

**Delaware Department of Transportation
Division of Transportation Solutions
Design Guidance Memorandum**

Memorandum Number 1-26

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|-----------------------|----------------------------|----------------------------------|
| 1. Road Design Manual | 2. Bridge Design Manual | 3. Utilities Design Manual |
| 4. Real Estate Manual | 5. Standard Specifications | 6. Standard Construction Details |

Title: Roundabouts Effective date: March 21, 2012

Sections to Implement:

- | | | |
|---|--|---|
| <input checked="" type="checkbox"/> Project Development | <input checked="" type="checkbox"/> Planning | <input type="checkbox"/> DTC |
| <input checked="" type="checkbox"/> Bridge | <input type="checkbox"/> Quality | <input checked="" type="checkbox"/> Traffic |
| <input type="checkbox"/> Team Support | <input type="checkbox"/> Maintenance &
Operations | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> Utilities | | |

I. Purpose

To give guidance for the consideration, planning, design, and construction of roundabouts.

II. Design Guidance

The Department recognizes the potential benefits of modern roundabout designs. Throughout North America, Europe, Asia, and Australia, their growing use has clearly demonstrated significant improvements to safety and traffic operations when placed at appropriate locations with careful design. Widely documented performance statistics show large reductions in collision severity and injury where traditional intersections have been replaced with roundabouts. The potential benefits of reductions in injuries and costs associated with crashes alone are sufficient for considering modern roundabouts as an option when safety, capacity or traffic calming are the chief reasons for intersection projects.

At the same time, there have been notable failures which have resulted in negative public opinion. The best way to alter the undeserved negative image of roundabouts is to apply sound decision making when choosing locations to construct roundabouts, to apply the best possible project development and construction practices, and to conduct an effective public education program. The efforts to gain acceptance would be harmed if applications fail to live up to expectations. For that reason, it is very important that the Department exercise care in terms of planning locations, analyzing traffic performance, and designing roundabouts.

Location

One of the first considerations is to decide if the intersection is an appropriate location. The following list incorporates several guidelines and Delaware-specific conditions.

A. Potentially Appropriate Locations

1. Highway Safety Improvement Program and relatively high crash sites, especially where high left/right turn, or angle crashes occur
2. High delays, especially where four way stop capacity is exceeded
3. More than four legs exist
4. Unusual intersection geometry exists (such as Y or acute angles)

5. High left turn movements
 6. Highly variable traffic patterns
 7. High U-turn movements
 8. Constrained storage capacity for signalization or where signal queues create operational or safety problems
 9. Two adjacent intersections which are very closely spaced
 10. Junctions where speed or character of traffic changes (e.g., rural transition to town or residential areas)
 11. Aesthetics features such as gateways and parks
 12. Single lane capacity is adequate for the design year
 13. Traffic calming needed
- B. Inappropriate locations - The following conditions do not necessarily exclude the location. However, there must be other compelling reasons to choose these sites. Chief Engineer approval is required to choose such locations.
1. Existing or projected design year traffic suggests a multi-lane roundabout is warranted. Multi-lane roundabouts require considerably more experience, comfort, and acceptance than presently exists.
 2. If any approach of the roundabout is more than a single lane in one direction and pedestrian facilities are included, then pedestrian-activated traffic signals may be needed to accommodate visually impaired pedestrians per anticipated federal requirements. There are very few U.S. locations at this time with signalized roundabout approaches, and very little guidance on signalization design techniques (e.g., the use of a typical traffic control signal vs. a pedestrian hybrid-beacon). Capacity impacts of signalization must be fully understood prior to considering this as an option.
 3. Unfavorable right-of-way constraints
 4. Grades in the intersection of 3% or less cannot be achieved
 5. Within a coordinated signal system where platoons would be disrupted
 6. Low volumes on the minor road cause undesirably high delays on the major road
 7. Unbalanced flows, where major street traffic is greater than 90% of total traffic entering the intersection, and V/C ratios are projected to be greater than 0.7.
- C. Special considerations - The following conditions require particular caution in choosing sites for roundabouts. Additional data and analysis is required.
1. Somewhat unbalanced flows, where major street traffic is between 70% and 90% of the total traffic, and V/C ratios are projected to be greater than 0.7.
 2. Presence of numerous bicycles or pedestrians
 3. Presence of pedestrians with vision impairment
 4. Back-ups through a roundabout are possible due to the proximity of signals, rail crossing, etc.
 5. Back-ups are possible into rail crossings or signalized intersections due to roundabout queues

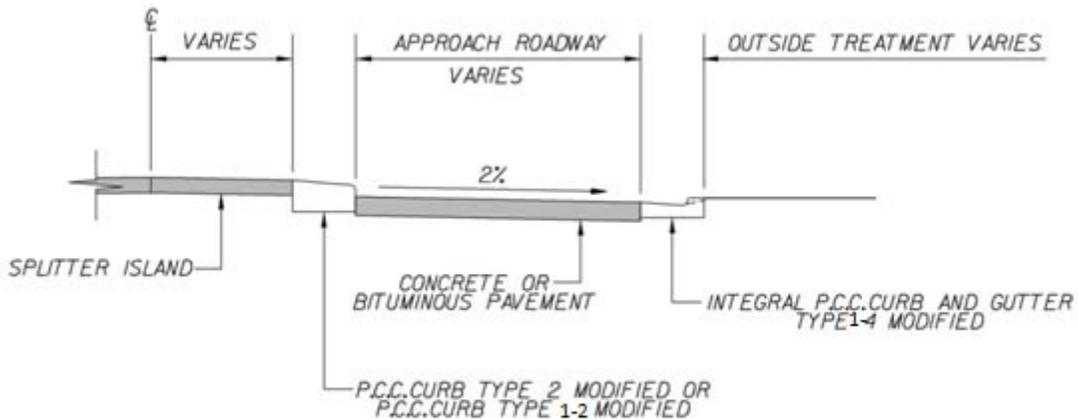
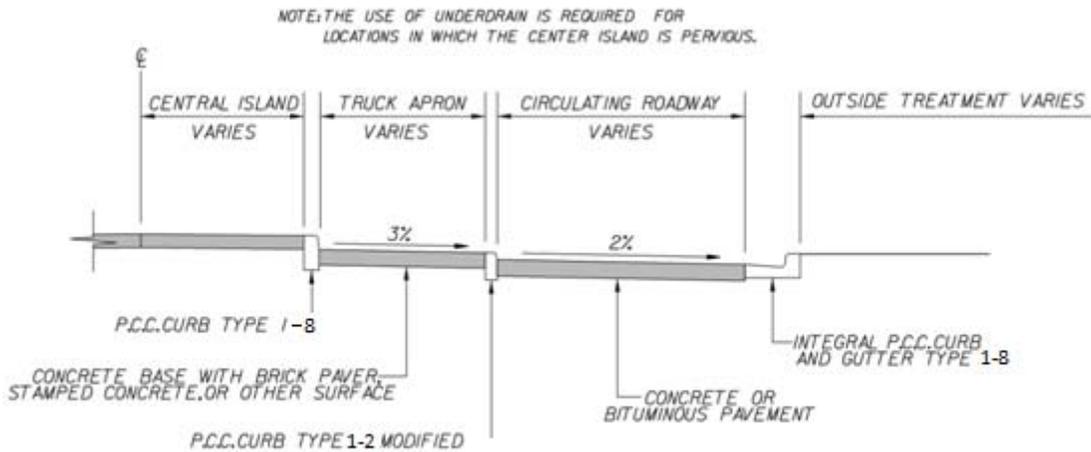
6. Presence of high volumes of large trucks
7. When on a designated evacuation route, coordinate with the TMC Operations Manager

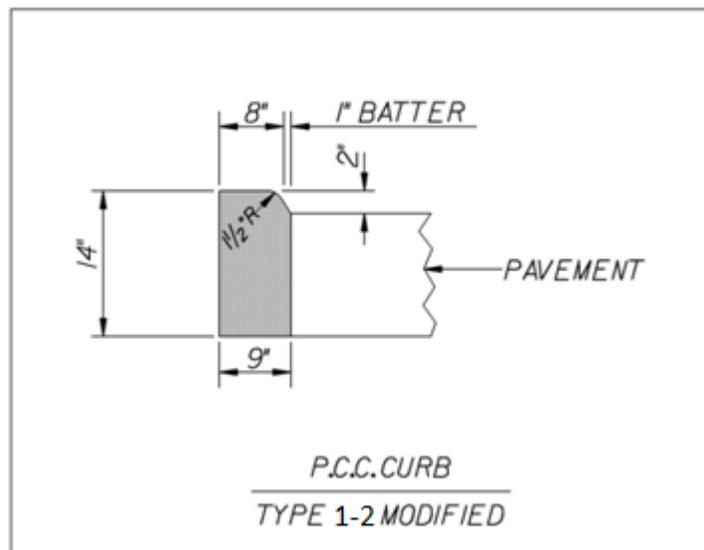
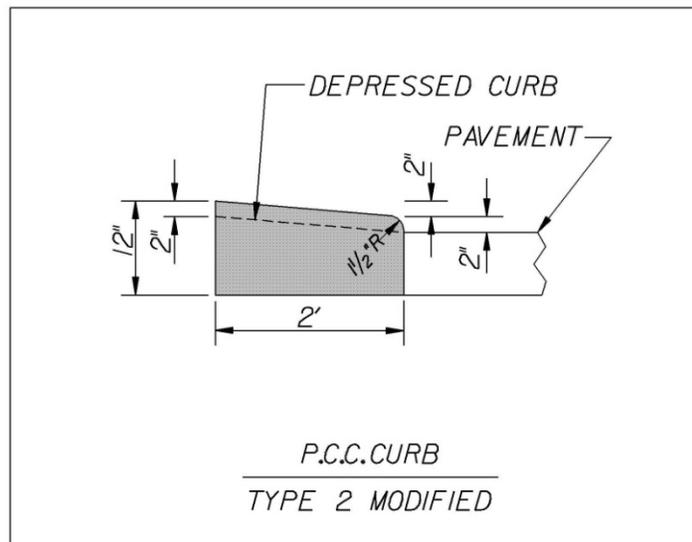
Project Development

- A. Traffic analysis shall be in accordance with procedures outlined in National Cooperative Highway Research Program Report 672, Roundabouts: An Informational Guide, Second Edition.
 1. Where the v/c ratio on any approach exceeds 0.85, additional analysis should be conducted using alternate analysis methods such as aaSIDRA (with USA environmental factor of 1.2), RODEL or VISSIM. Microscopic simulation models should be used to estimate network effects, e.g., queuing, platooning or other operational performance measures, if applicable.
 2. When signal warrants are also met, the signal should be compared to a roundabout for delay, queues, level of service, expected crash rate, and estimated costs for right-of-way, construction and maintenance.
- B. Design shall be consistent with recommendations and guidance of:
 1. National Cooperative Highway Research Program Report 672, Roundabouts: An Informational Guide, Second Edition.
 2. Where feasible, entry alignments should be offset to the left of center. Entry alignments through the center of the roundabout are acceptable. Offset right alignments are discouraged.
 3. Signing and striping shall follow the latest edition of the Delaware Manual for Uniform Traffic Control Devices,
 - a. Where exceptionally large trucks or farm vehicles are infrequently expected (i.e. not the design vehicle), and could strike the keep right sign on the splitter island nose, these signs may be replaced with tubular markers
 4. Lighting, in accordance with DelDOT Lighting Design Guidelines, shall be provided at all locations on State maintained roads, except for the intersection of internal subdivision streets.
 5. If full consideration has been given to potential multi-lane roundabout issues as described earlier in this DGM, then the designer should consider whether the design and right-of-way will allow for the future expansion of a single lane roundabout to a multi-lane roundabout.
- C. Design vehicle
 1. WB-67 to be accommodated on roads with a state maintenance road number. However, in predominantly residential areas served by urban collectors/arterials, WB-50 may be more contextually appropriate. The designer should consider vehicle mix, adjacent land uses, and functional classification of the facility both present and forecast. Where large vehicles are less than 5% of traffic, the truck apron is sufficient. In rural areas, special attention to the requirements of large agricultural equipment shall be addressed, and include coordination with appropriate representatives of the agricultural community.
 2. Within subdivisions, emergency response vehicles shall be accommodated
- D. Landscaping within the central island on roads with a state maintenance road number shall be low maintenance. While some vertical growth is desirable to provide enhanced visual cues to drivers, proper sight distance in accordance with design guidelines must be assured and sustained when plantings mature. More elaborate landscaping or other aesthetic features may be acceptable if a maintenance agreement is made with the municipality or other local agency, and the features do not

interfere with driver sight distance. The crashworthiness of aesthetic features should also be taken into consideration. Any aesthetic features that make noise (e.g., a fountain) should not be used due to considerations for cues for the visually impaired.

- E. It is preferred that there is a separation (such as a grass strip) between the sidewalk and the curb in order to better indicate to pedestrians where there are crossings. If the sidewalk is flush against the curb, then anticipated federal requirements may include a continuous, detectable edge treatment along the street side of the sidewalk.
- F. Constructability and maintenance of traffic feasibility should be considered early in project development, particularly the decision to use detours on any of the approach roads
- G. Consideration should be made for striping materials required for the roundabout. Tight turning radii may need striping to be placed by handcart rather than by truck.
- H. The figures of the typical sections and modified curb are intended to provide additional design guidance specific to Delaware.





Education

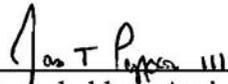
- A. Practices and research continue to evolve. Transportation Solutions and Planning Divisions shall remain abreast of developments and provide training opportunities to ensure best practices are sustained. Periodic meetings should be held to discuss evolving changes and to achieve long-term consistent standards throughout the Department.
- B. The Department will work with Division of Motor Vehicles to ensure that driver education curriculum addresses roundabout use.
- C. Public education is important. The Department will develop and implement a program to improve understanding and acceptance for use throughout the State. Public education should also be considered for project public workshops.

III. Justification

The appropriate design, construction and use of modern roundabouts has the potential for significant improvements to safety and traffic operations.

Prepared by: Roundabout Committee

Date: January 13, 2012



Recommended by: Assistant Director – Design

3.16.12
Date



Approved: Chief Engineer

3/19/12
Date

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