- **Weaving segment v/c ratio**: 0.831
- **Weaving segment density, D**: 33.2 pc/mln
- **Weaving intensity factor, W**: 0.302
- **Weaving segment speed, S**: 48.2 mph
- **Weaving segment speed, S**: 57.7 mph
- **Average non-weaving speed, S_{NW}**: 47.6 mph
- **Maximum weaving length, L_{MAX}**: 6355 ft

### Notes
1. 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".
2. For volumes that exceed the weaving segment capacity, the level of service is "F".
## Ohio River Bridge Project

### Freeway Weaving Worksheet

<table>
<thead>
<tr>
<th>General Information</th>
<th>Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyst</td>
<td>Freeway/Dir of Travel : I-64 WB</td>
</tr>
<tr>
<td>Agency/Company</td>
<td>Freeway Segment Location : Btw Story On and I-65 Off</td>
</tr>
<tr>
<td>Date Performed</td>
<td>Analysis Year : 2030 No Build</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td></td>
</tr>
</tbody>
</table>

### Project Description: Ohio River Bridge Project

<table>
<thead>
<tr>
<th>Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaving configuration</td>
</tr>
<tr>
<td>Weaving number of lanes, N</td>
</tr>
<tr>
<td>Weaving segment length, l_s</td>
</tr>
<tr>
<td>Freeway free-flow speed, FFS</td>
</tr>
<tr>
<td>Segment type</td>
</tr>
<tr>
<td>Freeway minimum speed, S_{MIN}</td>
</tr>
<tr>
<td>Freeway maximum capacity, C_{FL}</td>
</tr>
<tr>
<td>Terrain type</td>
</tr>
</tbody>
</table>

### Conversions to pc/h Under Base Conditions

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_{IV}</th>
<th>f_p</th>
<th>V (pc/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{FF}</td>
<td>2383</td>
<td>0.92</td>
<td>4</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.980</td>
<td>1.00</td>
</tr>
<tr>
<td>V_{RF}</td>
<td>1417</td>
<td>0.92</td>
<td>4</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.980</td>
<td>1.00</td>
</tr>
<tr>
<td>V_{FR}</td>
<td>177</td>
<td>0.92</td>
<td>1</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.995</td>
<td>1.00</td>
</tr>
<tr>
<td>V_{RR}</td>
<td>323</td>
<td>0.92</td>
<td>4</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.980</td>
<td>1.00</td>
</tr>
<tr>
<td>V_{NW}</td>
<td>4406</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V_{W}</td>
<td>353</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V_{R}</td>
<td>0.074</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Configuration Characteristics

| Minimum maneuver lanes, N_{WL} | 0 lc |
| Interchange density, ID | 1.80 int/mi |
| Minimum RF lane changes, L_{CRF} | lc/pc |
| Minimum FR lane changes, L_{CRF} | lc/pc |
| Minimum RR lane changes, L_{CRR} | 2 lc/pc |
| Minimum weaving lane changes, L_{C_{MIN}} | 706 lc/h |
| Weaving lane changes, L_{C_{W}} | 994 lc/h |
| Non-weaving lane changes, L_{C_{NW}} | 1197 lc/h |
| Total lane changes, L_{C_{ALL}} | 2191 lc/h |
| Non-weaving vehicle index, L_{NW} | 0.290 |

### Weaving Segment Speed, Density, Level of Service, and Capacity

| Weaving segment flow rate, v | 4759 pc/h |
| Weaving segment capacity, c_{W} | 5679 veh/h |
| Weaving segment v/c ratio | 0.822 |
| Weaving segment density, D | 33.1 pc/mi/ln |
| Level of Service, LOS | D | 0.290 |
| Weaving intensity factor, W | 47.9 mph |
| Weaving segment speed, S | 57.8 mph |
| Average weavine speed, S_{AVERAGE} | 47.3 mph |
| Maximum weaving length, L_{MAX} | 6423 ft |

### Notes

1. 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".
2. For volumes that exceed the weaving segment capacity, the level of service is "F".

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2/22/2012
### General Information

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<thead>
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<th>Analyst</th>
<th>Agency/Company</th>
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<td></td>
<td>KTA</td>
</tr>
<tr>
<td>Date</td>
<td>12/13/2011</td>
</tr>
<tr>
<td>Time</td>
<td>PM</td>
</tr>
</tbody>
</table>

| Project Description | Ohio River Bridge Project |

### Site Information

- Freeway/Dir of Travel: I-64 WB
- Weaving Segment Location: Btw I-65 On and 3rd Off
- Analysis Year: 2030 No Build

### Inputs

- Weaving configuration: Two-Sided
- Weaving number of lanes, N: 4
- Weaving segment length, L_s: 1468 ft
- Freeway free-flow speed, FFS: 60 mph

### Conversions to pc/h Under Base Conditions

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_RV</th>
<th>f_p</th>
<th>v (pc/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_FF</td>
<td>3615</td>
<td>0.92</td>
<td>3</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.985</td>
<td>1.00</td>
</tr>
<tr>
<td>V_RF</td>
<td>410</td>
<td>0.92</td>
<td>1</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.995</td>
<td>1.00</td>
</tr>
<tr>
<td>V_FR</td>
<td>1285</td>
<td>0.92</td>
<td>4</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.980</td>
<td>1.00</td>
</tr>
<tr>
<td>V_RR</td>
<td>290</td>
<td>0.92</td>
<td>3</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.985</td>
<td>1.00</td>
</tr>
<tr>
<td>V_NW</td>
<td>5881</td>
<td>0.92</td>
<td>3</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.985</td>
<td>1.00</td>
</tr>
<tr>
<td>v</td>
<td>320</td>
<td>0.92</td>
<td>3</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.985</td>
<td>1.00</td>
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<tr>
<td>VR</td>
<td>0.052</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Configuration Characteristics

- Minimum maneuver lanes, N_WL: 0
- Minimum weaving lane changes, L_C_MIN: 320 lc/h
- Weaving lane changes, L_C: 806 lc/h
- Non-weaving lane changes, L_C_NW: 1901 lc/h
- Total lane changes, L_C_ALL: 2707 lc/h
- Non-weaving vehicle index, l_NW: 0.367

### Weaving Segment Speed, Density, Level of Service, and Capacity

- Weaving segment flow rate, v: 6181 pc/h
- Weaving intensity factor, W: 0.367
- Weaving segment capacity, c_w: 7633 veh/h
- Average weaving speed, S_w: 50.6 mph
- Average non-weaving speed, S_NW: 57.3 mph
- Maximum weaving length, L_MAX: 6210 ft

### Notes

1. 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".
2. For volumes that exceed the weaving segment capacity, the level of service is "F".
**Ohio River Bridge Project**

**FREEWAY WEAVING WORKSHEET**

### General Information

<table>
<thead>
<tr>
<th>Analyst</th>
<th>KTA</th>
<th>Freeway/Dir of Travel</th>
<th>I-71 NB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency/Company</td>
<td>KTA</td>
<td>Weaving Segment Location</td>
<td>Btw I-65 SB On and I-64 Off</td>
</tr>
<tr>
<td>Date Performed</td>
<td>10/26/2011</td>
<td>Analysis Year</td>
<td>2030 No Build</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>PM</td>
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**Project Description** Ohio River Bridge Project

### Inputs

<table>
<thead>
<tr>
<th>Weaving configuration</th>
<th>Two-Sided</th>
<th>Segment type</th>
<th>Freeway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaving number of lanes, N</td>
<td>2</td>
<td>Freeway minimum speed, $S_{MIN}$</td>
<td>50</td>
</tr>
<tr>
<td>Weaving segment length, L&lt;sub&gt;S&lt;/sub&gt;</td>
<td>2200 ft</td>
<td>Freeway maximum capacity, $C_{FL}$</td>
<td>2300</td>
</tr>
<tr>
<td>Freeway free-flow speed, FFS</td>
<td>60 mph</td>
<td>Terrain type</td>
<td>Level</td>
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</tbody>
</table>

### Conversions to pc/h Under Base Conditions

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>$E_T$</th>
<th>$E_R$</th>
<th>f&lt;sub&gt;HV&lt;/sub&gt;</th>
<th>f&lt;sub&gt;p&lt;/sub&gt;</th>
<th>V (pc/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{FF}$</td>
<td>1518</td>
<td>0.92</td>
<td>3</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.985</td>
<td>1.00</td>
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<tr>
<td>$V_{RF}$</td>
<td>1182</td>
<td>0.92</td>
<td>5</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.976</td>
<td>1.00</td>
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<td>$V_{FR}$</td>
<td>1488</td>
<td>0.92</td>
<td>1</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.995</td>
<td>1.00</td>
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<td>$V_{RR}$</td>
<td>313</td>
<td>0.92</td>
<td>3</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.985</td>
<td>1.00</td>
</tr>
<tr>
<td>$V_{NW}$</td>
<td>4617</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V = 4961</td>
</tr>
<tr>
<td>$V_{W}$</td>
<td>344</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>$V_{R}$</td>
<td>0.069</td>
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</table>

### Configuration Characteristics

| Minimum maneuver lanes, N<sub>WL</sub> | 0 | Minimum weaving lane changes, L<sub>C_MIN</sub> | lc/h |
| Interchange density, ID | 2.30 int/mi | Weaving lane changes, L<sub>C_W</sub> | lc/h |
| Minimum RF lane changes, L<sub>C_RF</sub> | lc/pc | Non-weaving lane changes, L<sub>C_NW</sub> | lc/h |
| Minimum FR lane changes, L<sub>C_FR</sub> | lc/pc | Total lane changes, L<sub>C_ALL</sub> | lc/h |
| Minimum RR lane changes, L<sub>C_RR</sub> | 1 lc/pc | Non-weaving vehicle index, I<sub>NW</sub> | |

### Weaving Segment Speed, Density, Level of Service, and Capacity

| Weaving segment flow rate, v | 4961 pc/h | Weaving intensity factor, W |
| Weaving segment capacity, c<sub>W</sub> | 3001 veh/h | Weaving segment speed, S | mph |
| Weaving segment v/c ratio | 1.253 | Average weaving speed, S<sub>W</sub> | mph |
| Weaving segment density, D | pc/ml/h | Average non-weaving speed, S<sub>NW</sub> | mph |
| Level of Service, LOS | F | Maximum weaving length, L<sub>MAX</sub> | 6377 ft |

### Notes

a. 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".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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**HCS 2010™ Version 6.1** Generated: 2/22/2012 5:40 PM

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## General Information

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<th>Analyst</th>
<th>Agency/Company</th>
<th>Date Performed</th>
<th>Analysis Time Period</th>
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<tbody>
<tr>
<td></td>
<td>KTA</td>
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<td>PM</td>
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</table>

## Site Information

<table>
<thead>
<tr>
<th>Freeway/Dir of Travel</th>
<th>Weaving Segment Location</th>
<th>Analysis Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-71 SB</td>
<td>Btw I-64 On and I-65 NB Off</td>
<td>2030 No Build</td>
</tr>
</tbody>
</table>

## Project Description
Ohio River Bridge Project

## Inputs

### Weaving configuration
- Two-Sided

### Weaving number of lanes, N
- 2

### Weaving segment length, L_s
- 1500 ft

### Freeway free-flow speed, FFS
- 60 mph

### Segment type
- Freeway

### Freeway minimum speed, S_{MN}
- 50

### Freeway maximum capacity, C_{FL}
- 2300

### Terrain type
- Level

## Conversions to pc/h Under Base Conditions

<table>
<thead>
<tr>
<th>V (veh/h)</th>
<th>PHF</th>
<th>Truck (%)</th>
<th>RV (%)</th>
<th>E_T</th>
<th>E_R</th>
<th>f_{HV}</th>
<th>f_{P}</th>
<th>v (pc/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{FF}</td>
<td>1356</td>
<td>0.92</td>
<td>2</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.990</td>
<td>1.00</td>
</tr>
<tr>
<td>V_{RF}</td>
<td>745</td>
<td>0.92</td>
<td>3</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.985</td>
<td>1.00</td>
</tr>
<tr>
<td>V_{FR}</td>
<td>364</td>
<td>0.92</td>
<td>1</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.995</td>
<td>1.00</td>
</tr>
<tr>
<td>V_{RR}</td>
<td>1536</td>
<td>0.92</td>
<td>2</td>
<td>0</td>
<td>1.5</td>
<td>1.2</td>
<td>0.990</td>
<td>1.00</td>
</tr>
<tr>
<td>V_{NW}</td>
<td>2709</td>
<td></td>
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<tr>
<td>V_{W}</td>
<td>1703</td>
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<tr>
<td>VR</td>
<td>0.386</td>
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<td></td>
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<td></td>
<td></td>
</tr>
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</table>

## Configuration Characteristics

| Minimum maneuver lanes, N_{WL} | 0 lc |
| Interchange density, ID | 2.20 in/ft |
| Minimum RF lane changes, L_{RF} | ic/pc |
| Minimum RR lane changes, L_{RR} | 1 lc/pc |

## Minimum weaving lane changes, L_{MIN} | ic/h |

## Weaving Segment Speed, Density, Level of Service, and Capacity

| Weaving segment flow rate, v | 4412 pc/h |
| Weaving segment capacity, c_{w} | 3319 veh/h |
| Weaving segment v/c ratio | 1.316 |
| Level of Service, LOS | F |

| Weaving intensity factor, W | |
| Weaving segment speed, S | mph |
| Average weaving speed, S_{w} | mph |
| Average non-weaving speed, S_{NW} | mph |

## Notes

a. 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".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".
<table>
<thead>
<tr>
<th>General Information</th>
<th>Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyst</td>
<td>Highway/Direction of Travel</td>
</tr>
<tr>
<td>Agency or Company</td>
<td>From/To</td>
</tr>
<tr>
<td>Date Performed</td>
<td>Jurisdiction</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>Analysis Year</td>
</tr>
<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flow Inputs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume, V</td>
<td>2400 veh/h</td>
</tr>
<tr>
<td>AADT</td>
<td>veh/day</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td>%Trucks and Buses, PT = 15</td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
<td>%RVs, PR = 0</td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>veh/h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Calculate Flow Adjustments</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>f_p</td>
<td>1.00</td>
</tr>
<tr>
<td>E_T</td>
<td>1.5</td>
</tr>
<tr>
<td>f_HV = 1/[(1 + (PTf_HV - 1) + (PRf_R - 1)) = 0.930</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Speed Inputs</th>
<th>Calc Speed Adj and FFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane Width</td>
<td>ft</td>
</tr>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>3</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>60.0 mph</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LOS and Performance Measures</th>
<th>Design (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational (LOS)</td>
<td>Design (N)</td>
</tr>
<tr>
<td>v_p = (V or DDHV) / (PHF x N x f_HV) x f_p</td>
<td></td>
</tr>
<tr>
<td>x f_p)</td>
<td>pc/h/ln</td>
</tr>
<tr>
<td>S</td>
<td>60.0 mph</td>
</tr>
<tr>
<td>D = v_p / S</td>
<td>15.6 pc/mi/ln</td>
</tr>
<tr>
<td>LOS</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>pc/mi/ln</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Glossary</th>
<th>Factor Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>N - Number of lanes</td>
<td>S - Speed</td>
</tr>
<tr>
<td>V - Hourly volume</td>
<td>D - Density</td>
</tr>
<tr>
<td>v_p - Flow rate</td>
<td>FFS - Free-flow speed</td>
</tr>
<tr>
<td>LOS - Level of service</td>
<td>BFFS - Base free-flow speed</td>
</tr>
</tbody>
</table>
### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 5/16/11
- **Analysis Time Period**: AM Peak Hour
- **Project Description**: Ohio River Bridges Project

### Site Information
- **Highway/Direction of Travel**: I-64 Southbound
- **From/To**: Sherman Minton Bridge SB
- **Jurisdiction**: Analysis Year 2030

### Flow Inputs
- **Volume, V**: 6700 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %
- **Peak-Hr Direction Prop, D**: 
- **DDHV = AADT x K x D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, PT**: 8
- **%RVs, PR**: 0
- **General Terrain**: Level
- **Grade**: %
- **Length**: mi
- **Up/Down %**: 

### Calculate Flow Adjustments
- \( f_p \) = 1.00
- \( E_R \) = 1.2
- \( f_{HV} = \frac{1}{1 + p_A (E_T - 1) + p_R (E_R - 1)} \) = 0.962

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

### Speed Adj and FFS
- **Calc Speed**: mph
- **TRD Adjustment**: mph
- **FFS**: mph

### LOS and Performance Measures
### Design (N)

### Glossary
- **N**: Number of lanes
- **S**: Speed
- **V**: Hourly volume
- **D**: Density
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

### Factor Location
- **E_R**: Exhibits 11-10, 11-12
- **f_{LV}**: Exhibit 11-8
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_{LC}**: Exhibit 11-9
- **f_p**: Page 11-18
- **TRD**: Page 11-11
- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3
# Basic Freeway Segments Worksheet

## General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 5/16/11
- **Analysis Time Period**: PM Peak Hour
- **Project Description**: Ohio River Bridges Project

## Site Information
- **Highway/Direction of Travel**: I-64 Northbound
- **From/To**: Sherman Minton Bridge NB

## Flow Inputs
- **Volume, V**: 6700 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: veh/h
- **Peak-Hr Direction Prop, D**: veh/h
- **DDHV = AADT x K x D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 10
- **%RVs, P_R**: 0
- **General Terrain**: Level
- **Grade**:
  - **% Length**: mi
  - **Up/Down %**:

## Calculate Flow Adjustments
- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( E_R = 1.2 \)
- \( f_{HV} = (f_p/E_T)(E_T/E_R) = 0.952 \)

## Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

## LOS and Performance Measures
- **Operational (LOS)**
  - \( v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV}) = 2549 \text{ pc/h/ln} \)
  - \( S = 43.6 \text{ mph} \)
  - \( D = v_p / S = 58.4 \text{ pc/mi/ln} \)
  - **LOS**:
- **Design (N)**
  - **Design LOS**
  - **Design (N)**

## Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

## Factor Location
- **E_R**: Exhibits 11-10, 11-12
- **f_{HV}**: Exhibit 11-8
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_LW**: Exhibit 11-9
- **f_p**: Page 11-18
- **TRD**: Page 11-11
- **BFFS**: Base free-flow speed
- **FFS**: Free-flow speed
- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3
## BASIC FREEWAY WORKSHEET

### BASIC FREEWAY SEGMENTS WORKSHEET

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<td>Analysis Year</td>
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<table>
<thead>
<tr>
<th>Flow Inputs</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Volume, V</td>
<td>Peak-Hour Factor, PHF</td>
</tr>
<tr>
<td>AADT</td>
<td>%Trucks and Buses, P_T</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td>%RVs, P_R</td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
<td>General Terrain: Level</td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>Grade % Length Up/Down %</td>
</tr>
<tr>
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<table>
<thead>
<tr>
<th>Calculate Flow Adjustments</th>
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<tbody>
<tr>
<td>f_p</td>
<td>E_R</td>
</tr>
<tr>
<td>E_T</td>
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<table>
<thead>
<tr>
<th>Speed Inputs</th>
<th>Calc Speed Adj and FFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane Width</td>
<td>f_LW</td>
</tr>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>f_LC</td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>TRD Adjustment</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>FFS</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td></td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>LOS and Performance Measures</th>
<th>Design (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational (LOS)</td>
<td></td>
</tr>
<tr>
<td>v_p = (V or DDHV) / (PHF x N x f_HV 1466)</td>
<td>v_p = (V or DDHV) / (PHF x N x f_HV)</td>
</tr>
<tr>
<td>x f_p</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td></td>
</tr>
<tr>
<td>D = v_p / S</td>
<td></td>
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<tr>
<td>LOS C</td>
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</table>

<table>
<thead>
<tr>
<th>Glossary</th>
<th>Factor Location</th>
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<tbody>
<tr>
<td>N - Number of lanes</td>
<td>E_R - Exhibits 11-10, 11-12</td>
</tr>
<tr>
<td>V - Hourly volume</td>
<td>f_LW - Exhibit 11-8</td>
</tr>
<tr>
<td>v_p - Flow rate</td>
<td>E_T - Exhibits 11-10, 11-11, 11-13</td>
</tr>
<tr>
<td>LOS - Level of service</td>
<td>f_LC - Exhibit 11-9</td>
</tr>
<tr>
<td>DDHV - Directional design hour volume</td>
<td>f_p - Page 11-18</td>
</tr>
<tr>
<td></td>
<td>TRD - Page 11-11</td>
</tr>
</tbody>
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Copyright © 2010 University of Florida, All Rights Reserved  
HCS 2010™ Version 6.1 Generated: 2/8/2012 12:51 PM
**MULTILANE HIGHWAYS WORKSHEET (Direction 1)**

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<tr>
<th>General Information</th>
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<tbody>
<tr>
<td>Analyst: J. Sherman</td>
<td>Highway/Direction to Travel: US 31 Clark Bridge</td>
</tr>
<tr>
<td>Agency or Company: Parsons</td>
<td>From/To: Bridge</td>
</tr>
<tr>
<td>Date Performed: 12/30/2011</td>
<td>Jurisdiction:</td>
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<tr>
<td>Analysis Time Period: AM Peak</td>
<td>Analysis Year: 2030 No-Action</td>
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<tr>
<th>Project Description</th>
<th>Ohio River Bridges Project (Direction 1=NB, Direction 2=SB)</th>
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</table>

<table>
<thead>
<tr>
<th>Flow Inputs</th>
<th>Oper (LOS)</th>
<th>Det. (N)</th>
<th>Plan. (Vg)</th>
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<tbody>
<tr>
<td>Volumes, V (veh/h): 720</td>
<td>Peak-Hour Factor, FH: 0.92</td>
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<tr>
<td>AADT (veh/day):</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Peak-Hour Prop of AADT (veh/day):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak-Hour Direction Prop, D:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DHPV (veh/h):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driver Types Adjustment: 1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Calculate Flow Adjustments | | | |
|-----------------------------|----------|----------|
| F | 1.00 | E_r | 1.2 |
| E_t | 1.5 | E_v | 0.955 |

<table>
<thead>
<tr>
<th>Speed Inputs</th>
<th>Calc Speed Adj and FFS</th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Lane Width, LW (ft): 12.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Lateral Clearance, LC (ft): 12.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access Points, A (Alms): 0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median Type, M:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FFS (measured): 45.0</td>
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<tr>
<td>Base Free Flow Speed, BFFS: 45.0</td>
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<table>
<thead>
<tr>
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<th>Design</th>
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</thead>
<tbody>
<tr>
<td>Operational LOS:</td>
<td>Design (N)</td>
</tr>
<tr>
<td>Flow Rate, v (pc/h/m): 363</td>
<td>Required Number of Lanes, N</td>
</tr>
<tr>
<td>Speed, S (mph): 45.0</td>
<td>Flow Rate, v (pc/h)</td>
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<tr>
<td>D (pc/h/m): 8.7</td>
<td>Max Service Flow Rate (pc/h/m)</td>
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<tr>
<td>LOS</td>
<td>Design LOS</td>
</tr>
</tbody>
</table>

**Bicycle Level of Service**
### MULTILANE HIGHWAYS WORKSHEET (Direction 2)

#### General Information
- **Analyst:** J. Sherman
- **Agency or Company:** Parsons
- **Data Performed:** 12/30/2011
- **Analysis Time Period:** AM Peak
- **Project Description:** Ohio River Bridges Project (Direction 1: NB, Direction 2: SB)

#### Site Information
- **Highway/Direction to Travel:** US 31 Clark Bridge
- **Jurisdiction:** Fort Wayne
- **Analysis Year:** 2030 No-Action

#### Flow Inputs
- **Flow Rate, V_n (veh/h):** 1660
- **Peak Hour Factor, PHF:** 0.92
- **% Trucks and Buses, P_T:** 1
- **%Veh., P_v:** 0
- **General Terrain:** Level
- **Grade (Length in):** 0.00
- **Up/Down %:** 0.00
- **Number of Lanes:** 2

#### Calculate Flow Adjustments
- **Y:** 1.00
- **Y_H:** 1.2
- **Y_W:** 0.995

#### Speed Inputs
- **Lane Width, L (ft):** 12.0
- **Total Lateral Clearance, LC (ft):** 12.0
- **Access Points, A (Access):** 0
- **Median Type, M:**
- **FFS (measured):** 45.0
- **Base Free-Flow Speed, FFS:** 45.0

#### Operations
- **Operational LOS:**
  - **Flow Rate, V_n (veh/h):** 917
  - **Speed, S (mph):** 40.0
  - **D (psf/ft^2):** 20.4
  - **LOS:** C

#### Bicycle Level of Service

---

**Note:** The file paths and dates at the bottom indicate the document was generated on 2/24/2012.
### MULTILANE HIGHWAYS WORKSHEET (Dir 1)

#### General Information
- **Analyst:** J Shanam
- **Agency or Company:** Parsons
- **Date Performed:** 12/30/2011
- **Analytic Time Period:** PM Peak
- **Project Description:** Ohio River Bridges Project (Direction 1=NB, Direction 2=SB)

#### Site Information
- **Highway/Direction to Travel:** US 31 Clark Bridge
- **Jurisdiction:** Bridge
- **Analysis Year:** 2030 No-Action

#### Flow Inputs
<table>
<thead>
<tr>
<th>Volume, V (vph)</th>
<th>1980</th>
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</thead>
<tbody>
<tr>
<td>%Trucks and Buses, Pb</td>
<td>1</td>
</tr>
<tr>
<td>%Steer, Pst</td>
<td>0</td>
</tr>
<tr>
<td>%Divided Median, PD</td>
<td>Level</td>
</tr>
<tr>
<td>%Number of Lanes, N</td>
<td>2</td>
</tr>
</tbody>
</table>

#### Calculate Flow Adjustments
- \(F_r = 1.00\)
- \(F_v = 1.2\)
- \(F_w = 0.955\)

#### Speed Inputs
- **Lane Width, LW (ft):** 12.0
- **Total Lateral Clearance, LC (ft):** 12.0
- **Access Points, A (Alms):** 0
- **Median Type, M:**
  - Internal M
  - 45.0
- **Base Free Flow Speed, FFS:** 45.0

#### Design
- **Desire (N):**
- **Flow Rate, \(v_x\) (pcph):** 1691
- **Speed, \(S\) (mph):** 45.0
- **D (pc/h/ln):** 24.0
- **LOS:** C

---

**Note:** The document contains tables and calculations related to traffic flow and operational aspects of a highway project. The tables include various inputs, adjustments, and outputs related to traffic volume, speed, and design criteria.
### MULTILANE HIGHWAYS WORKSHEET (Direction 2)

#### General Information
- **Analyst:** J. Sherman
- **Agency or Company:** Parsons
- **Date Performed:** 12/30/2011
- **Analysis Time Period:** PM Peak
- **Project Description:** Ohio River Bridges Project (Direction 1=NB, Direction 2=SB)

#### Site Information
- **Highway/Direction to Travel:** US 31 Clark Bridge
- **Jurisdiction:** Analysis Year
- **Analysis Year:** 2030 No-Action

#### Flow Inputs

<table>
<thead>
<tr>
<th>Volumetric, V (veh/h)</th>
<th>1300</th>
<th>Peak Hour Factor, PHF</th>
<th>0.92</th>
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<td>AADT (veh/h)</td>
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<td>%Trucks and Buses, P_T</td>
<td>1</td>
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<tr>
<td>Peak Hour Prop of AADT (veh/h)</td>
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<td>%Vans, P_V</td>
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<tr>
<td>Peak Hour Direction Prop, D</td>
<td></td>
<td>General Terrain: Level</td>
<td>0.00</td>
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<tr>
<td>DOHV (veh/h)</td>
<td></td>
<td>Grate Length (m)</td>
<td>0.00</td>
</tr>
<tr>
<td>Driver Type Adjustment</td>
<td>1.00</td>
<td>Up/Down %</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Number of Lanes</td>
<td>2</td>
</tr>
</tbody>
</table>

#### Calculate Flow Adjustments
- \( F_T = 1.00 \)
- \( F_R = 1.2 \)
- \( F_W = 1.5 \)
- \( F_H = 0.995 \)

#### Speed Inputs

<table>
<thead>
<tr>
<th>Lane Width, LW (ft)</th>
<th>12.0</th>
<th>( I_{mi} ) (mph)</th>
<th>45.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Lateral Clearance, LC (ft)</td>
<td>12.0</td>
<td>( I_{mi} ) (mph)</td>
<td>45.0</td>
</tr>
<tr>
<td>Access Points, A (Alms)</td>
<td>0</td>
<td>( I_{mi} ) (mph)</td>
<td>45.0</td>
</tr>
<tr>
<td>Median Type, M</td>
<td>45.0</td>
<td>FF3 (measured)</td>
<td>45.0</td>
</tr>
<tr>
<td>Base Free Flow Speed, FF3</td>
<td>45.0</td>
<td></td>
<td></td>
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#### Operations

<table>
<thead>
<tr>
<th>Operational LOS</th>
<th>Design LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Rate, ( v_c ) (pcv/h)</td>
<td>730</td>
</tr>
<tr>
<td>Speed, S (mph)</td>
<td>45.0</td>
</tr>
<tr>
<td>D (pcv/min)</td>
<td>16.0</td>
</tr>
<tr>
<td>LOS</td>
<td>B</td>
</tr>
</tbody>
</table>

### Design
- **Required Number of Lanes, N**: 
- **Flow Rate, \( v_c \) (pcv/h)**: 
- **Max Service Flow Rate (pcv/h)**: 
- **Design LOS**: 
### BASIC FREEWAY SEGMENTS WORKSHEET

#### General Information

<table>
<thead>
<tr>
<th>Analyst</th>
<th>Adams</th>
<th>Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency or Company</td>
<td>Parsons</td>
<td>Highway/Direction of Travel</td>
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<tr>
<td></td>
<td></td>
<td>I-64 Northbound</td>
</tr>
<tr>
<td>Date Performed</td>
<td>5/16/11</td>
<td>From/To</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>AM Peak Hour</td>
<td>Jurisdiction</td>
</tr>
<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project</td>
<td>Analysis Year</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2030 FEIS</td>
</tr>
<tr>
<td>Oper.(LOS)</td>
<td>Des.(N)</td>
<td>Planning Data</td>
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#### Flow Inputs

<table>
<thead>
<tr>
<th>Volume, V</th>
<th>2600 veh/h</th>
<th>Peak-Hour Factor, PHF</th>
<th>0.92</th>
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</thead>
<tbody>
<tr>
<td>AADT</td>
<td>veh/day</td>
<td>%Trucks and Buses, PT</td>
<td>13</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td>%RVs, PR</td>
<td>General Terrain: Level</td>
<td>0</td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
<td>Grade</td>
<td>Length</td>
<td>mi</td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>veh/h</td>
<td>Up/Down</td>
<td>%</td>
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</tbody>
</table>

#### Calculate Flow Adjustments

<table>
<thead>
<tr>
<th>$f_p$</th>
<th>1.00</th>
<th>$E_R$</th>
<th>1.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E_T$</td>
<td>1.5</td>
<td>$f_{HV} = 1/1 + P_T(E_T - 1) + P_R(E_R - 1)$</td>
<td>0.939</td>
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#### Speed Inputs

<table>
<thead>
<tr>
<th>Lane Width</th>
<th>ft</th>
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<tbody>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
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<tr>
<td>Number of Lanes, N</td>
<td>3</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>60.0 mph</td>
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<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
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#### Calc Speed Adj and FFS

<table>
<thead>
<tr>
<th>$f_{LW}$</th>
<th>mph</th>
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<tr>
<td>$f_{LC}$</td>
<td>mph</td>
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<tr>
<td>TRD Adjustment</td>
<td>mph</td>
</tr>
<tr>
<td>FFS</td>
<td>60.0 mph</td>
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</tbody>
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#### LOS and Performance Measures

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
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<tbody>
<tr>
<td>$v_p = (V$ or DDHV) / (PHF x N x $f_{HV} \times 1003$) pc/h/ln</td>
</tr>
<tr>
<td>$S$</td>
</tr>
<tr>
<td>$D = v_p / S$</td>
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<tr>
<td>LOS</td>
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#### Design (N)

<table>
<thead>
<tr>
<th>Design (N)</th>
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<tbody>
<tr>
<td>Design LOS</td>
</tr>
<tr>
<td>$v_p = (V$ or DDHV) / (PHF x N x $f_{HV} \times 1003$) pc/h/ln</td>
</tr>
<tr>
<td>$S$</td>
</tr>
<tr>
<td>$D = v_p / S$</td>
</tr>
</tbody>
</table>

#### Required Number of Lanes, N

#### Glossary

- **N** - Number of lanes
- **V** - Hourly volume
- **$v_p$** - Flow rate
- **LOS** - Level of service
- **DDHV** - Directional design hour volume

#### Factor Location

- $E_R$ - Exhibits 11-10, 11-12
- $f_{LW}$ - Exhibit 11-8
- $E_T$ - Exhibits 11-10, 11-11, 11-13
- $f_{LC}$ - Exhibit 11-9
- $f_p$ - Page 11-18
- TRD - Page 11-11
- LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3
# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

<table>
<thead>
<tr>
<th>Analyst</th>
<th>Adams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency or Company</td>
<td>Parsons</td>
</tr>
<tr>
<td>Date Performed</td>
<td>5/16/11</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>AM Peak Hour</td>
</tr>
<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project</td>
</tr>
</tbody>
</table>

## Site Information

| Highway/Direction of Travel | I-64 Southbound |
| From/To | Sherman Minton Bridge SB |
| Jurisdiction | |
| Analysis Year | 2030 FEIS |

## Flow Inputs

| Volume, V | 5300 veh/h |
| AADT | veh/day |
| Peak-Hr Prop. of AADT, K | |
| Peak-Hr Direction Prop, D | |
| DDHV = AADT x K x D | veh/h |

## Calculate Flow Adjustments

\[ f_p = 1.00 \]
\[ E_T = 1.5 \]

## Speed Inputs

| Lane Width | ft |
| Rt-Side Lat. Clearance | ft |
| Number of Lanes, N | 3 |
| Total Ramp Density, TRD | ramps/mi |
| FFS (measured) | 60.0 mph |
| Base free-flow Speed, BFFS | mph |

## Calc Speed Adj and FFS

| \( f_{LW} \) | mph |
| \( f_{LC} \) | mph |

## LOS and Performance Measures

| \( v_p = (V \text{ or DDHV}) \times (PHF \times N \times f_{HV}^{-1987}) \) | pc/h/ln |
| S | mph |
| D = \( v_p / S \) | pc/mi/ln |

## Design (N)

| Design LOS | Design (N) |
| Requires Number of Lanes, N | |

## Glossary

- N - Number of lanes
- V - Hourly volume
- \( v_p \) - Flow rate
- LOS - Level of service
- DDHV - Directional design hour volume

## Factor Location

- E_R - Exhibits 11-8
- E_T - Exhibits 11-10, 11-11
- \( f_{LW} \) - Exhibit 11-8
- \( f_{LC} \) - Exhibit 11-9
- \( f_p \) - Page 11-18
- TRD - Page 11-11
- LOS, S, FFS, \( v_p \) - Exhibits 11-2, 11-3

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Generated: 2/8/2012 4:08 PM
### BASIC FREEWAY SEGMENTS WORKSHEET

#### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 5/16/11
- **Analysis Time Period**: PM Peak Hour
- **Project Description**: Ohio River Bridges Project

#### Site Information
- **Highway/Direction of Travel**: I-64 Northbound
- **From/To**: Sherman Minton Bridge NB
- **Jurisdiction**: Analysis Year 2030 FEIS

#### Flow Inputs
- **Volume, V**: 6000 veh/h
- **Peak-Hr Prop. of AADT, K**:
- **Peak-Hr Direction Prop, D**:
- **DDHV = AADT x K x D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, PT**: 8
- **%RVs, PR**: 0

#### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_T**: 1.5
- **f_{HV} = 1/(1 + P_T f_E_T + P_R (E_R - 1))**: 0.962

#### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

#### LOS and Performance Measures
- **Operational (LOS)**
  - **v_p = (V or DDHV) / (PHF x N x f_{HV})**: pc/h/ln
  - **x f_p**:
  - **S**: 52.1 mph
  - **D = v_p / S**: 43.4 pc/mi/ln
  - **LOS**: E

#### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **V_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

#### Design (N)
- **Design LOS**

#### Factor Location
- **E_R - Exhibits 11-10, 11-12**
- **E_T - Exhibits 11-10, 11-11, 11-13**
- **f_p - Page 11-18**
- **f_{HV} - Exhibit 11-8**
- **f_{LC} - Exhibit 11-9**
- **TRD - Page 11-11**
- **LOS, S, FFS, v_p - Exhibits 11-2, 11-3**

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2/8/2012
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<td>From/To</td>
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<tr>
<td>Analysis Time Period</td>
<td>Analysis Year</td>
</tr>
<tr>
<td>Project Description</td>
<td>Sherman Minton Bridge SB</td>
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<table>
<thead>
<tr>
<th>Flow Inputs</th>
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<tbody>
<tr>
<td>Volume, V</td>
<td>Peak-Hour Factor, PHF 0.92</td>
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<tr>
<td>AADT</td>
<td>%Trucks and Buses, P_T 11</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td>%RVs, P_R 0</td>
</tr>
<tr>
<td>Peak-Hr Direction Prop. D</td>
<td>General Terrain: Level</td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>Grade % Length mi</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Calculate Flow Adjustments</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>f_p</td>
<td>E_R 1.2</td>
</tr>
<tr>
<td>E_T</td>
<td>f_{HV} = \frac{1}{(1 + P_T(E_T - 1) + P_R(E_R - 1))} 0.948</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Speed Inputs</th>
<th>Calc Speed Adj and FFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane Width</td>
<td></td>
</tr>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td></td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td></td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td></td>
</tr>
<tr>
<td>FFS (measured)</td>
<td></td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LOS and Performance Measures</th>
<th>Design (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational (LOS)</td>
<td></td>
</tr>
<tr>
<td>v_p = (V or DDHV) / (PHF x N x f_{HV}) 1529 pc/h/ln</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td></td>
</tr>
<tr>
<td>D = v_p / S</td>
<td></td>
</tr>
<tr>
<td>LOS</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Glossary</th>
<th>Factor Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>N - Number of lanes</td>
<td>E_R - Exhibits 11-10, 11-12</td>
</tr>
<tr>
<td>V - Hourly volume</td>
<td>f_LW - Exhibit 11-8</td>
</tr>
<tr>
<td>V_p - Flow rate</td>
<td>f_T - Exhibits 11-10, 11-11, 11-13</td>
</tr>
<tr>
<td>LOS - Level of service</td>
<td>f_p - Page 11-18</td>
</tr>
<tr>
<td>DDHV - Directional design hour volume</td>
<td>TRD - Page 11-11</td>
</tr>
</tbody>
</table>

|                         | LOS, S, FFS, v_p - Exhibits 11-2, 11-3  |
### MULTILANE HIGHWAYS WORKSHEET (Direction 1)

#### General Information

- **Analyst:** J. Sherman
- **Agency or Company:** Parsons
- **Date Performed:** 12/30/2011
- **Analysis Time Period:** AM Peak
- **Project Description:** Ohio River Bridges Project (Direction 1-HB, Direction 2-SS)

#### Site Information

- **Highway/Direction to Travel:** US 31 Clark Bridge
- **Jurisdiction:** Bridge
- **Analysis Year:** 2033 FEIS

#### Flow Inputs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume, V (veh/h)</td>
<td>500</td>
</tr>
<tr>
<td>AADT (veh/h)</td>
<td>600</td>
</tr>
<tr>
<td>Peak-Hour Prop of AADT (veh/h)</td>
<td>1</td>
</tr>
<tr>
<td>P0</td>
<td>0</td>
</tr>
<tr>
<td>General Terrain</td>
<td>Level</td>
</tr>
<tr>
<td>Grade Length (m)</td>
<td>0.00</td>
</tr>
<tr>
<td>Up/Down %</td>
<td>0.00</td>
</tr>
<tr>
<td>Number of Lanes</td>
<td>2</td>
</tr>
</tbody>
</table>

#### Calculate Flow Adjustments

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR</td>
<td>1.2</td>
</tr>
<tr>
<td>FW</td>
<td>0.935</td>
</tr>
</tbody>
</table>

#### Speed Inputs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane Width, LW</td>
<td>12.0</td>
</tr>
<tr>
<td>Total Lateral Clearance, LC</td>
<td>12.0</td>
</tr>
<tr>
<td>Antasus Points, A (Aiste)</td>
<td>0</td>
</tr>
<tr>
<td>Median Type, M</td>
<td>45.0</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>45.0</td>
</tr>
<tr>
<td>Base Free-Flow Speed, BFFS</td>
<td></td>
</tr>
</tbody>
</table>

#### Operations

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational LOS</td>
<td>Design (N)</td>
</tr>
<tr>
<td>Flow Rate, (v_o) (pchr)</td>
<td>327</td>
</tr>
<tr>
<td>Speed, S (mph)</td>
<td>45.0</td>
</tr>
<tr>
<td>D (ft)</td>
<td>7.3</td>
</tr>
<tr>
<td>LOS A</td>
<td></td>
</tr>
</tbody>
</table>

#### Bicycle Level of Service

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direction</td>
<td>N1</td>
</tr>
<tr>
<td>Effective width, (W_e) (ft)</td>
<td>24</td>
</tr>
<tr>
<td>Effective speed factor, (S_e)</td>
<td>3.64</td>
</tr>
<tr>
<td>Bicycle level of service score, LBOS</td>
<td>1.84</td>
</tr>
<tr>
<td>Bicycle level of service (Chastain 15-4)</td>
<td>8</td>
</tr>
</tbody>
</table>
### MULTILANE HIGHWAYS WORKSHEET (Direction 2)

**General Information**
- **Analyst:** J. Sherman
- **Agency or Company:** Parsons
- **Date Performed:** 12/30/2011
- **Analysis Time Period:** AM Peak
- **Project Description:** Ohio River Bridges Project (Direction 1=NB, Direction 2=SB)

**Site Information**
- **Highway/Direction to Travel:** US 31 Clark Bridge
- **From/To:** Bridge
- **Jurisdiction:**
- **Analysis Year:** 2030 FHWA

**Flow Inputs**
- **Volume, V (veh/h):** 2000
- **Peak Hour Factor, PHF:** 0.92
- **AADT (veh/h):**
- **% Trucks and Buses, P_t:** 1
- **Peak Hour Prop of AADT (veh/h):**
- **% RVs, P_r:** 0
- **Peak Hour Direction Prop, D:**
- **General Terrain:** Level
- **CDHV (veh/h):**
- **Driver Type Adjustment:** 1.00
- **Grade Length (mi):** 0.00
- **Up/Down %:** 0.00
- **Number of Lanes:** 2

**Calculate Flow Adjustments**
- **S:** 1.5
- **E_r:** 1.0
- **F_s:** 1.5
- **F_r:** 0.993

**Speed Inputs**
- **Lanes Wide, L*W (ft):** 12.0
- **Total Lateral Clearance, L* (ft):** 12.0
- **Access Points, A (A/mark):**
- **Median Type, M:**
- **FFS (measured):** 450
- **Base Free-Flow Speed, BFFS:**

**Operational (LOGS)**
- **Operational (LOGS):**
- **Flow Rate, V_s (pc/h/ln):** 1.092
- **Speed, S (mph):** 45.0
- **D (mph/hr):** 24.3
- **LOS:**

**Bicycle Level of Service**

---

**Multilane Highways Worksheet (Direction 2)**

<table>
<thead>
<tr>
<th>Directional demand flow rate in outside lane, V_d (Eq. 15-24) (veh/h)</th>
<th>1087.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective width, W_e (Eq. 15-29) (ft)</td>
<td>24.00</td>
</tr>
<tr>
<td>Effective speed factor, S_e (Eq. 15-30) (mph)</td>
<td>2.84</td>
</tr>
<tr>
<td>Empirical level of service, LOS (Eq. 15-31)</td>
<td>2.4</td>
</tr>
<tr>
<td>Empirical level of service (Equation 13-4)</td>
<td>8</td>
</tr>
</tbody>
</table>

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HDS 2000™ Version 8.1 Generated 7/8/2012 17:42 PM
**Multilane Highways Worksheet (Direction 1)**

**General Information**
- **Analyst:** J. Sherrman
- **Agency or Company:** FHWA
- **Data Processed:** 12/09/2011
- **Analysis Time Period:** PM Peak
- **Project Description:** Chilhowie Bridges Project (Direction 1=NB, Direction 2=SB)

**Site Information**
- **Highway/Direction to Travel:** US 31 Clark Bridge
- **From:** Bridge
- **Jurisdiction:**
- **Analysis Year:** 2038 FEIS

**Flow Inputs**
- **Volume, V (veh/h):** 2100
- **Peak Hour Factor, PHF:** 0.92
- **ADT (veh/h):**
- **Peak Hour Prop of ADT (veh/h):**
- **Peak Hour Direct Prop, D:**
- **Driver Typ Adjustment:** 1.00

**Calculate Flow Adjustments**
- **f_l:** 1.00
- **f_v:** 1.5
- **f_hv:** 0.995

**Speed Inputs**
- **Lane Width, LW (ft):** 12.0
- **Total Lateral Clearance, LC (ft):** 12.0
- **Access Points, A (Aims):** 0
- **Median Type, M:**
- **FFS (measured):** 45.0

**Calc Speed Adj and FFS**
- **f_m:**
- **f_c:**
- **f_l:**
- **f_g:**

**Operational LOS**
- **Design (N):**
- **Required Number of Lanes, N:**
- **Flow Rate, v_n (pc/h):** 1147
- **Speed, s (mph):** 45.0
- **D (pc/h/ln):** 28.5
- **LOS:**

**Bicycle Level of Service**

---

**Multilane Highways Worksheet (Direction 1)**

**Directional Demand Flow Rate in Outside Lane, v_n:**

- **Effective width, W_e (ft):**
- **Effective speed factor, S_e (Eq. 15-29):**
- **Bicycle level of service, BLOS (Eq. 15-23):**
- **Bicycle level of service (Table 16-4):**

---

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HOS 2010™ Edition 8.1

Generated: 2/24/2012 11:41 AM
# MULTILANE HIGHWAYS WORKSHEET (Direction 2)

<table>
<thead>
<tr>
<th>General Information</th>
<th>Site Information</th>
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<tbody>
<tr>
<td>Analyst</td>
<td>J. Sherman</td>
</tr>
<tr>
<td>Agency or Company</td>
<td>Parsons</td>
</tr>
<tr>
<td>Data Performed</td>
<td>12/03/2011</td>
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<tr>
<td>Analysis Time Period</td>
<td>PM Peak</td>
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</table>

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Cho River Bridges Project (Direction 1=NB, Direction 2=SB)</th>
</tr>
</thead>
</table>

## Flow Inputs

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume, V (veh/h)</td>
<td>1400</td>
</tr>
<tr>
<td>Peak-Hour Factor, PHF</td>
<td>0.92</td>
</tr>
<tr>
<td>%Trucks and Buses, P&lt;sub&gt;T&lt;/sub&gt;</td>
<td>1</td>
</tr>
<tr>
<td>%Veh, P&lt;sub&gt;P&lt;/sub&gt;</td>
<td>0</td>
</tr>
<tr>
<td>Grade Length (mi)</td>
<td>0.00</td>
</tr>
<tr>
<td>Number of Lanes</td>
<td>2</td>
</tr>
</tbody>
</table>

## Calculate Flow Adjustments

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>S&lt;sub&gt;F&lt;/sub&gt;</td>
<td>1.00</td>
</tr>
<tr>
<td>E&lt;sub&gt;R&lt;/sub&gt;</td>
<td>1.2</td>
</tr>
<tr>
<td>f&lt;sub&gt;UV&lt;/sub&gt;</td>
<td>0.995</td>
</tr>
</tbody>
</table>

## Speed Inputs

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane Width, LW (ft)</td>
<td>12.0</td>
</tr>
<tr>
<td>Total Lateral Clearance, LC (ft)</td>
<td>12.0</td>
</tr>
<tr>
<td>Access Points, A (A/kmi)</td>
<td>0</td>
</tr>
<tr>
<td>Median Type, M</td>
<td>FFS (surfaced)</td>
</tr>
<tr>
<td>Base Free-Flow Speed, FFS</td>
<td>45.0</td>
</tr>
</tbody>
</table>

## FFS (surfaced)

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>f&lt;sub&gt;FS&lt;/sub&gt;</td>
<td>0.96</td>
</tr>
<tr>
<td>Design LOS</td>
<td>B</td>
</tr>
</tbody>
</table>

## Bicycle Level of Service

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOS</td>
<td>B</td>
</tr>
</tbody>
</table>

## Design

- Required Number of Lanes, N
- Flow Rate, v<sub>RF</sub> (pc/h/ln)
- Flow Rate, v<sub>(p)<sub>RF</sub> (pc/h/ln)
- Max Service Flow Rate (pc/h/ln)
- Design LOS

---

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# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information

<table>
<thead>
<tr>
<th>Analyst</th>
<th>Adams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency or Company</td>
<td>Parsons</td>
</tr>
<tr>
<td>Date Performed</td>
<td>5/1/11</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>AM Peak Hour</td>
</tr>
<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project</td>
</tr>
</tbody>
</table>

## Site Information

<table>
<thead>
<tr>
<th>Highway/Direction of Travel</th>
<th>I-65 Northbound</th>
</tr>
</thead>
<tbody>
<tr>
<td>From/To</td>
<td>Kennedy Bridge</td>
</tr>
<tr>
<td>Jurisdiction</td>
<td></td>
</tr>
<tr>
<td>Analysis Year</td>
<td>2030 FEIS</td>
</tr>
</tbody>
</table>

## Flow Inputs

| Volume, V | 3000 veh/h |
| AADT      | veh/day    |
| Peak-Hr Prop. of AADT, K |           |
| Peak-Hr Direction Prop, D |           |
| DDHV = AADT x K x D | veh/h |

| Peak-Hour Factor, PHF | 0.92 |
| %Trucks and Buses, P_T | 10  |
| %RVs, P_R              | 0   |
| General Terrain, Level |      |

## Calculate Flow Adjustments

\[
f_p = 1.00 \\
E_T = 1.5 \\
f_{HV} = \frac{f_p}{1 + f_p(E_T - 1) + P_R(E_T - 1)} = 0.952 \\
E_R = 1.2
\]

## Speed Inputs

| Lane Width | ft |
| Rt-Side Lat. Clearance | ft |
| Number of Lanes, N | 6  |
| Total Ramp Density, TRD | ramps/mi |
| FFS (measured) | 60.0 mph |
| Base free-flow Speed, BFFS | mph |

## Calc Speed Adj and FFS

| f_{LW} | mph |
| f_{LC} | mph |
| TRD Adjustment | mph |
| FFS | 60.0 mph |

## LOS and Performance Measures

| Operational (LOS) | Design (N) |
| v_p = (V or DDHV) / (PHF x N x f_{HV} x 571) | Design LOS |
| S | pc/h/ln |
| D = v_p / S | mph |

## Glossary

- N - Number of lanes
- V - Hourly volume
- v_p - Flow rate
- LOS - Level of service
- DDHV - Directional design hour volume
- S - Speed
- D - Density
- FFS - Free-flow speed
- BFFS - Base free-flow speed
- pc/h/ln - Passenger cars per hour per lane
- pc/ft - Passenger cars per hour per foot
- mph - Miles per hour
- pc/mi - Passenger cars per hour per mile
- Exhibit 11-3 - 11-12 - 11-13 - 11-8 - 11-9
- Page 11-18 - TRD - Page 11-11

## Factor Location

- Exhibit 11-3
- 11-2
- 11-8
- 11-9
### Basic Freeway Segments Worksheet

#### General Information
- **Analyst:** Adams  
- **Agency or Company:** Parsons  
- **Date Performed:** 5/11/11  
- **Analysis Time Period:** AM Peak Hour  
- **Project Description:** Ohio River Bridges Project

#### Site Information
- **Highway/Direction of Travel:** I-65 Southbound  
- **From/To:** Kennedy Bridge  
- **Jurisdiction:**  
- **Analysis Year:** 2030 FEIS

#### Flow Inputs
- **Volume, V:** 8300 veh/h  
- **AADT:** veh/day  
- **Peak-Hr Prop. of AADT, K:**  
- **Peak-Hr Direction Prop, D:** veh/h  
- **Peak-Hr Factor, PHF:** 0.92  
- **%Trucks and Buses, P_T:** 8  
- **%RVs, P_R:** 0  
- **General Terrain:** Level  
- **Grade:** %  
- **Length:** mi  
- **Up/Down %:**

#### Calculate Flow Adjustments
- **f_p:** 1.00  
- **E_R:** 1.2  
- **E_T:** 1.5  
- **f_{HV} = \frac{1}{\frac{1}{\frac{1}{f_{p}}+P_T(E_T-1)}+P_R(E_R-1)}:** 0.962

#### Speed Inputs
- **Lane Width:** ft  
- **Rt-Side Lat. Clearance:** ft  
- **Number of Lanes, N:** 6  
- **Total Ramp Density, TRD:** ramps/mi  
- **FFS (measured):** 60.0 mph  
- **Base free-flow Speed, BFFS:** mph  

#### LOS and Performance Measures
- **f_{LW}**  
- **f_{LC}**  
- **TRD Adjustment**
- **FFS:** 60.0 mph

#### Glossary
- **N - Number of lanes**  
- **S - Speed**  
- **V - Hourly volume**  
- **D - Density**  
- **v_p - Flow rate**  
- **FFS - Free-flow speed**  
- **LOS - Level of service**  
- **BFFS - Base free-flow speed**  
- **DDHV - Directional design hour volume**

#### Factor Location
- **E_R - Exhibits 11-10, 11-12**  
- **f_{LW} - Exhibit 11-8**  
- **E_T - Exhibits 11-10, 11-11, 11-13**  
- **f_{LC} - Exhibit 11-9**  
- **f_p - Page 11-18**  
- **TRD - Page 11-11**  
- **LOS, S, FFS, v_p - Exhibits 11-2, 11-3**
# BASIC FREEWAY WORKSHEET

## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 5/11/11
- **Analysis Time Period**: PM Peak Hour
- **Project Description**: Ohio River Bridges Project

### Site Information
- **Highway/Direction of Travel**: I-65 Northbound
- **From/To**: Kennedy Bridge
- **Jurisdiction**: Analysis Year
- **Analysis Year**: 2030 FEIS

### Flow Inputs
- **Volume, V**: 8100 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: 
- **Peak-Hr Direction Prop, D**: 
- **DDHV = AADT x K x D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 12
- **%RVs, P_R**: 0
- **General Terrain**: Level
- **Grade %**: 
- **Length mi**: 
- **Up/Down %**: 

### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_T**: 1.5
- **F_HV = \frac{1}{[1 + \frac{P_T(E_T - 1)}{P_R(E_R - 1)}]}**: 0.943

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 6
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

### Calc Speed Adj and FFS
- **f_LW**: mph
- **f_LC**: mph
- **TRD Adjustment**: mph
- **FFS**: 60.0 mph

### LOS and Performance Measures

#### Operational (LOS)
- **v_p = (V or DDHV) / (PHF x N x f_HV)**
- **S**: 60.0 mph
- **D = v_p / S**: 25.9 pc/mi/ln

### Design (N)
- **Design LOS**
- **Design (N)**
- **V_p = (V or DDHV) / (PHF x N x f_HV)**
- **S**: mph
- **D = v_p / S**: pc/mi/ln

### Glossary
- **N**: Number of lanes
- **S**: Speed
- **V**: Hourly volume
- **D**: Density
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

#### Factor Location
- **E_R**: Exhibits 11-10, 11-12
- **f_LW**: Exhibit 11-8
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_LC**: Exhibit 11-9
- **f_p**: Page 11-18
- **TRD**: Page 11-11
- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3

---

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### Basic Freeway Segments Worksheet

#### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 5/11/11
- **Analysis Time Period**: PM Peak Hour
- **Project Description**: Ohio River Bridges Project

#### Site Information
- **Highway/Direction of Travel**: I-65 Southbound
- **From/To**: Kennedy Bridge
- **Jurisdiction**: Analysis Year
- **Analysis Year**: 2030 FEIS

#### Flow Inputs
- **Volume, V**: 4500 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**:
- **Peak-Hr Direction Prop, D**:
- **DDHV = AADT x K x D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 19
- **%RVs, P_R**: 0
- **General Terrain**: Level
- **Grade**: %
- **Length**: mi
- **Up/Down %**:

#### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_T**: 1.5
- **f_{HV} = 1/(1 + P_T(E_T - 1) + P_R(E_R - 1))**: 0.913
- **E_R**: 1.2

#### Speed Inputs
- **Lane Width**: ft
- **RT-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 6
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

#### LOS and Performance Measures

#### Design (N)

#### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **V_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

#### Factor Location
- **E_R - Exhibits 11-10, 11-12**: f_{LW} - Exhibit 11-8
- **E_T - Exhibits 11-10, 11-11, 11-13**: f_{LC} - Exhibit 11-9
- **f_p - Page 11-18**: TRD - Page 11-11
- **LOS, S, FFS, v_p - Exhibits 11-2, 11-3**:

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file://C:\Documents and Settings\76429\Local Settings\Temp\f2k92.tmp
## Basic Freeway Segments Worksheet

### General Information
- **Analyst:** Adams
- **Agency or Company:** Parsons
- **Date Performed:** 5/16/11
- **Analysis Time Period:** AM Peak Hour
- **Project Description:** Ohio River Bridges Project
- **Highway/Direction of Travel:** I-265 Northbound
- **From/To:** East End Bridge NB
- **Jurisdiction:**
- **Analysis Year:** 2030 FEIS

### Site Information
- **Peak-Hour Factor, PHF:** 0.92
- **%Trucks and Buses, \( P_T \):** 5
- **%RVs, \( P_R \):** 0
- **General Terrain:** Level
- **Grade:**
- **Length:** mi
- **Up/Down %:**

### Flow Inputs
- **Volume, \( V \):** 4200 veh/h
- **AADT:** veh/day
- **Peak-Hr Prop. of AADT, \( K \):** veh/h
- **Peak-Hr Direction Prop, \( D \):** veh/h
- \[ E_R = \frac{1}{1 + P_T (E_T - 1) + P_R (E_R - 1)} \]
- **Flow Adjustments**
- **\( E_R \):** 1.2
- **\( f_p \):** 1.00
- **\( E_T \):** 1.5

### Calculate Flow Adjustments

### Speed Inputs
- **Lane Width:** ft
- **Rt-Side Lat. Clearance:** ft
- **Number of Lanes, \( N \):** 3
- **Total Ramp Density, TRD:** ramps/mi
- **FFS (measured):** 65.0 mph
- **Base free-flow Speed:** mph

### LOS and Performance Measures
- **Operational (LOS)**
  - \[ v_p = \frac{(V \text{ or DDHV}) \times (PHF \times N \times f_{HV})}{1550} \]
  - \( f_{HV} \):
  - \( S \): mph
  - \( D = v_p / S \): pc/mi/in
  - \( LOS \):

### Glossary
- **N:** Number of lanes
- **V:** Hourly volume
- **\( v_p \):** Flow rate
- **LOS:** Level of service
- **DDHV:** Directional design hour volume

### Factor Location
- **\( E_R \):** Exhibits 11-10, 11-12
- **\( f_LW \):** Exhibit 11-8
- **\( E_T \):** Exhibits 11-10, 11-11, 11-13
- **\( f_{LC} \):** Exhibit 11-9
- **\( f_p \):** Page 11-18
- **TRD:** Page 11-11
- **LOS, S, FFS, \( v_p \):** Exhibits 11-2, 11-3

---

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HCS 2010™ Version 8.1 Generated: 2/9/2012 11:43 AM
**BASIC FREEWAY SEGMENTS WORKSHEET**

<table>
<thead>
<tr>
<th>General Information</th>
<th>Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyst</td>
<td>Adams</td>
</tr>
<tr>
<td>Agency or Company</td>
<td>Parsons</td>
</tr>
<tr>
<td>Date Performed</td>
<td>5/16/11</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>AM Peak Hour</td>
</tr>
<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project</td>
</tr>
<tr>
<td></td>
<td>Highway/Direction of Travel I-265 Southbound East End Bridge SB</td>
</tr>
<tr>
<td></td>
<td>From/To</td>
</tr>
<tr>
<td></td>
<td>Jurisdiction</td>
</tr>
<tr>
<td></td>
<td>Analysis Year</td>
</tr>
</tbody>
</table>

**Flow Inputs**

- Volume, V: 1900 veh/h
- AADT: veh/day
- Peak-Hr Prop. of AADT, K: %
- Peak-Hr Direction Prop, D: %
- DDHV = AADT x K x D: veh/h

**Calculate Flow Adjustments**

- \( f_p \): 1.00
- \( E_T \): 1.5
- \( E_R \): 1.2
- \( f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} \): 0.962

**Speed Inputs**

- Lane Width: ft
- Rt-Side Lat. Clearance: ft
- Number of Lanes, N: 3
- Total Ramp Density, TRD: ramps/ri
- FFS (measured): 65.0 mph
- Base free-flow speed, BFFS: mph

**Calc Speed Adj and FFS**

- \( f_{LV} \): mph
- \( f_{LC} \): mph
- TRD Adjustment: mph
- FFS: 65.0 mph

**LOS and Performance Measures**

**Operational (LOS)**

- \( v_p = \frac{(V \text{ or } DDHV) \times \left( PHF \times N \times f_{HV} \right)}{716} \) pc/h/ln
- S: 65.0 mph
- D = \( v_p / S \):
- LOS:

**Design (N)**

- Design LOS
- \( v_p = \frac{(V \text{ or } DDHV) \times \left( PHF \times N \times f_{HV} \right)}{716} \) pc/h/ln
- S: mph
- D = \( v_p / S \):
- Required Number of Lanes, N:

**Glossary**

- N - Number of lanes
- S - Speed
- V - Hourly volume
- D - Density
- \( v_p \) - Flow rate
- LOS - Level of service
- DDHV - Directional design hour volume

**Factor Location**

- \( E_R \) - Exhibits 11-10, 11-12
- \( f_{LV} \) - Exhibit 11-8
- \( E_T \) - Exhibits 11-10, 11-11, 11-13
- \( f_{LC} \) - Exhibit 11-9
- \( f_p \) - Page 11-18
- TRD - Page 11-11
- LOS, S, FFS, \( v_p \) - Exhibits 11-2, 11-3
**BASIC FREEWAY WORKSHEET**

**BASIC FREEWAY SEGMENTS WORKSHEET**

<table>
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<tbody>
<tr>
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<td>Highway/Direction of Travel I-265 Northbound</td>
</tr>
<tr>
<td>Agency or Company</td>
<td>From/To</td>
</tr>
<tr>
<td>Date Performed</td>
<td>East End Bridge NB</td>
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<tr>
<td>Analysis Time Period</td>
<td>Jurisdiction</td>
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<td>Analysis Year</td>
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<td></td>
<td>2030 FEIS</td>
</tr>
<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project</td>
</tr>
</tbody>
</table>

**Flow Inputs**

<table>
<thead>
<tr>
<th>Volume, V</th>
<th>2200 veh/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADT</td>
<td>veh/day</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td>%Trucks and Buses, P_T</td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
<td>%RVs, P_R</td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>veh/h</td>
</tr>
</tbody>
</table>

Peak-Hour Factor, PHF: 0.92
%Trucks and Buses, P_T: 9
%RVs, P_R: 0

**Calculate Flow Adjustments**

<table>
<thead>
<tr>
<th>f_p</th>
<th>1.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>E_T</td>
<td>1.5</td>
</tr>
</tbody>
</table>

f_TV = 1/(1 + P_T(E_T - 1) + P_R(E_R - 1)) = 0.957

**Speed Inputs**

<table>
<thead>
<tr>
<th>Lane Width</th>
<th>ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>3</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>65.0 mph</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
</tr>
</tbody>
</table>

**Calc Speed Adj and FFS**

<table>
<thead>
<tr>
<th>f_LW</th>
<th>f_LC</th>
<th>f_TV</th>
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**LOS and Performance Measures**

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
<th>Design (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>v_p = (V or DDHV) / (PHF x N x f_TV)</td>
<td>Design LOS</td>
</tr>
<tr>
<td>S</td>
<td>pc/h/ln</td>
</tr>
<tr>
<td>D</td>
<td>mph</td>
</tr>
<tr>
<td>LOS</td>
<td>pc/mi/ln</td>
</tr>
</tbody>
</table>

**Glossary**

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume

**Factor Location**

<table>
<thead>
<tr>
<th>E_R - Exhibits 11-10, 11-12</th>
<th>f_LW - Exhibit 11-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>E_T - Exhibits 11-10, 11-11, 11-13</td>
<td>f_LC - Exhibit 11-9</td>
</tr>
<tr>
<td>f_p - Page 11-18</td>
<td>TRD - Page 11-11</td>
</tr>
<tr>
<td>LOS, S, FFS, v_p - Exhibits 11-2, 11-3</td>
<td></td>
</tr>
</tbody>
</table>
**General Information**

- **Analyst:** Adams
- **Agency or Company:** Parsons
- **Date Performed:** 5/16/11
- **Analysis Time Period:** PM Peak Hour
- **Project Description:** Ohio River Bridges Project

**Site Information**

- **Highway/Direction of Travel:** I-265 Southbound
- **From/To:** East End Bridge SB
- **Jurisdiction:** Analysis Year
- **Analysis Year:** 2030 FEIS

---

**Flow Inputs**

- **Volume, V:** 4500 veh/h
- **AADT:** veh/day
- **Peak-Hr Prop. of AADT, K:** veh/h
- **Peak-Hr Direction Prop, D:** veh/h
- **DDHV = AADT x K x D:** veh/h

**Calculate Flow Adjustments**

- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( f_{HV} = \frac{1}{1 + \left( P_T \cdot E_T - 1 \right)} + \left( P_R \cdot E_R - 1 \right) \) 0.971

**Speed Inputs**

- **Lane Width:** ft
- **Rt-Side Lat. Clearance:** ft
- **Number of Lanes, N:** 3
- **Total Ramp Density, TRD:** ramps/mi
- **FFS (measured):** 65.0 mph
- **Base free-flow Speed, BFFS:** mph

**Calc Speed Adj and FFS**

- **Design (N):** mph
- **TRD Adjustment:** mph
- **FFS:** 65.0 mph

**LOS and Performance Measures**

- **Operational (LOS):** pc/h/ln
- **LOS:** pc/mi/ln

**Glossary**

- **N - Number of lanes**
- **S - Speed**
- **V - Hourly volume**
- **D - Density**
- **V_p - Flow rate**
- **LOS - Level of service**
- **DDHV - Directional design hour volume**

---

**Factor Location**

- **E_R - Exhibits 11-10, 11-12**
- **f_{HV} - Exhibit 11-8**
- **E_T - Exhibits 11-10, 11-11, 11-13**
- **f_{LC} - Exhibit 11-9**
- **f_p - Page 11-18**
- **TRD - Page 11-11**
- **LOS, S, FFS, V_p - Exhibits 11-2, 11-3**
# BASIC FREEWAY WORKSHEET

## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information
- **Analyst**: JJS
- **Agency or Company**: Parsons
- **Date Performed**: 7/7/2011
- **Analysis Time Period**: AM Peak
- **Project Description**: Ohio River Bridges

### Site Information
- **Highway/Direction of Travel**: WB I-64
- **From/To**: Sherman Minton Bridge
- **Jurisdiction**: Analysis Year
- **Analysis Year**: 2030 Mod Pref with Tolls

### Oper.(LOS)  Des.(N)  Planning Data

### Flow Inputs
- **Volume, V**: 3200 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %
- **Peak-Hr Direction Prop, D**: %
- **DDHV = AADT x K x D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, PT**: 13
- **%RVs, PR**: 0
- **General Terrain**: Level
- **Grade**, **Length**, **Up/Down %**

### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_T**: 1.5
- **E_R**: 1.2
- **f_{HV} = 1[(1 + f_p(E_T - 1)) + f_R(E_R - 1)]**: 0.939

### Speed Inputs
- **Lane Width**: ft
- **Rt.-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

### Calc Speed Adj and FFS
- **f_{LW}**, **mph**
- **f_{LC}**, **mph**
- **TRD Adjustment**, **mph**
- **FFS**: 60.0 mph

### LOS and Performance Measures

### Design (N)
- **Design LOS**
- **Design (N)**

### Operational (LOS)
- **V_p = (V or DDHV) / (PHF x N x f_{HV})**: pc/h/ln
- **x f_p)**
- **S**: 60.0 mph
- **D = v_p / S**: pc/mi/ln
- **LOS**: C

### Glossary
- **N - Number of lanes**
- **V - Hourly volume**
- **v_p - Flow rate**
- **LOS - Level of service**
- **DDHV - Directional design hour volume**

### Factor Location
- **E_R - Exhibits 11-10, 11-12**
- **f_{LW} - Exhibit 11-8**
- **E_T - Exhibits 11-10, 11-11, 11-13**
- **f_{LC} - Exhibit 11-9**
- **f_p - Page 11-18**
- **TRD - Page 11-11**
- **LOS, S, FFS, v_p - Exhibits 11-2, 11-3**

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<td>Date Performed</td>
<td>Jurisdiction</td>
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<td>Analysis Time Period</td>
<td>Analysis Year</td>
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<td>Project Description</td>
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<table>
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<th>Flow Inputs</th>
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<td>Volume, V</td>
<td>5700 veh/h</td>
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<td>AADT</td>
<td>veh/day</td>
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<td>Peak-Hr Prop. of AADT, K</td>
<td>%Trucks and Buses, $p_T$</td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
<td>%RVs, $p_R$</td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>General Terrain: Level</td>
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<td>Grade % Length mi Up/Down %</td>
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<th>Calculate Flow Adjustments</th>
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<td>$f_p$</td>
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<td>$E_T$</td>
<td>1.5</td>
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<td>$E_R$</td>
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<tr>
<th>Speed Inputs</th>
<th>Calc Speed Adj and FFS</th>
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<tbody>
<tr>
<td>Lane Width</td>
<td>ft</td>
</tr>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>3</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>60.0 mph</td>
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<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
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</table>

<table>
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<th>LOS and Performance Measures</th>
<th>Design (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$v_p$ = (V or DDHV) / (PHF x N x $f_{hv}$ x $f_p$)</td>
<td>Design LOS</td>
</tr>
<tr>
<td>S</td>
<td>mph</td>
</tr>
<tr>
<td>$D = v_p / S$</td>
<td>mph</td>
</tr>
<tr>
<td>LOS</td>
<td>pc/mi/ln</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Glossary</th>
<th>Factor Location</th>
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<tbody>
<tr>
<td>N - Number of lanes</td>
<td>E_R - Exhibits 11-10, 11-12</td>
</tr>
<tr>
<td>V - Hourly volume</td>
<td>E_T - Exhibits 11-10, 11-11, 11-13</td>
</tr>
<tr>
<td>$v_p$ - Flow rate</td>
<td>$f_p$ - Page 11-18</td>
</tr>
<tr>
<td>LOS - Level of service</td>
<td>TRD - Page 11-11</td>
</tr>
<tr>
<td>DDHV - Directional design hour volume</td>
<td>Lost, S, FFS, $v_p$ - Exhibits 11-2, 11-3</td>
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</tbody>
</table>
## BASIC FREEWAY WORKSHEET

### GENERAL INFORMATION
- **Analyst**: JJS
- **Agency or Company**: Parsons
- **Date Performed**: 7/7/2011
- **Analysis Time Period**: PM Peak
- **Project Description**: Ohio River Bridges

### SITE INFORMATION
- **Highway/Direction of Travel**: WB I-64
- **From/To**: Sherman Minton Bridge
- **Jurisdiction**: Analysis Year
- **Project Description**: 2030 Mod Pref with Tolls

### OPERATING (LOS) TABLE

<table>
<thead>
<tr>
<th>Flow Inputs</th>
<th>Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Volume, V</strong></td>
<td>6100 veh/h</td>
</tr>
<tr>
<td><strong>AADT</strong></td>
<td>veh/day</td>
</tr>
<tr>
<td><strong>Peak-Hr Prop. of AADT, K</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Peak-Hr Direction Prop, D</strong></td>
<td>veh/h</td>
</tr>
</tbody>
</table>

### SITE INFORMATION
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 8
- **%RVs, P_R**: 0
- **General Terrain**: Level

### CALCULATE FLOW ADJUSTMENTS
- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( E_R = 1.2 \)
- \( f_{HV} = \frac{1}{4} \left[ \left( P_T - 1 \right) + P_R \right] \left( E_R - 1 \right) \) 0.962

### SPEED INPUTS
- **Lane Width** ft
- **Rt-Side Lat. Clearance** ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD** ramps/mi
- **FFS (measured)** mph
- **Base free-flow Speed, BFFS** mph

### SPEED AND PERFORMANCE MEASURES
- **LOS and Performance Measures**
  - \( V_p = \frac{V + DDHV}{PHF \times N \times f_{HV}} \) pc/h/ln
  - \( S = \frac{V_p}{D} \) mph
  - \( D = \frac{V_p}{S} \) pc/mi/ln

### DESIGN (N)
- **Design (N)**
  - Design LOS

### GLOSSARY
- **N**: Number of lanes
- **V**: Hourly volume
- **V_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

### FACTOR LOCATION
- **E_R**: Exhibits 11-10, 11-12
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_p**: Page 11-18
- **TRD**: Page 11-11

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### BASIC FREeways WORKSHEET

#### General Information
- **Analyst**: JJS
- **Agency or Company**: Parsons
- **Date Performed**: 7/7/2011
- **Analysis Time Period**: PM Peak
- **Project Description**: Ohio River Bridges Project
- **From/To**: Sherman Minton Bridge
- **Jurisdiction**: Analysis Year: 2030 Mod Pref with Tolls

#### Site Information
- **Highway/Direction of Travel**: SB I-64
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 11
- **%RVs, P_R**: 0
- **General Terrain**: Level
- **Grade %**:
- **Length mi**:
- **Up/Down %**:

#### Flow Inputs
- **Volume, V**: 4800 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: veh/h
- **Peak-Hr Direction Prop, D**: veh/h
- **DDHV = AADT x K x D**: veh/h

#### Calculate Flow Adjustments
- \( f_p \) = 1.00
- \( E_T \) = 1.5
- \( E_R \) = 1.2
- \( f_{HV} = 1.1^{(1+P_T(E_T-1)+P_R(E_R-1))} \)

#### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

#### Speed Adjustments and FFS
- \( f_{LW} \) mph
- \( f_{LC} \) mph
- **TRD Adjustment** mph
- **FFS** mph

#### LOS and Performance Measures
- **\( V_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV}^{1835}) \)** pc/h/ln
- **\( S \)** mph
- **\( D = v_p / S \)** pc/mi/ln
- **LOS**

#### Design (N)
- **Design (N)
- **Design LOS**
- **Required Number of Lanes, N**

#### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **\( V_p \)**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

#### Factor Location
- **E_R**: Exhibits 11-10, 11-12
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_p**: Page 11-18
- **LOS, S, FFS, \( v_p \)**: Exhibits 11-2, 11-3

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**HCS 2010™ Version 6.1**

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<td>Highway/Direct to Travel: US 31 Clark Bridge</td>
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<td>Agency or Company: Panama</td>
<td>Station To: Bridge</td>
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<td>Jurisdiction</td>
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<td>Analysis Year: 2030 Mod Peak</td>
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<td>Project Description: Ohio River Bridges Project (Direction 1=NB, Direction 2=SB)</td>
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<td>Peak-Hour Prop of AADT (veh/h)</td>
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<td>%ARV, P_A</td>
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<td>Peak-Hour Direction Prop, D</td>
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<tr>
<td>General Terrain:</td>
<td>Level</td>
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<td>Grade Length (ft)</td>
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<tr>
<td>Driver Type Adjustment</td>
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<td>Up/Down %</td>
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<td>f_p</td>
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<tr>
<td>f_r</td>
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<td>f_t</td>
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<td>f_w</td>
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<table>
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<tr>
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<th>Calc Speed Adj and FFS</th>
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<tr>
<td>Total Lateral Clearance, LC (ft)</td>
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<td>Access Points, A (Akn)</td>
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<tr>
<td>Median Type, M</td>
<td>45.0</td>
</tr>
<tr>
<td>FFS (measured)</td>
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<tr>
<td>FFS (m/s)</td>
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<th>Design</th>
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</thead>
<tbody>
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<td>Design (N)</td>
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<td>Speed, S (m/s)</td>
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<tr>
<td>D (pc/h)</td>
<td>13.3</td>
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<tr>
<td>LOS</td>
<td>B</td>
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<table>
<thead>
<tr>
<th>Bicycle Level of Service</th>
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<tbody>
<tr>
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### General Information
- **Analyst:** J. Sherman
- **Agency or Company:** Parsons
- **Data Performed:** 12/30/2011
- **Analysis Time Period:** AM Peak
- **Project Description:** Ohio River Bridges Project (Direction 1=NB, Direction 2=SB)

### Site Information
- **Highway/Direction to Travel:** US 31 Clark Bridge
- **From To:** Bridge
- **Jurisdiction:** 2030 Mod Ped

### Flow Inputs
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>Volume, V (veh/h)</td>
<td>2100</td>
<td>Peak Hour Factor, PHF</td>
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<tr>
<td>AADT (veh/h)</td>
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<td>%Traffic and Buses, P_t</td>
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<td>Peak Hour Prop of AADT (veh/h)</td>
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<td>%RtV, P_o</td>
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<td>Peak Hour Direction Prop, D</td>
<td>General Terrain: Level</td>
<td>Grade: Length (mi) 0.00</td>
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<tr>
<td>Driver Type Adjustment</td>
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<td>Up/Down % 0.00</td>
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### Calculate Flow Adjustments
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<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>f_t</td>
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</tr>
<tr>
<td>f_d</td>
<td>1.5</td>
</tr>
<tr>
<td>f_v</td>
<td>0.995</td>
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</table>

### Speed Inputs
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Lane Width, LW (ft)</td>
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<tr>
<td>Total Lateral Clearance, LC (ft)</td>
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<tr>
<td>Access Points, A (A/M)</td>
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<td>Median Type, M</td>
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</tr>
<tr>
<td>FFS (measured)</td>
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<tr>
<td>Free Flow Speed, FFS</td>
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</table>

### Design
<table>
<thead>
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<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
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<td>Design (N)</td>
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<tr>
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<td>Speed, S (mph)</td>
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<td>D (pol/mi)</td>
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<td>LOS</td>
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### Bicycle Level of Service
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
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<tr>
<td>Bicycle Level of Service (Factor 15-4)</td>
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**File Path:** C:\Documents and Settings\76429\Local Settings\Temp\a2kC1.tmp 2/24/2012
## MULTILANE HIGHWAYS WORKSHEET

### Direction 1

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<th>General Information</th>
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<tbody>
<tr>
<td>Analyst</td>
<td>J. Sherman</td>
</tr>
<tr>
<td>Agency or Company</td>
<td>Parsons</td>
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<tr>
<td>Data Performed</td>
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<tr>
<td>Analysis Time Period</td>
<td>PM Peak</td>
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<tr>
<td>Jurisdiction</td>
<td>US 31 Bridge</td>
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<td>Analysis Year</td>
<td>2030 Model Year</td>
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<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project (Direction 1: NB, Direction 2: SG)</td>
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### Flow Inputs

<table>
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<th>Volume, V (veh/h)</th>
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<tr>
<td>Peak-Hour Factor</td>
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</tr>
<tr>
<td>% Trucks and Buses</td>
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<td>% RVs, P2</td>
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<tr>
<td>General Terrain</td>
<td>Level</td>
</tr>
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<td>Grades Length</td>
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<tr>
<td>Up/Down %</td>
<td>0.00</td>
</tr>
<tr>
<td>Number of Lanes</td>
<td>2</td>
</tr>
</tbody>
</table>

### Calculate Flow Adjustments

| f_C | 1.00 |
| f_E | 1.5  |
| f_V | 0.995|

### Speed Inputs

| Lane Width, LW (ft) | 12.0 |
| Total Lateral Clearance, LC (ft) | 12.0 |
| Access Points, A (A/min) | 0   |
| Median Type | M |
| FFS (measured) | 45.0 |
| Basic Free Flow Speed, BFFS | FFS (mi/h) 45.0 |

### Operations

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
<th>Design (N)</th>
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<td>Speed, S (mi/h)</td>
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<td>D (pcv/h)</td>
<td>26.7</td>
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<tr>
<td>LOS</td>
<td>Design LOS</td>
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---

**Multilane Demand Flow Ratio to Outside Lane, V_f:** 19.37

Effective width, W_e: 68

Effective speed factor, S_c: 1.81

Bicycle level of service, LOSb: 2.43

Bicycle level of service (LOS): 2.43

---

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### General Information

**Analyst**: J Sherman  
**Agency or Company**: Parsons  
**Data Performed**: 12/30/2011  
**Analysis Time Period**: PM Peak  
**Project Description**: Ohio River Bridges Project (Direction 1-NB, Direction 2-SB)

### Site Information

**Highway/Direction to Travel**: US 31 Clark Bridge  
**Jurisdiction**:  
**Analysis Year**: 2030 Mod Plan

### Flow Inputs

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<th>Value</th>
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<tr>
<td>Peak-Hour Factor, PHF</td>
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<tr>
<td>AADT (veh/h)</td>
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<td>% Trucks and Buses, PT</td>
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<tr>
<td>Peak Hour Proportion AADT (veh/h)</td>
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<td>% ARVs, PA</td>
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<tr>
<td>Peak Hour Direction Prop, D</td>
<td></td>
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<tr>
<td>General Terrain, Level</td>
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<td>Grade Length (mi)</td>
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<tr>
<td>Up/Down %</td>
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<tr>
<td>Number of Lanes</td>
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### Calculate Flow Adjustments

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<tr>
<td>F_t</td>
<td>1.2</td>
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<tr>
<td>F_s</td>
<td>1.5</td>
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<tr>
<td>F_o</td>
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### Speed Inputs

<table>
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<tr>
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<tbody>
<tr>
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<td>Total Lateral Clearance, LC (ft)</td>
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<td>Median Type, M</td>
<td>45.0</td>
</tr>
<tr>
<td>FFS (measured)</td>
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<td>Base Free Flow Speed, FFS</td>
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### Speed Calculation

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<td>V_c</td>
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<td>V_s</td>
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<td>Design N</td>
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### Design

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<td>Flow Rate, V_d (pc/h)</td>
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<td>Max Service Flow Rate (pc/h)</td>
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HCS 2010™ Version 6.1  
Generated 2/24/2012 11:45 AM
## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information
- Analyst: JJS
- Agency or Company: Parsons
- Date Performed: 7/7/2011
- Analysis Time Period: AM Peak
- Project Description: Ohio River Bridges Project

### Site Information
- Highway/Direction of Travel: NB I-65
- From/To: Kennedy Bridge
- Jurisdiction: 
- Analysis Year: 2030 Modal Pref with Tolls

- Oper.(LOS)
- Des.(N)
- Planning Data

### Flow Inputs
- Volume, V: 2000 veh/h
  - Peak-Hour Factor, PHF: 0.92
  - %Trucks and Buses, PT: 15
  - %RVs, PR: 0
  - General Terrain: Level
  - Grade:
    - % Length
    - Up/Down %

- Peak-Hr Prop. of AADT, K
- DDHV = AADT x K x D: veh/h

### Calculate Flow Adjustments
- \( f_p \): 1.00
- \( E_T \): 1.5
- \( E_R \): 1.2
- \( f_{HV} = \frac{1}{1 + 0.5(F_T - 1) + P_R(F_R - 1)} \): 0.930

### Speed Inputs
- Lane Width: ft
- Rt-Side Lat. Clearance: ft
- Number of Lanes, N: 6
- Total Ramp Density, TRD: ramps/mi
- FFS (measured): 60.0 mph
- Base free-flow Speed, BFFS: mph

### Calc Speed Adj and FFS
- \( f_{LV} \): mph
- \( f_{LC} \): mph
- TRD Adjustment: mph
- FFS: 60.0 mph

### LOS and Performance Measures
- Operational (LOS)
  - \( v_p = \frac{(V \times DDHV)}{(PHF \times N \times f_p \times f_{HV}} \): pch/h
  - S: 60.0 mph
  - D = \( \frac{v_p}{S} \): pc/mi
  - LOS: A

### Design (N)
- Design LOS: 
  - Design (N)
  - \( v_p = \frac{(V \times DDHV)}{(PHF \times N \times f_p \times f_{HV}} \): pch/h
  - S: mph
  - D = \( \frac{v_p}{S} \): pc/mi
  - Required Number of Lanes, N:

### Glossary
- N - Number of lanes
- V - Hourly volume
- \( v_p \) - Flow rate
- LOS - Level of service
- DDHV - Directional design hour volume
- T - Transient
- FFS - Free-flow speed
- BFFS - Base free-flow speed
- Exhibit

### Factor Location
- \( E_R \) - Exhibits 11-10, 11-12
- \( f_{LV} \) - Exhibit 11-8
- \( E_T \) - Exhibits 11-10, 11-11, 11-13
- \( f_{LC} \) - Exhibit 11-9
- \( f_p \) - Page 11-18
- TRD - Page 11-11
- LOS, S, FFS, \( v_p \) - Exhibits 11-2, 11-3

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2/9/2012
### Basic Freeway Segments Worksheet

#### General Information
- **Analyst:** JJS
- **Agency or Company:** Parsons
- **Date Performed:** 7/7/2011
- **Analysis Time Period:** AM Peak
- **Project Description:** Ohio River Bridges
- **Highway/Direction of Travel:** SB I-65 Kennedy Bridge
- **From/To:**
- **Jurisdiction:**
- **Project Description:**
- **Analysis Year:** 2030 Mod Pref with Tolls

#### Site Information
- **Oper.(LOS):**
- **Des.(N):**
- **Planning Data:**

#### Flow Inputs
- **Volume, V (veh/h):** 7700
- **AADT (veh/day):**
- **Peak-Hr Prop. of AADT, K:**
- **Peak-Hr Direction Prop, D:**
- **DDHV = AADT x K x D (veh/h):**
- **Peak-Hour Factor, PHF:** 0.92
- **%Trucks and Buses, PT:** 8
- **%RVs, PR:** 0
- **General Terrain:** Level
- **Grade %:**
- **Length mi:**
- **Up/Down %:**

#### Calculate Flow Adjustments
- **f_p:** 1.00
- **E_T:** 1.5
- **f_{HV} = \frac{1}{f_p + E_T} [1 + \frac{1}{2} (E_R - 1) + P_R (E_R - 1)]**
- **E_R:** 1.2

#### Speed Inputs
- **Lane Width (ft):**
- **Rt-Side Lat. Clearance (ft):**
- **Number of Lanes, N:** 6
- **Total Ramp Density, TRD (ramps/mi):**
- **FFS (measured) (mph):** 60.0
- **Base free-flow Speed, BFFS (mph):**

#### Calc Speed Adj and FFS
- **f_{LV} (mph):**
- **f_{LC} (mph):**
- **TRD Adjustment (mph):**
- **FFS (mph):** 60.0

#### LOS and Performance Measures
- **Operational (LOS):**
- **V_p = \frac{(V or DDHV)}{(PHF \times N \times f_{HV}} 1451 (pc/h/ln)
- **S (mph):** 60.0
- **D = \frac{V_p}{S} (pc/mi/ln):** 24.2
- **LOS:**

#### Design (N)
- **Design LOS**
- **Design (N) (pc/h/ln):**
- **D = \frac{V_p}{S} (pc/mi/ln):**

#### Glossary
- **N - Number of lanes**
- **S - Speed**
- **V - Hourly volume**
- **D - Density**
- **v_p - Flow rate**
- **FFS - Free-flow speed**
- **LOS - Level of service**
- **BFFS - Base free-flow speed**
- **DDHV - Directional design hour volume**

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2/9/2012
# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information
- **Analyst**: JJS
- **Agency or Company**: Parsons
- **Date Performed**: 7/1/2011
- **Analysis Time Period**: PM Peak
- **Project Description**: Ohio River Bridges Project

## Site Information
- **Highway/Direction of Travel**: NB I-65
- **From/To**: Kennedy Bridge
- **Jurisdiction**: 2030 Mod Pref with Tolls

## Flow Inputs
- **Volume, V**: 7900 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: veh/h
- **Peak-Hr Direction Prop, D**: veh/h
- **DDHV = AADT x K x D**: veh/h

## Calculate Flow Adjustments
- **f_p**: 1.00
- **E_T**: 1.5
- **E_R**: 1.2
- **f_{HV} = 1/[1 + P_T(E_T - 1) + P_R(E_R - 1)]**: 0.943

## Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 6
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

## Calc Speed Adj and FFS
- **f_{LW}**: mph
- **f_{LC}**: mph
- **FFS**: 60.0 mph
- **TRD Adjustment**: mph

## LOS and Performance Measures
- **v_p = (V or DDHV) / (PHF x N x f_{HV})**: pc/h/ln
- **S**: 60.0 mph
- **D = v_p / S**: pc/mi/ln
- **LOS**: C

## Design (N)
- **Design LOS**: Design (N)
- **Design (N)**: Required Number of Lanes, N

## Glossary
- **N**: Number of lanes
- **S**: Speed
- **V**: Hourly volume
- **D**: Density
- **v_p**: Flow rate
- **LOS**: Level of service
- **BFFS**: Base free-flow speed
- **DDHV**: Directional design hour volume

## Factor Location
- **E_R**: Exhibits 11-10, 11-12
- **f_{LW}**: Exhibit 11-8
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_{LC}**: Exhibit 11-9
- **f_p**: Page 11-18
- **TRD**: Page 11-11
- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3

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HCS 2010™ Version 6.1 Generated: 2/9/2012 10:11 AM
# Basic Freeway Segments Worksheet

## General Information
- **Analyst**: JJS
- **Agency or Company**: Parsons
- **Date Performed**: 7/7/2011
- **Analysis Time Period**: PM Peak
- **Project Description**: Ohio River Bridges Project
- **Highway/Direction of Travel**: SB I-65
- **From/To**: Kennedy Bridge
- **Jurisdiction**: 2030 Mod Pref with Tolls
- **Analysis Year**: 2030 Mod Pref with Tolls

## Site Information

<table>
<thead>
<tr>
<th>Flow Inputs</th>
<th>Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume, V</td>
<td>3600 veh/h</td>
</tr>
<tr>
<td>AADT</td>
<td>1800 veh/day</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td>600 veh/h</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, D</td>
<td>50 veh/h</td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>100 veh/h</td>
</tr>
<tr>
<td>Peak-Hr Factor, PHF</td>
<td>0.92</td>
</tr>
<tr>
<td>%Trucks and Buses, P_T</td>
<td>23</td>
</tr>
<tr>
<td>%RVs, P_R</td>
<td>0</td>
</tr>
<tr>
<td>General Terrain:</td>
<td>Level</td>
</tr>
<tr>
<td>Grade %</td>
<td></td>
</tr>
<tr>
<td>Up/Down %</td>
<td></td>
</tr>
</tbody>
</table>

## Calculate Flow Adjustments
- \( f_p = 1.00 \)
- \( E_R = 1.2 \)
- \( f_{HV} = \frac{1}{\left(1 + P_T \left(f_E - 1\right) + P_R \left(f_E - 1\right)\right)} \)
- \( 0.897 \)

## Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 6
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

## Calc Speed Adj and FFS
- \( f_{LV} \)
- \( f_{LC} \)
- **FFS Adjustment**: 60.0 mph

## LOS and Performance Measures

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
<th>Design (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( v_p = \frac{(V \ or \ DDHV) \times \ (PHF \times N \times f_{HV})}{727} ) pc/h/in</td>
<td>Design LOS</td>
</tr>
<tr>
<td>( S )</td>
<td>S</td>
</tr>
<tr>
<td>( D = \frac{v_p}{S} )</td>
<td>D</td>
</tr>
<tr>
<td>( B )</td>
<td>B</td>
</tr>
</tbody>
</table>

## Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **V_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

## Factor Location
- \( E_R \)- Exhibits 11-10, 11-12, 13
- \( f_{LV} \)- Exhibit 11-8
- \( E_T \)- Exhibits 11-10, 11-11, 11-13
- \( f_{LC} \)- Exhibit 11-9
- \( f_p \)- Page 11-18
- \( TRD \)- Page 11-11

### Footnotes
- File: \C:\Documents and Settings\76429\Local Settings\Temp\f2k1D.tmp
- Date: 2/9/2012
# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information
- Analyst: JJS
- Agency or Company: Parsons
- Date Performed: 7/7/2011
- Analysis Time Period: AM Peak
- Project Description: Ohio river Bridges Project
- Highway/Direction of Travel: WB I-265
- From/To: East End Bridge
- Jurisdiction: 
- Analysis Year: 2030 Mod Prefereed with Tolls
- Oper:(LOS): Des.(N): Planning Data:

## Site Information
- Peak-Hour Factor, PHF: 0.92
- %Trucks and Buses, P_T: 6
- %RVs, P_R: 0
- General Terrain: Level
- Grade: % Length: mi: Up/Down %:

## Flow Inputs
| Volume, V | 3300 | v/h |
| AADT | veh/day |
| Peak-Hr Prop. of AADT, K | |
| Peak-Hr Direction Prop, D | |
| DDHV = AADT x K x D | veh/h |

## Calculate Flow Adjustments
- \( f_p \) = 1.00
- \( E_T \) = 1.5
- \( f_{HV} = \frac{1}{1 + \left( f_p \cdot E_T \cdot 1 \right) + P_R \cdot (E_R - 1)} \) = 0.971

## Speed Inputs
- Lane Width: ft
- Rt-Side Lat. Clearance: ft
- Number of Lanes, N = 2
- Total Ramp Density, TRD: ramps/mi
- FFS (measured): 65.0 mph
- Base free-flow Speed, BFFS: mph

## Calc Speed Adj and FFS
- \( f_{LW} \) = mph
- \( f_{LC} \) = mph
- TRD Adjustment = mph
- FFS = 65.0 mph

## LOS and Performance Measures

## Design (N)

## Glossary
- N - Number of lanes
- V - Hourly volume
- \( v_p \) - Flow rate
- LOS - Level of service
- DDHV - Directional design hour volume
- S - Speed
- D - Density
- FFS - Free-flow speed
- BFFS - Base free-flow speed
- PC/h/ln - pc/h/ln
- Mph - mph
- Pch/ln - pc/h/ln
- Design (N)
- Design LOS
- Required Number of Lanes, N
- E_R - Exhibits 11-10, 11-12
- E_T - Exhibits 11-10, 11-11, 11-13
- \( f_{LW} \) - Exhibit 11-8
- \( f_{LC} \) - Exhibit 11-9
- \( f_p \) - Page 11-18
- TRD - Page 11-11
- LOS, S, FFS, v_p - Exhibits 11-2, 11-3
## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information
- **Analyist**: JJS
- **Agency or Company**: Parsons
- **Date Performed**: 7/7/2011
- **Analysis Time Period**: AM Peak
- **Project Description**:
  - **Oper.(LOS)**
  - **Des.(N)**
  - **Planning Data**

### Site Information
- **Highway/Direction of Travel**: EB I-265
- **From/To**: East End Bridge
- **Jurisdiction**: Analysis Year: 2030 Mod Pref with Tolls

### Flow Inputs
- **Volume, V**: 1700 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: veh/h
- **Peak-Hr Direction Prop, D**: veh/h
- **DDHV = AADT x K x D**: veh/h

### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_T**: 1.5
- **E_R**: 1.2
- **f_{HV} = \frac{1}{4(1+P_T(1+P_R)+P_R(1+P_T))}**: 0.980

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2 ramps/mi
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 65.0 mph
- **Base free-flow Speed, BFFS**: mph

### Calc Speed Adj and FFS
- **f_{LW}**: mph
- **f_{LC}**: mph
- **FFS Adjustment**: mph

### LOS and Performance Measures
- **Operational (LOS)**
  - **v_p = (V or DDHV) / (PHF x N x f_{HV})**: pc/h/in
  - **S**: mph
  - **D = v_p / S**: pc/mi/in
  - **LOS**: B

### Design (N)
- **Design LOS**
- **Design (N)**
- **Design LOS**

### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

---

**Factor Location**
- **E_R**: Exhibits 11-10, 11-12
- **f_{LW}**: Exhibit 11-8
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_{LC}**: Exhibit 11-9
- **f_p**: Page 11-18
- **TRD**: Page 11-11
- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3

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### General Information
- **Analyst**: JJS
- **Agency or Company**: Parsons
- **Date Performed**: 7/7/2011
- **Analysis Time Period**: PM Peak
- **Project Description**: Ohio River Bridges Project
- **Highway/Direction of Travel**: WB I-265
- **From/To**: East End Bridge
- **Jurisdiction**: Analysis Year: 2030 Mod Pref with Tolls

### Site Information
- **Oper.(LOS)**
- **Design (N)**
- **Planning Data**

### Flow Inputs
- **Volume, V**: 2000 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %Trucks and Buses, \( P_T \)
- **Peak-Hr Direction Prop, D**: %RVs, \( P_R \)
- **DDHV = AADT x K x D**: veh/h

### Calculate Flow Adjustments
- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( E_R = 1.2 \)
- \( f_{HV} = \frac{1}{1 + (P_T/E_T - 1) + (P_R/E_R - 1)} = 0.962 \)

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 2
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 65.0 mph
- **Base free-flow Speed, BFFS**: mph

### Speed Adjustments and FFS
- \( f_{LV} \)
- \( f_{LC} \)
- \( f_{HV} = \frac{1}{1 + (P_T/E_T - 1) + (P_R/E_R - 1)} = 0.962 \)

### LOS and Performance Measures
- **Design (N)**
- **Design LOS**
- **LOS**

### glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **V_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

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**HCS 2010™ Version 6.1**

**Generated: 2/8/2012 3:42 PM**
### General Information
- Analyst: JJS
- Agency or Company: Parsons
- Date Performed: 7/7/2011
- Analysis Time Period: PM Peak
- Project Description: Ohio River Bridges Project
- Highway/Direction of Travel: EB I-265
- From/To: East End Bridge
- Jurisdiction: 2030 Mod Pref with Tolls

### Site Information
- Analysis Year: 2030

### Flow Inputs
- Volume, V: 3600 veh/h
- AADT: 7 veh/day
- Peak-Hr Prop. of AADT, K
- Peak-Hr Direction Prop, D
- DDHV = AADT x K x D: veh/h
- Peak-Hour Factor, PHF: 0.92
- %Trucks and Buses, PT: 7
- %RVs, PR: 0
- General Terrain: Level
- Grade: %
- Length: mi
- Up/Down %

### Calculate Flow Adjustments
- \( f_p \) = 1.00
- \( E_T \) = 1.5
- \( E_R \) = 1.2
- \( f_{HV} = \frac{1}{1+P_T(E_T - 1) + P_R(E_R - 1)} \) = 0.966

### Speed Inputs
- Lane Width: ft
- Rt-Side Lat. Clearance: ft
- Number of Lanes, N: 2 ramps/mi
- Total Ramp Density, TRD: 65.0 mph
- FFS (measured): 65.0 mph
- Base free-flow Speed, BFFS: mph

### Speed Adj and FFS
- \( f_{LW} \) mph
- \( f_{LC} \) mph
- TRD Adjustment: mph
- FFS: 65.0 mph

### LOS and Performance Measures
- \( V_p = \frac{(V \text{ or DDHV}) \times f_{HV}}{f_p} \) pc/h/ln
- \( S = \frac{V_p}{D} \) mph
- \( D = \frac{V_p}{S} \text{ pc/mi/ln} \)
- \( D = \frac{V_p}{S} \text{ pc/mi/ln} \)

### Glossary
- N - Number of lanes
- V - Hourly volume
- \( v_p \) - Flow rate
- LOS - Level of service
- DDHV - Directional design hour volume

### Factor Location
- \( E_R \) - Exhibits 11-10, 11-12
- \( f_{LW} \) - Exhibit 11-8
- \( E_T \) - Exhibits 11-10, 11-11, 11-13
- \( f_{LC} \) - Exhibit 11-9
- \( f_p \) - Page 11-18
- TRD - Page 11-11
- LOS, S, FFS, \( v_p \) - Exhibits 11-2, 11-3

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Generated: 2/8/2012
## BASİC FREEWAY SEGMENTS WORKSHEET

### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 5/16/11
- **Analysis Time Period**: AM Peak Hour
- **Project Description**: Ohio River Bridges Project
- **Highway/Direction of Travel**: I-64 Northbound
- **From/To**: Sherman Minton Bridge NB
- **Jurisdiction**: Analysis Year: 2030 East End

### Site Information
- **Des.(N)**
- **Planning Data**

### Flow Inputs
- **Volume, V**: 2400 veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **Peak-Hr Prop. of AADT, K**: 14
- **Peak-Hr Direction Prop, D**: 0
- **DDHV = AADT x K x D**: veh/h
- **%Trucks and Buses, P_T**: 14
- **%RVs, P_R**: 0

### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_T**: 1.5
- **f_HV = 1/(1 + P_T(1 - E_T) + P_R(1 - E_R))**: 0.935

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

### Calc Speed Adj and FFS
- **f_LW**: m/h
- **f_LC**: m/h
- **TRD Adjustment**: m/h
- **FFS**: 60.0 mph

### LOS and Performance Measures
- **Design (N)**
- **Operational (LOS)**
  - **v_p = (V or DDHV) / (PHF x N x f_HV)**
  - **930 pc/h/ln**: pcf/h/ln
  - **S**: 60.0 mph
  - **D = v_p / S**: pc/mi/ln
  - **LOS**: B

### Glossary
- **N** - Number of lanes
- **V** - Hourly volume
- **V_p** - Flow rate
- **LOS** - Level of service
- **DDHV** - Directional design hour volume

### Factor Location
- **E_R - Exhibits 11-10, 11-12**
- **E_T - Exhibits 11-10, 11-11, 11-13**
- **f_p - Page 11-16**
- **TRD - Page 11-11**

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*HCS 2010TM Version 6.1 Generated: 2/23/2012 3:29 PM*
### BASIC FREEWAY WORKSHEET

#### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 5/16/11
- **Analysis Time Period**: AM Peak Hour
- **Project Description**: Ohio River Bridges Project

#### Site Information
- **Highway/Direction of Travel**: I-64 Southbound
- **From/To**: Sherman Minton Bridge SB
- **Jurisdiction**: Analysis Year 2030 East End

#### Flow Inputs
- **Volume, V**: 5200 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: veh/h
- **Peak-Hr Direction Prop, D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, P_T**: 6
- **%RVs, P_R**: 0
- **General Terrain**: Level
- **Grade**, **% Length**, **Up/Down %**

#### Calculate Flow Adjustments
- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( E_R = 1.2 \)
- \( f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} \) 0.971

#### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph
- **Calc Speed Adj and FFS**

#### LOS and Performance Measures
- **Operational (LOS)**
  - \( v_p = \frac{(V or DDHV) \times (PHF \times N \times f_{HV} \times f_p)}{1941} \) pc/h/ln
  - **S**: 57.9 mph
  - **D = v_p / S**: 33.5 pc/mi/ln
  - **LOS**: D

#### Glossary
- **N** - Number of lanes
- **V** - Hourly volume
- **v_p** - Flow rate
- **LOS** - Level of service
- **DDHV** - Directional design hour volume

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2/23/2012
### BASIC FREEWAY WORKSHEET

#### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 5/16/11
- **Analysis Time Period**: PM Peak Hour
- **Project Description**: Ohio River Bridges Project

#### Site Information
- **Highway/Direction of Travel**: I-64 Northbound
- **From/To**: Sherman Minton Bridge NB
- **Jurisdiction**: Analysis Year: 2030 East End

#### Flow Inputs
- **Volume, V**: 5800 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %Trucks and Buses, $P_T$
- **Peak-Hr Direction Prop, D**: %RVs, $P_R$
- **DDHV = AADT x K x D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **$P_T$**: 8
- **$P_R$**: 0
- **General Terrain**: Level

#### Calculate Flow Adjustments
- **$f_p$**: 1.00
- **$E_R$**: 1.2
- **$f_HV = 1/(1 + P_T(E_T - 1) + P_R(E_R - 1))**: 0.962

#### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

#### Calc Speed Adj and FFS
- **$f_{LW}$**: mph
- **$f_{LC}$**: mph
- **TRD Adjustment**: mph
- **FFS**: 60.0 mph

#### LOS and Performance Measures
- **LOS**
- **Design (N)**

#### Glossary
- **N**: Number of lanes
- **S**: Speed
- **V**: Hourly volume
- **D**: Density
- **$v_p$**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

### Factor Location
- **$E_R$**: Exhibits 11-10, 11-12
- **$f_{LW}$**: Exhibit 11-8
- **$E_T$**: Exhibits 11-10, 11-11, 11-13
- **$f_{LC}$**: Exhibit 11-9
- **$f_p$**: Page 11-18
- **TRD**: Page 11-11
- **LOS, S, FFS, $v_p$**: Exhibits 11-2, 11-3
### Basic Freeway Segments Worksheet

#### General Information
- Analyst: Adams
- Agency or Company: Persons
- Date Performed: 5/16/11
- Analysis Time Period: PM Peak Hour
- Project Description: Ohio River Bridges Project

#### Site Information
- Highway/Direction of Travel: I-64 Southbound
- From/To: Sherman Minton Bridge SB
- Jurisdiction: Analysis Year: 2030 East End

#### Flow Inputs
- Volume, V: 3900 veh/h
- AADT: veh/day
- Peak-Hr Prop. of AADT, K: veh/h
- Peak-Hr Direction Prop, D: veh/h
- DDHV = AADT x K x D: veh/h
- Peak-Hr Factor, PHF: 0.92
- %Trucks and Buses, PT: 11
- %RVs, PR: 0
- General Terrain: Level
- Grade: %
- Length: mi
- Up/Down: %

#### Calculate Flow Adjustments
- \( f_p \): 1.00
- \( E_T \): 1.5
- \( f_{hv} = \frac{1}{(1+P_T E_T - 1) + P_R E_R - 1)} \): 0.948

#### Speed Inputs
- Lane Width: ft
- RT-Side Lat. Clearance: ft
- Number of Lanes, N: 3
- Total Ramp Density, TRD: ramps/mi
- FFS (measured): mph
- Base free-flow speed, BFFS: mph

#### Speed Adj and FFS
- \( f_{lw} \): mph
- \( f_{lc} \): mph

#### LOS and Performance Measures
- Design (N)
- Design LOS
- Design N
- Design (N)

#### Glossary
- N - Number of lanes
- V - Hourly volume
- \( v_p \) - Flow rate
- LOS - Level of service
- DDHV - Directional design hour volume
- S - Speed
- D - Density
- FFS - Free-flow speed
- BFFS - Base free-flow speed
- PC/MI/In
- pc/h/ln
- mph
- pc/h/ln

#### Factor Location
- \( E_R \) - Exhibits 11-10, 11-12
- \( f_{lw} \) - Exhibit 11-8
- \( E_p \) - Exhibits 11-10, 11-11, 11-13
- \( f_{lc} \) - Exhibit 11-9
- \( f_p \) - Page 11-18
- TRD - Page 11-11
- LOS, S, FFS, \( v_p \) - Exhibits 11-2, 11-3

---

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### MULTILANE HIGHWAYS WORKSHEET (Direction 1)

**General Information**
- Analyst: Adams
- Agency or Company: Parsons
- Date Performed: 12/02/2011
- Analysis Time Period: AM Peak
- Project Description: Ohio River Bridges Project (Direction 1=NB, Direction 2=SB)

**Site Information**
- Highway/Directio to Travel: US 31 Clark Bridge
- Jurisdiction: Bridge
- Analysis Year: 2030 East End

#### Flow Inputs
- Volume, V (veh/h): 720
- AADT (veh/d): 720
- Peak-Hour Prop of AADT (veh/d): 0.92
- Peak Hour Direction Prop, D: 1
- Driver Type Adjustment: 1.00

#### Calculate Flow Adjustments
- \( f_1 \): 1.00
- \( B_k \): 1.2
- \( f_w \): 0.955

#### Speed Inputs
- Lane Width, LW (ft): 12.0
- Total Lateral Clearance, LC (ft): 12.0
- Access Points, A (All): 0
- Median Type, M: 0
- FFS (measured): 45.0
- Base Free Flow Speed, BFFS: 45.0

#### Operations
- Operational (LOS): Design
- Flow Rate, \( \nu_p \) (pcu/h): 393
- Speed, \( B \) (mph): 45.0
- D (poles/mi): 8.7
- LOS: A

#### Design
- Required Number of Lanes, N
- Flow Rate, \( \nu_p \) (pcu/h)
- Max Service Flow Rate (pcu/h)
- Design LOS

---

**MULTILANE HIGHWAYS WORKSHEET (Direction 1)**

**Directional Demand Flow Rate in Outside Lane, \( \nu_{p1} \) (Eq. 15-24) (veh/h)**: 181.9

**Effective Width, \( W_e \) (Eq. 15-23) ft**: 24.00

**Effective Speed Factor, \( \nu_s \) (Eq. 15-23)**: 1.64

**Single Lane Service Area, \( R_{SLA} \) (Eq. 15-21)**: 1.62

---

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## MULTILANE HIGHWAYS WORKSHEET (Direction 2)

### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Data Performed**: 12/03/2011
- **Analysis Time Period**: AM Peak
- **Project Description**: Ohio River Bridges Project (Direction 1-N, Direction 2-S)
- **US 31 Clark Bridge**

### Site Information
- **Highway/Direction to Travel**: From To Bridge
- **Jurisdiction**: Analysis Year: 2035 East End

### Flow Inputs
- **Volume, V (veh/h)**: 1680
- **AADT (veh/h)**: Peak Hour Factor: RHF: 0.92
- **Peak-Hour Prop of AADT (veh/h)**: %Trucks and Busses: P_t = 1
- **Peak-Hour Direction Prop, D**: %RVs, P_d = 0
- **Driver Type Adjustment**: Grade: Length (m): 0.00
- **Elevation**: Up/Down %: 0.00
- **Number of Lanes**: 2

### Calculate Flow Adjustments
- **E_1**: 1.00
- **E_2**: 1.2
- **E_3**: 1.5

### Speed Inputs
- **Lane Width, LW (ft)**: 12.0
- **Total Lateral Clearance, LC (ft)**: 12.0
- **Access Points, A (A/mi)**: 0
- **Median Type, M**: 45.0
- **FFS (measured)**: 45.0

### Calc Speed Adj and FFS
- **Operational (LOS)**: Design (M)
  - Flow Rate, v (cph/ln): 917
  - Speed, S (mph): 45.0
  - D (mph/hr): 20.4
  - LOS: C

### Bicycle Level of Service
- **Effective width, W_e (Eq. 15-20) ft**: 24.00
- **Effective speed factor, S_f (Eq. 15-36)**: 1.00
- **Bicycle level of service, BLOS (Eq. 15-39)**: 2.00
- **Bicycle level of service (Exhibit 15-4)**: B

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### General Information
- Analyst: Adams
- Agency or Company: Parsons
- Data Performed: 13/02/2011
- Analytical Time Period: PM Peak
- Project Description: One River Bridge Project (Direction 1=N, Direction 2=S)

### Site Information
- Highway/Direction to Travel: US 31 Clark Bridge
- From To: Bridge
- Jurisdiction: Analysis Year: 2030 East End

### Flow Inputs
- Volumes, V (veh/h): 1850
- AADT (veh/h): Peak Hour Factor, PHF: 0.92
- % Trucks and Buses, P_T: 1
- % RVs, P_R: 0
- Peak Hour Prop of AADT (veh/h):
- General Terrain: Level
- Grade: Length (m): 0.00
- Driver Type Adjustment: Up/Down %: 0.00
- Number of Lanes: 2

### Calculate Flow Adjustments
- T_1: 1.00
- R: 1.2
- T: 1.5
- T_0: 0.995

### Speed Inputs
- Lane Width, LW (ft): 12.0
- Total Lateral Clearance, LC (ft): 12.0
- Access Points, A (A/mi): 0
- Median Type, M:
- FFS (measured): 45.0
- Base Free Flow Speed, BFFS: 45.0

### Operations
- Design
- Operational (LOS): Design HS
- Flow Rate, \( y_\text{c}(\text{pcu/h}) \): 1015
- Speed, \( S \) (mph): 45.0
- D (pcu/mi): 22.5
- LOG: C

### Bicycle Level of Service
<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>v_0 (mph)</td>
<td>1015</td>
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<tr>
<td>Flow Rate, ( y_\text{c}(\text{pcu/h}) )</td>
<td>1015</td>
</tr>
<tr>
<td>Max Service Flow Rate (pcu/mi)</td>
<td>22.5</td>
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<tr>
<td>Design LOS</td>
<td>C</td>
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### MULTILANE HIGHWAYS WORKSHEET (Direction 2)

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<th>General Information</th>
<th>Site Information</th>
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<tbody>
<tr>
<td>Analyst</td>
<td>Adams</td>
</tr>
<tr>
<td>Agency or Company</td>
<td>Parsons</td>
</tr>
<tr>
<td>Date Performed</td>
<td>12/01/011</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>PM Peak</td>
</tr>
<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project (Direction 1-N3, Direction 2-5S)</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Flow Inputs</th>
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</thead>
<tbody>
<tr>
<td>Volume, V (veh/h)</td>
<td>1240</td>
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<tr>
<td>AADT (veh/h)</td>
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<tr>
<td>Peak-Hour Factor, PHF</td>
<td>0.92</td>
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<tr>
<td>%Trucks and Buses, P_t</td>
<td>1</td>
</tr>
<tr>
<td>%Buses, P_b</td>
<td>0</td>
</tr>
<tr>
<td>General Terrain</td>
<td></td>
</tr>
<tr>
<td>Grade</td>
<td></td>
</tr>
<tr>
<td>Up/Down %</td>
<td>6.00</td>
</tr>
<tr>
<td>Number of Lanes</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Calculate Flow Adjustments</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>f_p</td>
<td>1.00</td>
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<tr>
<td>f_s</td>
<td>1.5</td>
</tr>
<tr>
<td>f_v</td>
<td>0.99</td>
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<table>
<thead>
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<th>Speed Inputs</th>
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<tbody>
<tr>
<td>Lane Width, LW (ft)</td>
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<td>Total Lateral Clearance, LC (ft)</td>
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<tr>
<td>Access Points, A (Amen)</td>
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<tr>
<td>Median Type, M</td>
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<tr>
<td>FFS (measured)</td>
<td>45.0</td>
</tr>
<tr>
<td>Base Free-Flow Speed, FFS</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operations</th>
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<tbody>
<tr>
<td>Design (N)</td>
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<tr>
<td>Required Number of Lanes, N</td>
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<tr>
<td>Flow Rate, v_p (pc/h/m)</td>
<td>67</td>
</tr>
<tr>
<td>Max Service Flow Rate (pc/h/m)</td>
<td></td>
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<tr>
<td>Design LOS</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recycle Level of Service</th>
<th></th>
</tr>
</thead>
</table>
**BASIC FREEWAY SEGMENTS WORKSHEET**

### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 5/11/11
- **Analysis Time Period**: AM Peak Hour
- **Project Description**: Ohio River Bridges Project

### Site Information
- **Highway/Direction of Travel**: I-65 Northbound
- **From/To**: Kennedy Bridge
- **Jurisdiction**: Analysis Year 2030 East End

### Flow Inputs
- **Volume, V**: 2700 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %
- **Peak-Hr Direction Prop, D**: %
- **DDHV = AADT x K x D**: veh/h

### Calculate Flow Adjustments
- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( f_{HV} = \frac{1}{\{1 + f_p (E_T - 1) + P_R (E_R - 1)\}} = 0.952 \)

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 4
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

### Speed Speed Adj and FFS
- **Calc Speed**: mph
- **TRD Adjustment**: mph
- **FFS**: 60.0 mph

### LOS and Performance Measures
- **Operational (LOS)**
  - \( v_p = \frac{(V \text{ or } DDHV)}{(PHF \times N \times f_{HV})} \times f_p \)
  - \( S = 60.0 \) mph
  - \( D = \frac{v_p}{S} = 12.8 \) pc/mi/ln

### Design (N)
- **Design (N)**

### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **\( v_p \)**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

### Factor Location
- **\( E_R \)**: Exhibits 11-10, 11-12
- **\( f_{HV} \)**: Exhibit 11-8
- **\( E_T \)**: Exhibits 11-10, 11-11, 11-13
- **\( f_L \)**: Page 11-18
- **\( f_{BF} \)**: Exhibits 11-2, 11-3

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2/23/2012
## Basic Freeway Segments Worksheet

### General Information

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<tr>
<th>Analyst</th>
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<tbody>
<tr>
<td>Agency or Company</td>
<td>Parsons</td>
</tr>
<tr>
<td>Date Performed</td>
<td>5/11/11</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>AM Peak Hour</td>
</tr>
<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project</td>
</tr>
</tbody>
</table>

### Site Information

| Highway/Direction of Travel | I-65 Southbound |
| From/To | Kennedy Bridge |
| Jurisdiction | |
| Analysis Year | 2030 East End |

### Flow Inputs

| Volume, V | 7100 veh/h |
| AADT | veh/day |
| Peak-Hr Prop. of AADT, K | |
| Peak-Hr Direction Prop, D | |
| DDHV = AADT x K x D | veh/h |

### Calculate Flow Adjustments

\[
\begin{align*}
    f_p &= 1.00 \\
    E_r &= 1.2 \\
    E_T &= 1.5 \\
    f_{HV} &= \frac{1}{1 + P_T(P_T - 1) + P_R(P_R - 1)} = 0.957
\end{align*}
\]

### Speed Inputs

| Lane Width | ft |
| Right-Side Lat. Clearance | ft |
| Number of Lanes, N | 3 |
| Total Ramp Density, TRD | ramps/MI |
| FFS (measured) | 60.0 mph |
| Base free-flow Speed, BFFS | mph |

### Speed Adj and FFS

| Design LOS |
| f_LW |
| f_LC |
| TRD Adjustment |
| FFS |
| mph |
| mph |
| mph |
| mph |

### LOS and Performance Measures

| Operational (LOS) |
| V_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) | pc/h/ln |
| S | 38.5 mph |
| D = v_p / S | 69.8 pc/mi/ln |
| LOS | F |

### Glossary

| N - Number of lanes | S - Speed |
| V - Hourly volume | D - Density |
| v_p - Flow rate | FFS - Free-flow speed |
| LOS - Level of service | BFFS - Base free-flow speed |
| DDHV - Directional design hour volume | |

### Factor Location

| E_r - Exhibits 11-10, 11-12 |
| f_LW - Exhibit 11-8 |
| E_T - Exhibits 11-10, 11-11, 11-13 |
| f_LC - Exhibit 11-9 |
| f_p - Page 11-18 |
| TRD - Page 11-11 |
| LOS, S, FFS, v_p - Exhibits 11-2, 11-3 |

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2/23/2012
### Basic Freeway Segments Worksheet

#### General Information
- **Analyst:** Adams
- **Agency or Company:** Parsons
- **Date Performed:** 5/1/11
- **Analysis Time Period:** PM Peak Hour
- **Project Description:** Ohio River Bridges Project

#### Site Information
- **Highway/Direction of Travel:** I-65 Northbound
- **From/To:** Kennedy Bridge
- **Jurisdiction:**
- **Analysis Year:** 2030 East End

#### Flow Inputs
- **Volume, V:** 7900 veh/h
- **AADT:** veh/day
- **Peak-Hr Prop. of AADT, K:** veh/h
- **DDHV = AADT x K x D:** veh/h
- **Peak-Hr Direction Prop, D:**
- **Peak-Hr Factor, PHF:** 0.92
- **%Trucks and Buses, P_T:** 12
- **%RVs, P_R:** 0
- **General Terrain:** Level
- **Grade:** %
- **Length:** mi
- **Up/Down %**

#### Calculate Flow Adjustments
- **f_p = 1.00**
- **E_T = 1.5**
- **E_R = 1.2**
- **f_hv = 1/[1+P_T(F_T - 1) + P_R(F_R - 1)]**

#### Speed Inputs
- **Lane Width:** ft
- **Rt-Side Lat. Clearance:** ft
- **Number of Lanes, N:** 4
- **Total Ramp Density, TRD:** ramps/mi
- **FFS (measured):** 60.0 mph
- **Base free-flow Speed, BFFS:** mph

#### Calc Speed Adj and FFS
- **f_LW:** mph
- **f_LC:** mph
- **FFS Adjustment:** mph
- **FFS:** 60.0 mph

#### LOS and Performance Measures
- **LOS:**
- **Operational (LOS):**
  - **V_p = (V or DDHV) / (PHF x N x f_hv)**
  - **S:** pc/h/ln
  - **D = V_p / S:** pc/ln
  - **LOS:** E

#### Design (N)
- **Design LOS:**
  - **V_p = (V or DDHV) / (PHF x N x f_hv)**
  - **S:** pc/h/ln
  - **D = V_p / S:** pc/ln
  - **Required Number of Lanes, N**

#### Glossary
- **N - Number of lanes**
- **V - Hourly volume**
- **V_p - Flow rate**
- **LOS - Level of service**
- **DDHV - Directional design hour volume**

#### Factor Location
- **E_R - Exhibits 11-10, 11-12**
- **f_LW - Exhibit 11-8**
- **E_T - Exhibits 11-10, 11-11, 11-13**
- **f_LC - Exhibit 11-9**
- **f_p - Page 11-18**
- **TRD - Page 11-11**
- **LOS, S, FFS, V_p - Exhibits 11-2, 11-3**

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## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information
- Analyst: Adams
- Agency or Company: Parsons
- Date Performed: 5/11/11
- Analysis Time Period: PM Peak Hour
- Project Description: Ohio River Bridges Project

### Site Information
- Highway/Direction of Travel: I-65 Southbound
- From/To: Kennedy Bridge
- Jurisdiction: 2030 East End

### Flow Inputs
- Volume, V: 4300 veh/h
- AADT: veh/day
- Peak-Hr Prop. of AADT, K: %
- Peak-Hr Direction Prop, D: veh/h
- DDHV = AADT x K x D
- Peak-Hour Factor, PHF: 0.92
- %Trucks and Buses, PT: 20
- %RVs, PR: 0
- General Terrain: Level
- Grade: %
- Length: mi
- Up/Down: %

### Calculate Flow Adjustments
- f_p: 1.00
- E_T: 1.5
- f_HV = \frac{1 + f_p (E_T - 1)}{1 + P_T (E_T - 1)}: 0.909

### Speed Inputs
- Lane Width: ft
- RI-Side Lat. Clearance: ft
- Number of Lanes, N: 3
- Total Ramp Density, TRD: ramps/mi
- FFS (measured): 60.0 mph
- Base free-flow Speed, BFFS: mph

### Speed Inputs
- Calc Speed Adj and FFS
- f_LW: m
- f_LC: m
- TRD Adjustment: m
- FFS: 60.0 mph

### LOS and Performance Measures
- Operational (LOS)
- Design (N)
- f_p: (V or DDHV) / (PHF x N x f_HV)
- x 1714 pc/h/ln
- S: 59.8 mph
- D = v_p / S: pc/mt/ln
- LOS: D

### Glossary
- N - Number of lanes
- V - Hourly volume
- v_p - Flow rate
- LOS - Level of service
- DDHV - Directional design hour volume
- S - Speed
- D - Density
- FFS - Free-flow speed
- BFFS - Base free-flow speed
- E_R - Exhibits 11-10, 11-12
- E_T - Exhibits 11-10, 11-11, 11-13
- f_LW - Exhibit 11-8
- f_LC - Exhibit 11-9
- f_p - Page 11-18
- TRD - Page 11-11
- LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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### Basic Freeway Segments Worksheet

#### General Information

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<tr>
<th>Analyst</th>
<th>Adams</th>
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<tr>
<td>Agency or Company</td>
<td>Parsons</td>
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<td>Date Performed</td>
<td>5/16/11</td>
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<tr>
<td>Analysis Time Period</td>
<td>AM Peak Hour</td>
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#### Project Description

- **Ohio River Bridges Project**

#### Site Information

<table>
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<tr>
<th>Highway/Direction of Travel</th>
<th>I-265 Northbound</th>
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<tbody>
<tr>
<td>From/To</td>
<td>East End Bridge NB</td>
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<tr>
<td>Jurisdiction</td>
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<td>Analysis Year</td>
<td>2030 East End</td>
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#### Flow Inputs

<table>
<thead>
<tr>
<th>Volume, V</th>
<th>4500</th>
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<tbody>
<tr>
<td>AADT</td>
<td>veh/day</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td></td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
<td></td>
</tr>
<tr>
<td>DDHV = AADT x K x D</td>
<td>veh/h</td>
</tr>
</tbody>
</table>

#### Calculate Flow Adjustments

| $f_p$ | 1.00 |
| $E_T$ | 1.5  |

| ER     | 1.2  |
| $f_{HV}$ | $1/[(1+P_T(E_T - 1) + P_R(E_R - 1))^{0.971}]$ |

#### Speed Inputs

<table>
<thead>
<tr>
<th>Lane Width</th>
<th>ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rte-Side Lat. Clearance</td>
<td>ft</td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>3</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>65.0 mph</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
</tr>
</tbody>
</table>

#### Calculate Speed Adj and FFS

| $f_{lw}$ | mph |
| $f_{LC}$ | mph |
| FFS Adjustment | mph |

#### LOS and Performance Measures

| $v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV})$ | 1679 pc/h-ln |
| $S$ | 63.9 mph |
| $D = v_p / S$ | 26.3 pc/mi-ln |
| $LOS$ | $D$ |

#### Design (N)

| Design (N) | Design LOS |
| $v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV})$ | pc/h-ln |
| $S$ | mph |
| $D = v_p / S$ | pc/mi-ln |
| Required Number of Lanes, N | |

#### Glossary

- **N** - Number of lanes
- **S** - Speed
- **V** - Hourly volume
- **D** - Density
- **$v_p$** - Flow rate
- **LOS** - Level of service
- **DDHV** - Directional design hour volume

#### Factor Location

- $E_R$ - Exhibits 11-10, 11-12
- $f_{lw}$ - Exhibit 11-8
- $E_T$ - Exhibits 11-10, 11-11, 11-13
- $f_{LC}$ - Exhibit 11-9
- $f_p$ - Page 11-18
- TRD - Page 11-11
- LOS, S, FFS, $v_p$ - Exhibits 11-2, 11-3
### BASIC FREEWAY SEGMENTS WORKSHEET

#### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 5/6/11
- **Analysis Time Period**: AM Peak Hour
- **Project Description**: Ohio River Bridges Project

#### Site Information
- **Highway/Direction of Travel**: I-265 Southbound
- **From/To**: East End Bridge SB
- **Jurisdiction**: Analysis Year 2030 East End

#### Flow Inputs
- **Volume, V**: 2400 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %Trucks and Buses, \( P_T \)
- **Peak-Hr Direction Prop, D**: %RVs, \( P_R \)
- **DDHV = AADT x K x D**: veh/h

#### Calculate Flow Adjustments
- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( f_{HV} = \frac{1}{1 + f_p(E_T - 1) + P_R(E_R - 1)} \) = 0.957

#### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 65.0 mph
- **Base free-flow Speed, BFFS**: mph

#### Speed Adj and FFS
- **Calc Speed Adj**: mph
- **FFS Adjustment**: mph

#### LOS and Performance Measures
- **Operational (LOS)**
  - \( v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV}) \) pc/h/ln
  - \( S = 65.0 \) mph
  - \( D = v_p / S \) pc/mi/ln
  - **LOS**: B

#### Design (N)
- **Design LOS**
  - \( v_p = (V \text{ or } DDHV) / (PHF \times N \times f_{HV}) \) pc/h/ln
  - **S**: mph
  - \( D = v_p / S \) pc/mi/ln

#### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **\( v_p \)**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

#### Factor Location
- **E_T**: Exhibits 11-10, 11-12
- **E_R**: Exhibits 11-10, 11-12
- **f_{LVW}**: Exhibit 11-8
- **f_{LC}**: Exhibit 11-9
- **f_p**: Page 11-18
- **TRD**: Page 11-11

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2/23/2012
**BASIC FREEWAY SEGMENTS WORKSHEET**

**General Information**
- **Analyst:** Adams
- **Agency or Company:** Parsons
- **Date Performed:** 5/16/11
- **Analysis Time Period:** PM Peak Hour
- **Project Description:** Ohio River Bridges Project

**Site Information**
- **Highway/Direction of Travel:** I-265 Northbound
- **From/To:** East End Bridge NB
- **Jurisdiction:**
- **Analysis Year:** 2030 East End

**Flow Inputs**
- **Volume, V:** 2400 veh/h
- **AADT:** veh/day
- **Peak-Hr Prop. of AADT, K:** %
- **Peak-Hr Direction Prop, D:** %
- **DDHV = AADT x K x D:** veh/h
- **Peak-Hour Factor, PHF:** 0.92
- **%Trucks and Buses, P_T:** 9
- **%RVs, P_R:** 0
- **General Terrain:** Level
- **Grade:** %
- **Length:** mi
- **Up/Down %:**

**Calculate Flow Adjustments**
- **f_p:** 1.00
- **E_T:** 1.5
- **E_R:** 1.2
- **f_HV = 1/[f_p + E_T (E_T - 1) + P_R (E_T - 1)]:** 0.957

**Speed Inputs**
- **Lane Width:** ft
- **Rt-Side Lat. Clearance:** ft
- **Number of Lanes, N:** 3
- **Total Ramp Density, TRD:** ramps/mi
- **FFS (measured):** 65.0 mph
- **Base free-flow Speed, BFFS:** mph

**Calc Speed Adj and FFS**
- **f_LW:** mph
- **f_LC:** mph
- **FFS Adjustment:** mph

**LOS and Performance Measures**
- **Operational (LOS):**
  - \( v_p = \frac{(V \text{ or DDHV})}{(PHF \times N \times f_{HV})}\)
  - \( S = \frac{65.0 \text{ mph}}{14.0 \text{ pc/mi/ln}}\)
  - \( D = \frac{v_p}{S}\)
  - \( B = \) LOS
  - \( N = \) Number of lanes

**Design (N)**
- **Design LOS**
- **Design (N)**
- **TRD Adjustment:** mph
- **Required Number of Lanes, N**

**Glossary**
- **N:** Number of lanes
- **V:** Hourly volume
- **V_p:** Flow rate
- **LOS:** - Level of service
- **DDHV:** - Directional design hour volume
  - S - Speed
  - D - Density
  - BFFS - Base free-flow speed
  - FFS - Free-flow speed

**Factor Location**
- **E_R:** Exhibits 11-10, 11-12
- **E_T:** Exhibits 11-10, 11-11, 11-13
- **f_LW:** Exhibit 11-8
- **f_LC:** Exhibit 11-9
- **f_p:** Page 11-18
- **LOS, S, FFS, v_p:** Exhibits 11-2, 11-3
- **TRD:** Page 11-11
### Basic Freeway Segments Worksheet

#### General Information
- **Analyst:** Adams
- **Agency or Company:** Parsons
- **Date Performed:** 5/16/11
- **Analysis Time Period:** PM Peak Hour
- **Project Description:** Ohio River Bridges Project
- **Highway/Direction of Travel:** I-265 Southbound
- **From/To:** East End Bridge SB
- **Jurisdiction:** Analysis Year
- **Des. (N):** 2030 East End

#### Site Information

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak-Hour Factor, PHF</td>
<td>0.92</td>
</tr>
<tr>
<td>%Trucks and Buses, PT</td>
<td>6</td>
</tr>
<tr>
<td>%RVs, PR</td>
<td>0</td>
</tr>
<tr>
<td>General Terrain, Level</td>
<td></td>
</tr>
<tr>
<td>Grade</td>
<td></td>
</tr>
<tr>
<td>% Length</td>
<td></td>
</tr>
<tr>
<td>Up/Down %</td>
<td></td>
</tr>
</tbody>
</table>

#### Flow Inputs
- **Volume, V:** 4700 veh/h
- **AADT:** 1754 veh/day
- **Peak-Hr Prop. of AADT, K:** 1.5 veh/h
- **AADT**
- **Peak-Hr Direction Prop, D:**
- **DDHV = AADT x K x D:** veh/h

#### Calculate Flow Adjustments
- **f_p:** 1.00
- **E_R:** 1.5
- **E_T:** 1.2
- **f_HV = \( \frac{1}{1 + f_p(E_R - 1) + P_R(E_R - 1)} \):** 0.971

#### Speed Inputs
- **Lane Width:** ft
- **Rt-Side Lat. Clearance:** ft
- **Number of Lanes, N:** 3 ramps/ml
- **Total Ramp Density, TRD:** mph
- **FFS (measured):** 65.0 mph
- **Base free-flow Speed, BFFS:** mph

#### Speed Adjustments and FFS
- **Calc Speed Adj and FFS**

#### LOS and Performance Measures
- **Operational (LOS):**
  - \( V_p = \frac{(V \text{ or } DDHV)}{(PHF \times N \times f_{HV})} \times f_p \): pc/h/ln
  - \( S \): mph
  - \( D = V_p / S \): pc/mi/ln
  - **LOS:**

#### Design (N)
- **Design (N)**
  - **Design LOS**
  - **V_p:** pc/h/ln
  - **S:** mph
  - **D:** pc/mi/ln

#### Glossary
- **N:** Number of lanes
- **S:** Speed
- **V:** Hourly volume
- **D:** Density
- **p:** Flow rate
- **LOS:** Level of service
- **DDHV:** Directional design hour volume

#### Factor Location
- **E_R:** Exhibits 11-10, 11-12
- **f_{LVW}:** Exhibit 11-8
- **E_T:** Exhibits 11-10, 11-11, 11-13
- **f_{LC}:** Exhibit 11-9
- **f_p:** Page 11-18
- **TRD:** Page 11-11
- **LOS:** S, FFS, \( V_p \): Exhibits 11-2, 11-3
### BASIC FREEWAY SEGMENTS WORKSHEET

#### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 5/16/11
- **Analysis Time Period**: AM Peak Hour
- **Project Description**: Ohio River Bridges Project

#### Site Information
- **Highway/Direction of Travel**: I-64 Northbound
- **From/To**: Sherman Minton Bridge NB
- **Jurisdiction**: Analysis Year: 2030 Downtown

#### Flow Inputs
- **Volume, V**: 2300 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %
- **Peak-Hr Direction Prop, D**: %
- **DDHV = AADT x K x D**: veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **%Trucks and Buses, PT**: 15%
- **%RVs, PR**: 0%
- **General Terrain**: Level
- **Grade %**: Up/Down %

#### Calculate Flow Adjustments
- **f_p**: 1.00
- **E_T**: 1.5
- **E_R**: 1.2
- **f_HV = 1/(1+(f_pE_r - 1) + (f_rE_r - 1)0.930**

#### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/MI
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

#### LOS and Performance Measures

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
<th>Design (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( v_p = (V \text{ or DDHV}) / (PHF \times N \times f_HV) )</td>
<td>( v_p = (V \text{ or DDHV}) / (PHF \times N \times f_HV) )</td>
</tr>
<tr>
<td>696 pc/h/ln</td>
<td>696 pc/h/ln</td>
</tr>
<tr>
<td>( S )</td>
<td>( S )</td>
</tr>
<tr>
<td>60.0 mph</td>
<td>mph</td>
</tr>
<tr>
<td>( D = v_p / S )</td>
<td>( D = v_p / S )</td>
</tr>
<tr>
<td>14.9 pc/mi/ln</td>
<td>pc/mi/ln</td>
</tr>
<tr>
<td><strong>LOS</strong></td>
<td><strong>Required Number of Lanes, N</strong></td>
</tr>
</tbody>
</table>

#### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **v_p**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume
- **S**: Speed
- **D**: Density
- **FFS**: Free-flow speed
- **BFFS**: Base free-flow speed

#### Factor Location
- **E_R**: Exhibits 11-10, 11-12
- **f_LW**: Exhibit 11-8
- **f_T**: Exhibits 11-10, 11-11, 11-13
- **f_p**: Page 11-18
- **TRD**: Page 11-11
- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3

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2/24/2012
### BASIC FREEWAY SEGMENTS WORKSHEET

#### General Information

<table>
<thead>
<tr>
<th>Analyst</th>
<th>Adams</th>
<th>Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency or Company</td>
<td>Parsons</td>
<td>Highway/Direction of Travel I-64 Southbound</td>
</tr>
<tr>
<td>Date Performed</td>
<td>5/16/11</td>
<td>From/To Sherman Minton Bridge SB</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>AM Peak Hour</td>
<td>Jurisdiction</td>
</tr>
<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project</td>
<td>Analysis Year 2030 Downtown</td>
</tr>
</tbody>
</table>

#### Flow Inputs

<table>
<thead>
<tr>
<th>Volume, V</th>
<th>4900 veh/h</th>
<th>Peak-Hour Factor, PHF</th>
<th>0.92</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADT</td>
<td>veh/day</td>
<td>%Trucks and Buses, P_T</td>
<td>8</td>
</tr>
<tr>
<td>Peak-Hr Prop. of AADT, K</td>
<td></td>
<td>%RVs, P_R</td>
<td>0</td>
</tr>
<tr>
<td>Peak-Hr Direction Prop, D</td>
<td></td>
<td>General Terrain:</td>
<td>Level</td>
</tr>
<tr>
<td>D/DHV = AADT x K x D</td>
<td>veh/h</td>
<td>Grade</td>
<td>%</td>
</tr>
</tbody>
</table>

#### Calculate Flow Adjustments

- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( f_{HV} = 1 + P_T(E_T - 1) + P_R(E_R - 1) \) 0.962

#### Speed Inputs

<table>
<thead>
<tr>
<th>Lane Width</th>
<th>ft</th>
<th>Calc Speed Adj and FFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rt-Side Lat. Clearance</td>
<td>ft</td>
<td>( f_{LV} ) mph</td>
</tr>
<tr>
<td>Number of Lanes, N</td>
<td>3</td>
<td>( f_{LC} ) mph</td>
</tr>
<tr>
<td>Total Ramp Density, TRD</td>
<td>ramps/mi</td>
<td>TRD Adjustment</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>60.0 mph</td>
<td>FFS 60.0 mph</td>
</tr>
<tr>
<td>Base free-flow Speed, BFFS</td>
<td>mph</td>
<td></td>
</tr>
</tbody>
</table>

#### LOS and Performance Measures

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
<th>Design (N)</th>
<th>Design LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>( v_p = \frac{(V \ or \ DDHV)}{PHF \times N \times f_{HV}} )</td>
<td>( v_p = \frac{(V \ or \ DDHV)}{PHF \times N \times f_{HV}} )</td>
<td>pc/h/ln</td>
</tr>
<tr>
<td>S = 58.9 mph</td>
<td>S</td>
<td>mph</td>
</tr>
<tr>
<td>D = ( \frac{v_p}{S} )</td>
<td>D = ( \frac{v_p}{S} )</td>
<td>pc/mi/ln</td>
</tr>
<tr>
<td>LOS</td>
<td>Required Number of Lanes, N</td>
<td></td>
</tr>
</tbody>
</table>

#### Glossary

- **N** - Number of lanes
- **V** - Hourly volume
- **v_p** - Flow rate
- **LOS** - Level of service
- **DDHV** - Directional design hour volume

#### Factor Location

- \( E_R \) - Exhibits 11-10, 11-12
- \( f_{LV} \) - Exhibit 11-8
- \( E_T \) - Exhibits 11-10, 11-11, 11-13
- \( f_{LC} \) - Exhibit 11-9
- \( f_p \) - Page 11-18
- TRD - Page 11-11
- LOS, S, FFS, v_p - Exhibits 11-2, 11-3
### BASIC FREEWAY SEGMENTS WORKSHEET

**General Information**
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 5/16/11
- **Analysis Time Period**: PM Peak Hour
- **Project Description**: Ohio River Bridges Project

**Site Information**
- **Highway/Direction of Travel**: I-64 Northbound
- **From/To**: Sherman Minton Bridge NB
- **Jurisdiction**: 2030 Downtown

**Flow Inputs**
- **Volume, V**: 5900 veh/h
- **AADT**: veh/day
- **Peak-Hr Prop. of AADT, K**: %
- **Peak-Hr Direction Prop, D**: veh/h
- **DDHV = AADT x K x D**: veh/h

<table>
<thead>
<tr>
<th>Flow Adjustments</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f_p )</td>
</tr>
<tr>
<td>( E_T )</td>
</tr>
</tbody>
</table>

**Calculate Flow Adjustments**

| \( E_R \) | 1.2 |
| \( f_{HV} = \frac{1}{(1 + \frac{f_p}{E_T}) + \frac{f_p}{E_R - 1}} \) | 0.957 |

**Speed Inputs**
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

**LOS and Performance Measures**

**Operational (LOS)**

\[
v_p = \frac{(V \text{ or DDHV})}{(PHF \times N \times f_{HV})} \times f_p \times \frac{2234}{S} \text{ pc/h/ln}
\]

- **S**: 52.7 mph
- **D = V_p / S**: 42.4 pc/mi/ln

**Glossary**

- **N**: Number of lanes
- **V**: Hourly volume
- **v_p**: Flow rate
- **LOS**: Level of service

**Factor Location**

- **E_R**: Exhibits 11-10, 11-12
- **f_{LV}**: Exhibit 11-8
- **E_T**: Exhibits 11-10, 11-11, 11-13
- **f_{LC}**: Exhibit 11-9
- **f_p**: Page 11-18
- **TRD**: Page 11-11
- **LOS, S, FFS, v_p**: Exhibits 11-2, 11-3
# Basic Freeway Segments Worksheet

## General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 5/16/11
- **Analysis Time Period**: PM Peak Hour
- **Project Description**: Ohio River Bridges Project
- **Highway/Direction of Travel**: I-64 Southbound
- **From/To**: Sherman Minton Bridge SB
- **Jurisdiction**: Analysis Year: 2030 Downtown

## Site Information

## Flow Inputs
| Volume, V | 4200 veh/h |
| AADT | veh/day |
| Peak-Hr Prop. of AADT, K | |
| Peak-Hr Direction Prop, D | |
| DDHV = AADT x K x D | veh/h |

## Calculate Flow Adjustments
- \( f_p = 1.00 \)
- \( E_T = 1.5 \)
- \( f_{HV} = \frac{1}{1 + 0.92(1.5 - 1.2)} = 0.943 \)

## Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 3
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow Speed, BFFS**: mph

## Speed Adj and FFS
- **Calc Speed Adj**: \( f_{LV} \)
- **Calc Speed FFS**: 60.0 mph

## LOS and Performance Measures
- **Operational (LOS)**:
  - \( v_p = \frac{(V \text{ or } DDHV)}{(PHF \times N \times f_{HV, 613})} \)
  - S: 60.0 mph
  - D: \( v_p / S \)
  - LOS: D

## Design (N)
- **Design (N)**
- **Design LOS**
  - \( v_p = \frac{(V \text{ or } DDHV)}{(PHF \times N \times f_{HV})} \)
  - S
  - D = \( v_p / S \)
  - LOS: D

## Glossary
- N: Number of lanes
- V: Hourly volume
- \( v_p \): Flow rate
- LOS: Level of service
- DDHV: Directional design hour volume

## Factor Location
- \( E_T \): Exhibits 11-10, 11-12
- \( f_{LV} \): Exhibit 11-8
- \( E_R \): Exhibits 11-10, 11-11, 11-13
- \( f_{LC} \): Exhibit 11-9
- \( f_p \): Page 11-18
- TRD: Page 11-11
- LOS, S, FFS, \( v_p \): Exhibits 11-2, 11-3

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### MULTILANE HIGHWAYS WORKSHEET (Direction 1)

**General Information**
- **Analyst:** J. Sherman
- **Agency or Company:** Parsons
- **Date Performed:** 12/03/2011
- **Analysis Time Period:** AM Peak
- **Project Description:** Ohio River Bridges Project (Direction 1-N, Directions 2-N)
- **Site Information:** Highway/Direct to Travel US 31 Clark Bridge From/To Bridge Jurisdiction Analysis Year

#### Flow Inputs

<table>
<thead>
<tr>
<th>Flow Inputs</th>
<th>Direction 1</th>
<th></th>
<th>Direction 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume, V (veh/hr)</td>
<td>750</td>
<td>Peak-Hour Factor, FHP</td>
<td>0.92</td>
<td>Peak-Hour Factor, FHP</td>
</tr>
<tr>
<td>AADT (veh/day)</td>
<td></td>
<td>%Trucks and Buses, P1</td>
<td>1</td>
<td>%Trucks and Buses, P1</td>
</tr>
<tr>
<td>Peak-Hour Prop of AADT (veh/h)</td>
<td></td>
<td>General Terrain:</td>
<td>Level</td>
<td>General Terrain:</td>
</tr>
<tr>
<td>OD HW (veh/h)</td>
<td></td>
<td>Grade</td>
<td>0.00</td>
<td>Grade</td>
</tr>
<tr>
<td>Driver Type Adjustment</td>
<td>1.00</td>
<td>Up/Down %</td>
<td>0.00</td>
<td>Up/Down %</td>
</tr>
<tr>
<td>Calculate Flow Adjustments</td>
<td></td>
<td>Number of Lanes</td>
<td>2</td>
<td>Number of Lanes</td>
</tr>
<tr>
<td>E&lt;sub&gt;1&lt;/sub&gt;</td>
<td>1.00</td>
<td>E&lt;sub&gt;2&lt;/sub&gt;</td>
<td>1.2</td>
<td>E&lt;sub&gt;2&lt;/sub&gt;</td>
</tr>
<tr>
<td>E&lt;sub&gt;3&lt;/sub&gt;</td>
<td>1.5</td>
<td>F&lt;sub&gt;4&lt;/sub&gt;</td>
<td>0.95</td>
<td>F&lt;sub&gt;4&lt;/sub&gt;</td>
</tr>
</tbody>
</table>

#### Speed Inputs

<table>
<thead>
<tr>
<th>Speed Inputs</th>
<th>Calc Speed Adj and FFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane Width, LW (ft)</td>
<td>12.0</td>
</tr>
<tr>
<td>Total Lateral Clearance, LC (ft)</td>
<td>12.0</td>
</tr>
<tr>
<td>Access Points, A (Am)</td>
<td>0</td>
</tr>
<tr>
<td>Median Type, M</td>
<td>0</td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>45.0</td>
</tr>
<tr>
<td>Base Free-Flow Speed, BFFS</td>
<td>45.0</td>
</tr>
</tbody>
</table>

### Design

**Operational (LOS)**
- **Flow Rate, v<sub>1</sub> (pct/hu):** 426
- **Speed, S (mph):** 45.0
- **D (pct/hu):** 5.5
- **LOS:** A

**Design:**
- **Design (N):**
- **Required Number of Lanes, N:**
- **Flow Rate, v<sub>1</sub> (pct/hu):**
- **Max Service Flow Rate (pct/hu):**
- **Design LOS:**
### MULTILANE HIGHWAYS WORKSHEET (Direction 2)

#### General Information
- **Analyst:** J Sherman
- **Agency or Company:** Parsons
- **Data Performed:** 12/09/2011
- **Analysis Time Period:** AM Peak

#### Site Information
- **Project Description:** Ohio River Bridges Project (Direction 1=NB, Direction 2=SB)
- **Highway/Direction to Travel From/Fr:** US 31 Clark Bridge
- **Jurisdiction:** Bridge
- **Analysis Year:** 2030 Downtown

#### Flow Inputs
- **Volume, V (veh/h):** 1820
- **AADT (veh/day):**
  - Peak-Hour Factor, PHF: 0.92
  - %NTRAC, P1: 1
  - %NRV, P2: 0
  - General Terrain, Level: 0
- **CDHV (veh/h):**
- **Other Type Adjustment:** 1.00
- **Other Flow Adjustment:**
  - E\(_i\): 1.00
  - E\(_f\): 1.2

#### Speed Inputs
- **Lane Width, LW (ft):** 12.0
- **Total Lateral Clearance, LC (ft):** 120
- **Access Points, A (Aim):** 0
- **Median Type, M:**
- **FFS (Measured):** 45.0
- **Base Free Flow Speed, FFS:**

#### Operations
- **Flow Rate, \(v_f\) (pcv/h):** 594
- **Speed, S (mph):** 45.0
- **D (pcv/mi):** 22.1
- **LOS:** C

#### Design
- **Traffic Volume:**
  - **Desired Number of Lanes, N:**
  - **Flow Rate, \(v_d\) (pcv/h):**
  - **Max Service Flow Rate (pcv/mi):**
  - **Design LOS:**

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### MULTILANE HIGHWAYS WORKSHEET (Direction 1)

#### General Information
- **Analyst:** J. Sherman
- **Agency or Company:** Parsons
- **Data Performed:** 12/00/2011
- **Analysis Time Period:** PM Peak
- **Project Description:** Ohio River Bridge Project (Direction 1-NB, Direction 2-SB)

#### Site Information
- **Highway/Direction to Travel:** US 31 Clark Bridge
- **Jurisdiction:** Bureau County
- **Analysis Year:** 2030 Downtown

#### Flow Inputs
<table>
<thead>
<tr>
<th>Volume, V (veh/h)</th>
<th>1820</th>
<th>Peak Hour Factor, FHF</th>
<th>0.92</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADT (veh/h)</td>
<td></td>
<td>%Trucks and Buses, Pn</td>
<td>1.0</td>
</tr>
<tr>
<td>Peak Hour Prop of AADT (veh/h)</td>
<td></td>
<td>NRLs, Pn</td>
<td>0.0</td>
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<tr>
<td>General Terrain:</td>
<td></td>
<td>Grade Length (m)</td>
<td>0.00</td>
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<tr>
<td>Other Type Adjustment</td>
<td></td>
<td>Up/Down %</td>
<td>0.00</td>
</tr>
<tr>
<td>Number of Lanes</td>
<td>2.0</td>
<td></td>
<td></td>
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</tbody>
</table>

#### Calculate Flow Adjustments
- $L_1 = 1.20$
- $E_n = 1.2$
- $I_n = 1.5$
- $V_n = 0.995$

#### Speed Inputs
- **Lane Width, LW (ft):** 12.0
- **Total Lateral Clearance, LC (ft):** 12.0
- **Access Pans, A (A/m):** 0
- **Median Type, M:**
- **FFS (measured):** 45.0
- **Base Free Flow Speed, BFFS:** 45.0

#### Operations
- **Operational (LOS):**
  - Flow Rate, $v_b$ (pcv/h): 884
  - Speed, $v_s$ (mph): 45.0
  - $D$ (pums/h): 19.0
  - LOS: C
- **Design (N):**
  - Required Number of Lanes, N
  - Flow Rate, $v_f$ (pcv/h)
  - Max Service Flow Rate (pcv/h)
  - Design LOS

#### Bicycle Level of Service
<table>
<thead>
<tr>
<th>General Information</th>
<th>Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyst</td>
<td>J. Sherman</td>
</tr>
<tr>
<td>Agency or Company</td>
<td>Highway/Direc. to Travel</td>
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<tr>
<td>Data Performed</td>
<td>12/09/2011</td>
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<td>Analysis Time Period</td>
<td>FM 10</td>
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<tr>
<td>Project Description</td>
<td>One River Bridge Project (Direction 1-NW, Direction 2=SB)</td>
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</table>

### Flow Inputs

<table>
<thead>
<tr>
<th>Volume, V (veh/h)</th>
<th>Peak-Hour Factor, PHF</th>
<th>0.92</th>
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</thead>
<tbody>
<tr>
<td>AADT (veh/h)</td>
<td>%Trucks and Buses, P2</td>
<td>1</td>
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<tr>
<td>Peak-Hour Prop of AADT (veh/h)</td>
<td>%Vehicles, P2</td>
<td>0</td>
</tr>
<tr>
<td>Peak-Hour Direction Prop, D</td>
<td>General Terrain</td>
<td>Level</td>
</tr>
<tr>
<td>Design (veh/h)</td>
<td>Grade Length (mi)</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Up/Down %</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Number of Lanes</td>
<td>2</td>
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</tbody>
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### Calculate Flow Adjustments

<table>
<thead>
<tr>
<th>$f'_1$</th>
<th>$E_a$</th>
<th>1.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td></td>
<td>0.988</td>
</tr>
</tbody>
</table>

### Speed Inputs

<table>
<thead>
<tr>
<th>Lane Width, LW (ft)</th>
<th>12.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Lateral Clearance, LC (ft)</td>
<td>12.0</td>
</tr>
<tr>
<td>Access Points, A (Ainj)</td>
<td>0</td>
</tr>
<tr>
<td>Median Type, M</td>
<td></td>
</tr>
<tr>
<td>FFS (measured)</td>
<td>45.0</td>
</tr>
<tr>
<td>Base Free-Flow Speed, BFFS</td>
<td>45.0</td>
</tr>
</tbody>
</table>

### Design

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
<th>Design (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Rate, $v_o$ (veh/h)</td>
<td>Required Number of Lanes, N</td>
</tr>
<tr>
<td>Speed, $S$ (mi/h)</td>
<td>Flow Rate, $v_o$ (veh/h)</td>
</tr>
<tr>
<td>$D$ (veh/h)</td>
<td>Max Service Flow Rate (veh/h)</td>
</tr>
<tr>
<td>LOS</td>
<td>Design LOS</td>
</tr>
</tbody>
</table>
# BASIC FREEWAY SEGMENTS WORKSHEET

## General Information
- **Analyst:** Adams
- **Agency or Company:** Parsons
- **Date Performed:** 5/11/11
- **Analysis Time Period:** AM Peak Hour
- **Project Description:** Ohio River Bridges Project

## Site Information
- **Highway/Direction of Travel:** I-65 Northbound
- **From/To:** Kennedy Bridge
- **Jurisdiction:**
- **Analysis Year:** 2030 Downtown

## Flow Inputs
- **Volume, V:** 4900 veh/h
- **AADT:** veh/day
- **Peak-Hr Prop. of AADT, K:**
- **Peak-Hr Direction Prop, D:** veh/h
- **DDHV = AADT x K x D:**
- **Peak-Hr Factor, PHF:** 0.92
- **%Trucks and Buses, P_T:** 8
- **%RVs, P_R:** 0
- **General Terrain:** Level
- **Grade:**
- **Length:** mi
- **Up/Down %:**

## Calculate Flow Adjustments
- **f_p:** 1.00
- **E_R:** 1.2
- **f_{HV} = 1/[1+(P_T x (E_R - 1) + P_R x (E_R - 1))]:** 0.962

## Speed Inputs
- **Lane Width:** ft
- **RT-Side Lat. Clearance:** ft
- **Number of Lanes, N:** 6
- **Total Ramp Density, TRD:** ramps/mi
- **FFS (measured):** 60.0 mph
- **Base free-flow Speed, BFFS:** mph

## Calc Speed Adj and FFS
- **f_{LW}:** mph
- **f_{LG}:** mph
- **TRD Adjustment:** mph
- **FFS:** 60.0 mph

## LOS and Performance Measures
- **Operational (LOS):**
- **v_p = (V or DDHV) / (PHF x N x f_{HV} x_k):** pc/h/ln
- **S:** 60.0 mph
- **D = v_p / S:** 15.4 pc/mi/ln

## Design (N)
- **Design (N):**
- **Design LOS:**
- **v_p = (V or DDHV) / (PHF x N x f_{HV} x_k):** pc/h/ln
- **S:** mph
- **D = v_p / S:** pc/mi/ln

## Required Number of Lanes, N

## Glossary
- **N:** Number of lanes
- **V:** Hourly volume
- **v_p:** Flow rate
- **LOS:** Level of service
- **DDHV:** Directional design hour volume

## Factor Location
- **E_R:** Exhibits 11-10, 11-12
- **E_T:** Exhibits 11-10, 11-11, 11-13
- **f_p:** Page 11-18
- **LOS, S, FFS, v_p:** Exhibits 11-2, 11-3

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2/24/2012
## BASIC FREEWAY WORKSHEET

### General Information

<table>
<thead>
<tr>
<th>Analyst</th>
<th>Adams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency or Company</td>
<td>Parsons</td>
</tr>
<tr>
<td>Date Performed</td>
<td>5/1/11</td>
</tr>
<tr>
<td>Analysis Time Period</td>
<td>AM Peak Hour</td>
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<tr>
<td>Project Description</td>
<td>Ohio River Bridges Project</td>
</tr>
</tbody>
</table>

### Site Information

| Highway/Direction of Travel | I-65 Southbound |
| Jurisdiction | Kennedy Bridge |
| Analysis Year | 2030 Downtown |

### Flow Inputs

| Volume, V | 8700 veh/h |
| AADT | veh/day |
| Peak-Hr Prop. of AADT, K | |
| Peak-Hr Direction Prop, D | |
| DDHV = AADT x K x D | veh/h |

| Peak-Hour Factor, PHF | 0.92 |
| %Trucks and Buses, P_T | 10 |
| %RVs, P_R | 0 |

### Calculate Flow Adjustments

| f_p | 1.00 |
| E_T | 1.5 |
| E_R | 1.2 |
| f_HV = 1/[(1 + f_p(E_T - 1) + P_R[E_R - 1]) | 0.952 |

### Speed Inputs

| Lane Width | ft |
| Rt-Side Lat. Clearance | ft |
| Number of Lanes, N | 6 |
| Total Ramp Density, TRD | ramps/mi |
| FFS (measured) | 60.0 mph |
| Base free-flow Speed, BFFS | mph |

### Calc Speed Adj and FFS

| f_LW | mph |
| f_LC | mph |
| TRD Adjustment | mph |
| FFS | 60.0 mph |

### LOS and Performance Measures

<table>
<thead>
<tr>
<th>Operational (LOS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>v_p = (V or DDHV) / (PHF x N x f_HV)</td>
</tr>
<tr>
<td>S</td>
</tr>
<tr>
<td>D = v_p / S</td>
</tr>
</tbody>
</table>

### Design (N)

| Design (N) |
| Design LOS |
| v_p = (V or DDHV) / (PHF x N x f_HV) |
| S | mph |
| D = v_p / S | pc/ml/in |

### Glossary

| N | Number of lanes |
| V | Hourly volume |
| v_p | Flow rate |
| LOS | Level of service |
| DDHV | Directional design hour volume |

### Factor Location

| E_R - Exhibits 11-10, 11-12 |
| E_T - Exhibits 11-10, 11-11, 11-13 |
| f_p - Page 11-18 |
| LOS, S, FFS, v_p - Exhibits 11-2, 11-3 |

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### BASIC FREEWAY WORKSHEET

#### General Information
- **Analyst:** Adams
- **Agency or Company:** Parsons
- **Date Performed:** 5/11/11
- **Analysis Time Period:** PM Peak Hour
- **Project Description:** Ohio River Bridges Project

#### Site Information
- **Highway/Direction of Travel:** I-65 Northbound
- **From/To:** Kennedy Bridge
- **Jurisdiction:**
- **Analysis Year:** 2030 Downtown

#### Flow Inputs
- **Volume, V:** 9100 veh/h
- **AADT:** veh/day
- **Peak-Hr Prop. of AADT, K:**
- **Peak-Hr Direction Prop, D:**
- **DDHV = AADT x K x D:** veh/h

#### Flow Adjustments
- **fₚ:** 1.00
- **fₜ:** 1.5

#### Speed Inputs
- **Lane Width:** ft
- **Rt-Side Lat. Clearance:** ft
- **Number of Lanes, N:** 6
- **Total Ramp Density, TRD:** ramps/mi
- **FFS (measured):** 60.0 mph
- **Base free-flow Speed, BFFS:** mph

#### LOS and Performance Measures

#### Glossary
- **N** - Number of lanes
- **V** - Hourly volume
- **fₚ** - Flow rate
- **LOS** - Level of service
- **DDHV** - Directional design hour volume

#### Site Information
- **Design (N):**

#### Factor Location
- **Eₚ** - Exhibits 11-10, 11-12
- **fₚ** - Page 11-18
- **TRD** - Page 11-11
# BASIC FREEWAY WORKSHEET

## BASIC FREEWAY SEGMENTS WORKSHEET

### General Information
- **Analyst**: Adams
- **Agency or Company**: Parsons
- **Date Performed**: 5/11/11
- **Analysis Time Period**: PM Peak Hour
- **Project Description**: Ohio River Bridges Project

### Site Information
- **Highway/Direction of Travel**: I-65 Southbound
- **From/To**: Kennedy Bridge
- **Jurisdiction**: Analysis Year
- **Analysis Year**: 2030 Downtown

### Flow Inputs
- **Volume, V**: 6700 veh/h
- **Peak-Hour Factor, PHF**: 0.92
- **AADD**: veh/day
- **%Trucks and Buses, \( P_T \)**: 16
- **Peak-Hr Prop. of AADD, K**: veh/h
- **%RVs, \( P_R \)**: 0
- **Peak-Hr Direction Prop, D**: 
- **DDHV = AADD x K x D**: veh/h
- **General Terrain**: Level
- **Grade**: %
- **Length**: mi
- **Up/Down %**:

### Calculate Flow Adjustments
- \( f_p \) = 1.00
- \( E_T \) = 1.5
- \( f_{HV} = \frac{1 + \left( P_T \right)}{1 + \left( P_R \right)} \)
- \( E_R = 1.2 \)

### Speed Inputs
- **Lane Width**: ft
- **Rt-Side Lat. Clearance**: ft
- **Number of Lanes, N**: 6
- **Total Ramp Density, TRD**: ramps/mi
- **FFS (measured)**: 60.0 mph
- **Base free-flow speed, BFFS**: mph

### Calc Speed Adj and FFS
- \( f_{LV} \)
- \( f_{LC} \)
- **FFS Adjustment**: mph
- **TRD Adjustment**: mph

### LOS and Performance Measures
- **Operational (LOS)**
- \( v_0 = \frac{(V \text{ or DDHV})}{(PHF \times N \times f_{HV})} \)
- \( x_{f_p} \)

### Design (N)
- **Design LOS**: pc/h/ln
- **Required Number of Lanes, N**: pc/mi/ln
- **Design (N)**

### Glossary
- **N**: Number of lanes
- **V**: Hourly volume
- **\( v_0 \)**: Flow rate
- **LOS**: Level of service
- **DDHV**: Directional design hour volume

### Factor Location
- **\( E_R \)**: Exhibits 11-10, 11-12
- **\( f_{LV} \)**: Exhibit 11-8
- **\( E_T \)**: Exhibits 11-10, 11-11, 11-13
- **\( f_{LC} \)**: Exhibit 11-9
- **\( f_p \)**: Page 11-18
- **TRD**: Page 11-11
- **LOS, S, FFS, \( v_p \)**: Exhibits 11-2, 11-3

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