

## TABLE OF CONTENTS

	PAGE
<b>EXECUTIVE SUMMARY .....</b>	<b>iii</b>
<b>1.0 BACKGROUND .....</b>	<b>1</b>
TRAFFIC CIRCLES AND MODERN ROUNABOUTS .....	1
THE TAC SYNTHESIS .....	3
SURVEY RESULTS.....	3
INTERPRETATION AND CONCLUSIONS.....	4
REFERENCES .....	5
<b>2.0 PLANNING AND SITE SELECTION.....</b>	<b>7</b>
REASONS FOR USING ROUNABOUTS .....	7
PLANNING AND SITE SELECTION.....	8
SURVEY RESULTS .....	10
INTERPRETATION AND RECOMMENDATIONS .....	10
REFERENCES .....	10
<b>3.0 DESIGN METHODS AND GUIDANCE .....</b>	<b>11</b>
CAPACITY ANALYSIS METHODS .....	11
OPERATIONAL ANALYSIS AS THE BASIS FOR DESIGN (NCHRP 572 IN THE UNITED STATES).....	12
DESIGN GUIDES.....	13
U.K. AND CONTINENTAL EUROPE DESIGN.....	15
DESIGN CHECKS .....	16
Deflection of Roundabout Entry Paths.....	16
Path Overlap .....	18
Other Design Checks.....	19
RESULTS OF SURVEY.....	20
INTERPRETATION.....	20
CONCLUSIONS AND RECOMMENDATIONS .....	21
A COMPARISON OF TWO GUIDES.....	23
REFERENCES .....	25
<b>4.0 DESIGN AND CONSTRUCTION .....</b>	<b>27</b>
GEOMETRIC DESIGN ELEMENTS .....	27
Approaches.....	27
Entries .....	27
Circulatory Road .....	28
Pedestrian Crossings.....	29
CONSTRUCTION .....	30
RESULTS OF SURVEY.....	31
INTERPRETATION AND RECOMMENDATIONS .....	32
REFERENCES .....	33
<b>5.0 SAFETY EXPERIENCE.....</b>	<b>35</b>
ROUNABOUT SAFETY PREDICTION .....	35
NCHRP 572 IN THE UNITED STATES.....	35
MOTOR VEHICLE COLLISIONS.....	36
PEDESTRIAN-VEHICLE COLLISIONS.....	38
BICYCLIST-VEHICLE COLLISIONS .....	39
RESULTS OF SURVEY.....	39

**TABLE OF CONTENTS – CONTINUED**

	<b>PAGE</b>
INTERPRETATION AND CONCLUSIONS.....	40
REFERENCES .....	41
<b>6.0 OPERATIONS EXPERIENCE .....</b>	<b>43</b>
MODERN ROUNDBOUT SIGNS .....	43
Regulatory and Warning Signs .....	43
Guide Signs.....	45
ROUNDBOUT MARKINGS .....	46
Markings at All Roundabouts .....	46
Circulatory Road Markings at Multi-Lane Roundabouts .....	47
ILLUMINATION .....	48
LANDSCAPING .....	49
MAINTENANCE .....	50
RESULTS OF SURVEY.....	50
INTERPRETATION AND RECOMMENDATIONS .....	51
REFERENCES .....	53
<b>7.0 RULES OF THE ROAD .....</b>	<b>55</b>
LITERATURE REVIEW.....	55
RESULTS OF SURVEY.....	57
INTERPRETATION AND CONCLUSIONS.....	58
REFERENCES .....	58
<b>8.0 VULNERABLE ROAD USERS .....</b>	<b>59</b>
PROVISIONS FOR PEDESTRIANS.....	59
Pedestrian Facilities .....	59
Pedestrian Crosswalk Markings.....	59
Pedestrian Signals .....	60
PROVISIONS FOR VISUALLY IMPAIRED PEDESTRIANS.....	61
PROVISIONS FOR BICYCLISTS .....	62
RESULTS OF SURVEY.....	63
INTERPRETATION AND CONCLUSIONS.....	63
REFERENCES .....	64
<b>9.0 PUBLIC EDUCATION AND ACCEPTANCE .....</b>	<b>65</b>
LITERATURE REVIEW.....	65
RESULTS OF SURVEY.....	65
INTERPRETATION AND CONCLUSIONS.....	67
REFERENCES .....	67
<b>10. SYSTEM CONSIDERATIONS.....</b>	<b>69</b>
ROUNDBOUTS AND ACCESS MANAGEMENT.....	69
PROXIMITY TO OTHER TRAFFIC CONTROL DEVICES.....	69
ROUNDBOUTS AND RAILWAYS.....	69
ROUNDBOUTS IN CORRIDORS .....	71
ROUNDBOUTS AT INTERCHANGES.....	73
ROUNDBOUTS IN A ROADWAY HIERARCHY .....	75
RESULTS OF SURVEY.....	76
INTERPRETATION AND CONCLUSIONS.....	77
REFERENCES .....	77
<b>BIBLIOGRAPHY OF NORTH AMERICAN ROUNDBOUT INFORMATION .....</b>	<b>79</b>

**TABLE OF CONTENTS – CONTINUED**

**PAGE**

**TABLES**

<b>Table 1.1</b>	Comparison of Modern Roundabouts and Traffic Circles.....	2
<b>Table 1.2</b>	Classification of Existing and Planned Roundabouts (All Jurisdictions Surveyed).....	5
<b>Table 2.1</b>	Performance Measures for Intersection Alternatives Assessment.....	9
<b>Table 3.1</b>	Comparison of Selected Roundabout Guides in North America.....	16
<b>Table 3.2</b>	Comparison of UK and Continental Europe Roundabout Design.....	17
<b>Table 3.3</b>	Comparison of FHWA and Quebec Roundabout Guides.....	24
<b>Table 5.1</b>	Safety Impacts at US Roundabouts.....	38
<b>Table 6.1</b>	Central and Peripheral Illumination at Roundabouts.....	49
<b>Table 9.1</b>	Typical Public Attitudes Towards Roundabouts.....	65
<b>Table 9.2</b>	Summary of Public Opinion of Roundabouts (All Jurisdictions Surveyed).....	66

**FIGURES**

<b>Figure 1.1</b>	Rotary Being Replaced With Modern Roundabout, Kingston, New York.....	2
<b>Figure 3.1</b>	Actual and Predicted Entry Capacities from NCHRP 3-36.....	13
<b>Figure 3.2</b>	Too Little Entry Path Deflection.....	18
<b>Figure 3.3</b>	Entry Radius and Entry Path Radius.....	18
<b>Figure 3.4</b>	Example of Entry Path Overlap.....	19
<b>Figure 3.5</b>	Exit Path Overlap.....	19
<b>Figure 3.6</b>	Rule of Alignment vs. Principle of Deflection.....	22
<b>Figure 3.7</b>	The “Objectives Triangle”.....	23
<b>Figure 4.1</b>	Geometric Treatments for High-Speed Approaches.....	28
<b>Figure 4.2</b>	Example of Hazardous Central Island Toe Wall.....	29
<b>Figure 4.3</b>	Example of Truck Apron Too Low to Discourage Use by Smaller Vehicles.....	30
<b>Figure 4.4</b>	Straight and Angled Pedestrian Crossings.....	30
<b>Figure 4.5</b>	Typical Concrete Jointing Pattern for Roundabouts.....	31
<b>Figure 5.1</b>	Comparison of Vehicle and Pedestrian Conflicts at a 4-Leg Intersection.....	36
<b>Figure 5.2</b>	Tangential and Straight Entry Geometry.....	37
<b>Figure 6.1</b>	TAC Modified Yield Sign, Ra-3.....	43
<b>Figure 6.2</b>	Central Island Signs in Canada and the UK.....	44
<b>Figure 6.3</b>	Standard and “Fishhook” Lane Designation Signs.....	44
<b>Figure 6.4</b>	Roundabout Ahead Sign.....	44
<b>Figure 6.5</b>	Example of “Stack-Type” Sign.....	45
<b>Figure 6.6</b>	Example of “Map-Type” Sign at Complex Roundabout.....	45
<b>Figure 6.7</b>	Examples of Exit Signs at Roundabouts.....	46
<b>Figure 6.8</b>	Example of Secondary Map-Type Sign.....	46
<b>Figure 6.9</b>	Broken Line and “Sharks Teeth” Yield Line Markings.....	47
<b>Figure 6.10</b>	“Fishhook” Lane Arrows.....	48
<b>Figure 6.11</b>	Example of “See-Through” Problem.....	50
<b>Figure 6.12</b>	High-Speed Approach Treatments in the UK.....	51
<b>Figure 6.13</b>	A Case for Circulatory Road Markings.....	52
<b>Figure 7.1</b>	Turning Left at a Multi-Lane Roundabout.....	56
<b>Figure 7.2</b>	Improper Lane Use and Turn Conflicts at Multi-Lane Roundabouts.....	57
<b>Figure 8.1</b>	“Yield Here to Pedestrian” Sign at Pedestrian Crossing.....	59
<b>Figure 8.2</b>	Signalized Pedestrian Crossing at Roundabout, Gatineau, Quebec.....	60
<b>Figure 8.3</b>	Example of Low-Growth Landscaping to Direct Pedestrians.....	61
<b>Figure 8.4</b>	Pedestrian Crossing With Tactile Treatments.....	62
<b>Figure 8.5</b>	Bicycle Re-Entry at a Roundabout Exit.....	62

**TABLE OF CONTENTS – CONTINUED**

---

	<b>PAGE</b>
<b>Figure 10.1</b> Rail Crossings Adjacent to a Roundabout .....	70
<b>Figure 10.2</b> Example of Rail Crossing in Middle of Roundabout .....	70
<b>Figure 10.3</b> Five-Roundabout Corridor, Avon, Colorado .....	72
<b>Figure 10.4</b> Collision Reductions Along South Golden Road .....	72
<b>Figure 10.5</b> Roundabout Interchanges.....	73
<b>Figure 10.6</b> Roundabout Interchange With Closely-Spaced Service Road, Lee Road, Michigan.....	74
<b>Figure 10.7</b> Roundabout Interchange With Integrated Service Roads, Vail, Colorado.....	75
<b>Figure 10.8</b> Modern Grid Road Network Using Roundabouts .....	76

**APPENDICES**

<b>Appendix A</b>	Survey of Roundabout Practice Results of Survey Report List of Agencies Responding to Survey
<b>Appendix B</b>	Example Instructions on Using a Roundabout (Region of Waterloo, Ontario)
<b>Appendix C</b>	Example Roundabout Public Education Campaign (City of Lacey, Washington)

## 7.0 RULES OF THE ROAD

### LITERATURE REVIEW

Roundabouts are relatively new to North American drivers, and any new traffic device requires widespread education. Unfortunately, only a relatively small number of road authorities are in the process of developing provincial or state vehicle codes, local ordinances or regulations for roundabouts. Slowly, driver education guidelines and statutory operating procedures for driving roundabouts are being disseminated.

Some of the methods by which drivers can be educated on roundabout use include:

- Adding roundabout information in driver education manuals.
- Including roundabout general operating principles in driving license tests.
- Using videos that demonstrate how to navigate a roundabout.

Many agencies are seeking a model for rules of the road at roundabouts. The model that has been in existence the longest is the UK model contained in their driver handbook. In the interests of providing Canadian road agencies with assistance in developing their highway codes to include roundabouts, the following is an excerpt from the UK Highway Code (transposed for North American driving):

- When entering a roundabout, give way to any traffic on your immediate left unless road markings indicate otherwise; but keep moving if the way is clear. At some junctions there may be more than one roundabout. At each, apply the normal rules for roundabouts. Keep a special lookout for the give way lines.
- Where there are two lanes at the entrance to a roundabout, unless signs or road markings indicate otherwise:

When turning right:

Approach in the right hand lane; keep to that lane in the roundabout.

When going forward:

Approach in the right hand lane; keep to that lane in the roundabout. If conditions dictate (for example, if the right hand lane is blocked), approach in

the left hand lane; keep to that lane in the roundabout. If the roundabout itself is clear of other traffic, take the most convenient route through the roundabout.

When turning left:

Approach in the left hand lane; keep to that lane in the roundabout.

- When there are more than two lanes at the entrance to a roundabout, unless signs or road markings indicate otherwise, use the clearest, most convenient lane on approach and through the roundabout suitable for the exit you intend to take.
- When in a roundabout, look out for and show consideration to other vehicles crossing in front of you, especially those intending to leave by the next exit.
- Turn signals at roundabouts:

When turning right:

Use the right turn indicator on approach and through the roundabout.

When going forward:

Use the right turn indicator when passing the exit before the one to be taken.

When turning left:

Use the left turn indicator on approach, and maintain this signal until passing the exit before the one to be taken. Then change to the right turn indicator.

- Watch out for cyclists and for long vehicles, which have to take a different course, both on the approach to and in the roundabout.

A second example, in North America, is the Vermont code:

- A roundabout is a circular intersection designed to slow traffic while lowering delays and handling higher traffic volumes. Roundabouts have proved to more safely accommodate vehicles, pedestrians and bicyclists than Stop signs or traffic signals. U-turns are also permitted at roundabouts.
- The most common signs you will see when approaching a roundabout are as follows: "Roundabout Ahead" and "Reduced Speed Ahead" signs which inform that you are approaching a roundabout.
- The advisory speed limit sign tells the driver the maximum safe operating speed for

# Entry Path Overlap (and Poor Deflection)

