Establishing Right-of-Way Standards for Roundabouts in the City of Calgary, Canada

THE CITY OF CALGARY, CANADA, IS DEVELOPING A ROUNDABOUT POLICY TO GUIDE DEVELOPERS AND CITY STAFF. THE PROCESS CONSIDERS THE NEEDS OF STAKEHOLDERS INCLUDING TRANSIT, PARKS, ROADS, MAINTENANCE, TRAFFIC ENGINEERING AND ROAD DESIGN. OVERALL, ADDITIONAL RIGHT OF WAY IS REQUIRED FOR UNDIVIDED AND DIVIDED COLLECTOR ROADWAYS. CURRENT RIGHT OF WAY FOR MAJOR STREETS IS SUFFICIENT TO ACCOMMODATE SINGLE OR MULTILANE ROUNDABOUTS.

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INTRODUCTION

Roundabouts have been used by the City of Calgary, Alberta, Canada, in a number of applications, including traffic calming, residential community entrance features, ramp terminals, rural intersection control and as an alternative to traffic signals. This has occurred in the absence of a formal policy or direction to pursue roundabouts as a viable form of traffic control.

In 2006, the City of Calgary retained the services of TSH (now AECOM) to assist with the development of a roundabout guide. A significant component of this exercise was the development of standard roundabout concepts for existing roadway cross-sections and the identification of right-of-way (ROW) requirements for various intersection types. This feature outlines the process and provides background on the application of roundabouts in a medium-sized urban center.

BACKGROUND

The City of Calgary is approximately one hour east of the Rocky Mountains. Calgary is considered a medium-sized city based on population (1.0 million according to the 2008 Census) and land area (848 square kilometers). A majority of the region's population resides in residential communities within Calgary's city limits, with a few smaller outlying communities. Like most cities in western Canada, it has an established grid network within the inner city and a hierarchical road classification system with defined communities extending away from the central business district.

Roundabouts are not new to Calgarians; they have existed in a variety of forms since the mid-1950s. The first use of a circular intersection in Calgary was at Elbow Drive SW, Lansdowne Avenue SW and Riverdale Avenue SW in 1956 (see Figure 1). It was originally designed as a large, six-leg, two-lane traffic circle with yield control on entry. Over time, the primary roadway was pushed through the center of the circle to address capacity and downstream constraints. Traffic is currently controlled with two traffic signals on Elbow Drive and stop and yield control on the side intersections.

Applications of roundabouts were limited over the next four decades until 1998, when the first modern roundabout appeared on Calgary's landscape in the community of McKenzie Towne. Rather than a simple, four-leg, single-lane roundabout, the City approved a developer's community plan, which included a centrally located, well landscaped, five-leg, multilane roundabout, as shown in Figure 2. This began a decade of fairly intense roundabout development, which resulted in approximately 40 roundabouts/traffic circles in the Calgary region, with more being planned every year.

Expansion of Calgary's residential areas continues at a rapid pace, and planners are dealing with more requests and demands for roundabouts. The lack of a guiding policy has left them to deal with applications on a case-by-case basis.

Most recently, roundabouts have been implemented for a number of traffic control purposes in Calgary, including replacement of a rural, high-speed, stop-controlled intersection; modification of an interchange ramp terminal to maximize the life of the narrow passage under the freeway; and at a number of internal community roadways in new residential communities.

Building on these successes, there is now a move to evaluate roundabouts as alternatives to traffic signal control in established but growing communities; to address safety concerns at both signalized and unsignalized intersections; and as potential for planning a new arterial corridor controlled by roundabouts.

The City of Calgary is well aware of the growing trend toward roundabouts as preferred forms of traffic control and is

Figure 1. The first use of a circular intersection in Calgary, Canada.

Figure 2. The first modern roundabout appeared on Calgary's landscape in 1998.

open to applying them within the transportation network as appropriate. Initially, the process for design and evaluation of roundabout locations involved consulting a local roundabout expert for advice. This worked when there was a low frequency of applications. However, as the demand for roundabouts grew, not only from city planners and engineers but also from the development community, it was logical to develop a set of standards and some guidance for those involved in the process. To manage the increasing demand, the City embarked on an exercise to develop a comprehensive roundabout policy.

DEVELOPMENT OF A ROUNDABOUT POLICY

In fall 2005, a roundabout committee was formed with internal staff representing several departments, including traffic signals, traffic engineering, roadway design, transportation planning and Calgary Transit. The committee held initial discussions on what policies currently applied to roundabouts; the existing warrant process for signals and multi-way stops; and the current process for reviewing proposed roundabout locations. It was agreed that a policy needed to be developed.

The initial meetings identified an extensive list of issues related to the application and design of roundabouts, as summarized in Table 1. One of the primary challenges related to the design of roundabouts was the relative lack of provincial and federal guidelines. As of 2008, neither the Alberta government nor the Transportation Association of Canada (TAC) had developed its own set of design guidelines. When the City started its process, there was some Canadian guidance with documents available through the Quebec Ministry of Transportation (MTQ) and the British Columbia Ministry of Transportation (BCMoT). Alberta Transportation also issued a design bulletin in 2005 endorsing the use of the Federal Highway Administration's (FHWA) *Roundabouts: An Informational Guide*.

The initial desire of the committee was to develop a comprehensive roundabout guide based on the City's existing road design standards. After identifying the issues that should be included in a comprehensive roundabout design guide, it was determined that the best approach would be to develop individual policies around specific issues as time permitted and gradually consolidate them into a larger document.

The initial phase of the policy development included identifying best practices for design, landscaping and evaluation and developing a set of ROW requirements that could be used to ensure that sufficient land was being set aside for potential roundabouts in new developments.

The first task was the development of recommended software values for the planning and evaluation of roundabouts. Consistent with the City's software

Table 1. Issues related to the application and design of roundabouts.

- Design standards
- Design vehicles
- Landscaping guidelines
- Impact on traffic control progression
- Warranting or installation criteria for roundabouts
- Design consistency of corridors (signal, roundabout, multi-way, mixed controls)
- Costs: initial, maintenance, social, environmental
- Retrofit roundabouts
- Application related to road hierarchy
- Pedestrian and cyclist accommodation
- Signage and road marking consistency
- Capacity analysis
- Right-of-way requirements
- Agreements with development industry
- Safety: collision history
- Public education on use

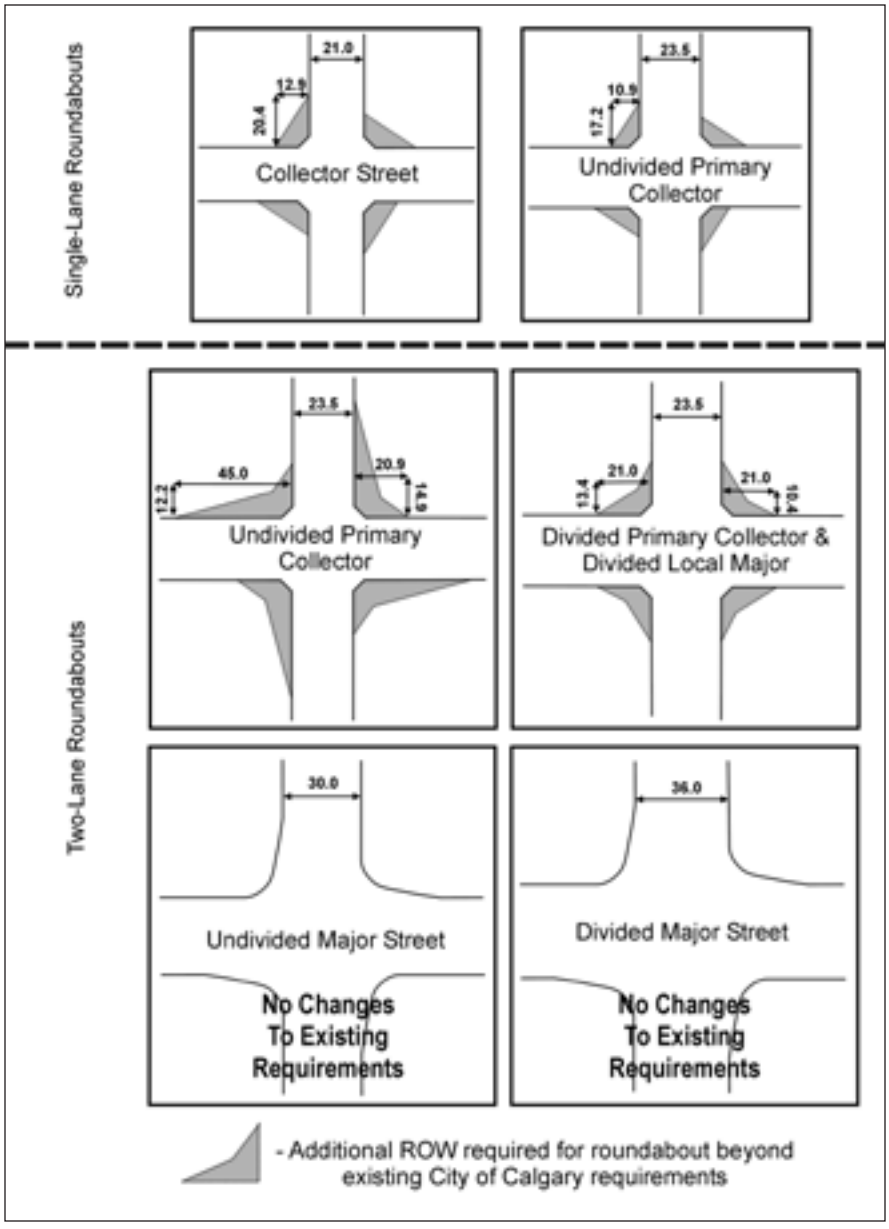

Figure 3. Requirements to identify the additional ROW for roundabouts along undivided and divided collector roadways, specifically to accommodate the inscribed circle, boulevard, sidewalk and sight distance clear zone.

standards for signalized intersections, the intent was to replicate the methodologies of the *Highway Capacity Manual*. This provides a consistent basis for comparing different traffic control devices. Without specifying any individual software package, the recommended values allow standard evaluation while providing flexibility to designers and engineers.

The second task was a best practices review of the design of landscaping at roundabouts and the recommendation of guidelines for use by the City of Calgary. The guidelines present the framework for designing the landscaping layout, but specifics pertaining to materials, plant species and maintenance procedures are not included. While the trend has been toward low-maintenance materials within the center island, appropriate planting material and maintenance procedures are evolving. Overall, the guidelines provide for maintaining operational and safety requirements while accommodating and promoting green spaces and urban art.

The third task was a comprehensive look at the ROW requirements for a standard set of roundabouts based on existing cross-sections for a number of road classifications.

DEVELOPMENT OF RIGHT-OF-WAY REQUIREMENTS

Standard ROW requirements are designated through the development process. New developments must reserve street ROW consistent with the City's subdivision guidelines. The junctions of these streets have additional ROW reservations for sight triangles based upon standards of the TAC. However, it was known that those reservations would be insufficient for roundabouts, particularly on collector streets.

The creation of the ROW requirements was a unique process for many of the individuals participating on the City's roundabout committee. It gave the opportunity for stakeholders to provide explicit guidance on both desired and required design considerations for new roundabouts. For the consultant, it meant developing concepts for each of the street classifications that balanced all of the desires/requirements of the various interested parties.

Specific criteria had to be met for each of the concepts. The intent was not to develop a template roundabout that could be used at all intersections. Therefore, the concepts needed to have enough flexibility to accommodate changes on a site-by-site basis.

- Design vehicle 1: Calgary Transit design vehicles. Although transit vehicles can be accommodated by the truck apron, the smoothness of the ride is greatly diminished when buses cross over the apron. It was agreed that roundabouts in Calgary needed to accommodate transit buses without requiring them to mount the truck apron (or any other vertical component).
- Design vehicle 2: The junction of each street category had a different design vehicle by classification. These "largest" reasonable expected design vehicles were assumed to use the truck apron when negotiating the center island.
- Bicycle facilities: The City of Calgary has an extensive and progressive network of bicycle facilities, both on- and off-street. When determining the required ROW for a roundabout, it was assumed that all roundabouts on major streets should accommodate

bike ramps and shared sidewalks. As the City gains additional experience with cyclists and roundabouts, the ROW provides for the flexibility in design for all users.

- Transit stops: Calgary Transit requested that transit stops be located as close to the intersection as possible. Transit stops are planned to be located after the exits, immediately downstream of the crosswalk, as is the case with other forms of traffic control.
- Pedestrian facilities: Sidewalks and crosswalks had to be included for all concepts to ensure that all locations could accommodate pedestrians even if the intermediate condition had no facilities. It was also agreed to provide a buffer strip between the sidewalk and the circulating roadway to discourage pedestrians from crossing directly into the roadway. It provided space for the installation of landscaping or barriers should they be desired/required.
- Utility placement: A major ROW and design consideration that was nearly overlooked was accommodation of the underground utilities that typically run through intersections. After discussion with the appropriate City departments, a 3-meter strip including the sidewalk, construction easement and boulevard was provided. All utilities were to be accommodated in that strip.
- Transition to/from standard cross-sections: In order to provide access points close to the intersections, it was desired to minimize the transition length on each leg.
- Circulating width for single-lane roundabouts: To reduce the probability of two vehicles traveling side by side within the circulating roadway of a single-lane roundabout, it was decided to limit the circulating width to 6 meters.
- Design speeds: Following the guidance from many documents, the concepts were designed with speeds appropriate to the classification and number of circulating lanes.[1,2]
- Sight distance: Adequate sight distance was required for all movements. The standards for sight distance were consistent with the guidelines in the MTQ publication.
- ROW protection: The overriding goal was to minimize the impact to ROW at intersections.

The consideration of each of these components was not simply the addition of each dimension to arrive at the concepts. Interaction between the constraints was most apparent when the initial concepts were tested using vehicle turning software. The City's transit buses could not negotiate the intersection without mounting the truck apron. Therefore, the inscribed circle had to be increased to a minimum of 36 meters to accommodate the buses on a roadway with a maximum circulating width of 6 meters.

The resulting ROW requirements, as shown in Figure 3, identify the additional ROW for roundabouts along undivided and divided collector roadways, specifically to accommodate the inscribed circle, boulevard, sidewalk and sight distance clear zone. Based on the planning guidelines used on site plan applications, the City decided to reserve the ROW required for adequate sight distance rather than use site plan controls. When the review was expanded to major streets, adequate land was already being reserved to accommodate future multilane roundabouts.

IMPLEMENTATION OF POLICIES/STANDARDS

Early in the roundabout committee's life, while defining the scope of the committee's reach, two critical decisions were made. First was defining what level of traffic necessitates a traffic calming circle versus a roundabout. That was important because it clarified that roundabouts would only be used at collector and higher classification streets (not at local-local intersections). With an upper limit of 1,000 vehicles per day, local-local intersections could never reach volumes high enough to justify the construction of a roundabout as a traffic control device. Similarly, traffic calming circles would not be installed on collector or higher classification streets in accordance with the City's traffic calming policy. However, if a traffic calming circle was installed at a local-local intersection, it could use some of the principles of roundabout design with confidence.

The second critical decision was allowing design engineers flexibility when creating new intersection designs. While FHWA's *Roundabouts: An Informational Guide* is currently used by many designers, it is expected that as the City gains additional experience, additional design criteria will be developed for Calgary roundabouts. In the meantime, designers are granted the freedom to use best industry practices to arrive at appropriate designs. The ROW determination task ensures that the goals of the various City departments can be met. It also ensures that designers have the flexibility to adapt designs to site-specific constraints.

As these draft policies began to be implemented, another key lesson was the significant capital cost differential between retrofit signals and roundabouts. As many "new" roadways in Calgary are still being built to former standards (which in essence are pre-building for a signalized intersection), the cost of constructing a roundabout as volumes increase is extremely high. Constructing a retrofit roundabout requires the reconstruction of approximately 125 meters upstream on each leg to eliminate the left-turn bay and channelized right turns. Even with the safety, environmental and life-cycle cost savings, a capital cost of approximately four times the cost of a signal is challenging to justify.

The best opportunity for new roundabout construction seems to lie with new streets being built within new developments and street construction projects that include intersection reconstruction. The opportunity to pre-build intersections and arterials using roundabouts as the preferred form of traffic control seems to have the most benefit at this time. Therefore, the preservation of intersection ROW early in the process is a critical step to ensure roundabouts and traffic signals can be compared on an equal basis.

CONCLUSIONS

The City has been working to address many of the outstanding issues related to properly implementing roundabouts, including the development of additional policies to ensure a consistent approach in the future. The development of ROW standards that accommodate roundabouts as readily as traffic signals was a critical planning task.

When additional tasks are completed, City of Calgary staff will bring all of the policies and standards together into a comprehensive document for approval by the City Council and the development industry. It is acknowledged that this type of policy cannot be static and will continue to evolve as more local and North American experience is gained and as that knowledge is applied to future applications. ■

References

1. *Roundabouts: An Informational Guide*. McLean, VA, USA: Federal Highway Administration, 2000.

2. Quebec Ministry of Transportation. "Roundabouts: A Different Type of Management Approach."

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