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## The Life of a Roundabout in Colorado Springs

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# The Life of a Roundabout in Colorado Springs

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Spring 2021

Advised by Dr. William Schneider IV

## TABLE OF CONTENTS

Abstract.....	Page 3
Introduction.....	Page 4
Roundabout History in Colorado Springs.....	Page 6
Safety of Roundabouts .....	Page 8
Advantages and Disadvantages of Roundabouts .....	Page 11
Costs and Economic Impact .....	Page 13
Importance of Design .....	Page 14
Future of Roundabouts .....	Page 19
Conclusion .....	Page 21
References .....	Page 22

## ABSTRACT

Colorado Springs is an up-and-coming area where many people have decided to move to for multiple opportunities. With more people, comes more traffic flow and unfortunately, more accidents. Throughout the state, there is a large attempt to lower accidents, especially at intersections. One type of intersection that can be of great benefit is the roundabout. In fact, Colorado was an early adapter of the roundabout in order to improve traffic flow and decrease fatal accident statistics. When designing a roundabout, although good intentions are planned, complications can still arise. In most scenarios, roundabouts are able to reduce the number of fatal crashes on the road and increase traffic flow efficiency. The following research report will analyze the advantages and disadvantages with roundabouts in Colorado as a whole, and more specifically, the City of Colorado Springs. In addition, the research conducted will provide an overall analysis of the life of a roundabout. Although roundabouts have a higher initial price per project than traffic signals, roundabouts are able to save cost long term. There are multiple benefits to utilize roundabouts, and Colorado Springs could potentially see an influx in roundabouts within the city. The following research was conducted under the supervision of Dr. William Schneider at The University of Akron.

The research conducted for this report has deemed a few conclusions. First, when analyzing an intersection, a roundabout should always be considered for multiple reasons. Roundabout safety and markings are vital when designing a roundabout. A roundabout is more costly in the initial stages of a project but will save money in the long term. And finally, Colorado Springs should expect to multiple roundabouts implemented throughout the city due to the benefits.

## Introduction

Roundabouts came alive in the 1900's within the United States. In fact, "Colorado Springs has fallen in love with roundabouts... 68 times" (Barris, Ted, 2011). Roundabouts are circular intersections designed to calm traffic, increase safety, reduce stop and go travel, and decrease traffic delays, according to the Colorado Department of Transportation (Area Roundabout History, 2010). Most roundabouts range from 3-6 intersections on average. While driving is a privilege, the community must understand the safety of roundabouts prior to encountering one. "Roundabouts are useful tools to solve numerous traffic problems" when used properly (Fromme, 2010). When it comes to roundabouts, the driver needs to know which direction they would like to go while approaching. When entering a roundabout, it is important to yield and watch for other drivers already in the flow of traffic. One benefit of roundabouts are the crashes reduced by half when implementing them (Area Roundabout History, 2010).

A few of the positive impacts that result from roundabouts are delayed traffic stops with a continuous flow of traffic, less expensive long term, reduce collisions, and in some instances, they are able to save space at intersections.

The following research report will dive into the details of how a roundabout functions, and the purpose of why an engineer would design one. The research will explore the life of roundabouts mainly in Colorado Springs, as well as throughout the United States. In addition to the safety, design, advantages, and disadvantages of a roundabout, the future of Colorado Springs traffic flow will be covered as well.

For this research project, four roundabouts located in Colorado Springs were observed, analyzed, and photographed when appropriate. Below in Figure I, a roundabout located towards the entrance of a neighborhood on the East side of Colorado Springs is shown. Figure I contains a point of view from Shale Drive and intersects with Graphite Drive. This particular roundabout is one-lane with four points of entry and has proper markings and signage which can be seen. The pedestrian crosswalks are further away from the intersection and can be seen in Figure III further in the report.



Figure I: Roundabout in Colorado Springs Neighborhood, View from Shale Dr.

## Roundabout History in Colorado Springs

The first roundabout was introduced to Colorado in the late 1980's, located in Colorado Springs (Area Roundabout History, 2010). After the first roundabout in Colorado deemed to be a success, multiple other roundabouts were placed in tourist areas like Vail, Golden, and Eagle. Since then, Colorado Springs has had dozens of roundabouts put within the city to help improve traffic flow and decrease fatal crashes.

One of the more recent roundabout projects was finished in April 2020. The roundabout has constant traffic flow. The previous intersection can be seen in Figure II-A below where five intersections met at one point. “The modern roundabout solution at this signalized intersection will improve operations, reduce travel delay, reduce long-term maintenance costs with the removal of the traffic signal, and carry bicyclists and pedestrians fully through all legs of the intersection” (S. Tejon Roundabout, 2020).

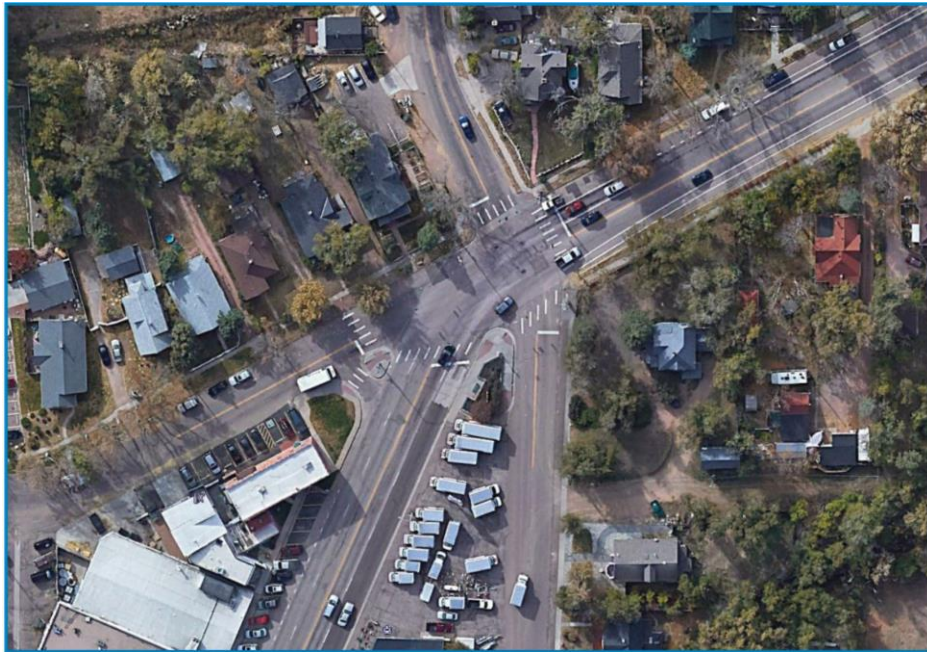


Figure II-A: Previous Intersection at S. Tejon Street.



Figure II-B is a birds-eye view of the proposed roundabout, which has since been completed. A roundabout was sufficient for this intersection since “the angles of the existing approaches” were “difficult for motorists to negotiate” and created poor sight distance (S. Tejon Roundabout, 2020).

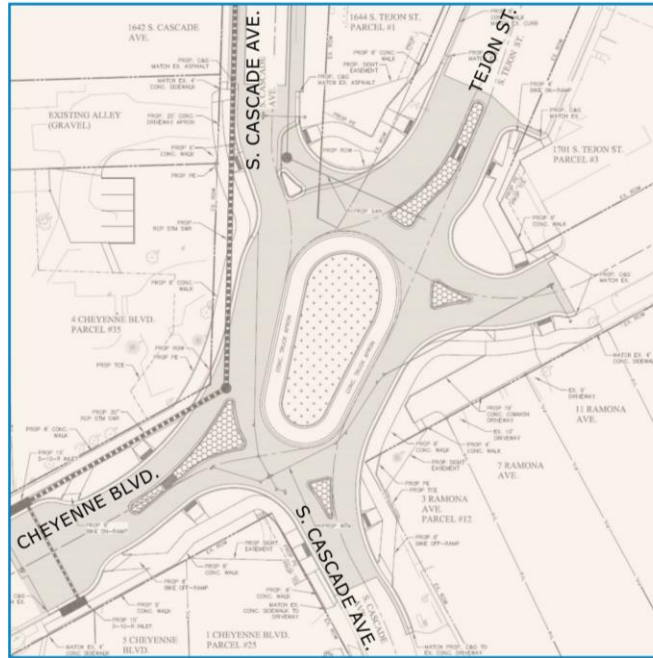


Figure II-B: Roundabout Project for S. Tejon Street.

Figure II-C was taken in March 2021 and is the point of view of the roundabout from S. Tejon Street.



Figure II-C: 5-Way Intersection Roundabout in Colorado Springs, View from S. Tejon St.



## Safety of Roundabouts

When a citizen is learning to drive, everyone is taught that driving is a privilege. When driving in roundabouts, safety is a top priority. Roundabouts reduced accidents by half when implemented in Colorado (Area Roundabout History, 2010). When a driver enters a roundabout, it is vital to slow down and pay attention to traffic already in the roundabout. Roundabouts also provide safety for pedestrians, as they only have to navigate with a single direction traffic flow. According to the Colorado Department of Transportation, there are five easy steps to know when it comes to roundabouts (Area Roundabout History, 2010):

- ***Slow down:*** Speeds of 15 mph or less are adequate in the roundabout
- ***Yield:*** Vehicles must yield to the left before entering a roundabout
- ***Entering:*** Never stop once inside the roundabout. ***The vehicle in the roundabout has the right of way.***
- ***Destination signs:*** Look for destination signs and exit in that direction.
- ***Exiting:*** Look to your right, check your mirror and use your turn signal.

When entering a roundabout, the driver must still watch for pedestrians prior to entering. Most roundabouts do not have pedestrian cross signals at the intersections. Roundabout crosswalks are placed several feet in front of the byway, as opposed to intersection crosswalks that are precisely at the turn points (The Dos and Don'ts, n.d.).

A proper display of pedestrian crosswalk marking, and signage can be seen below in Figure VI. This image was taken in a neighborhood located on the East Side of Colorado Springs.



Figure VI: Pedestrian Crosswalk at a Roundabout Intersection, View from Shale Dr.

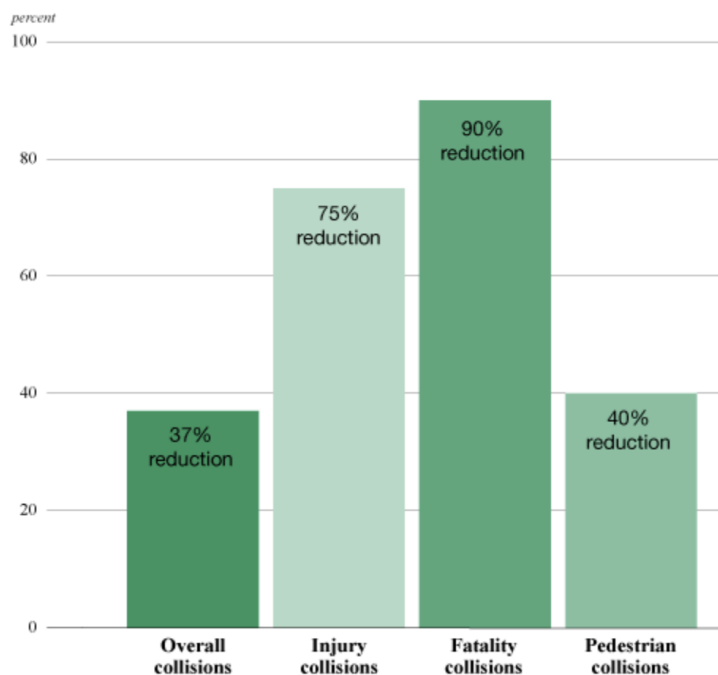
When driving in a roundabout, there are two important things to refrain from doing. First, don't stop within the flow of traffic (The Dos and Don'ts, n.d.). The purpose of the city implementing a roundabout is to continue the flow of traffic safely and efficiently. Second, to keep everyone safe in a roundabout, it is important to not ignore the yield sign. "However, if you choose to ignore a vehicle already in the circle, you run the risk of causing or suffering a T-bone accident—exactly the type of accident the roundabout is trying to avoid. There's absolutely no need to try and merge ahead of someone—simply flow right in behind him" (The Dos and Don'ts, n.d.).

According to a study by the Insurance Institute for Highway Safety (IIHS) there is a 90 percent reduction in fatality collisions when roundabouts were implemented over stop signs or traffic signals (Roundabout benefits, 2018). As seen in the bar graph (Table 1) provided by the Federal Highway Administration and insurance institute for Highway Safety, roundabouts also had a significant reduction in overall collisions, injury collisions, and pedestrian collisions. There are a

multitude of factors that assist in the reduction of collisions, including but not limited to, low travel speeds, no light to “beat”, and one-way travel.

In summary, the research conducted proved roundabouts to be safer than other intersections. The number of overall crashes, especially fatal crashes has lowered significantly with roundabout implementation.

### Reduction in collisions



Source: Federal Highway Administration and Insurance Institute for Highway Safety (FHWA and IIHS)

Table 1: Reduction in Collisions Bar Graph

## Advantages and Disadvantages of Roundabouts

One main reason for implementing a roundabout at an intersection is the decrease in accidents: non-injury, injury, and fatal crashes. According to FARS Data, Colorado's fatal crashes have decreased 2% in 2018 from 2017 which can be seen in Table 2. The same pattern can be seen for multiple years, as roundabouts have been placed at more intersections.

Table 2: Colorado Fatalities in 2017 and 2018.

State	2018	2017	Percent Change
<a href="#">Alabama</a>	953	948	1
<a href="#">Alaska</a>	80	79	1
<a href="#">Arizona</a>	1,010	998	1
<a href="#">Arkansas</a>	516	525	-2
<a href="#">California</a>	3,563	3,884	-8
<a href="#">Colorado</a>	632	648	-2
<a href="#">Connecticut</a>	294	281	5
<a href="#">Delaware</a>	111	119	-7
<a href="#">District of Columbia</a>	31	31	0
<a href="#">Florida</a>	3,133	3,116	1

### Advantages

A major advantage for implementing a roundabout is the installation space. A roundabout requires less space than traditional signal intersections with turning lanes. When a city is looking to design a roundabout, right-of-way must be purchased to have the needed land for the actual intersection. Though, roundabouts often take up less space on the streets approaching the intersection. "Because roundabouts can handle greater volumes of traffic more efficiently than signals where drivers may need to line up to wait for a green light, roundabouts usually require fewer lanes approaching the intersection" (Roundabout Benefits, 2018).

Another advantage is in the event of a power outage, a roundabout will remain fully functional.

Whereas a traditional traffic light would need to be treated as a four-way stop and, in some instances, may require the police to direct traffic (Roundabout Benefits, 2018).

Roundabouts can be a significant advantage to pedestrians. For instance, pedestrians and cyclists only have one direction of traffic flow to consider when crossing the road. All pedestrian crosswalks must have proper signaling in accordance with the City of Colorado Springs.

### **Disadvantages**

With any roadway design, drawbacks are present. Even though roundabouts have multiple advantages, as a civil engineer, the disadvantages must be taken into factor as well. One disadvantage of a roundabout is they are designed for drivers to go slower. In fact, “roundabouts increase the travel time by a huge margin” (The Case Against Roundabouts, 2011).

A second disadvantage of roundabouts, depending on the size, can take up a lot of public space. Although roundabouts require fewer lanes approaching the intersection, the city has to purchase significant amount of right-of-way in order to build the roundabout.

Even though roundabouts can be beneficial to pedestrians, there are still a few drawbacks. Roundabouts are not friendly to pedestrians who are handicapped, especially the visually impaired (The Case Against Roundabouts, 2011). Cyclists have the most blind spots while traveling in a roundabout. “Traffic rules allow inside lane turn-outs. In America this means that a vehicle in the inside lane -closest to the island- can turn right across the outside lane in order to exit. This can be unexpected to a bicyclist approaching behind the turning vehicle, and the bicycle can, at the same time, be in the motorist’s blind spot at an unexpected angle” (The Case Against Roundabouts, 2011).

## **Cost and Economic Impact**

Roundabouts cost more initially than conventional intersections, but when long term cost is considered, it appears that roundabouts can save a significant amount of money. “Roundabouts eliminate hardware, maintenance and electrical costs associated with traffic signals, which can cost between \$5,000 and \$10,000 per year” (Roundabout Benefits, 2018).

Roundabouts have a positive impact on the economy as well. Findings show roundabouts have the ability to improve the surrounding commercial venues (Fromme, 2010). Roundabouts have the potential to improve the image of an area and attract more customers. For instance, near Colorado Springs there is a small-town Manitou Springs. When entering the town, the signals hold lots of congestion while people are attempting to park. Though, further into the town there is a roundabout with three intersections that sees constant traffic flow. The roundabout in Manitou Springs greatly improves the towns functionality and image, which also improves customer inflow for local shops.

When analyzing an intersection and attempting to determine the proper signalization, a roundabout should always be considered. Based on the research conducted for this project, long-term roundabouts are more cost friendly even though they are costly upfront. After eliminating any electrical costs and lowering maintenance costs, roundabouts will save more money overall. In general, roundabouts seem to be the best option for most intersections throughout Colorado Springs.

## Importance of Design

When designing a roundabout, some aspects are able to be standardized by the city, like signing and marking, and other aspects must be designed to each specific intersection, for example, stopping sight distance. Prior to designing a roundabout for an intersection, the engineer should conduct traffic counts and perform the proper calculations to determine what type of intersection is needed. A roundabout may not always be the best option for every intersection. According to the Washington State Department of Transportation, the following should be taken into consideration for installing a roundabout at an intersection:

- **Accident history** – data about the number of accidents, type of crash, speeds, and other contributing factors are analyzed.
- **Intersection operation** – the level of current and projected travel delay being experienced, and backups on each leg of the intersection.
- **Types of vehicles using the intersection** – we look at the different kinds of vehicles that use the intersection. This is especially important for intersections frequently used by large trucks.
- **Cost** – this includes the societal cost of accidents, right-of-way (land purchase) requirements, and long-term maintenance needs.

When designing, the type of vehicles that will encounter the roundabout need to be taken into consideration. All roundabouts in Colorado Springs “need to allow single passenger cars, pickups, SUV trucks and city bus operation without the use of a truck apron. Larger trucks will require the use of a truck apron, especially on single lane roundabouts” (Traffic Criteria Manual, pg. 56).



During the design of a roundabout, pedestrian crosswalks are required where sidewalks are existing or planned at the intersection. Marked and signed crosswalks are also required for all roundabout crossings “on a school route or bordering a park, shopping area, or other area where pedestrian activity is expected” (Traffic Criteria Manual, pg. 57). The needed signs and sign placement for a roundabout was found in the *Traffic Criteria Manual Section III* for Colorado Springs. The proper signs for a roundabout in Colorado Springs can be seen below in Figure IV. The placement of the signs will vary for a multi lane or single land roundabout, which can be seen in Figures IV-A and IV-B, respectively.

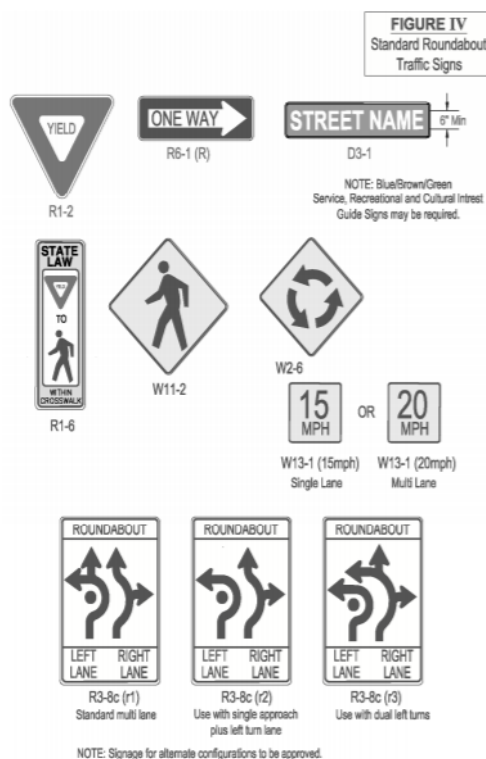


Figure IV: Standard Roundabout Traffic Signs.

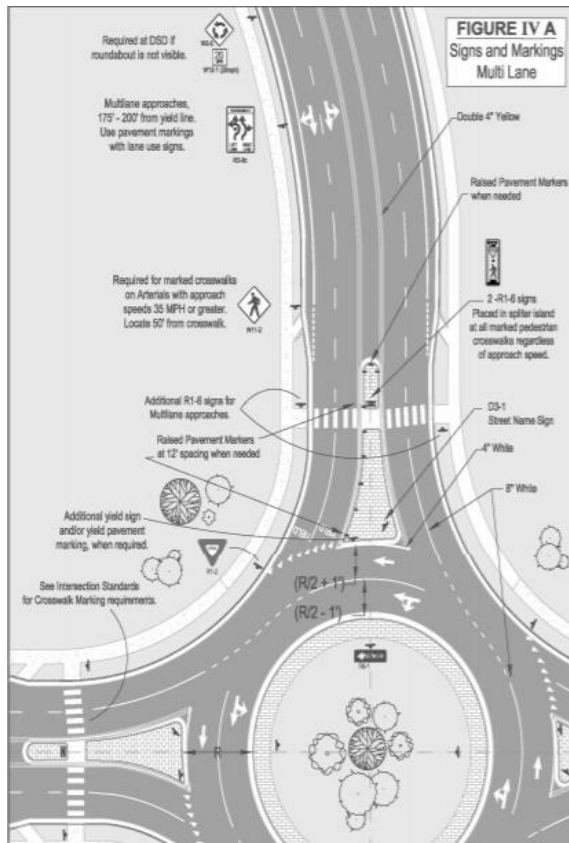


Figure IV-A: Signs and Markings for Multi Lane

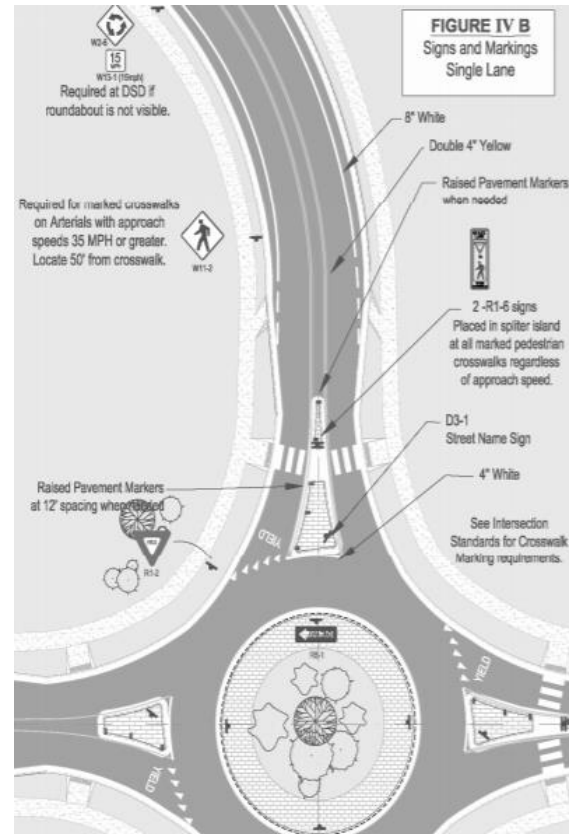


Figure IV-B: Signs and Markings for Single Lane

It is important for the designing engineer to make proper stopping sight distance calculations. Stopping sight distance is the distance from the hazard to the driver to ensure proper reaction time is taken into account. “Every conflict point at the intersection must be checked, based on vehicle speed near the conflict area for obstructions of the required visibility area – see Figure III” (Traffic Criteria Manual, pg. 61). The following stopping sight distance is based on AASHTO standards for urban roadways, but calculations need to be checked prior to design.

### Stopping Sight Distance

15 MPH	80'
20 MPH	115'
25 MPH	155'
30 MPH	200'
35 MPH	250'
40 MPH	305'
45 MPH	360'

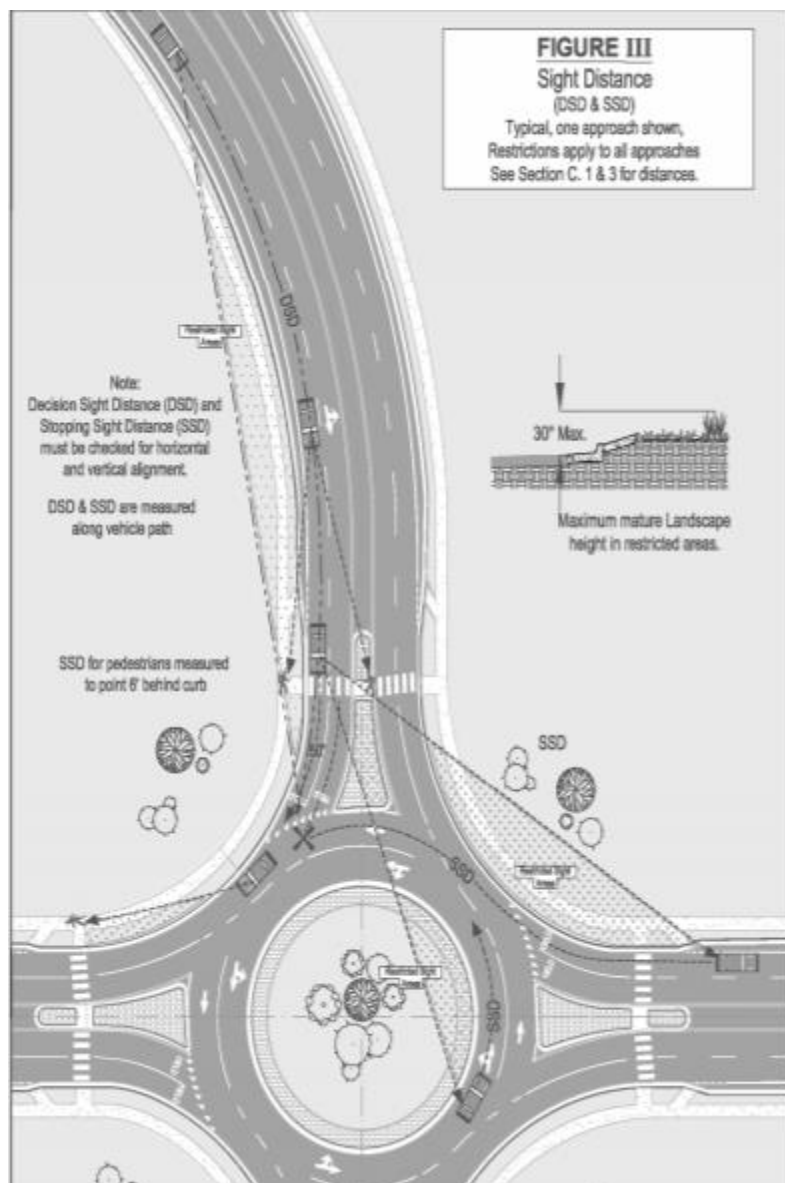


Figure III: Sight Distance for Roundabouts

“The approach roadway design elements include curb alignment, median width and transition, approach flare, crosswalk location, horizontal and vertical alignment of the approach lane(s), intersection and stopping sight distance calculations, approach speed, fastest path radii, and other associated elements” (Traffic Criteria Manual, pg. 60). Table 3, provided below, shows the minimum and maximum standards for Colorado Springs.

In summary, the design of a roundabout is very important to the community. Every city will have standards and regulations that need to be followed during the design process.

Table 3: Minimum and Maximum Standards for Approach Roadway Design.

Fastest Path		Single Lane		Multilane Roundabout	
		R Max	Speed (MPH)	R Max	Speed (MPH)
R1	Entry	86-99'	20	152-178'	25
R2	Circulating	99-116'	20	178-210'	25
R3	Exit	152-178'	25	152-178'	25
R4	Left turn	99-116'	15	178-210'	25
R4	Minimum*	18-20'	10	33-37'	13
R5	Right turn	152-178'	20	152-178'	25

*\*R4 has a minimum requirement to reduce rear end accidents caused by excessive speed differential*

*Note – radii are given as a range for various super elevation rates from 0% to 4%, positive for R1, R3 & R5, and negative for R2 and R4.*

*Calculations for each specific roadway segment and corresponding cross slope should follow AASHTO Geometric Design of Highways & Streets, 2001 or later*

## **Future of Roundabouts**

Currently, the state of Colorado has over 250 roundabouts. Without a doubt, Colorado will continue to implement roundabouts to improve traffic flow and decrease the number of fatal crashes. Although roundabouts are efficient and safer than traditional intersections, they are not ideal in every situation. It is vital for the designing engineer to properly collect data and make the proper calculations to determine if a roundabout is vital.

“In 1999 Golden, Colorado changed four intersections into roundabouts. They created a commercial roundabout district. This district had experienced a decrease in injury crashes by 94 percent, and a decrease in overall crashes by 88 percent” (Fromme, 2010). As Golden is only one small area of Colorado, they implemented roundabouts and saw a significant decrease in crashes. With similar data available for multiple other intersections, Colorado should expect to see a great influx over the years.

In fact, Colorado Springs has already begun the design of multiple other intersections. One roundabout project is on 30<sup>th</sup> Street from Fontanaro Street up to Mesa Road (City of Colorado Springs, 2021). The project is to start in May 2021 and can last up to 24 months. Figure V was obtained by the City of Colorado Springs and provides a visual of the roundabout project at 30<sup>th</sup> Street. In addition, a roundabout has been scheduled to be installed at Gateway Road leading into the Garden of the Gods (City of Colorado Springs, 2021).

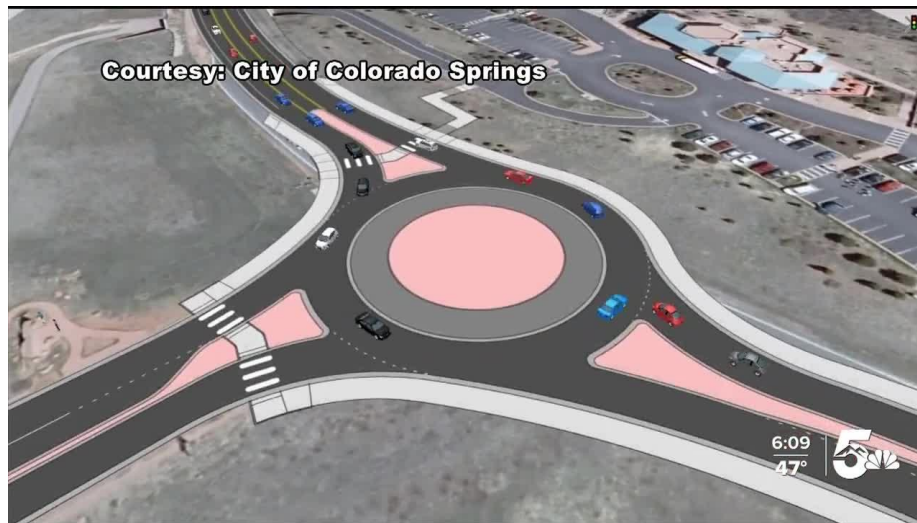


Figure V: Proposed Roundabout at 30<sup>th</sup> Street.

Some roundabouts can take years to be completed, depending on size. Even though construction of the roundabout will negatively impact the residents, the final product will be worth the wait and will benefit the community. Overall, Colorado Springs should expect to see more roundabouts throughout the city in the coming years.

## Conclusion

After completing multiple visits to roundabouts in Colorado Springs, it can be concluded that roundabouts serve the proper purpose as designed for. Roundabouts are able to increase safety, increase efficiency, lower maintenance, and overall be more cost effective. Roundabouts are able to not only improve safety and efficiency for vehicles, but also for pedestrians and cyclists.

Even though roundabouts are not the best option for every intersection, careful considerations are taken into account by the engineer prior to approval of the design. Once the advantages and disadvantages are paired with the collected data, the decision to use a roundabout can be determined. Then, after proper design considerations have been approved, the roundabout can be implemented into the city.

All engineers must adhere to city and state standards when designing. Colorado Springs has provided a layout of all necessary calculations, signing, markings, landscaping, drainage, and much more. Overall, Colorado Springs should expect to see more roundabouts implemented within the city since the benefits greatly outweigh the drawbacks.

Based on the research conducted for this project, the positives of the roundabouts seem to outweigh the negatives. As Colorado Springs continues to increase in population it is expected to see an influx of roundabouts. In fact, in the Springs, roundabouts are so common they are in large newer neighborhoods. Overall, roundabouts will continue to serve their purpose for the community to reduce fatal crashes and have a frequent traffic flow with minimal issues.



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