

City of Springfield Summary of Roundabout Analysis

After obtaining and reviewing all of the pertinent information regarding the roadways, site, and traffic volumes, a geometric analysis of the proposed roundabouts using the roundabout design software tool called RODEL (roundabout delay) was conducted. RODEL is a tool for roundabout designers and practitioners which assist them to:

- Improve design quality
- Drastically reduce design time
- Reduce land and service utility relocation costs
- Rapidly explore many geometric options, especially with respect to safety
- Derive the optimum layout within the conflicting constraints of cost, delay and safety
- Conduct planning level studies to evaluate intersection alternatives

Rather than simply checking designs after they have been drawn, RODEL generates geometry prior to scheme drawing. This avoids the time consuming practice of repeatedly drawing layouts and checking performance. RODEL is a powerful, accurate, and efficient tool designed to allow the practitioner to understand operational effects of different geometries and their impact on performance. The program provides accurate capacity and delay analysis data to assist a designer in finding a comprehensive solution for a given problem. <https://rodel-interactive.com/>

The RODEL calculations provided the initial lane geometry and capacity requirements for each of the five roundabout design alternatives based on the future 2035 design year traffic volumes. RODEL is based on empirical equations (observed and checked from field data) developed by the United Kingdom, verified and adopted by many countries including the United States, and utilizes specific geometric relationships to determine the capacity requirements of a roundabout. In general, RODEL calculates the required geometry for the roundabout to function within the desired capacity or, alternatively, to determine if the existing/planned geometry will be adequate with respect to capacity and delay. The modern roundabout capacity analyses are based on the general principles and performance measuring criteria identified in the Highway Capacity Manual. The Highway Capacity Manual evaluates intersections based on vehicular delay as well as their Level of Service.

Since both the AM and PM peak hour volumes are part of the intersection designs, separate RODEL calculations were completed for the intersection location to ensure the roundabout will operate appropriately under both peak hour traffic conditions. In addition, separate RODEL calculations were also performed under the peak minutes of the peak hour at an 85th percentile confidence level to ensure the proposed design would be adequate under the recommended geometric recommendations provided herein. Nearly all software programs that analyze traffic volumes with respect to operations and level of service are reported at a 50th percentile confidence level. RODEL allows for a “design check” at an 85th percentile confidence level to test the sensitivity of the layout and determine the roundabout’s operations during the peak minutes of the peak hour. This allows the designer to adjust the geometry of the roundabout (similar to adjusting the timing of a signal) to ensure adequate capacity of the roundabout during the peak hour.

The predominant consideration in roundabout capacity analyses is the volume of the circulating traffic and the volume of the entering traffic on each approach. Traffic entering a roundabout will look for gaps in the circulating traffic in order to enter the roundabout. This behavior is called gap seeking. In addition to gap seeking, the geometric design of the roundabout affects the speeds and comfort level at which drivers will negotiate the roundabout. This also affects the capacity and safety of roundabouts.

The Highway Capacity Manual^[1] evaluates roundabouts based on their volume to capacity ratios as well as their level of service. The volume to capacity (v/c) ratio describes the volume of traffic entering the circulating roadway from one approach as compared to the capacity of that approach. The capacity of an approach is dependent on the traffic volume within the circulating roadway at each specific approach. As the traffic within the circulating roadway goes up, the capacity of an approach would be reduced. Because of this, traffic engineers prefer to leave a “reserve capacity” for an approach. Typically, an intersection with a v/c ratio over 0.85 indicates the *potential* need for additional capacity on the approach. However, too much reserve capacity results in an unsafe (too fast or “too loose”) roundabout design. Hence, careful and specific **balance** is needed in the design of roundabouts for safety and operational capacity purposes.

Based on the established design criteria for the roundabout intersection analyses, the RODEL software program and engineering analyses produced the preliminary results. The analyses provide the following results for the future design year:

- Lane Configurations
- Anticipated Queue Lengths of Each Approach
- Preliminary Roundabout Geometry (E, L', R, Phi, D)
- Roundabout Size
- LOS Results for AM and PM Peak Hours

As shown in RODEL analysis, all five roundabout intersections operate at a LOS C or better in both the AM and PM peak hours. The City of Springfield’s LOS threshold is LOS C wherein the roundabouts operate better, comply or meet the criteria/standards in the future year of 2035. The required lane configurations of each approach of each intersection are based on the turning movement conflicts and the approaching existing roadway configuration. The recommended roundabout lane configurations, sizes, and shapes are site specific designs to match the capacity needs, available ROW, and existing/proposed roadway configurations. Each current roundabout design meets the minimum required lanes for capacity purposes.

The City of Springfield can provide the RODEL analysis upon request.

[1] Highway Capacity Manual, Transportation Research Board, 2000