

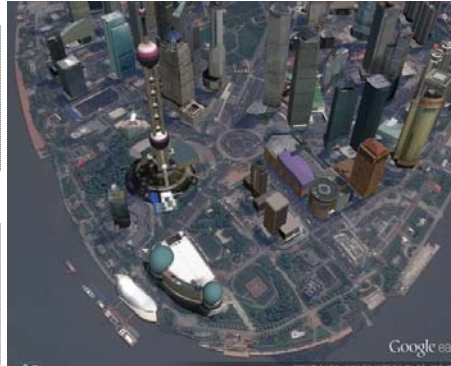
Experimental Analysis of a Direct Access Driveway at a Roundabout: Performance with One or More Slip Lanes

分析直接访问车道回旋处

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Access Management

Introduction

- Roundabouts can be used as an **intersection design** to facilitate major traffic turning movements and to enhance operational and safety performance.
- Should Access Management support direct driveway access to a roundabout?
- If a **slip lane is present**, how does the proposed driveway impact traffic delay?

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Roundabout: Shanghai, China- with Four Slip Lanes



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A Roundabout with a Driveway

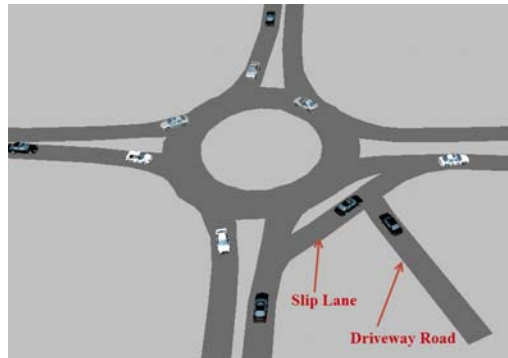


Hillsborough Street and W. Morgan Street, Raleigh, NC, USA

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Objective

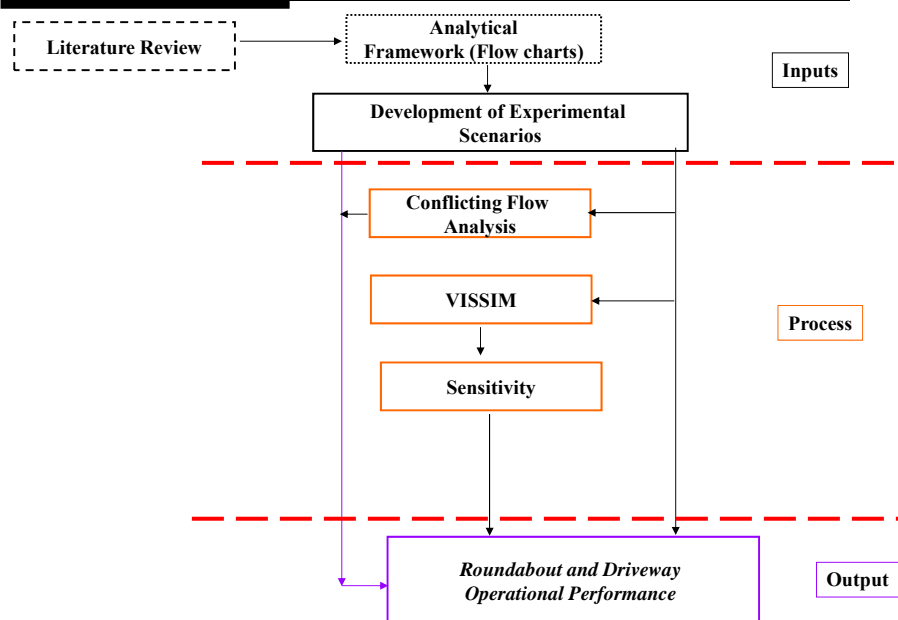
- To explore overall **roundabout and driveways' operational performance** in a simulated environment by quantifying average delay with and without slip lanes options.



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Approach

Methodology



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| Scenarios | | Scenario Experiment Design | Methodology Experimental Scenarios |
|--|---|--|---------------------------------------|
| Variable Symbols | Variable Description | Level of Description | |
| V_{rt} | Right-Turn volume as dominant turn at Northbound Approach | 50,100, 150, 200, 250, 300, 350, 400, 450, and 500 vehicles per hour. | |
| DRW | Driveway Volumes | DRW50: Low driveway's volumes (50 vehicles/hour). DRW100: Moderate driveway's volumes (100 vehicles/hour). DRW300: High driveway's volumes (300 vehicles/hour). | |
| S1= No Driveway S2= With a Driveway S3= Slip Lane and No Driveway S4= Slip Lane and a Driveway S5= Two Slip Lanes and No Driveway S6= Two Slip Lanes and a Driveway | Traffic percentage distribution flow matrices | <i>Balanced scenarios:</i> Balanced flow with 75 percent flow for all turns. | |

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| Assumptions | Methodology |
|---|-------------|
| <ul style="list-style-type: none"> • A single-lane roundabout. • Traffic percentage distribution flow matrices were assumed as balanced (traffic flow into and out of every roundabout approach is the same). • A dominate right-turn was assumed to be placed at the northbound (NB) entry to the roundabout. • A direct driveway access road, one lane driveway right-out movements only, to allow facility (land parcel) driveway volumes to access directly at a roundabout. | |

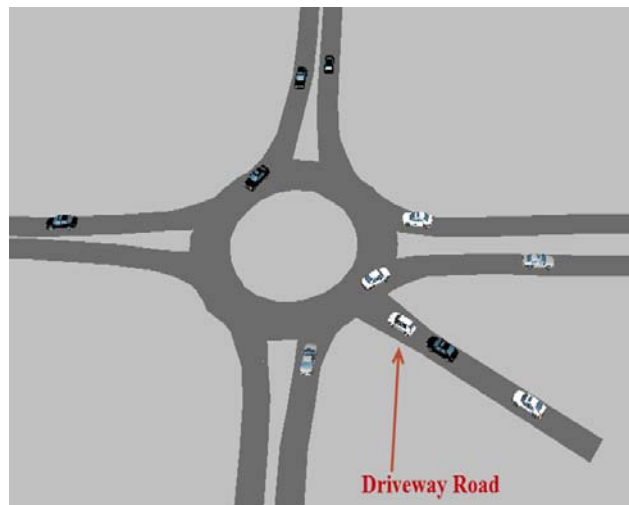
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Scenario S1 (No Driveway)



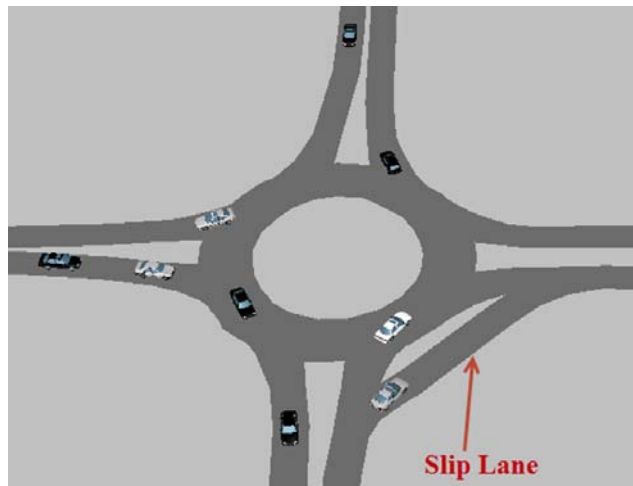
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Scenario S2 (With a Driveway)



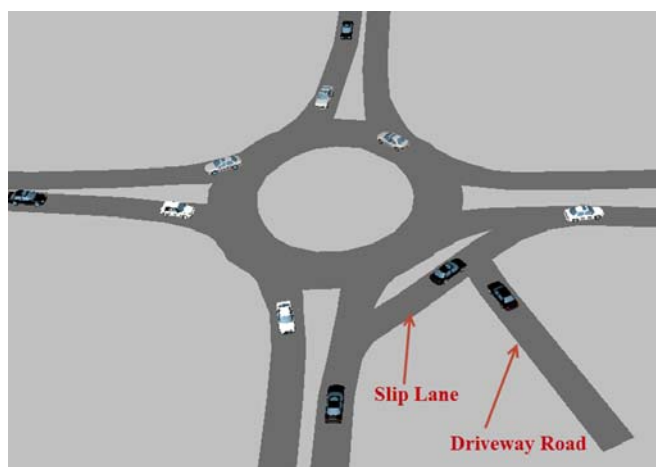
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Scenario S3 (Slip Lane and No Driveway)



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Scenario S4 (Slip Lane and a Driveway)



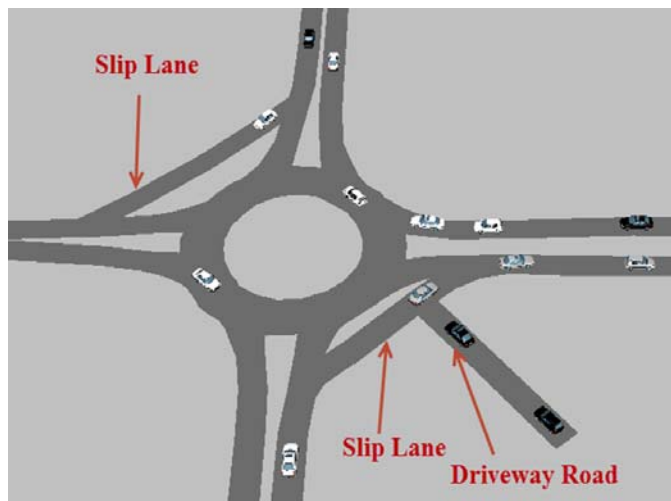
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Scenario S5 (Two Slip Lanes No Driveway)



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Scenario S6 (Two Slip Lanes and a Driveway)



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Analysis

Sample of VISSIM Driveway Average Delay – Balanced Scenarios (S2 and S4).

| Scenarios | V _{rt} : Right-Turn Volume at Northbound (NB) Approach (Vehicle/hour) | Average Driveway Delay (seconds) (Standard Deviation(s) Errors for 20 Runs) | | |
|-----------|--|---|---------------------------------|---------------------------------|
| | | Driveway Volumes (DRW50) | Driveway Volumes (DRW100) | Driveway Volumes (DRW300) |
| | | | | |
| S2 | 50 (Low) | 0.5 (1.2) | 0.5 (0.9) | 0.5 (1.4) |
| | 250 (Med) | 3.6 (4.7) | 3.9 (5.1) | 4.9 (6.0) |
| | 500 (High) | 11.6 (10.7) | 13 (13.0) | 27.6 (22.2) |
| S4 | 50 (Low) | 0.5 (1.7) | 0.7 (1.80) | 1.9 (2.9) |
| | 250 (Med) | 2.0 (3.2) | 2.7 (3.8) | 4.1 (4.5) |
| | 500 (High) | 3.7 (4.8) | 4.3 (5.1) | 7.9 (7.1) |

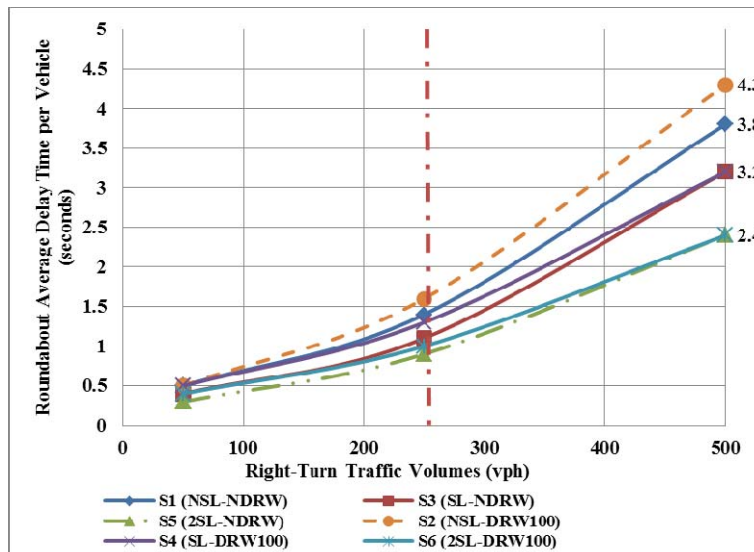
Reduced

Source: Al-Ghandour, et. al. 2011.

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Moderate Volume Driveway (DRW100) 100 vehicles per hour

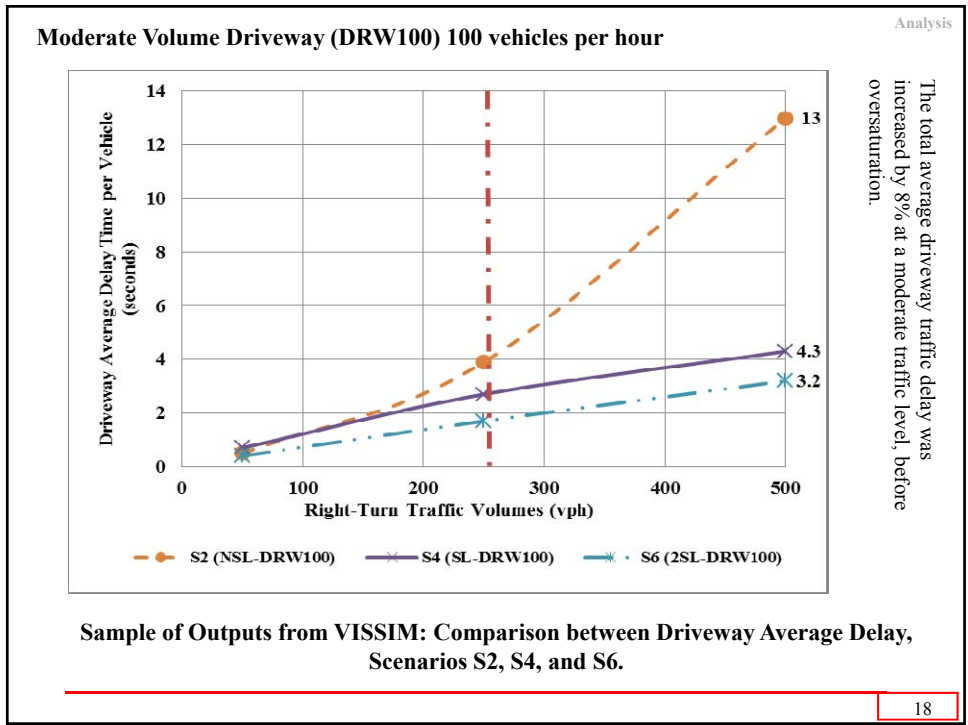
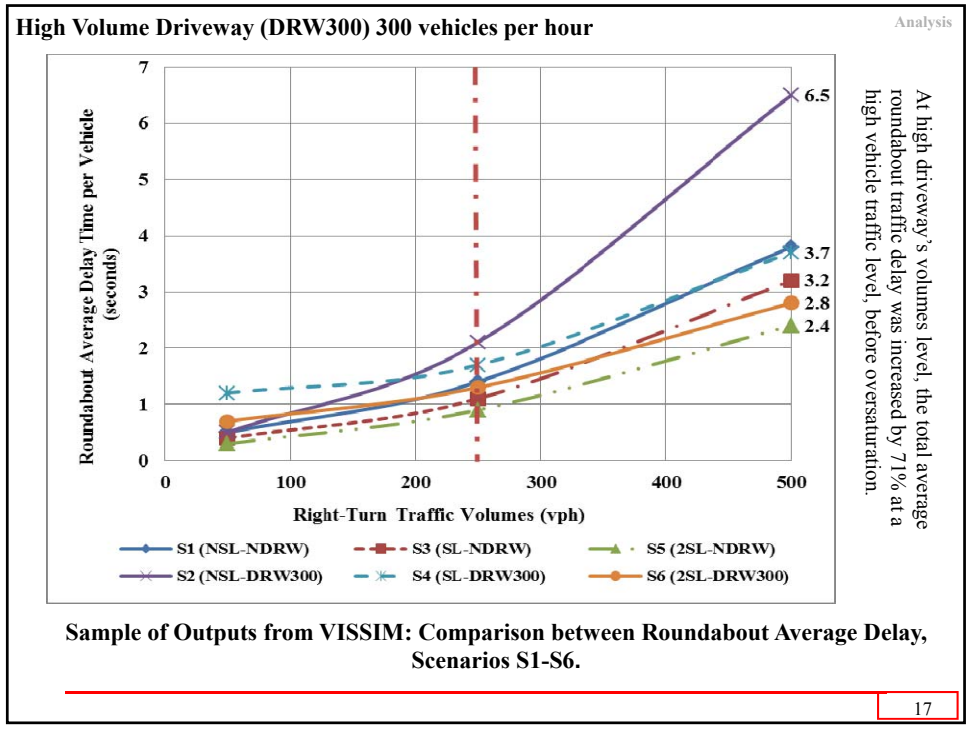
Analysis

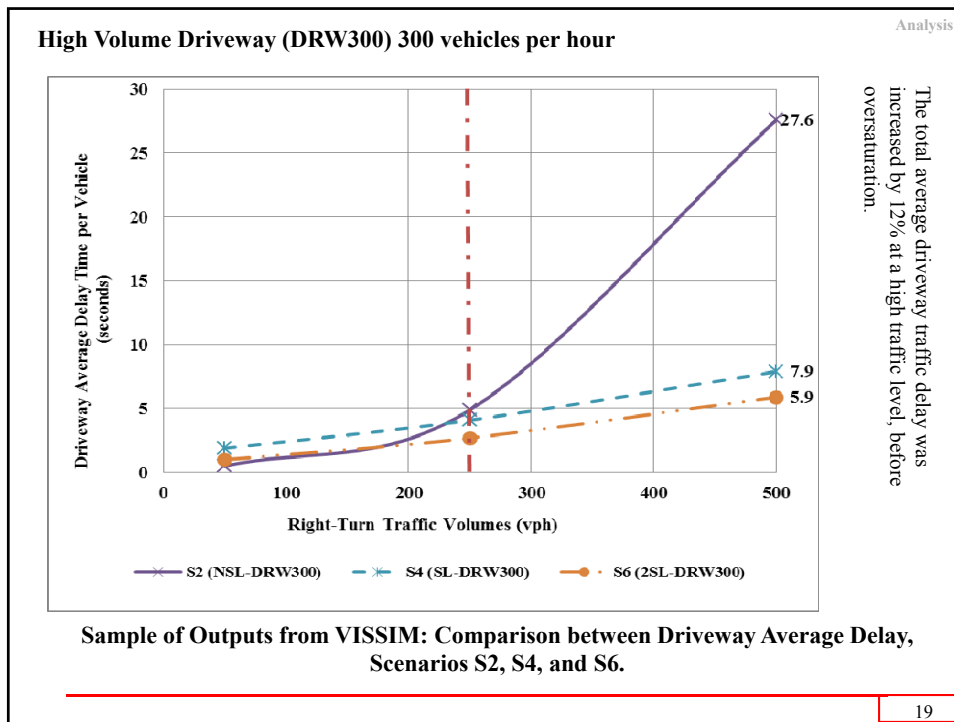


At high driveway's volumes level, the total average roundabout traffic delay was increased by 50% at a moderate vehicle traffic level, before oversaturation.

Sample of Outputs from VISSIM: Comparison between Roundabout Average Delay, Scenarios S1-S6.

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Conclusions & Recommendations

- Experiment results indicate that average delay of a roundabout is sensitive to changing driveway's volumes.
- As expected, results indicate a direct access driveway increases the roundabout vehicle average delay.
- At high driveway's volumes level, the total average roundabout traffic delay was increased by 50% at a moderate vehicle traffic level and by 71% at a high vehicle traffic level, before oversaturation.

Conclusions & Recommendations

- The total average driveway traffic delay also was increased by 8% at a moderate traffic level and by 12% at a high traffic level, before oversaturation.
- Finally, this study also suggests that **having more than one slip lane, at different roundabout approaches, reliefs total roundabout average delay, provides an efficient direct roadway driveway access, and enhances access management.**

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Future Research

- Future research should include investigating the performance of access point driveways with full movement (right-in and right-out) access near a roundabout, including the capacity of the access point, left-turn storage needs, including access spacing criteria and sight-distance.
- Finally, future analysis should be conducted to consider more variations in percentages of trucks in and out from the driveways.

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Contact Information & Questions

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THANK YOU
