



Operational and Safety Attributes of an Alternative Design, Space-Efficient One- Sided Interchange

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Program Manager

Oct. 25, 2018

Deep South ITE – 2018 Fall Meeting

Presentation Topics

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O

Obligations

S

Operational and Safety Attributes of an
Alternative Design, Space-Efficient One-Sided
Interchange

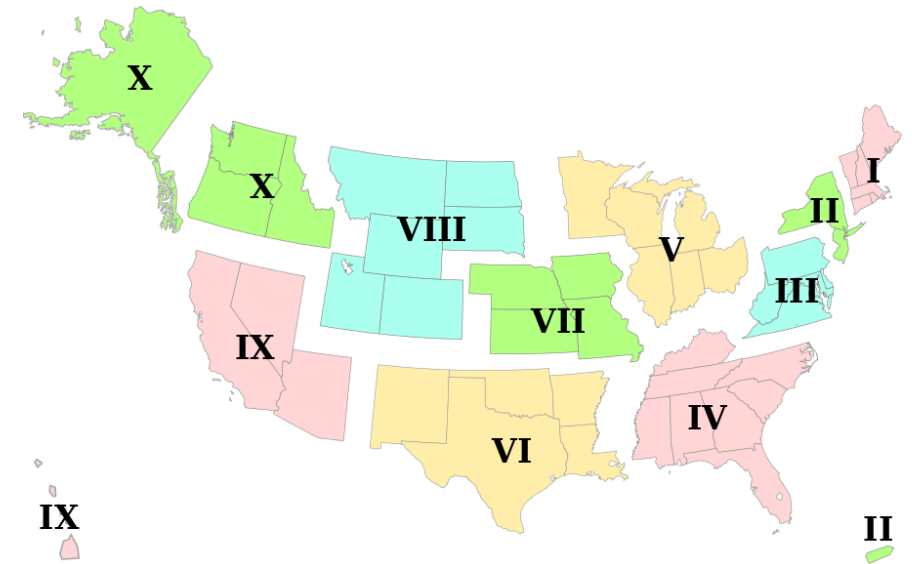


Obligations

Tran-SET

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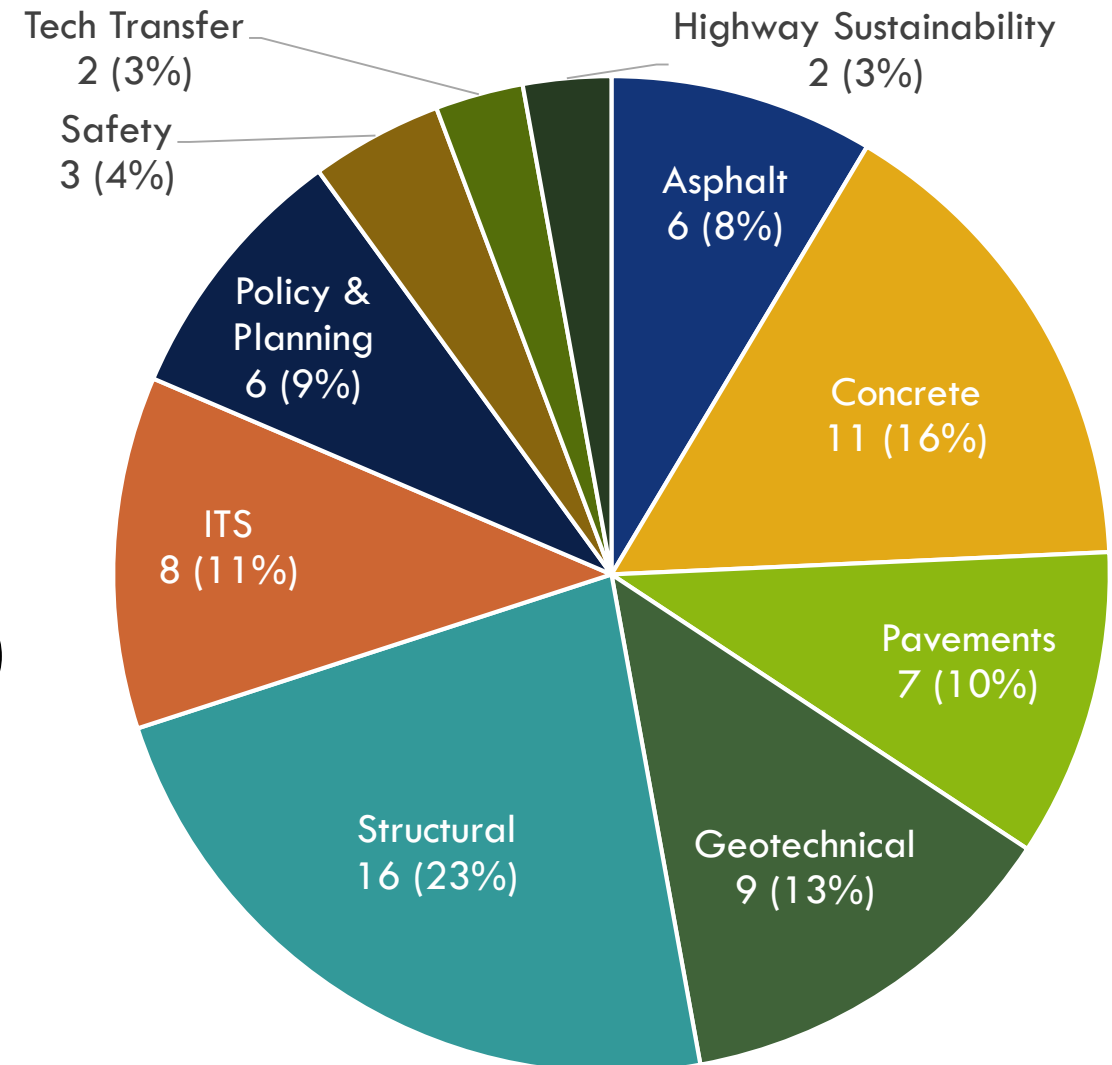
- USDOT – University Transportation Centers (UTC) Program
 - National (5), Regional (10), and Tier 1 (20)
- Tran-SET
 - Grantee of Region 6 UTC
 - Consortium of 11 partnering institutions



Tran-SET Research

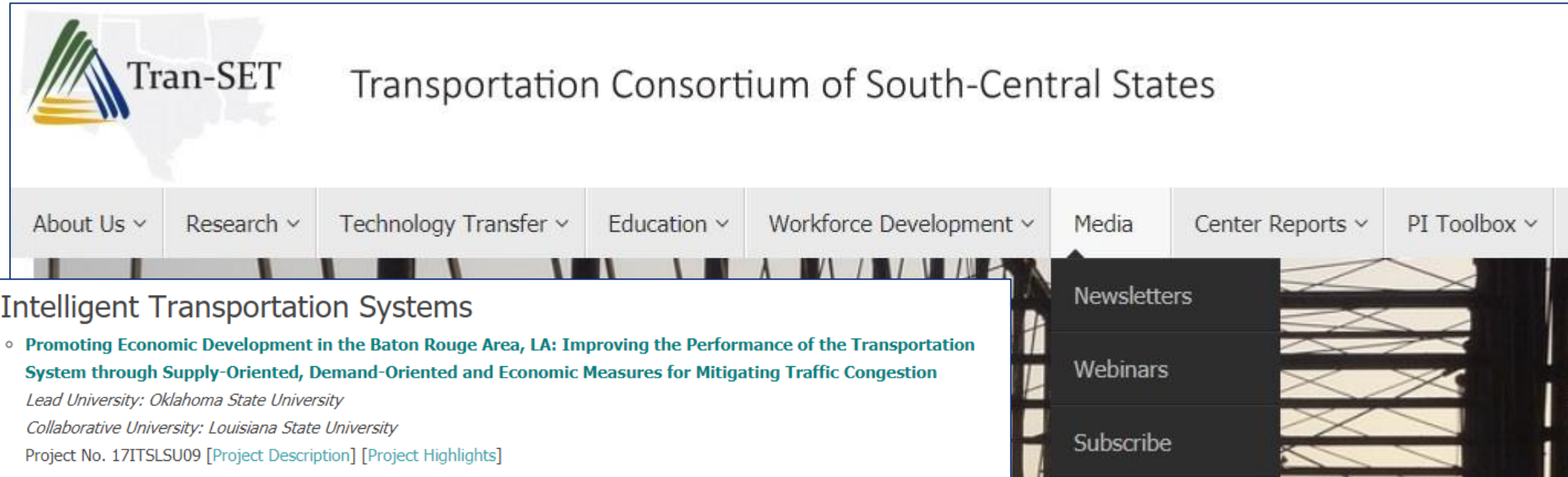
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- Research Themes
 - Enhancing durability and service life of infrastructure
 - Preserving existing transportation systems
 - Preserving the environment
 - Addressing immediate Region 6 transportation needs
- 66 research projects (33 FY17, 33 FY18)
- \$8.8 million in research funds



Tran-SET Website

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Intelligent Transportation Systems

- **Promoting Economic Development in the Baton Rouge Area, LA: Improving the Performance of the Transportation System through Supply-Oriented, Demand-Oriented and Economic Measures for Mitigating Traffic Congestion**
Lead University: Oklahoma State University
Collaborative University: Louisiana State University
Project No. 17ITSLSU09 [[Project Description](#)] [[Project Highlights](#)]
- **Study the Impacts of Freight Consolidation and Truck Sharing on Freight Mobility**
Lead University: Oklahoma State University
Project No. 17ITSOKS02 [[Project Description](#)] [[Project Highlights](#)]
- **Relationship between Road Network Characteristics and Traffic Safety**
Lead University: University of Texas at San Antonio
Project No. 17ITSTSA01 [[Project Description](#)] [[Project Highlights](#)]
- **Establishing Guidelines for Ramp Metering Performance Evaluation and Implementation Practices in Louisiana**
Lead University: Louisiana State University
Project No. 17ITSLSU14 [[Project Description](#)] [[Project Highlights](#)]

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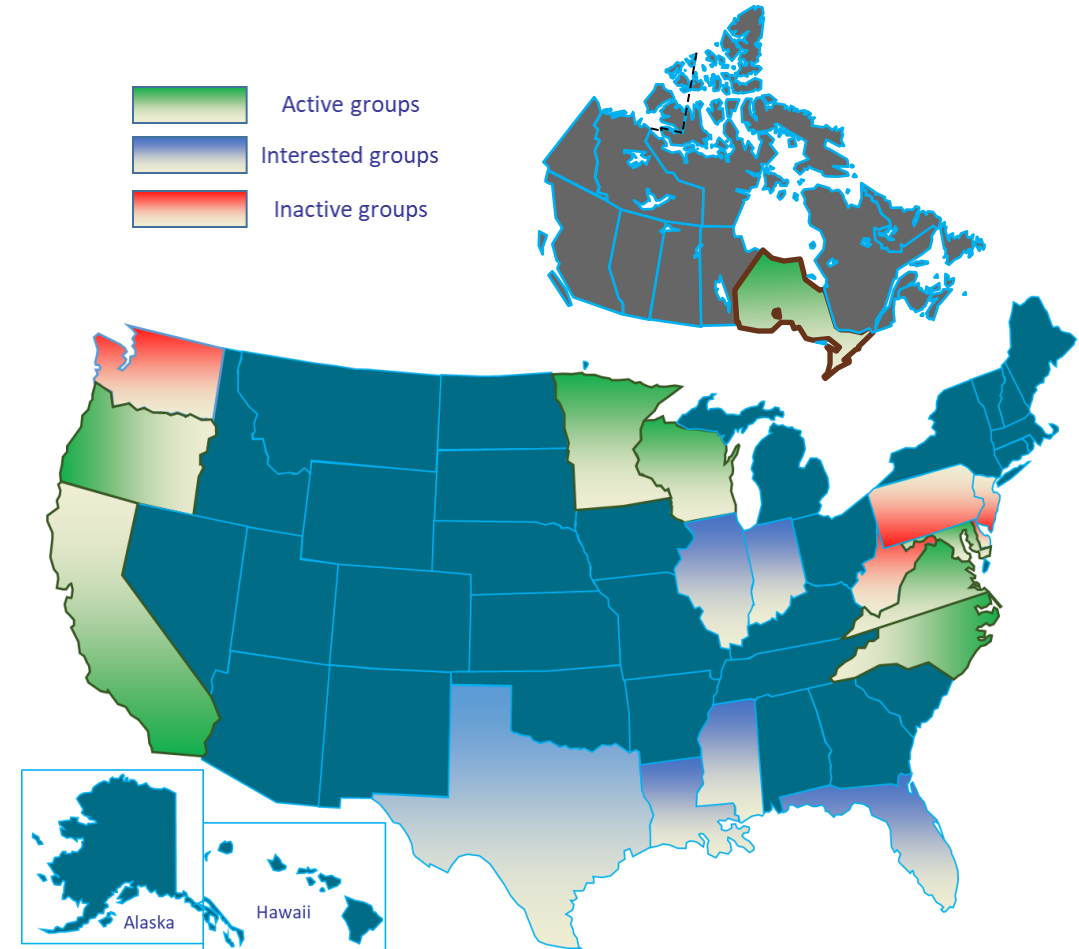
Tran-SET

SimCap

SimCap

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- SimCap: **Sim**ulation & **Cap**acity
Analysis User(s) Group
- 8 active local sections
- National “facilitation team”
- **Mission:** Support, promote, and improve best practices in the application of traffic simulation and capacity analysis



SimCap Louisiana

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ARTICLE II – AREA, MISSION, AND GOALS

Section 2.1 – The area designated as that of *SimCap Louisiana* shall be the state of Louisiana.

Section 2.2 – The Mission of *SimCap Louisiana* shall be to share information and experiences as to disseminate, promote, and develop guidance and best practices in the application of traffic simulation and capacity analysis tools, methods, and related practice areas.

Section 2.3 – The main Goals of *SimCap Louisiana* are to:

- (1) Provide a forum for the meaningful exchange of ideas, research, questions, and trends;
- (2) Serve as a resource for practitioners and organizations by sharing experiences and developing guidance and best practices; and
- (3) Advocate for consistency, reliability, and advances to the current state-of-the-practice.

Section 2.4 – The main Objectives of *SimCap Louisiana* are to:

- (1) Increase awareness of LADOTD initiatives, national activities and guidance, and the latest *SimCap* tools;
- (2) Increase communication of LADOTD updates and activities to stakeholders;
- (3) Provide a forum for sharing *SimCap* experiences (across organizations) and receiving feedback/answers to questions;
- (4) Provide educational opportunities to learn of more appropriate and efficient ways of conducting *SimCap* analysis; and
- (5) Become a mechanism to request education/training.



SimCap Louisiana: Activities

ARTICLE VII – ACTIVITIES

Section 7.1 – At least four educational meetings shall be organized and held each year. Educational meetings shall include an invited speaker (internal or external) on a relevant *SimCap*-related topic and be webinar accessible.

Section 7.2 – Each professional meeting shall have a planned agenda (with planned objectives and schedule) and disseminated to Members in adequate time to prepare and attend the meeting.

Section 7.3 – At least two business meetings shall be held each year. These may coincide with the educational meetings.

Section 7.4 – An electronic forum shall be established to share experiences, provide feedback, and solicit help in the practice and application of *SimCap* analysis and tools.

Section 7.5 – A Member “expertise” list shall be created and maintained.

Section 7.6 – *SimCap Louisiana* shall participate in a joint-sponsored event at least once per year with a related, transportation-affiliated organization (e.g., ITE, WTS, Tran-SET, etc.).

SimCap Louisiana: Upcoming Meeting

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EDUCATIONAL MEETING #2

Wednesday, October 31st, 2018 | 11:00 am – 12:30 pm [CST]
Call-In: +1 (669) 900-6833; Access Code: 488 596 369
Webinar: <https://zoom.us/j/488596369>
Room 101 | Transportation Training & Education Center
4099 Gourrier Ave | Baton Rouge, LA 70808



SimCap Louisiana



(under development)

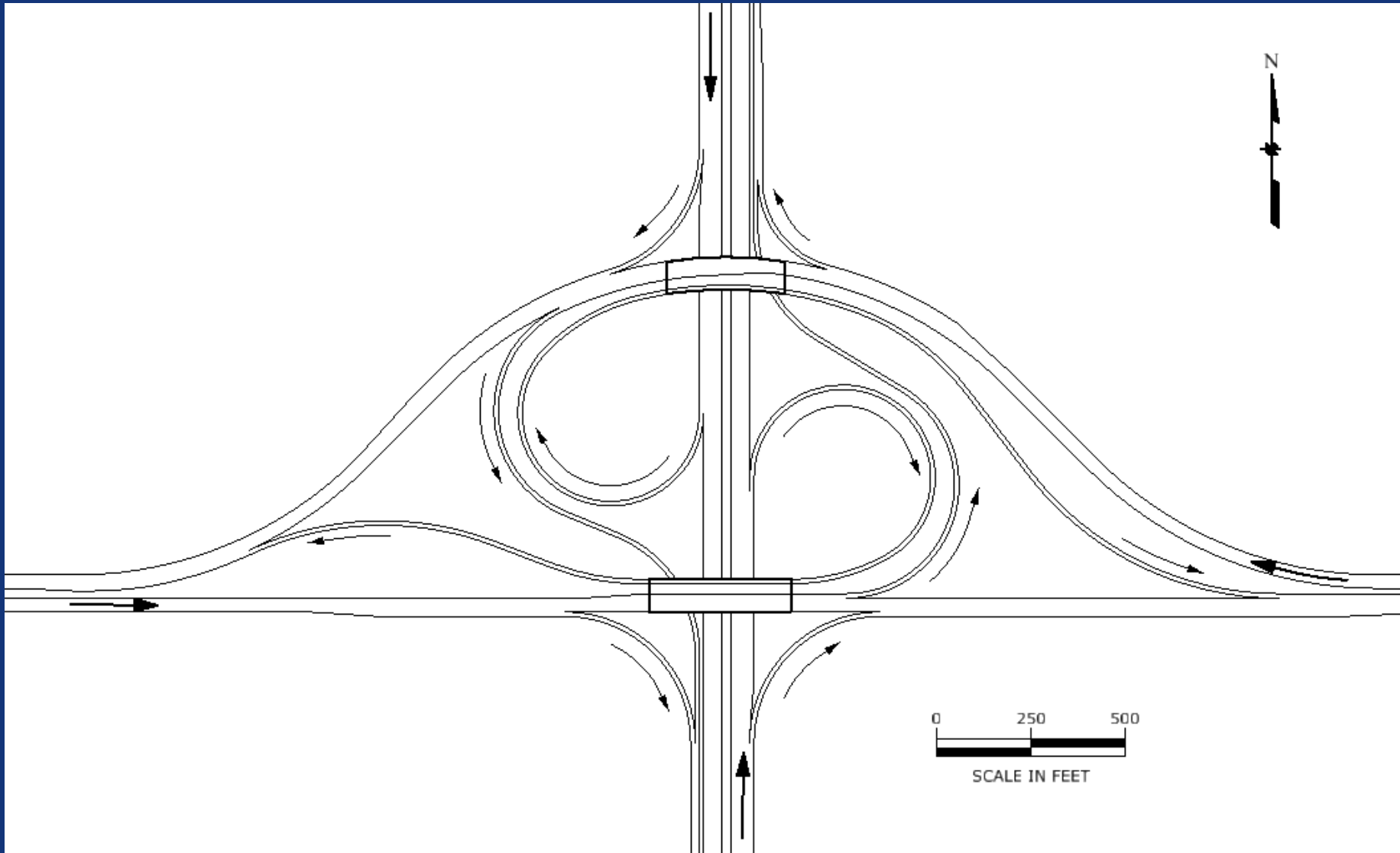


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Tran-SET

SimCap

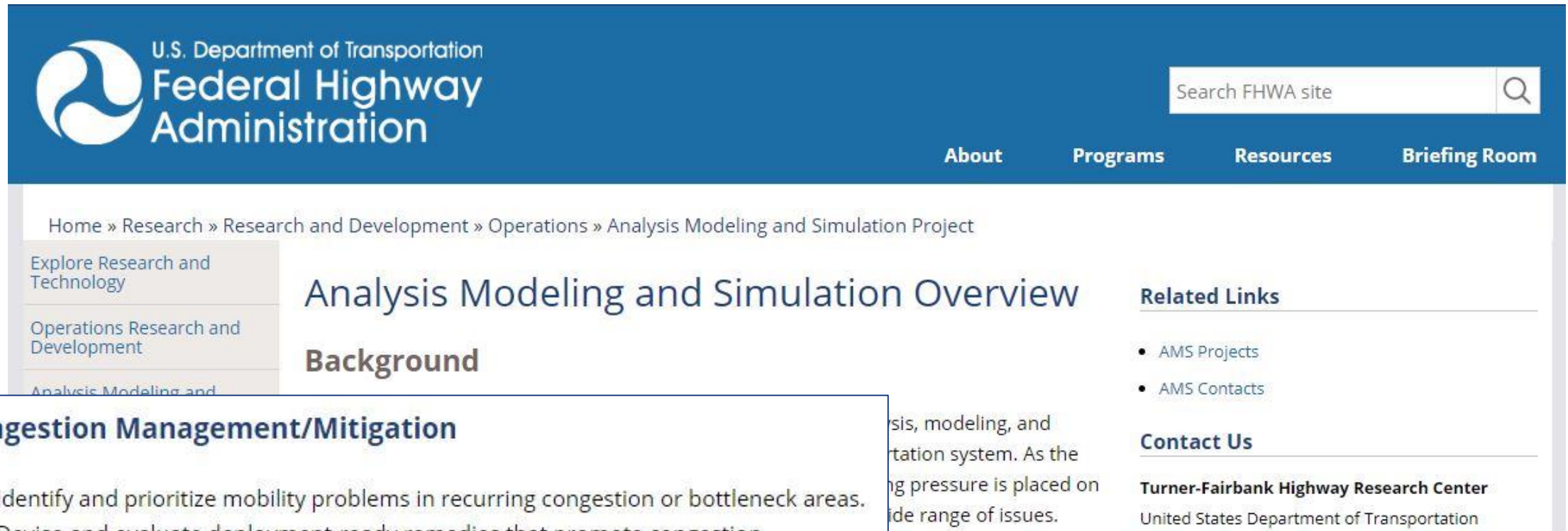
Time	Item/Description
11:00 – 11:05 AM	Welcome and Introduction / Stephen Mensah & Christopher Melson
11:05 – 11:25 AM	Overview and Updates from FHWA's Traffic Analysis Tools (TAT) Program <i>Jim Sturrock</i> / ITS Operations Engineer / FHWA <i>John Halkias</i> / Innovative Operations Strategies Team Leader / FHWA This presentation will provide an overview of two guidance documents that are part of FHWA's Traffic Analysis Tools (TAT) Program: (1) the recently developed Scoping and Conducting Data-Driven 21st Century Transportation System Analyses and (2) new updates (and modeling recommendations) to Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software .
11:25 – 11:50 AM	Microsimulation and LaDOTD <i>Jody Colvin</i> / Traffic Engineering Division Administrator / LaDOTD This presentation summarizes LaDOTD's perspective, views, and current use of traffic modeling and simulation analyses, specifically on the use of microsimulation.
11:50 – 12:05 PM	Overview of Toronto SimCap <i>Matthew Davis</i> / Program Manager / City of Toronto The presentation will give an overview of the Toronto SimCap: (1) brief history and context, (2) current organization, size, and operation, (3) activities, and (4) main "lessons learned".
12:05 – 12:30 PM	Business Discussion / All <ul style="list-style-type: none">• Comments to, discussion, and ratification of charter• Recommendation and election of Coordinating Committee• Topics for and scheduling next educational meeting



Operational and Safety Attributes of an Alternative Design, Space-Efficient One-Sided Interchange

Context

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U.S. Department of Transportation
Federal Highway Administration

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Home » Research » Research and Development » Operations » Analysis Modeling and Simulation Project

Explore Research and Technology

Operations Research and Development

Analysis Modeling and Simulation

Analysis Modeling and Simulation Overview

Background

Congestion Management/Mitigation

1. Identify and prioritize mobility problems in recurring congestion or bottleneck areas. Devise and evaluate deployment-ready remedies that promote congestion management/mitigation. This includes alternative operational strategies and designs.
2. Develop and disseminate AMS tools for these treatments or remedies. Develop and disseminate guidance on their application.

Related Links

- AMS Projects
- AMS Contacts

Contact Us

Turner-Fairbank Highway Research Center
United States Department of Transportation

www.fhwa.dot.gov/research/tfhrc/projects/operations/ams/index.cfm



Background

Design

Case Study

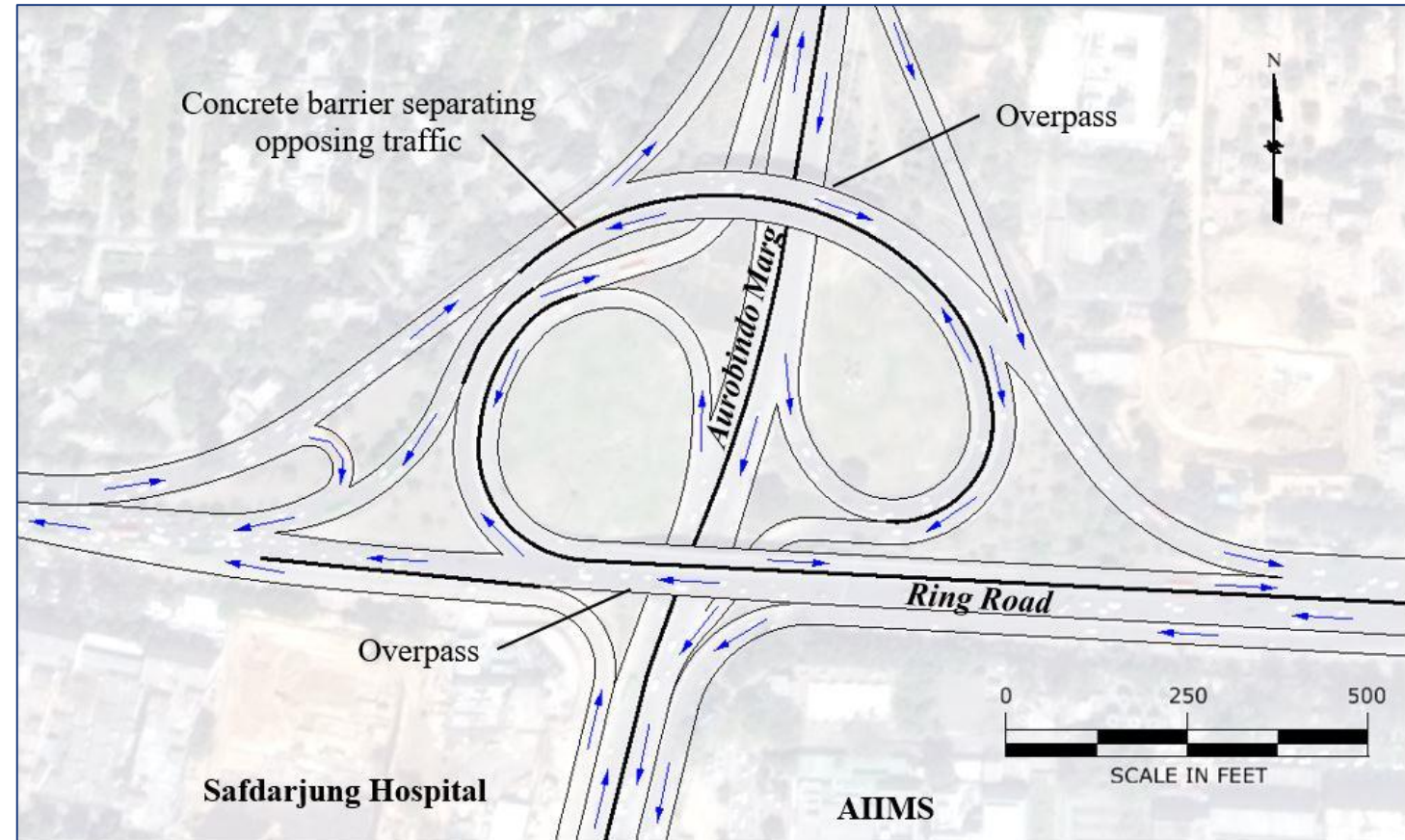
Results

Conclusion

Inspiration

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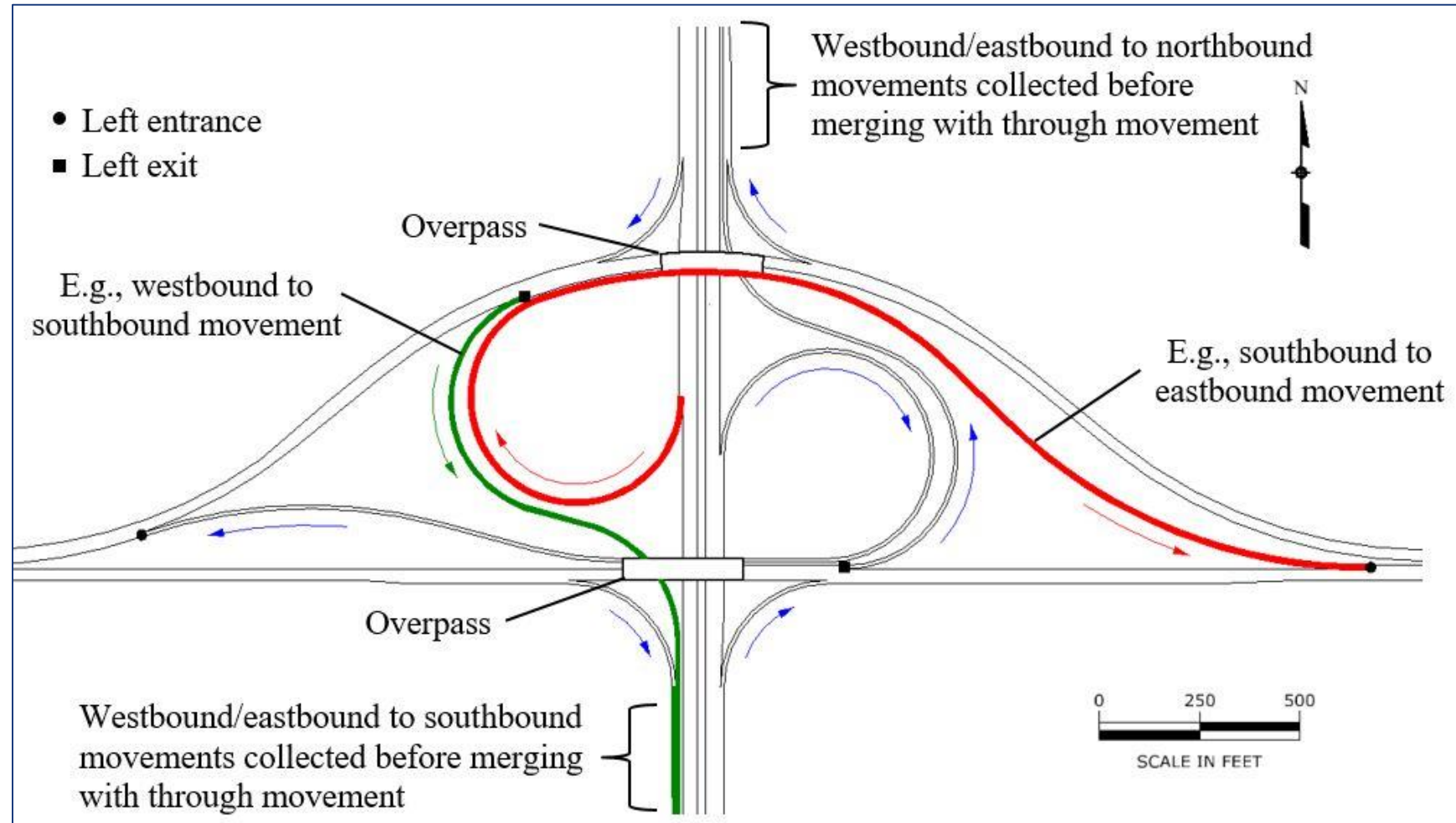
- Intersection of Ring Road and Aurobindo Marg
 - New Delhi, India (2003)
- Design emphasized:
 - Minimal ROW acquisition
 - Maintaining full access
 - Uninterrupted vehicular flow
- Substandard geometrics



Geometric Design

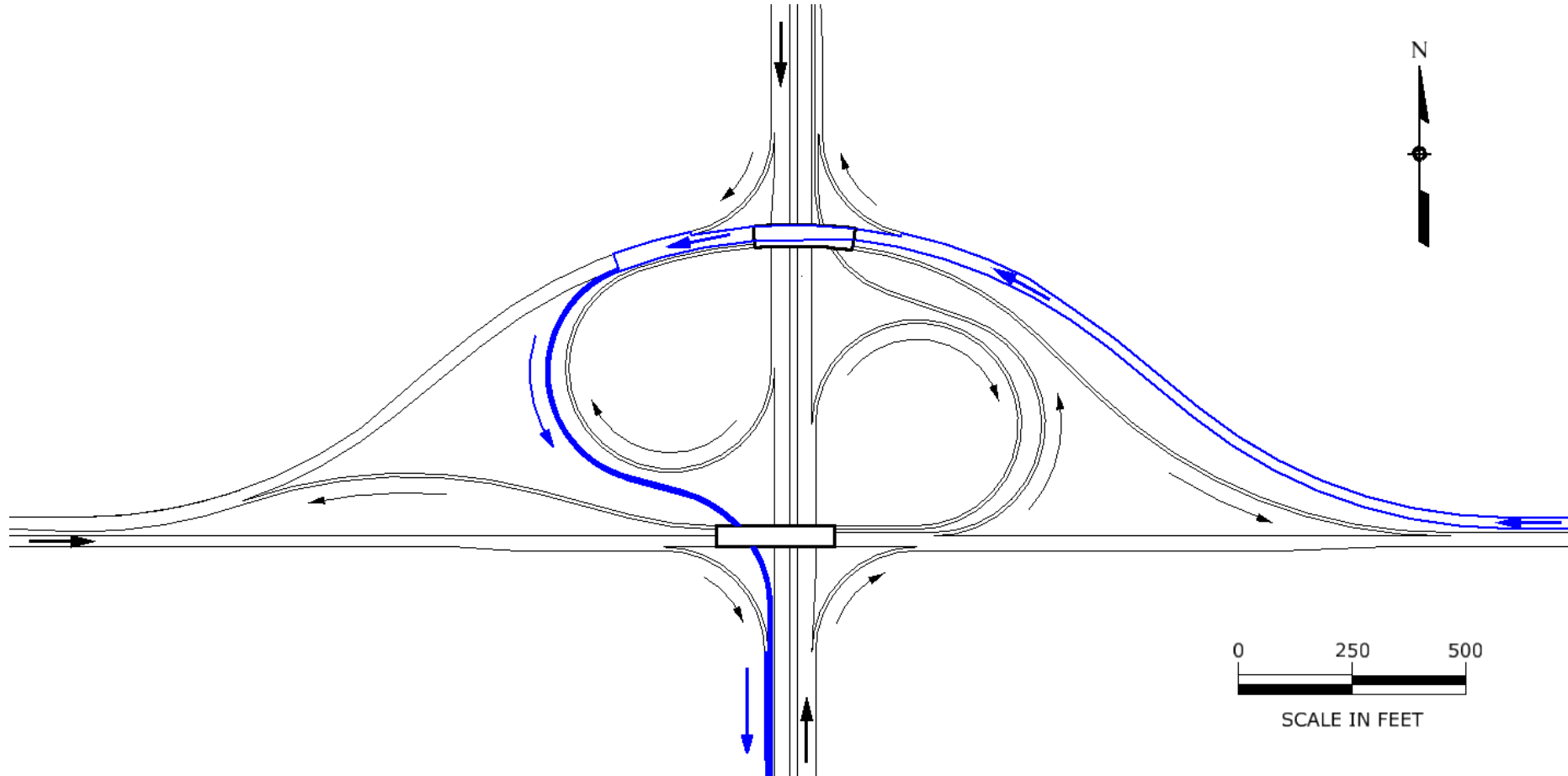
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- Design:
 - 70 mph
 - 65 mph (curve)
 - 35 mph (ramps)
- Exceptions:
 - Left entrances (2)
 - Left exits (2)
 - Reduced mainline speed
 - Ramp terminal spacing



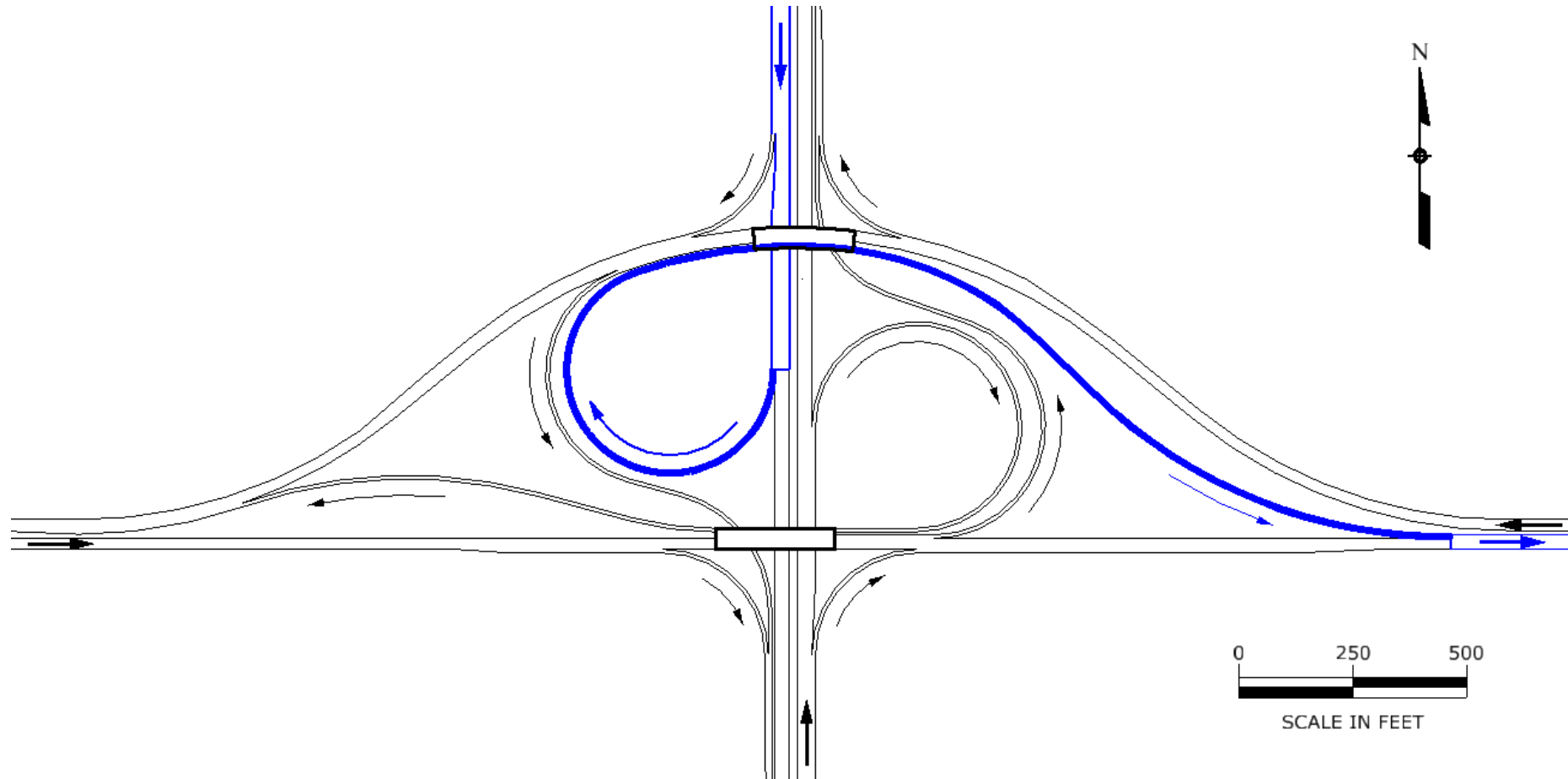
Interchange Flow: WB to SB

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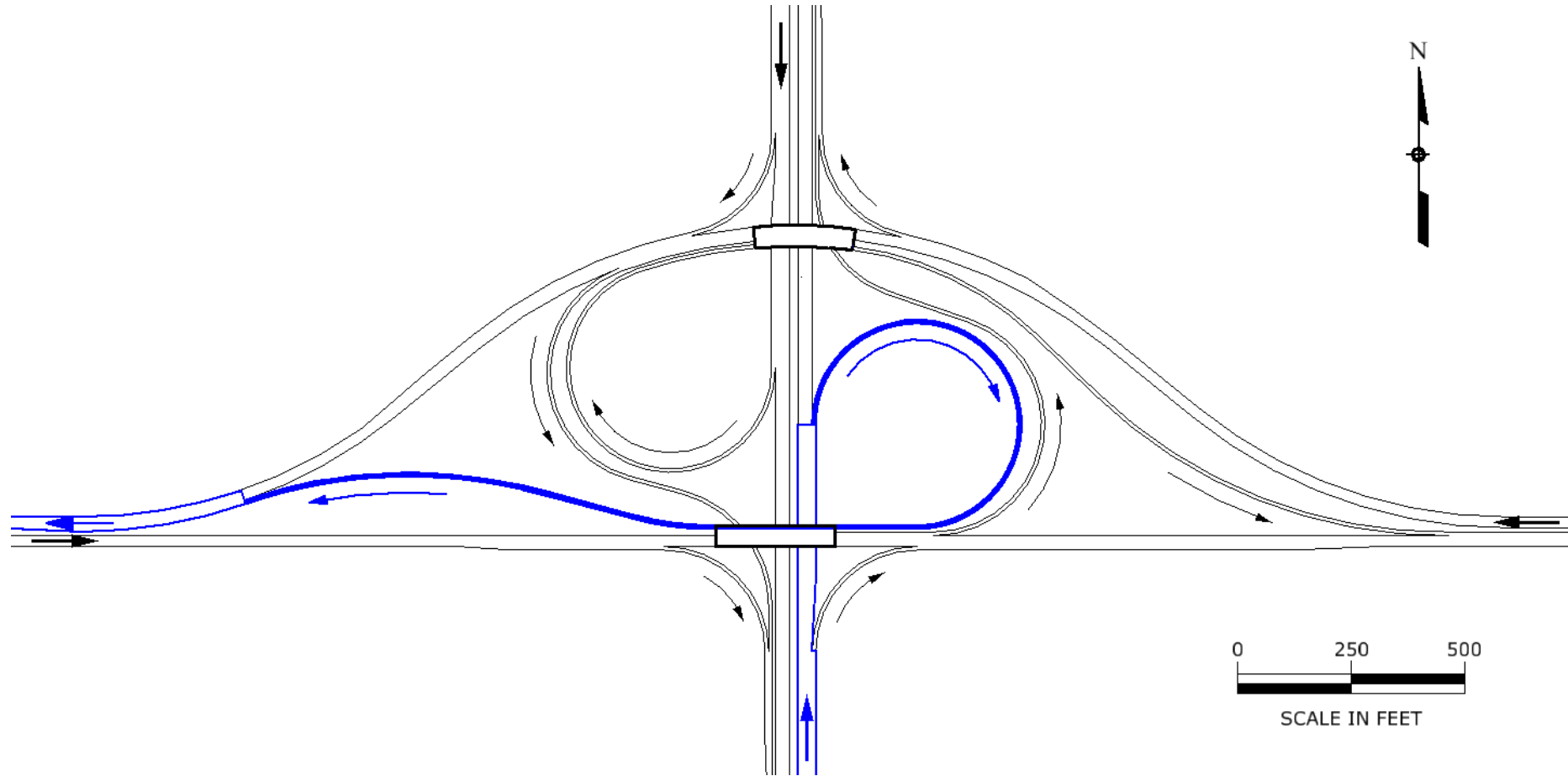
Interchange Flow: SB to EB

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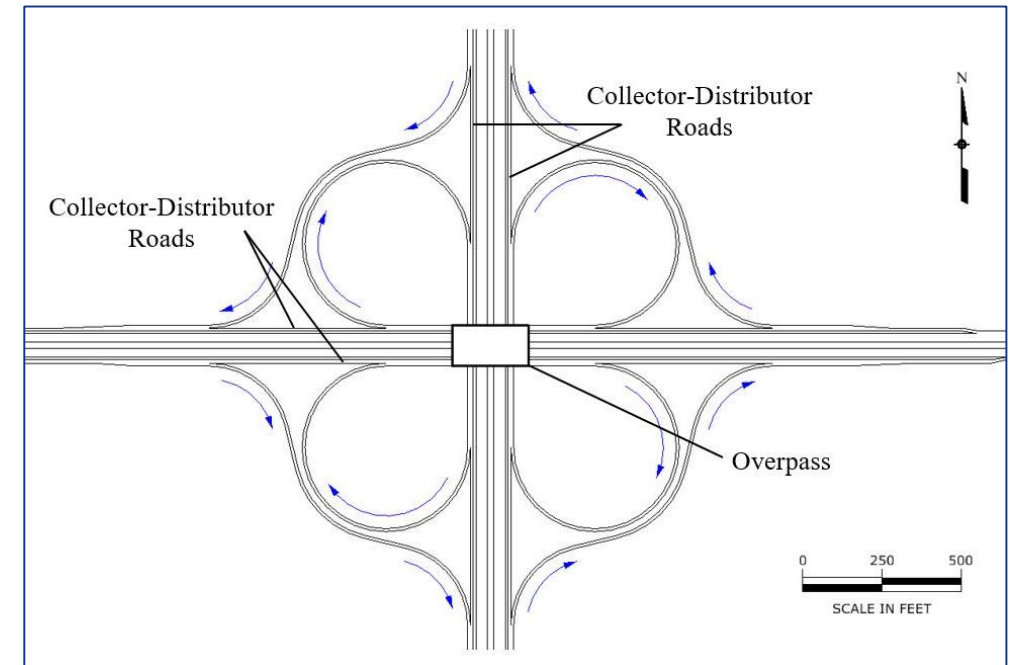
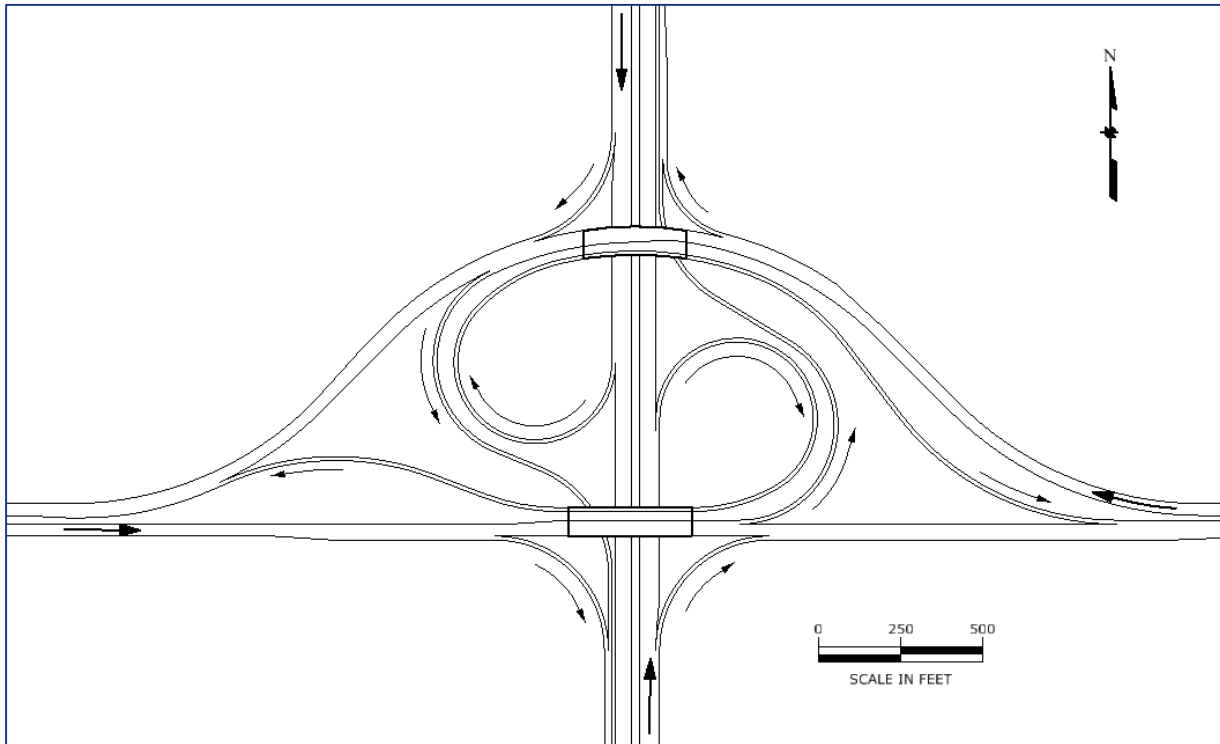
Interchange Flow: NB to WB

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Case Study

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Case Study: Geometries

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Area by Quadrant, acre	Cloverleaf (Traditional)	Cloverleaf (Case Network)	One-Sided	Difference
Northeast	24.7	15.8	25.8	+63%
Northwest	24.7	15.8	26.6	+68%
Southeast	24.7	15.8	2.06	-87%
Southwest	24.7	15.8	1.28	-92%
Total Area, acre	98.7	63.2	55.7	-12%
Length of Interchange, ln-mi	6.35	7.91	5.40	-32%
Surface Area of Bridge(s), ft ²	55,100	55,100	60,900	+11%

Case Study: Operational Analysis

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- Volume scenarios:
 - **Low** (3,500 vph; 6,000 vph directional)
 - **Medium** (4,500 vph; 7,000 vph directional)
 - **High** (5,500 vph; 8,000 vph directional)
- Traffic composition:
 - 98% passengers car; 2% heavy goods vehicles
- Traffic split:
 - 10:1:1 ratio
 - 84% mainline; 8% right-facing minor movement; 8% left-facing minor movements
- Modeling parameters:
 - Default driving parameters
 - 4,800-second simulation; 1,000-second warmup; 200-second cool-down; 1 hour of data collection
 - 8 simulation runs

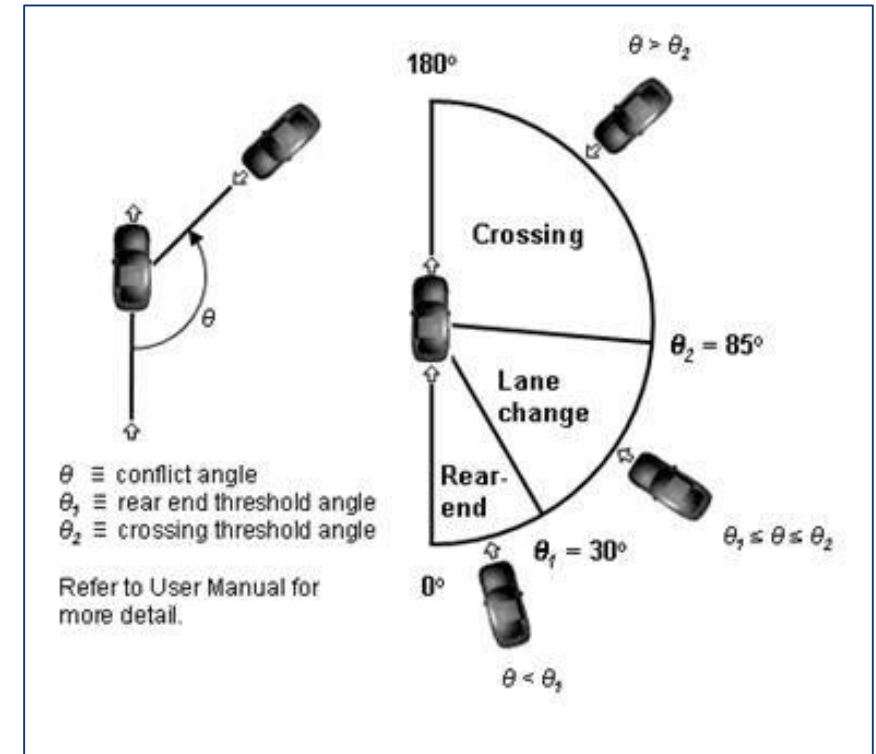


the mind of movement

Case Study: Safety Analysis

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- Software:
 - Surrogate Safety Assessment Model (SSAM)
- Surrogate safety measures:
 - Potential conflicts:
 - Time-to-collision (TEC) [1.25 s]
 - Post-encroachment (PET) [5.00 s]
 - Rear-end conflicts:
 - 0° to $<30^\circ$ vehicle-to-vehicle angle
 - Lane-changing conflicts:
 - 30° to 50° vehicle-to-vehicle angle



SSAM

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- Developed and disseminated by FHWA (2008)
 - “Major” update (2017)
- Utilizes simulated vehicle trajectories and calculates potential conflicts



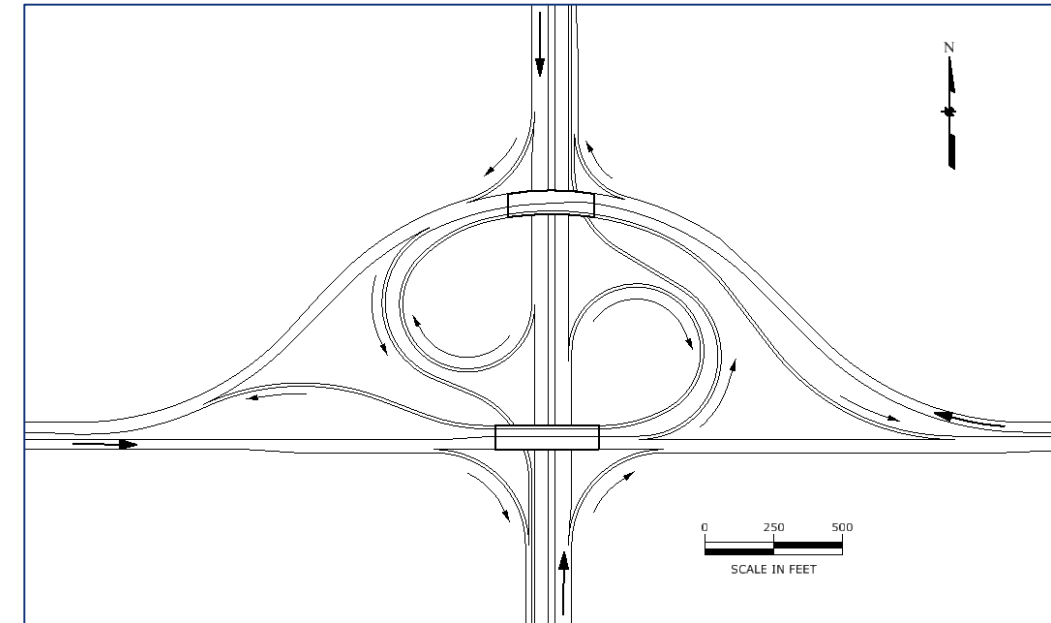
<https://www.fhwa.dot.gov/publications/research/operations/17027/17027.pdf>

Results: Operations and “Safety”

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Operational and Surrogate Safety Characteristics	High Volume			Medium Volume			Low Volume		
	Cloverleaf	One-Sided	Difference	Cloverleaf	One-Sided	Difference	Cloverleaf	One-Sided	Difference
Total Travel Time (hr)	928	952	+3%	764	762	0%	608	614	+1%
Total Delay (hr)	110	138	+25%	78	68	-13%	42	40	-5%
Throughput (veh)	27,071	27,014	0%	23,057	23,053	0%	19,030	19,023	0%
Rear-End Conflicts (#)	230	567	+144%	101	98	-3%	39	48	+23%
Lane-Changing Conflicts (#)	495	737	+49%	259	379	+46%	131	202	+54%

Bolded items indicate characteristics that are statistically different.



Results: Costs

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Construction costs

One-Sided Interchange		Cloverleaf Interchange	
Costs in Millions of 2014 Dollars		Costs in Millions of 2014 Dollars	
Northern Bridge	6.0		
Southern Bridge	8.0		
Total Bridge Cost	14.0	Total Bridge Cost	12.6
New Alignment – Mainline	22.3	New Alignment – Mainline	--
New Alignment – Ramps	16.0	New Alignment – Ramps	33.9
Speed-Change Lanes	11.6	Speed-Change Lanes	8.1
Total Construction Cost	63.9	Total Construction Cost	54.6

- (1) Bridge costs based on 2007 – 2011 National Bridge Inventory (NBI) data for the DC area
- (2) Other infrastructure costs based on data from the Highway Economic Requirements System (HERS) for a large urbanized area
- (3) Costs inflated to 2014 dollars based on the National Highway Construction Cost Index (NHCCI)

ROW costs

One-Sided Interchange		Cloverleaf Interchange	
Costs (in Millions) by Quadrant		Costs (in Millions) by Quadrant	
Northeast	14.0	Northeast	8.55
Northwest	14.4	Northwest	8.55
Southeast	2.20	Southeast	16.8
Southwest	1.36	Southwest	16.8
Total Right-of-Way Cost	32.0	Total Right-of-Way Cost	50.7

- (1) Costs based on state DOT data (WSDOT, GDOT, and TxDOT) for an urban area
- (2) Assumed low residential and no commercial land use in northern quadrants (i.e., low land costs)
- (3) Assumed high residential and moderate commercial land use in the southern quadrants (i.e., higher land costs, nearly double)

Conclusion

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- Operations:
 - Travel time and throughput equivalent
 - Increased delay at high volume
- Safety:
 - Significantly more rear-end and lane-changing conflicts at high volume
 - Rear-end conflicts: due to queue formations (NB to WB and SB to EB)
 - Lane-changing: turning maneuvers occurring on mainline; lane changes due to left exits and entrances
- Extension of left exit deceleration lanes and left entrance acceleration lanes:
 - Equivalent operational performance
 - Equivalent rear-end conflicts
 - Lane-changing conflicts still prominent
- Adequate configuration for freeway-to-freeway operations with limited turning movements, in locations with limited ROW, and where multi-level directional interchanges are infeasible

For More Information

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- Published in ITE Journal
- Received ITE Traffic Engineering Council Best Paper Award

feature |

Operational and Safety Characteristics of an

Alternative Design, Space-Efficient One-Sided Interchange

SHUTTERSTOCK.COM/ROS DALE

BY CHRISTOPHER L. MELSON, E.I.T., CORY KRAUSE, AND DR. JOE G. BARED, P.E.

This study presents the one-sided interchange: a unique, all-directional system interchange that emphasizes land savings. Operational and surrogate safety characteristics of the interchange are analyzed using microsimulation and safety software. Several variations of the design are compared to an equivalent cloverleaf interchange.

Questions?

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