TRAFFIC SIMULATION AND SAFETY ANALYSIS PROGRAM OVERVIEW DESIGN DIVISION

TRANSPORTATION SHORT COURSE
OCTOBER 2020

by
Khalid Jamil, P.E.
Agenda

- Background
- Purpose
- Team
- Traffic Simulation/ Analysis
- Safety Analysis
- Accomplishments
- Current Initiatives
Background

Advancements in Traffic Analysis Procedures/Tools
- Limitations of HCM
- Microsimulations/MOE's

AASHTO Highway Safety Manual
- Predictive Analysis
- Safety Analysis Tools

FHWA Review
- Quality of IAJR
- Quality of Design Exceptions

Need to Develop Expertise
- Traffic Simulation
- Safety Analysis
Purpose

Provide Guidance
- Traffic Simulation and Safety Analysis Guidelines
- Standard Operating Procedures (SOPs)
- Trainings

Provide Support to Districts
- Traffic Simulation Modeling & Analysis
- Safety Modeling & Analysis
- Subject Matter Expertise (SME)

Coordinate IAJR & Design Exceptions Process
- Coordination with District and FHWA
- Technical Approach
## Functions

| GUIDANCE                                      | • Develop, interpret, and implement guidelines  
|                                              | • Coordinate, develop, and conduct training    
|                                              | • Provide technical expertise                   |
| SUPPORT                                      | • Planning, scope, & traffic methodology       
|                                              | • Traffic simulation & safety analysis on select projects 
|                                              | • Review IAJRs & design exceptions             |
| COORDINATION                                 | • Meetings with FHWA                            
|                                              | • Participate in District and Division Meetings |
| CONSULTANT MANAGENT                          | • Consultant contracts on selected projects     |
Our Team

Khalid Jamil, P.E. (Section Director)
Farhan Khan, P.E., PTOE (Team Lead)
Eddie Espinoza, P.E. (Lead Engineer)
Milad Kiaee, P.E. (Traffic Engineer)
Saleh, Mousa, Ph.D., EIT
Traffic Simulation/Analysis

• Typical Objectives
• What is Traffic Analysis?
• When and How to conduct Traffic Analysis?
• What is Traffic Simulation and its role?
• What are the basic goals?
• Traffic Analysis Tools and Procedures
# Traffic Analysis Tool Selection Matrix

<table>
<thead>
<tr>
<th>Facility</th>
<th>Objective</th>
<th>MOEs</th>
<th>Tool Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Facility Types</td>
<td>Identify/Address Mobility/Capacity/Operations Issues</td>
<td>V/C, Travel time, Speed, Delay, LOS</td>
<td>TxDOT STARS, SAM, TxDOT Congestion Maps</td>
</tr>
<tr>
<td></td>
<td>Alternative Evaluation</td>
<td></td>
<td>HCM/HCS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HCS/Synchro</td>
</tr>
<tr>
<td>Interchange/Intersections</td>
<td>Determining Need for Capacity</td>
<td>Queues, V/C, Travel time, Speed, Delay, LOS</td>
<td>CAP-X</td>
</tr>
<tr>
<td></td>
<td>Alternative Evaluation</td>
<td></td>
<td>HCS/Synchro/SIDRA</td>
</tr>
<tr>
<td>Freeway Facilities</td>
<td>Identify Operational Issues, Evaluate Performance</td>
<td>LOS, Speed, Delay</td>
<td>HCS/Synchro</td>
</tr>
<tr>
<td>Urban Facilities</td>
<td></td>
<td>LOS, Delay</td>
<td>VISSIM/CORSIM</td>
</tr>
<tr>
<td>Rural Facilities</td>
<td></td>
<td>LOS, Delay</td>
<td>VISSIM/CORSIM</td>
</tr>
<tr>
<td>Alternative Interchange/Intersections</td>
<td>Identification of Operational Issues, Evaluate Performance</td>
<td>Queues, Delays, LOS, Trip Reliability, Travel Times</td>
<td>Synchro</td>
</tr>
<tr>
<td>Roundabout</td>
<td></td>
<td>Queues, Delays, LOS</td>
<td>SIDRA/Synchro/HCS</td>
</tr>
</tbody>
</table>

*Notices:*

- TxDOT STARS and Google Maps can be used for screening/evaluating existing conditions.

### Details

**Level of Effort:**

- **Planning Phase**
  - **Facility:** All Facility Types
  - **Objective:** Identify/Address Mobility/Capacity/Operations Issues
  - **MOEs:** V/C, Travel time, Speed, Delay, LOS
  - **Tool Category:** TxDOT STARS, SAM, TxDOT Congestion Maps
- **Facility:** Interchange/Intersections
  - **Objective:** Determine Need for Capacity
  - **MOEs:** Queues, V/C, Travel time, Speed, Delay, LOS
  - **Tool Category:** CAP-X
- **Facility:** Freeway Facilities
  - **Objective:** Identify Operational Issues, Evaluate Performance
  - **MOEs:** LOS, Speed, Delay

**Schematics Phase**

- **Facility:** Urban Facilities
  - **Objective:**
  - **MOEs:** LOS, Delay
- **Facility:** Rural Facilities
  - **Objective:**
  - **MOEs:** LOS, Delay
- **Facility:** Alternative Interchange/Intersections
  - **Objective:**
  - **MOEs:** Queues, Delays, LOS, Trip Reliability, Travel Times
- **Facility:** Roundabout
  - **Objective:**
  - **MOEs:** Queues, Delays, LOS

**Tool Category**

- **HCM based/Macroscopic**
- **Microsimulation**
FHWA CAP-X Tool Overview

- Screening level tool
- 18 types of intersections/interchanges
- 8 intersection types, 5 interchanges, 5 roundabout
  - Input - peak flow volumes, number of lanes
  - Output - V/C ratio
Traffic Simulation/Analysis

HCM-based Analysis Tools

• Macroscopic & deterministic
• Good for under-saturated flow
• Highway Capacity Software
  o Quick & reliable
  o Good for traditional analysis
  o Freeway facilities
• Synchro
  o Good for arterials
  o Signal optimization
• Sidra
  o Commonly used for roundabouts
Microsimulation Analysis Tools

- Warranted for complex scenarios
  - Pros
    - Good for longer congestion
    - Good for system effect
    - Good for presentation
  - Cons
    - Data requirement
    - Time consuming
- Common microsimulation tools
  - CORSIM
  - VISSIM
**Traffic Modeling Process**

1. **SCOPE** → **DATA COLLECTION**
2. **BASE MODEL** → **VERIFICATION**
3. **VERIFICATION** → **CALIBRATION**
4. **CALIBRATION** → **ALTERNATIVE ANALYSIS**
5. **ALTERNATIVE ANALYSIS** → **DOCUMENTATION**
Safety Analysis

• Purpose
• Requirements
• Traditional Approach
• Nominal vs. Substantive Safety
• Historical Crash Analysis
  • Crash data analysis for the latest 3 to 5 years
  • Crash severity
  • Crash types
  • Crash rates
  • Crash pattern & contributing factors
  • Crash diagram
Safety Analysis

Highway Safety Manual

- Quantitative Safety Analysis
- Predict crash frequency
- Similar to HCM

Part A: Human Factors
Part B: Safety Management Process
Part C: Predictive Method
Part D: Crash Modification Factors (CMF)
Part C Predictive Method

- Anticipated change in crash frequency
  - Function of traffic volume
  - Roadway characteristics
  - Crash Modification Factor (CMF)
- Safety Performance Functions (SPF)
- Assess or evaluate alternatives in terms of their safety effects
- Common safety tools
  - Interactive Highway Safety Design Model (IHSDM)
  - Highway Safety Software (HSS)
  - Spreadsheet based tools
## Safety Analysis

### Safety Analysis Tool Selection Matrix

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<thead>
<tr>
<th>Facility/Project Type</th>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Planning Phase</td>
</tr>
<tr>
<td>All Facility Types</td>
<td>Identify/Address safety issues</td>
<td>Crash Frequency &amp; Severity, Rate</td>
<td>C.R.I.S.</td>
</tr>
<tr>
<td></td>
<td>Optimize Safety</td>
<td>Safety Score</td>
<td>N.A.</td>
</tr>
<tr>
<td>Intersection</td>
<td>Alternative Evaluation</td>
<td>Crash Frequency &amp; Severity</td>
<td>C.R.I.S.</td>
</tr>
<tr>
<td></td>
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<td>Schematics Phase</td>
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<td>Identify/Address safety issues</td>
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<tr>
<td>Urban Facilities</td>
<td>Identify/Address safety issues</td>
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<td>Freeway Facilities</td>
<td>Identify/Address safety issues</td>
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<tr>
<td>IARs</td>
<td>Evaluate Impact on Safety</td>
<td>Crash Frequency &amp; Severity, Rate</td>
<td>C.R.I.S.</td>
</tr>
<tr>
<td>Design Exceptions</td>
<td>Evaluate Impact on Safety</td>
<td>Crash Frequency &amp; Severity, Rate</td>
<td>C.R.I.S.</td>
</tr>
<tr>
<td>Design Exceptions for Interstate</td>
<td>Evaluate Impact on Safety</td>
<td>Crash Frequency &amp; Severity, Rate</td>
<td>C.R.I.S.</td>
</tr>
<tr>
<td>VE Studies</td>
<td>Optimize Safety</td>
<td>Safety Score</td>
<td>C.R.I.S.</td>
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</table>

**Legend**
- CMF - Crash Modification Factor
- HSM SS - Highway Safety Manual Spreadsheet
- HSS - Highway Safety Software
- SPICE - Safety Performance of Intersection Control Evaluation
- ISATe - Enhanced Interchange Safety Analysis Tool
- IHSDM - Interactive Highway Safety Design Model
Accomplishments

• IAJR SOP
  o Webinars
  o Additional guidance
    ▪ Roadway Design Manual (RDM) – Safety analysis
    ▪ Peak hour Traffic Volumes
    ▪ IAJR checklists
• HSM and ISATe/IHSDM trainings
  o IAJR workshops traffic analysis
• Traffic & safety analysis SOW for DBB and DB
• Traffic and safety analysis tool selection
• Safety scoring tool

(Both IAJR SOP and Safety Scoring Tool are available @ https://www.txdot.gov/inside-txdot/division/design.html)
IAJR SOP Roadmap

IAJR Methodology w/FHWA
Oct. 10, 2018

Draft SOP w/ FHWA
July 2019

SA & FTW Dist. Pilot Presentations
Sept. 2019

El Paso, Waco, Bryan, Corpus Christi Dist. Pilot Presentations
Jan.-Feb 2020

Houston, Dallas, & Tyler Dist. Pilot Presentations
Oct. 2019

Statewide Webinar for Consultants
March 18, 2020

Issuance of Final IAJR SOP
April 21, 2020

Statewide Webinar for 25 TxDOT Districts
March 3, 2020

TxDOT IAJR Policy
Oct. 18, 2018

Presented SOP to FHWA
Aug 2019

Update SOP to FHWA HQ
Dec, 2019

Austin Dist. Pilot Presentation
Nov. 2019

IAJR SOP
Accomplishments – Interchange Safety Analysis Training

Design Division
TSSA
2018-2020 District Training

- Training Location
  - No Attendees
  - 1 to 4 Attendees
  - 5 to 10 Attendees
  - 11 or more Attendees
Current Initiatives

- Traffic and safety analysis manual
- Intersection safety scoring tool
- Design Exception SOP
- Intersection framework
- Highway safety manual implementation
  - Texas specific SPFs and calibration factors
  - Participation in FHWA DDSA EDC5
  - NCHRP panel
- FHWA pool fund
- Training
- Microsimulation toolbox (Future)
Design Division
TSSAS
2018-2020 District Projects

- FY 2018-2020 Current or Completed Projects
  - IAJR
  - Design Exception
  - Corridor Studies
  - TIA

- No Work Done thus far
Questions?
Feedback

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