

Roundabouts In Colorado

ABSTRACT

The first modern roundabout in Colorado was built in Colorado Springs in 1983. The construction of roundabouts in Vail and Avon, Colorado in the mid 1990's aroused the interest of the state's traffic engineers. In 1998, there were about a dozen roundabouts and ITE's Colorado-Wyoming Section sponsored a national roundabout conference to promote use of roundabouts. Inspired by that conference, over 250 roundabouts were built by 2008, many of which are employed in some unique applications. Roundabouts have become an accepted form of traffic control among not only traffic engineers, but planners, architects and developers. In 2008 the ITE Colorado-Wyoming Section sponsored a roundabout inventory and survey. This survey collected data on location, geometrics, traffic volumes and accidents; and posed questions about jurisdiction satisfaction with this form of traffic control as well as satisfaction with the roundabout design.

This paper presents:

- 1) The results of the inventory, with aggregations by geometric elements, functional classification and jurisdiction;
- 2) Calculations of accident rates by type;
- 3) Results of survey questions such as differences in satisfaction with design of older roundabouts vs. those designed with the FHWA Roundabout Design Guide;
- 4) Unique applications of roundabouts in Colorado.

INTRODUCTION

Although traffic circles have been used in the U.S. since 1905, their use has been limited since the 1950’s because the designs of that era were found to work neither efficiently nor safely. The modern roundabout was developed in the United Kingdom (UK) in the 1960’s to address these problems. Two key characteristics of the modern roundabout include (1) a requirement for entering traffic to yield to circulating traffic and (2) geometric constraints that slow entering vehicles. Many studies have shown that modern roundabouts (hereafter referred to simply as roundabouts) can be safe and effective, and they are now widely used internationally.

The first roundabout in Colorado was built in Colorado Springs in 1983. In 1995, roundabouts were constructed at the west Vail interchange on Interstate 70 (I-70). This high profile project was an immediate success and was followed by construction of roundabouts in West Vail and in Avon. By 1998, there were about a dozen roundabouts, and ITE’s Colorado-Wyoming Section sponsored a national roundabout conference in Loveland, Colorado, to promote use of roundabouts. This conference included 150 participants as well as roundabout experts from the UK, Australia, France, and Germany.

In May, 2005 the TRB National Roundabout Conference was held in Vail, Colorado with over 400 attendees and representatives from a dozen countries. Inspired by these conferences, over 250 roundabouts were built in Colorado by 2008, many of which are employed in some unique applications.

In 2008, the ITE Colorado-Wyoming Section sponsored a roundabout inventory and survey. The inventory was conducted by contacting public jurisdictions and examining aerial photos. Roundabouts have been constructed on all types of roadways except freeways and express-

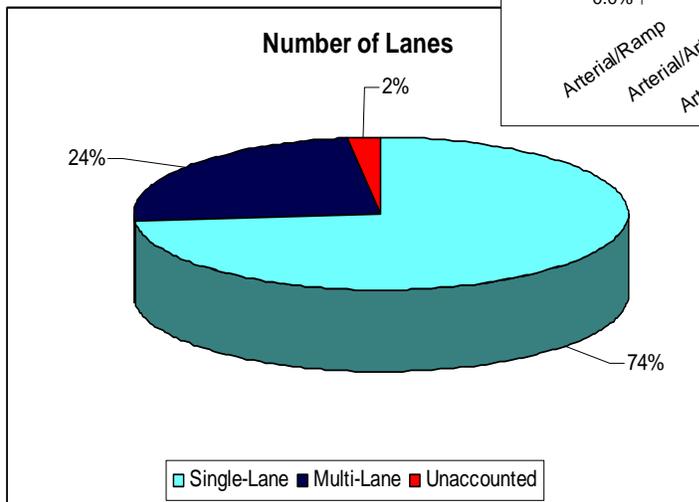
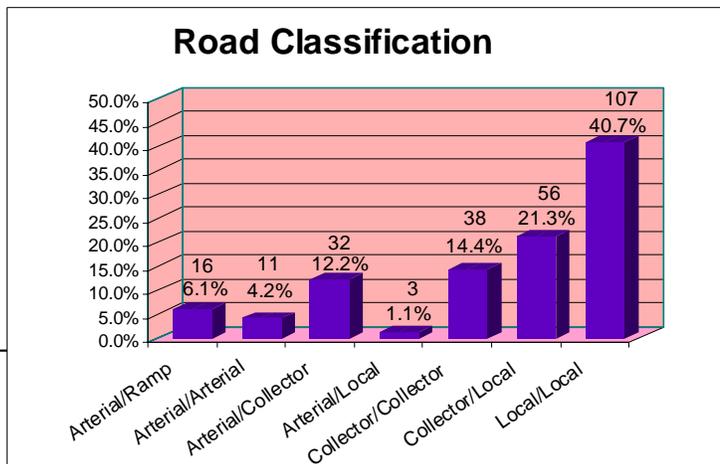


Figure 1

ways (although there are many at freeway ramp terminals). Figure 1 displays Colorado’s over 250 roundabouts broken down by roadway type. Figure 2 indicates that 74% or 193 roundabouts are single-lane, with 24% or 64 multi-lane.

Figure 2

In addition to the roundabout inventory, questionnaires were sent to local jurisdictions to solicit characteristics of Colorado roundabouts and to gauge satisfaction with roundabouts as a form of traffic control. Survey forms were completed by public jurisdictions on 82 roundabouts. As shown in Figure 3, the results of the survey show a diverse set of data representing both single and multi-lane roundabouts throughout the three environmental settings. Of the 82 roundabouts represented in the survey results, 36 (approx. 45%) are multi-lane, which is a much higher percentage as compared to the rest of the state. The majority of these roundabouts have been built in suburban areas.

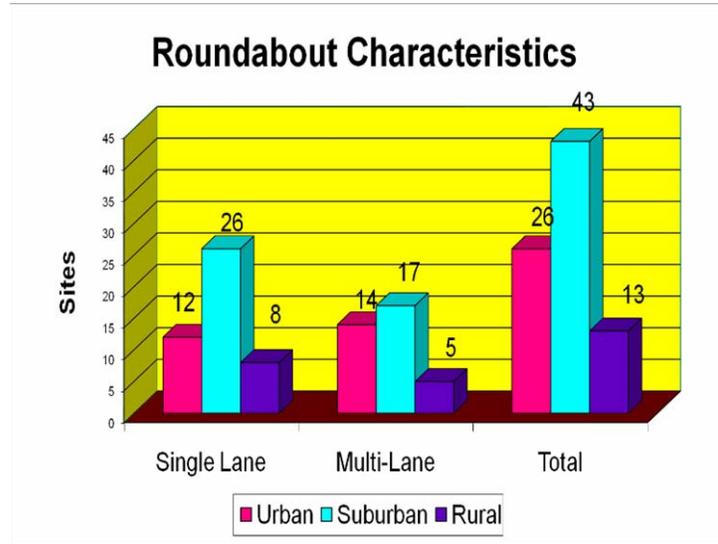


Figure 3

Colorado, especially along the Front Range, has been growing at an incredible rate in the past 20 years. This goes hand-in-hand with suburban expansion. Suburban expansion allows the opportunity to design roundabouts without having to retrofit an intersection. Therefore, as Figure 4 shows, nearly 60% of surveyed roundabouts are new intersections.

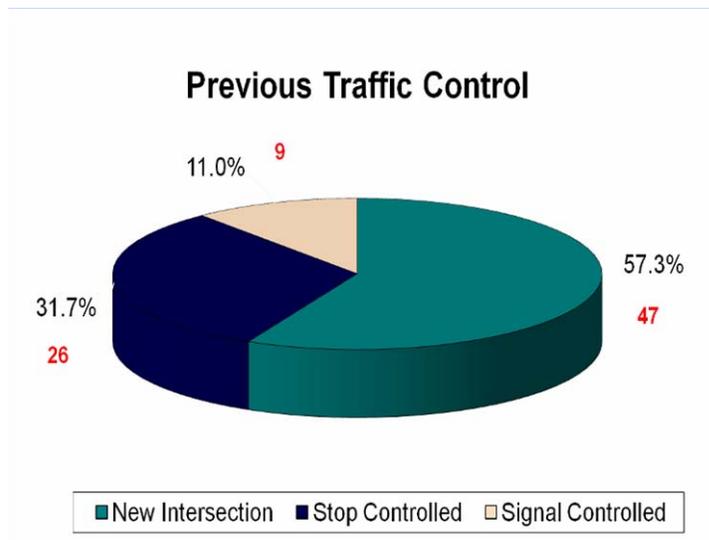


Figure 4

Figure 5 shows that the majority of roundabouts did not feature bicycle accommodations, but Figure 6 shows that they did feature pedestrian crosswalks.

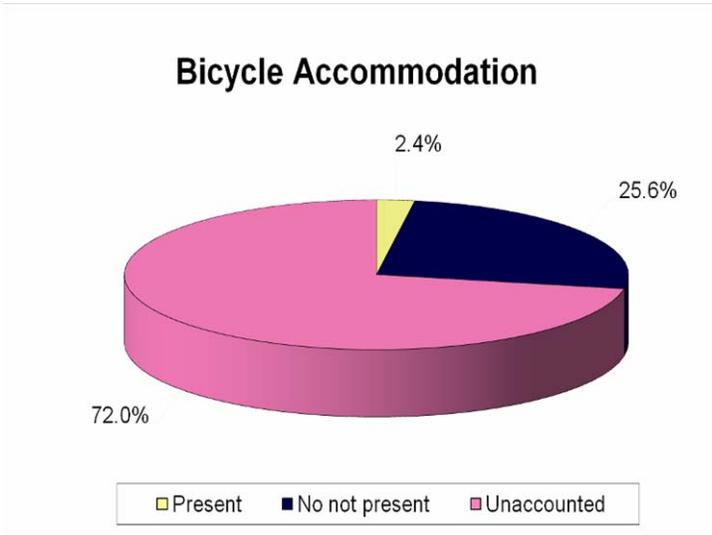


Figure 5

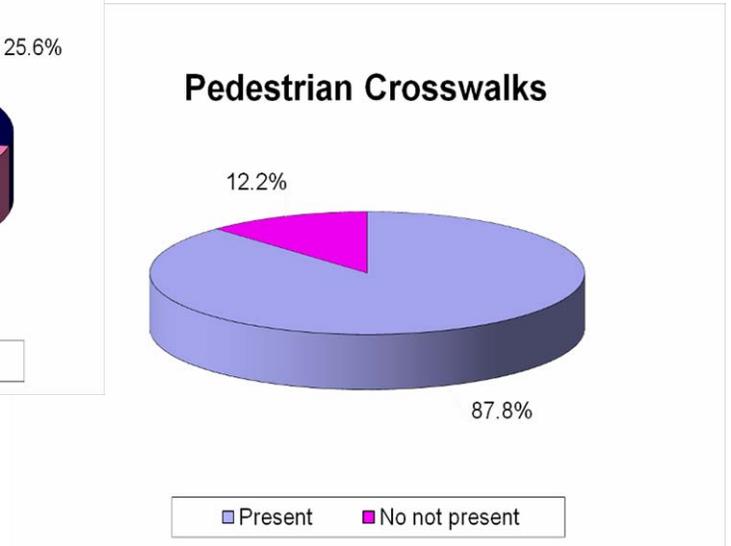


Figure 6

Figure 7 shows that almost 70% of the roundabouts used the *FHWA Informational Guide* for assistance during the design process.

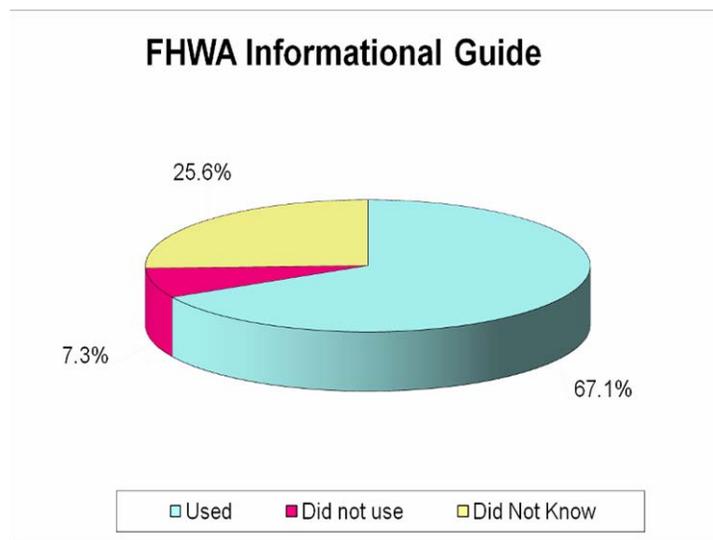


Figure 7

The survey form contained questions about the jurisdiction’s satisfaction with the design of the subject roundabout. Figure 8 shows that the results are overwhelmingly positive with only 6% (or 5 roundabouts) rated negatively. Results of this section might have been influenced by the use or avoidance of the *FHWA Informational Guide*. Figure 9 represents a qualitative measure of satisfaction with the operations of the roundabouts. Again, the results were overwhelmingly positive with an even smaller fraction of dissatisfied reactions.

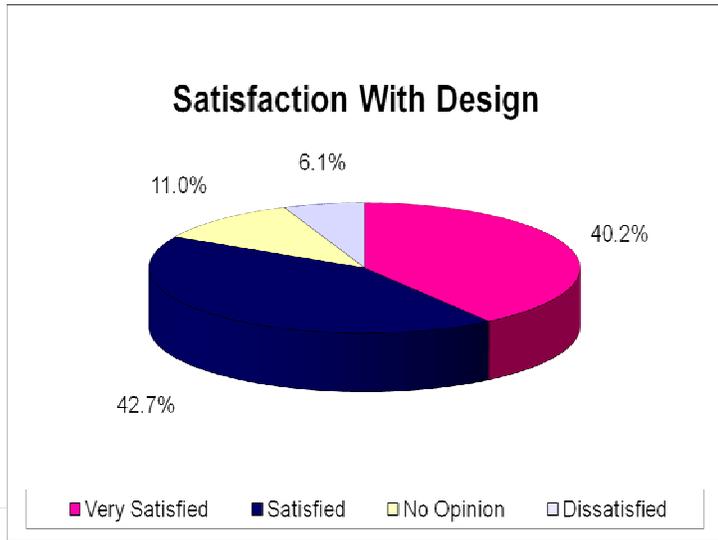


Figure 8

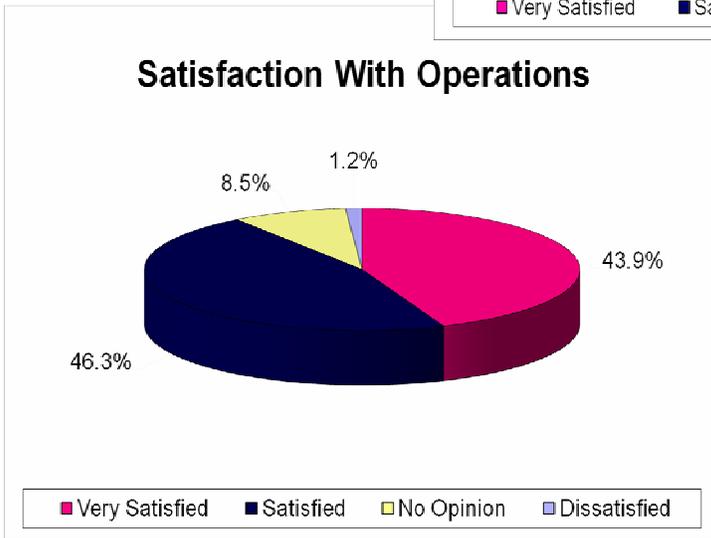


Figure 9

Figure 10 shows satisfaction with safety and again the results were overwhelmingly positive with only a small fraction of dissatisfied reactions. These results also might have been influenced quantitatively by determining the frequency, amount and severity of accidents within, or because of, the roundabout.

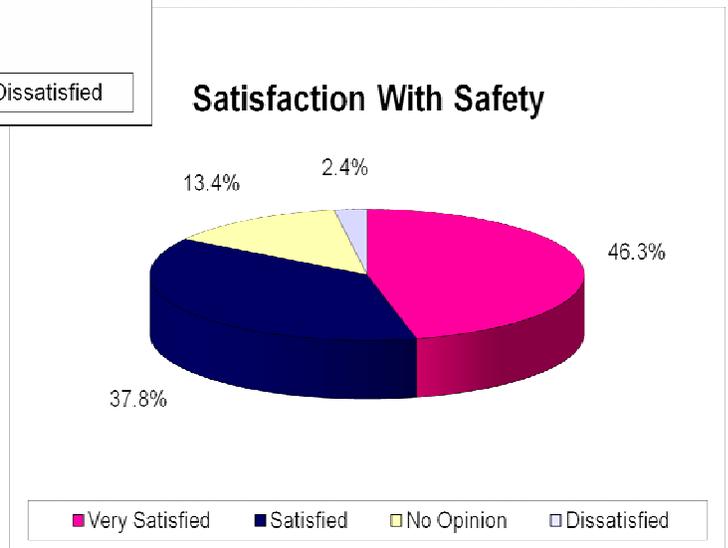


Figure 10

Finally, Figure 11 illustrates satisfaction with how appropriate the roundabout was as a form of traffic control for that intersection. The results show that no respondents were dissatisfied with the choice of a roundabout.

Roundabouts are becoming more and more popular with not only traffic engineers, but planners, architects and developers. Figure 12 shows that it was not until the turn of the millennium that roundabouts really became widely used in Colorado. This could possibly be attributed to the ITE roundabout Conference held in Loveland in 1998, as well as the release of the *FHWA Informational Guide* in 2001.

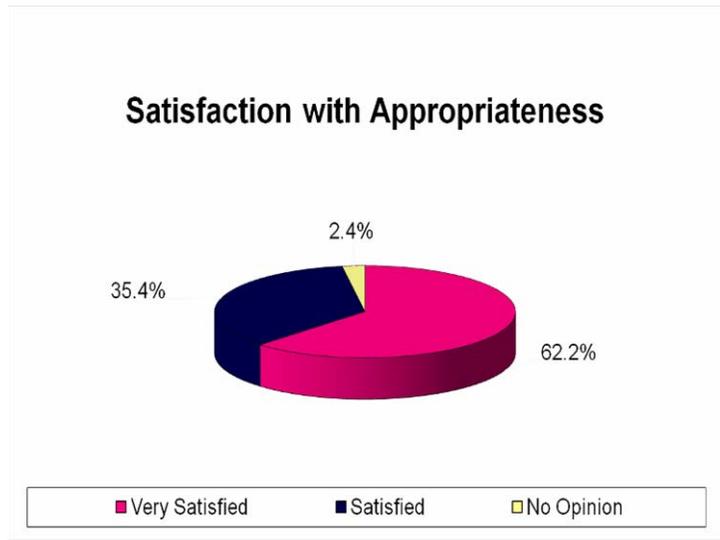


Figure 11

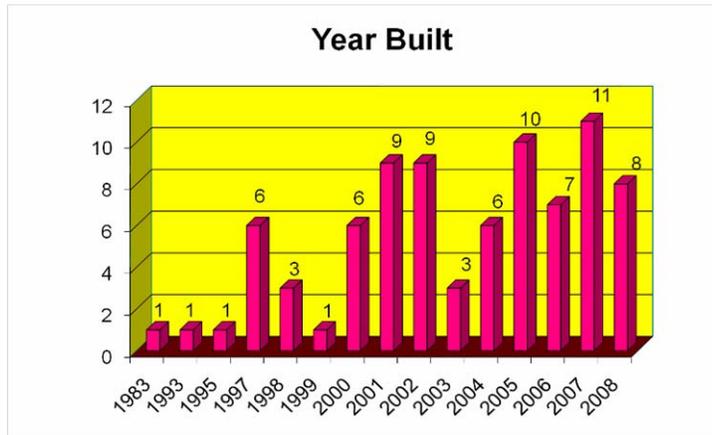


Figure 12

Roundabouts can be designed in many different sizes. Things to consider when designing them include available right-of-way, design vehicle, and traffic volume. Figure 13 shows that most surveyed roundabouts range from 100 feet to 160 feet in diameter.

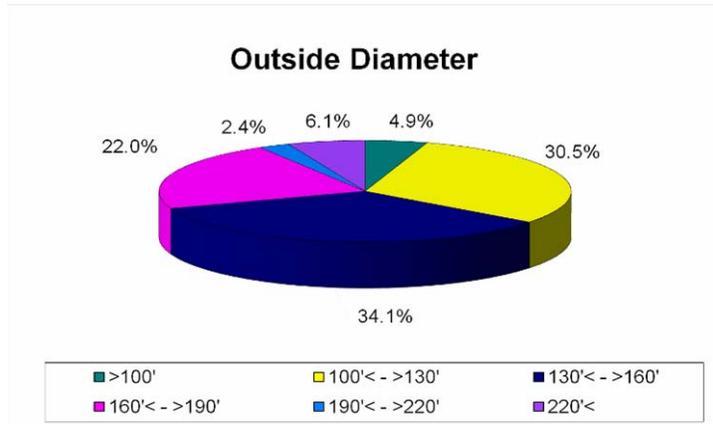


Figure 13 shows that most surveyed roundabouts range from 100 feet to 160 feet in diameter. This size range proves to be appropriate for the majority of roundabouts which accommodate less than 12,500 entering vehicles. ADTs for the surveyed roundabouts are shown in Figure 14.

Figure 13

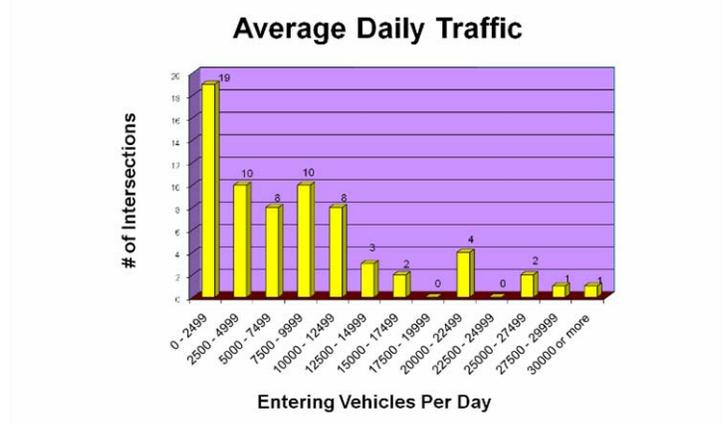


Figure 14

With the exception of just a couple outliers, most of the surveyed roundabouts had no more than 3 annual accidents. Figure 15 shows that a large majority had just one or no annual accident in a year's time. It should be noted that the outliers featuring double-digit accidents reported dissatisfaction with both the design and safety of the roundabouts.

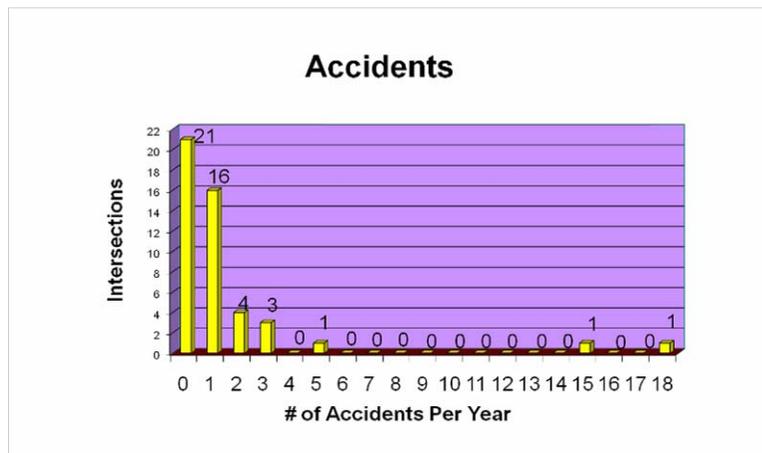


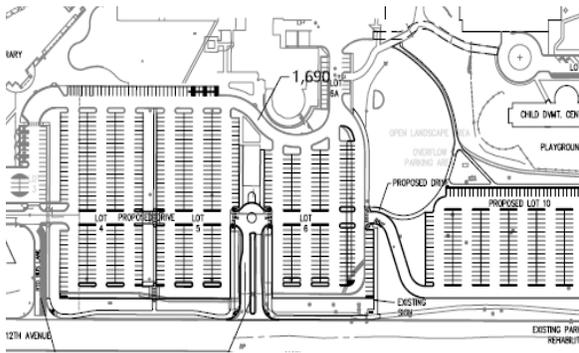
Figure 15

ROUNABOUT APPLICATIONS

The versatility of roundabouts is evident in the diverse application of roundabouts observed throughout Colorado. The following presents some of the applications where roundabouts are used to address a wide range of traffic engineering and land use issues.

Mini-Roundabouts

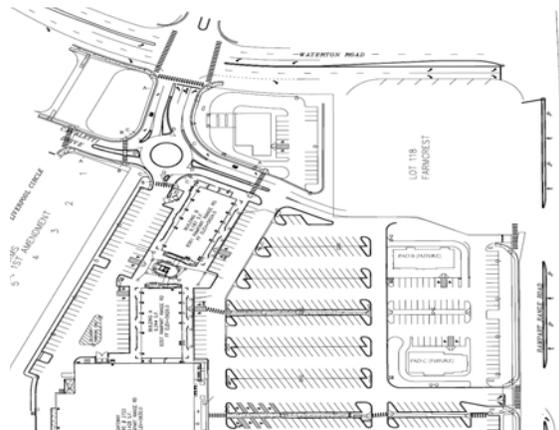
As you might have guessed, mini-roundabouts are just like normal roundabouts, just smaller. Because this type of roundabout is commonly used for internal distribution, a smaller design vehicle may be used.



Front Range Community College, Westminster

At the Front Range Community College in Westminster, a mini-roundabout was used to connect two parking lots with the main entrance from 112th Avenue. This not only makes an entry statement, but reduces the potential of queue back ups onto 112th Avenue during peak times. This application was possible because large vehicles were serviced by other routes so the roundabout could be designed for medium-sized vehicles.

Roxborough Marketplace features a mini-roundabout with a 100 foot diameter within a neighborhood retail development. The roundabout was necessary due to the minimal space and its proximity to a larger conventional intersection. It was designed with a mountable center island allowing large delivery vehicles to access the shopping center.



**Roxborough Marketplace,
Douglas County**

Within and Adjacent to Shopping Centers

It has become very popular, especially along the Front Range, for roundabouts to be implemented within shopping centers. This helps facilitate the distribution of vehicles in multiple directions, as well as serving as a traffic calming device. An additional benefit of implementing a roundabout is the opportunity to improve the aesthetics of the local circulation network.



Superior Marketplace in Superior, and Walnut Creek in Westminster are just a couple of many shopping centers benefitting from the implementation of roundabouts within the development.



Superior Marketplace, Superior

Roundabouts located adjacent to shopping centers also facilitate the distribution vehicles efficiently to and from nearby arterial roadways. The Factory Outlets in Loveland is a popular retail development that pioneered the use of roundabouts adjacent to shopping centers. The outlets have been in operation since 1998 featuring some of the earliest examples of modern roundabouts in Colorado. To date, reviews here have been positive.

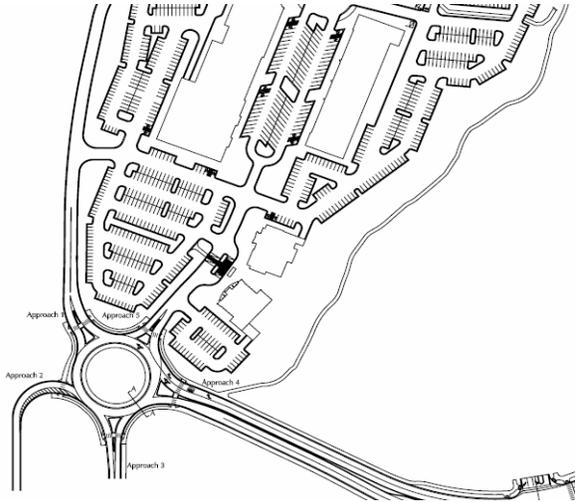


Factory Outlets, Loveland



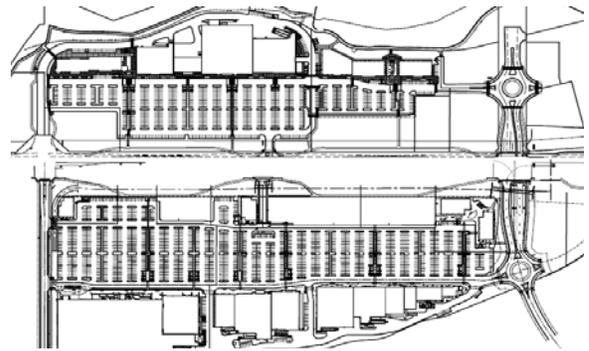
Walnut Creek, Westminster

Loveland also has the Centerra Lifestyle Mall which features a large five-legged roundabout. The landscaping of this roundabout along with its size creates an attractive entry statement for this development.



Centerra, Loveland

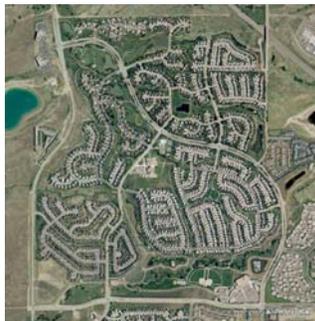
Harvest Junction in Longmont has two roundabouts adjacent to its development. These roundabouts help reduce delay for entering and exiting this shopping center. The use of roundabouts allowed the intersections to be located closer to the principal arterial than conventional intersections requiring turn lanes.



Harvest Junction, Longmont

Major Collectors

Rock Creek Parkway in Superior has four through lanes and a turn lane for each direction. Large radii curb returns and high speeds made crossing the street for pedestrians difficult. High speeds and high traffic volumes had resulted in many accidents. The concept of retrofitting this into a roundabout was introduced. The results proved positive. There has been a reduction in vehicle delay and in queue length. Also, accidents have been reduced by 25%.

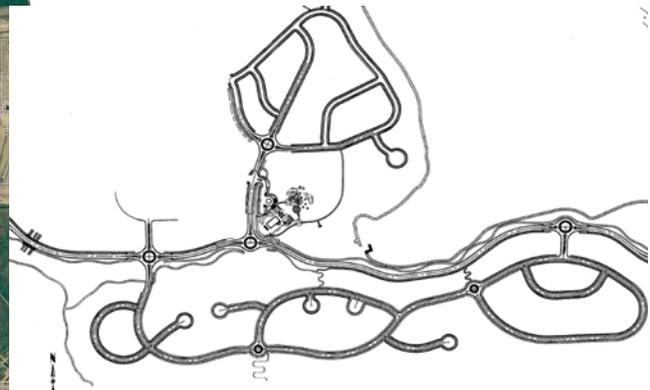


88th/Rock Creek Parkway, Superior, CO

Developments such as Promontory in Greeley and Mountain Shadows in Arvada, demonstrate that roundabouts can be successful even along major collectors with 4 lanes of traffic.



Promontory, Greeley



Mountain Shadows, Arvada

Rural/Urban Interface

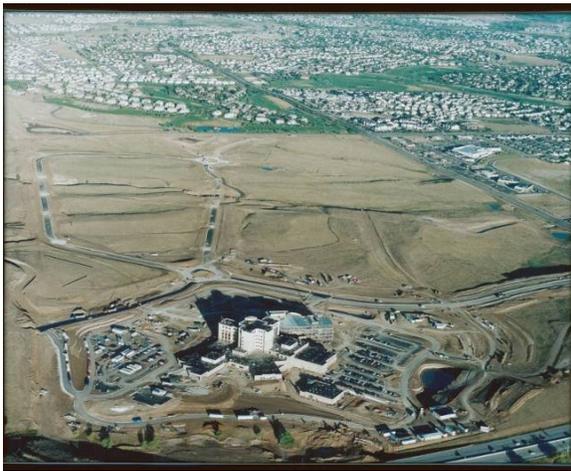
Many rural towns are centers of commerce and social gatherings for a large agricultural or recreational area. High speed state highways must transition to a slower speed environment through the urban core. Roundabouts can function as an urban design tool to efficiently make this transition. The Town of Eagle has roundabouts at either end of its urban core.



Eagle

Roundabouts Near Hospitals

Hospitals have recognized the safety benefits of roundabouts and have been receptive to their use. The obvious concerns of ambulances have not appeared to be an obstacle. Sky Ridge Hospital in Lone Tree was recently constructed with a roundabout near its main entrance.



Sky Ridge Hospital, Lone Tree



Roundabouts in Series for Access Management

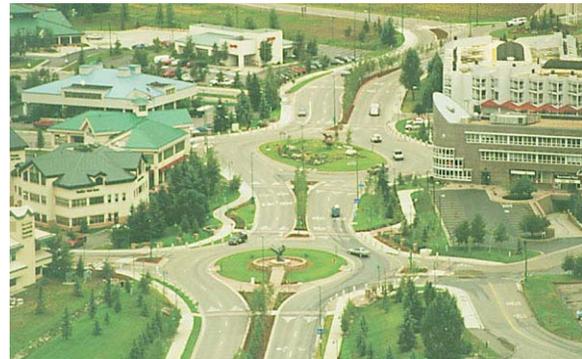
Communities such as Golden and Avon have used roundabouts in series combined with center medians to control access along arterials. Left-turns-out of commercial access points are restricted and U-Turns at the roundabouts are used to access businesses.



Golden



Avon



Roundabouts Near Schools

Since roundabouts can readily adjust to unbalanced flows, they are a good application near schools which have severe peaking issues. There have been concerns about school children using roundabouts, but to date no accidents involving school children have been reported at the roundabouts built near schools.



Battle Mountain High School, Edwards



Telluride Middle School, Telluride



**Ralston Valley High School,
Arvada**



Golden High School, Golden

CONCLUSIONS

There are over 250 roundabouts in Colorado and they are being used in a number of different applications. Roundabouts have been constructed near schools and hospitals and experience at these applications may be valuable to other jurisdictions considering the use of roundabouts near such institutions. There have been few accidents at Colorado's roundabouts, other than at a couple of roundabouts where poor design may have contributed to more accidents than expected. The survey of local jurisdictions indicates a high degree of satisfaction with roundabouts as a traffic control measure, especially for those that have been design in accordance with the *FHWA Roundabout Guidelines*.

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