

# Rotary Intersections

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# Roundabout Intersections

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*It may be described as an enlarged road intersection, where all entering vehicles can find suitable gaps to move around an island in one direction before they can "Weave" out of the traffic flow into their respective directions radiating from the island.*



## Difference in Rotary and Roundabout

### Roundabout

- smaller in size
- Drivers yield at entry to traffic in the roundabout, then enter the intersection and exit at their desired street
- Maintain relatively low speeds (< 40 kmph)
- No pedestrian activity on central island.
- Large entry angle helps to create entry deflection to control speed through the roundabout.

### Rotary

- Rotary is bigger in size
- Drivers enter a traffic circle in a straight line and do not have to yield
- Higher speeds allowed (> 40 kmph)
- Some large traffic circles allow pedestrian crossing to and from the central island.
- Splitter Island Optional
- Entry angle likely to be reduced to allow higher speed at entry.

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## Distinguishing Roundabouts from Other Circular Intersections

**Roundabouts****(a) Traffic control**

Yield control is used on all entries. The circulatory roadway has no control. *Santa Barbara, CA*

**Traffic Circles**

Some traffic circles use stop control, or no control, on one or more entries. *Hagerstown, MD*

**Roundabout****(b) Priority to circulating vehicles**

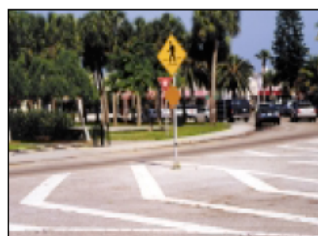
Circulating vehicles have the right-of-way. *Santa Barbara, CA*

**Traffic Circles**

Some traffic circles require circulating traffic to yield to entering traffic. *Sarasota, FL*

**Roundabout****(c) Pedestrian access**

Pedestrian access is allowed only across the legs of the roundabout, behind the yield line. *Santa Barbara, CA*

**Traffic Circles**

Some traffic circles allow pedestrian access to the central island. *Sarasota, FL*

**Roundabout****(d) Parking**

No parking is allowed within the circulatory roadway or at the entries. *Avon, CO*

**Traffic Circles**

Some traffic circles allow parking within the circulatory roadway. *Sarasota, FL*

**Roundabout**

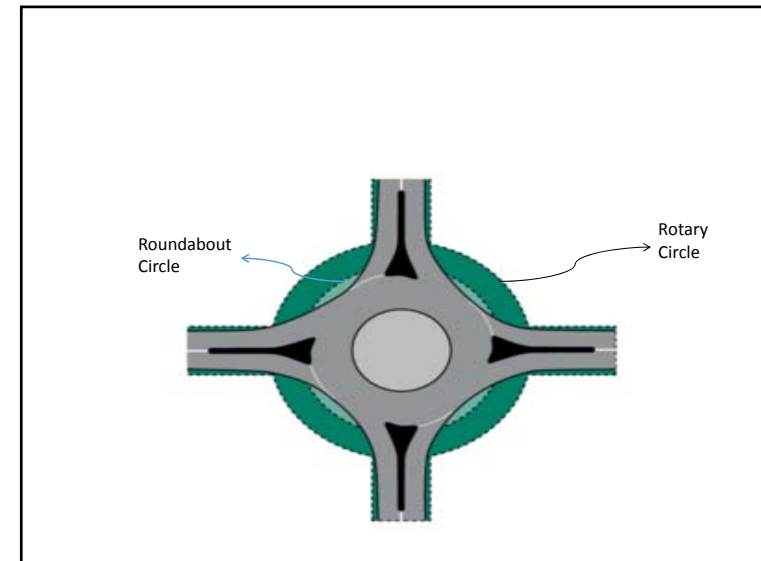


**(e) Direction of circulation**  
All vehicles circulate counter-clockwise and pass to the right of the central island. *Naples, FL*

**Traffic Circles**



Some neighborhood traffic circles allow left-turning vehicles to pass to the left of the central island. *Portland, OR*




**COMPLIANCE OF REQUIREMENTS AT ROUNDABOUT**

DIRECTIONS


PEDESTRIAN CROSSING

YIELD SIGN

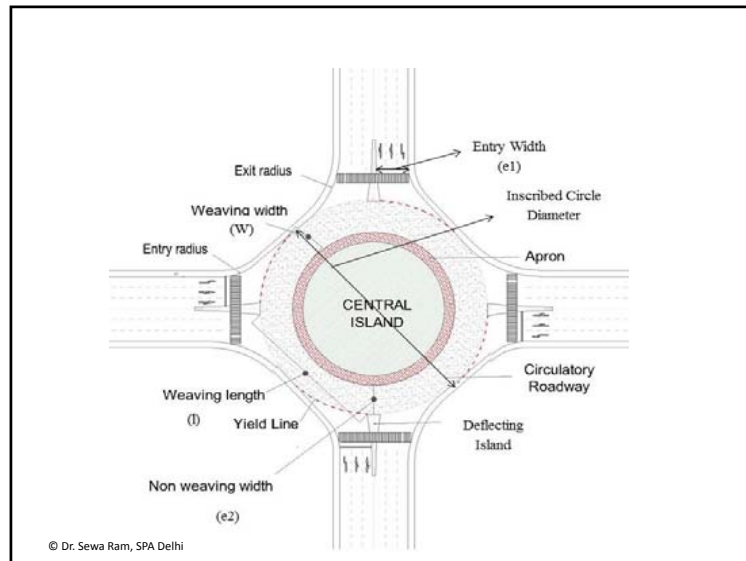


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**COMPLIANCE OF REQUIREMENTS AT ROUNDABOUT**



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### Modern Roundabout Characteristics



- yield on entry
- central island deflects traffic and forces it to slow down
- splitter islands that separate entering and exiting traffic.
- designed to accommodate vehicles of all sizes

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### Smoother transitions:



### Aesthetics:



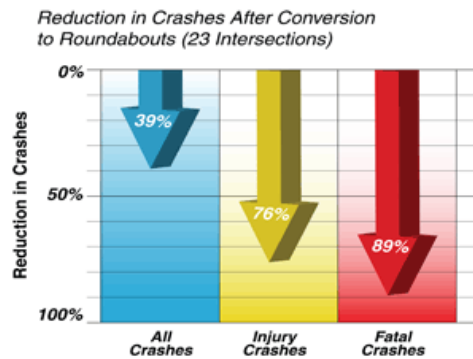


Operations and Maintenance:

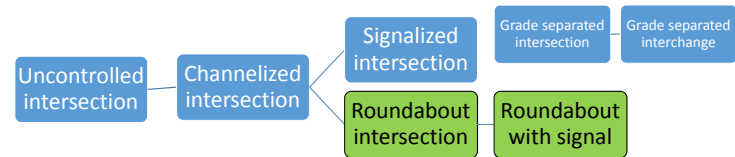
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More environmentally-friendly:

**Traffic Safety:** studies have shown that conversion of traffic signal- or stop sign-controlled intersections to roundabouts reduced injury crashes by 75-90% and all crashes by 35-40%.



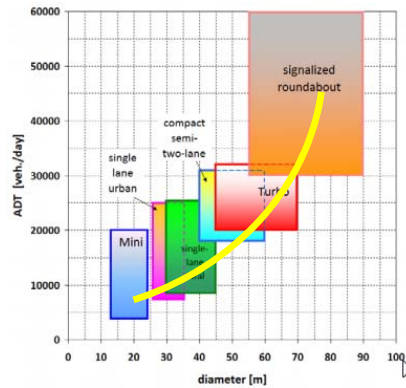
## FROM INTERSECTIONS TO ROUNDABOUTS



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## TYPES OF ROUNDABOUTS (International Practices)

1. Mini roundabouts
2. Turbo roundabouts
3. Raindrop
4. Twin or dumb bell
5. Two geometry
6. Super circle or magic roundabout
7. Through about or Cut – through Roundabouts



## Comparison of roundabout categories

Design Element	Mini-Roundabout	Urban Compact	Urban Single-Lane	Urban Double-Lane	Rural Single-Lane	Rural Double-Lane
Recommended maximum entry design speed	25 km/h (15 mph)	25 km/h (15 mph)	35 km/h (20 mph)	40 km/h (25 mph)	40 km/h (25 mph)	50 km/h (30 mph)
Maximum number of entering lanes per approach	1	1	1	2	1	2
Typical inscribed circle diameter <sup>1</sup>	13 m to 25 m (45 ft to 80 ft)	25 to 30 m (80 to 100 ft)	30 to 40 m (100 to 130 ft)	45 to 55 m (150 to 180 ft)	35 to 40 m (115 to 130 ft)	55 to 60 m (180 to 200 ft)
Splitter island treatment	Raised if possible, crosswalk cut if raised	Raised, with crosswalk cut	Raised, with crosswalk cut	Raised, with crosswalk cut	Raised and extended, with crosswalk cut	Raised and extended, with crosswalk cut
Typical daily service volumes on 4-leg roundabout (veh/day)	10,000	15,000	20,000	Refer to Chapter 4 procedures	20,000	Refer to Chapter 4 procedures

<sup>1</sup> Assumes 90-degree entries and no more than four legs.

Source:- Federal Highway Administration

## Recommended Maximum Entry Design Speeds.

Site Category	Recommended Maximum Entry Design Speed
Mini-Roundabout	25 km/h (15 mph)
Urban Compact	25 km/h (15 mph)
Urban Single Lane	35 km/h (20 mph)
Urban Double Lane	40 km/h (25 mph)
Rural Single Lane	40 km/h (25 mph)
Rural Double Lane	50 km/h (30 mph)

Source:- Federal Highway Administration

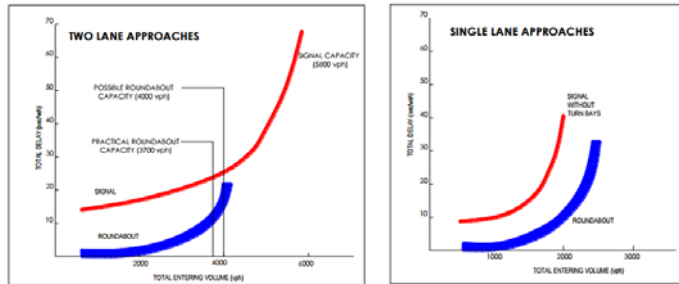
## Recommended Inscribed Circle Diameter Ranges

Site Category	Typical Design Vehicle	Inscribed Circle Diameter Range*
Mini-Roundabout	Single-Unit Truck	13–25m (45–80 ft)
Urban Compact	Single-Unit Truck/Bus	25–30m (80–100 ft)
Urban Single Lane	WB-15 (WB-50)	30–40m (100–130 ft)
Urban Double Lane	WB-15 (WB-50)	45–55m (150–180 ft)
Rural Single Lane	WB-20 (WB-67)	35–40m (115–130 ft)
Rural Double Lane	WB-20 (WB-67)	55–60m (180–200 ft)

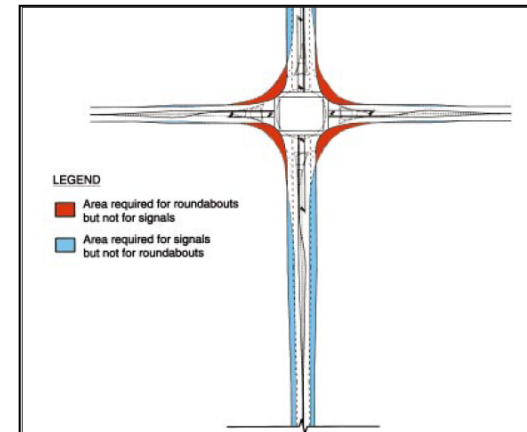
\* Assumes 90-degree angles between entries and no more than four legs.

Source:- Federal Highway Administration

## COMPARISON WITH OTHER INTERSECTIONS

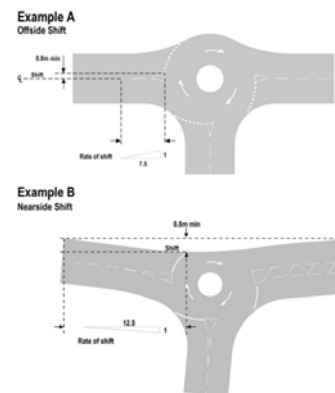


## Why Roundabouts ??



## 1. Mini Roundabouts

- Single lane entry and exit
- Diameter : 13m-24m
- Minimum circular lane width : 4m-6m
- Minimum Central Island elevation : 4cm-6cm
- Different pavement material should be used for central island



## 2. Turbo Roundabouts

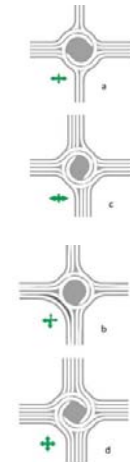
- Emerged to address the issues of conventional multi lane roundabouts.

## Characteristics

- Non circular central island
- No lane changing on the roundabout and near entry and exit
- Drivers are forced to follow specific path according to their destination.

## Advantages

- Reduction in conflict points
- Speed reduction along the entry, circulatory and exit zone.
- Low risk of side by side accidents



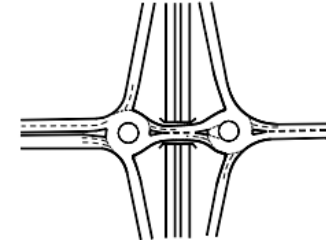
### 3. Raindrop Roundabouts

- Do not form a complete circle and have a "raindrop" shape.
- eliminate direct U-turn movements
- Can be provided to accommodate high turning movements



### 4. Twin, Dumb bell Roundabouts

- The double-roundabout - "dumb-bell" is a "hybrid" between the diamond interchange and the roundabout.
- Ramp intersections may be configured as a pair of roundabouts to create a so-called "twin roundabout" interchange.
- A variation known as the "dog-bone" occurs when the roundabouts do not form a complete circle but instead have a "double teardrop" shape



### 5. Two –geometry Roundabouts

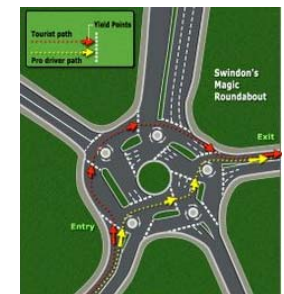
- A two-geometry roundabout is defined when the shape of the external margin is different from that of the central island  
e.g. the central island is circular and the external margin is elliptic.

#### Advantages

- It require less space, and may be more suited to locations with boundary constraints;
- Guarantee trajectory deflection and foster speed reduction with smaller centreline offsets, as may be common with "T" intersections;
- They may be more conducive to oversize/overweight large trucks due to varying lane width.

### 6. Magic Roundabouts

- "Magic roundabouts" are also known as "Ring Junctions".
- Despite clockwise traffic flows in British roundabouts, traffic is permitted to flow in a counter-clockwise direction within the roundabout.
- Consists of five mini-roundabouts arranged around a sixth central, anti-clockwise roundabout.
- It offers multiple paths between feeder roads.





## 7. Hamburger or Through about or Cut – through Roundabouts

- The hamburger roundabout is a type of roundabout with a straight-through section of carriageway regarding major roads.
- It has a split central island with a splitter island between the two halves of the central island.
- The width of the intermediate splitter island is equal to the length of one heavy vehicle or one bus (or more, but not less).
- The inscribed circular diameter of the hamburger roundabout is about 60 m or more.



## ROUNDBABOUTS ACCORDING TO ROAD HEIRARCHY (International Practices)

Road Classification 1 SU single lane 1 WB 40 single lane	Circulatory Lanes	Design Vehicle	Roundabout Type
Local	1	SU	Single lane
Collector	1	WB 40	Single lane
Minor arterial	1	WB 50	Single lane
Minor arterial	2	WB 50	Multi lane
Major arterial	2	WB 50	Multi lane
Area noted above, regardless of class	1-2	WB 67	Single or multi lane

Source:AASHTO

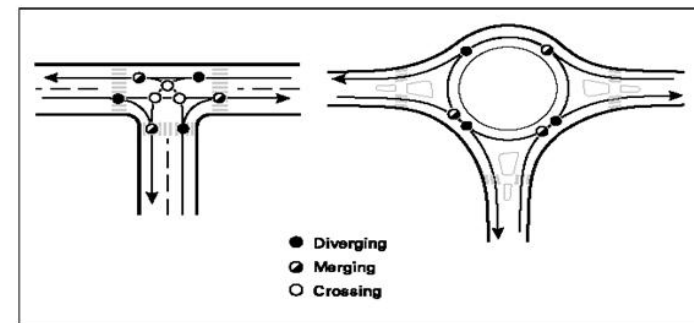
## Issues concerning Safety

### Motor vehicle Conflicts

- At traditional junctions with stop signs or traffic lights, the most serious accidents are right-angle, left-turn, or head-on collisions that can be severe because vehicles may be moving fast and collide at high angles of impact.
- Roundabouts eliminate these crashes as all vehicles travel in the same direction and most crashes are glancing blows at low angles of impact.
- Roundabouts are safer than traffic circles and junctions as they reduce conflict points

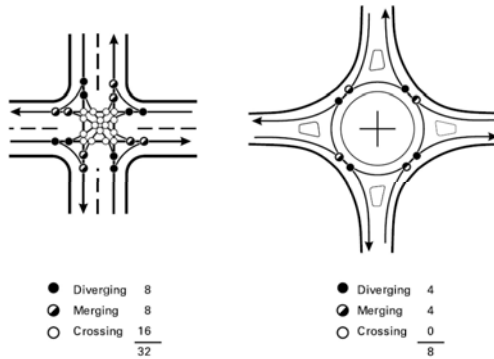
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## Traffic at Intersections



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### Traffic at Intersections



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### Traffic at Intersections



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### Conflict analysis at roundabouts



Angle of conflict in degree	2W-2W	2W-CAR
less than 20	0%	39%
20 - 30	0%	39%
30 - 45	63%	23%
more than 45	37%	0%

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### Deflection at entry – a good design approach



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**Truck Apron**

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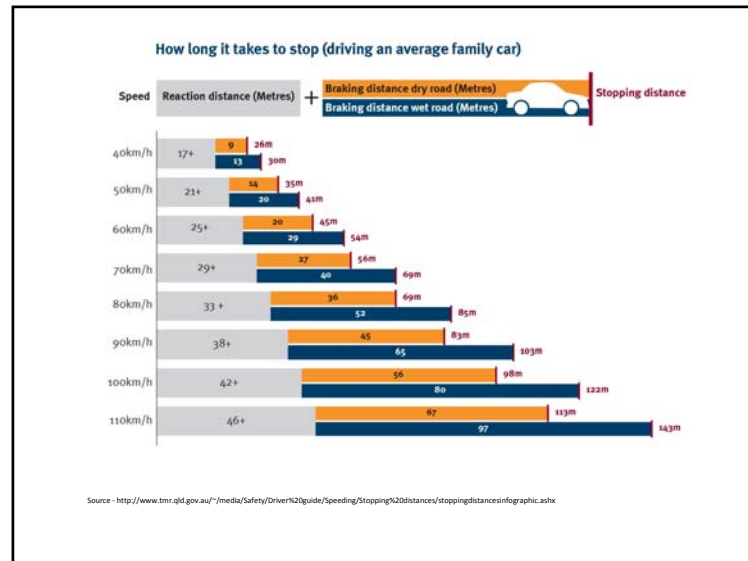
**Drainage and Apron**

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**Kerb height and Visibility**

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## Visibility blocks



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## Issues concerning Safety

### Cyclists

- Large roundabouts with faster traffic, are unsafe for cyclists.
- This problem is sometimes addressed at larger roundabouts by taking foot and bicycle traffic through a series of underpasses or alternate routes.
- motorists leaving the roundabout, colliding with cyclists who are continuing farther around the perimeter of the roundabout.

### Pedestrians

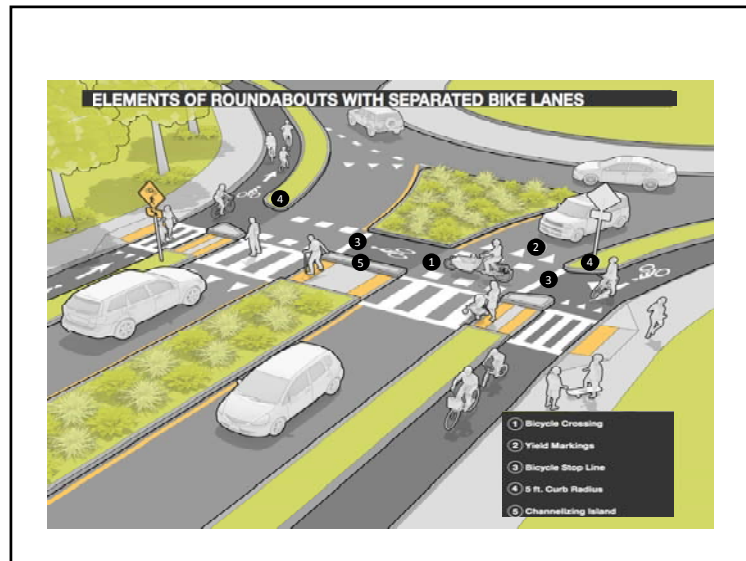
- If the adjacent footpaths are not properly designed, there are increased risks for persons with visual impairments.
- It is more difficult to detect whether there is a gap in traffic adequate to cross.

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## Non-motorized Design Users

User	Dimension	Affected Roundabout Features
<b>Bicycles</b>		
Length	1.8 m (5.9 ft)	Splitter island width at crosswalk
Minimum operating width	1.5 m (4.9 ft)	Bike lane width
Lateral clearance on each side	0.6 m (2.0 ft); 1.0 m (3.3 ft) to obstructions	Shared bicycle-pedestrian path width
<b>Pedestrian (walking)</b>		
Width	0.5 m (1.6 ft)	Sidewalk width, crosswalk width
<b>Wheelchair</b>		
Minimum width	0.75 m (2.5 ft)	Sidewalk width, crosswalk width
Operating width	0.90 m (3.0 ft)	Sidewalk width, crosswalk width
<b>Person pushing stroller</b>		
Length	1.70 m (5.6 ft)	Splitter island width at crosswalk
<b>Skaters</b>		
Typical operating width	1.8 m (6 ft)	Sidewalk width





### SIGNAGES USED

- Regulatory signs

- Yield signs



- ONE WAY

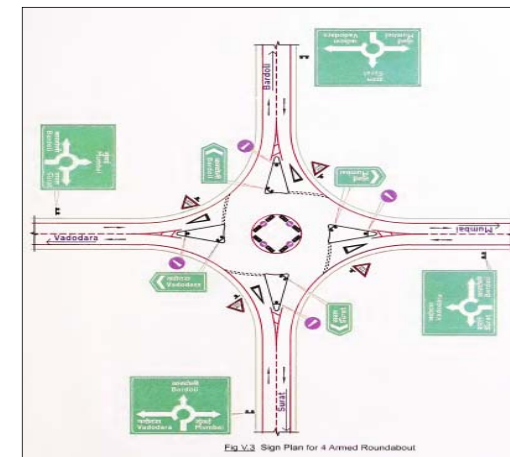
- Keep Left

- Lane- use control signs

- Warning signs



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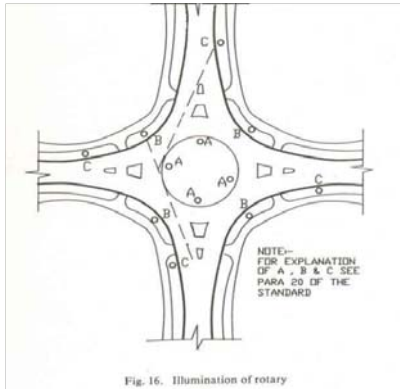


**SIGN PLAN FOR INDIAN ROUNDABOUTS**  
(According to IRC)



## ILLUMINATION

- If central island is small, (less than 20m dia), satisfactory results will be obtained by a single lantern having symmetrical distribution and mounted centrally at a height of 8 meters or more. (9-10 m mounting height is advantageous)
- For larger central islands:
- **LANTERN A:** provided above the curb of the central island in line with each appropriate traffic lane
- **LANTERN B:** (1 or more in number) provided above each section of the outer curb of the rotary (for rotaries with central island dia>30m)
- **LANTERN C:** provided at pedestrian cross at the channelising island.



## LANDSCAPING

- Plant material should be selected so that sight distance is maintained, including consideration of future maintenance requirements to ensure adequate sight distance for the life of the project.
- Large, fixed landscaping (trees, rocks, etc.) should be avoided in areas vulnerable to vehicle runoff.
- Ensure that whatever landscaping is installed, it will be maintained.



## Planning steps of RA

**The following steps may be followed when deciding whether to implement a roundabout at an intersection:**

- Step 1: Consider the context.
- Step 2: Determine the preliminary lane configuration
- Step 3: Identify the type
- Step 4: Determine the space requirements.
- Step 5: If additional space must be acquired or alternative intersection forms are viable, an economic evaluation may be useful

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## SELECTION CRITERIA OF ROUNDABOUT

### 1. Location

- High Accident Location (with left turn or right angle accidents)
- Capacity/Delay Problem Intersection
- Intersection in which traffic signal was requested but not warranted
- 4-Way Stops

### 2. Traffic Volume and Composition

- Heavy Delay on Side Street
- Flow Distribution with Heavy Left Turn Movement (makes signals less efficient -no impact on roundabout)
- DHV of 7000 or Less (initially)

### 3. Right-of-Way

- Generally take no more right-of-way than comparable solution using signals:

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**4. Appropriate Sites for Roundabouts**

- Heavy delay on minor road.
- Traffic signals result in greater delay.
- Intersection with heavy left turning traffic
- Intersection with more than four legs or unusual geometry
- At rural intersections (including those in high speed areas) at which there is an accident involving crossing traffic
- Where major roads intersect at “Y” or “T” junctions. At locations where traffic growth is expected to be high and where future traffic patterns are uncertain or changeable
- At intersections where U-turns are desirable
- At Freeway Interchange Ramps
- High accident intersection where right angle accidents are prominent.

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**5. Inappropriate Site for Roundabouts**

- Where a satisfactory geometric design cannot be provided.
- Where a signal interconnect system would provide a better level of service
- Where it is desirable to be able to modify traffic via signal timings.
- Where peak period reversible lanes may be employed
- Where the roundabout is close to existing signals and queueing from the signal could be a problem.

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**Roundabout Geometric design**

- Slow entry speeds
- Appropriate number of lanes
- Smooth channelization
- Adequate accommodation for design vehicles
- Meeting needs of pedestrians and bicyclists
- Appropriate sight distance and visibility

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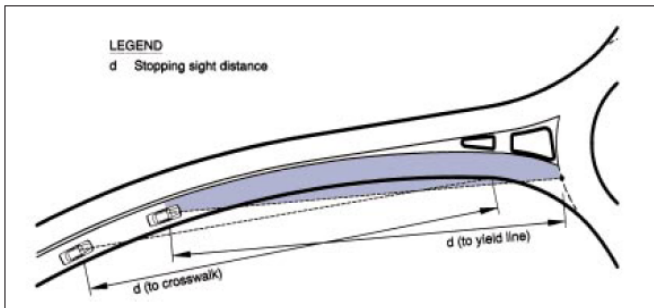
**Key Considerations in Horizontal Design**

- Design speed
- Design vehicle Size
- Path alignment
- Central Island
- Splitter Islands
- Sight Distance
- Cross and Longitudinal Slopes
- Signs and Markings
- Non-motorized Transportation

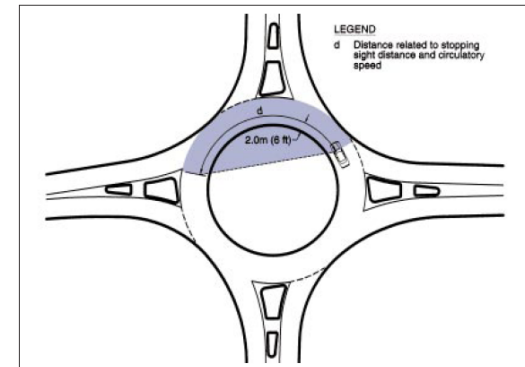
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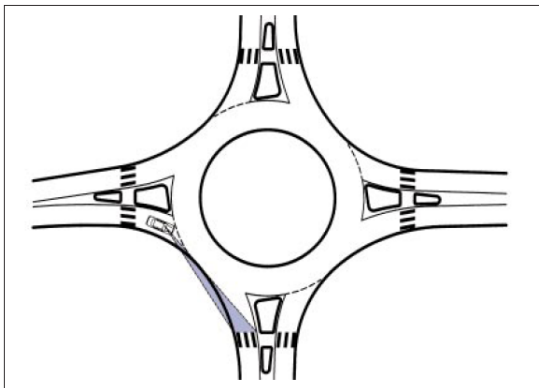
### Approach Sight Distance. (US Conditions)



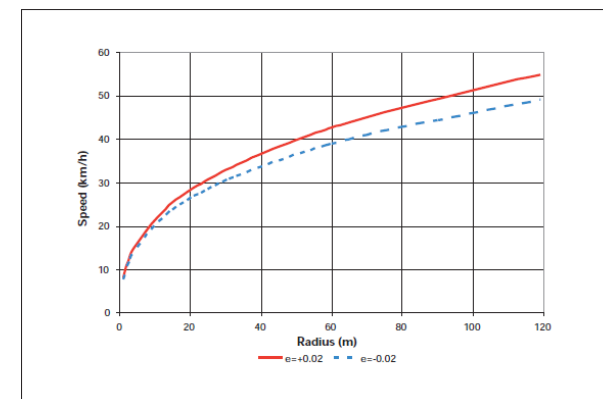
### Sight distance on circulatory roadway (US Conditions)



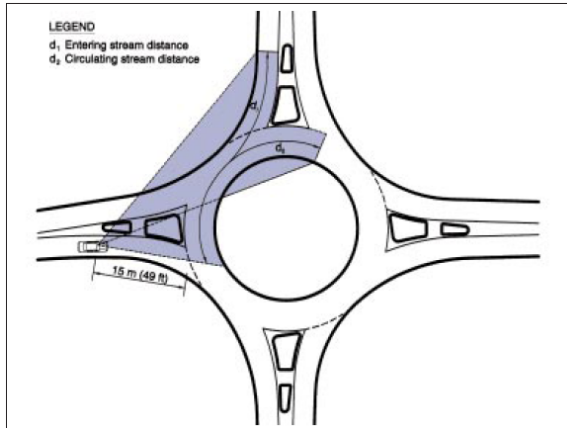
### Sight distance to crosswalk on exit (US Conditions)



### Speed-Radius Relationship (metric units)



### Intersection Sight Distance (US Conditions)



### Research upon Roundabout Capacity

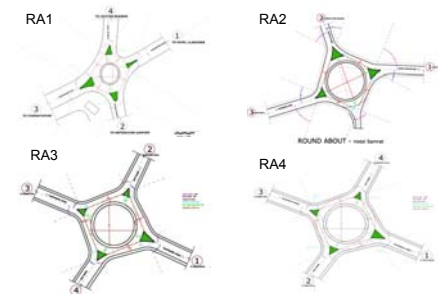
### Network showing roundabouts in New Delhi



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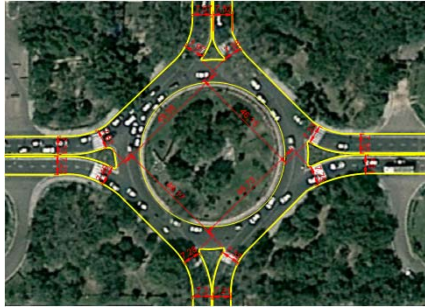
### Round About Details



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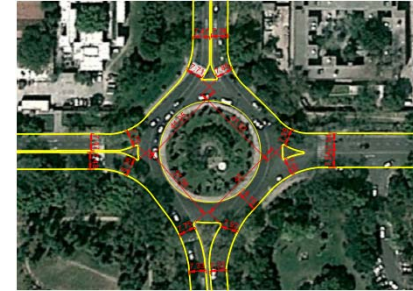
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RA- 4: (Intersection of Shanti Path and Panchshel Marg near US Embassy ,



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RA -3:(Intersection of Panchshel Marg and Niti Marg near Ashoka Hotel)



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### Variation of headways with flow

*Flow below 1000 vehicles per hour*

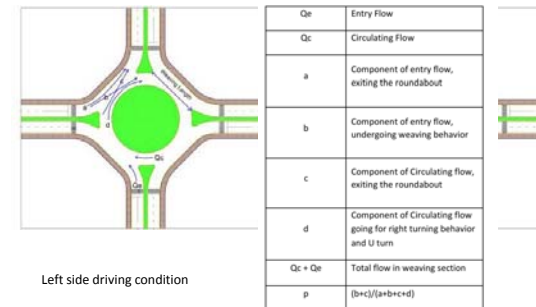


*Flow below 3500 vehicles per hour*



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### Flow terminologies for Roundabouts



Left side driving condition

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## Delays at Roundabouts

### Queuing Delay

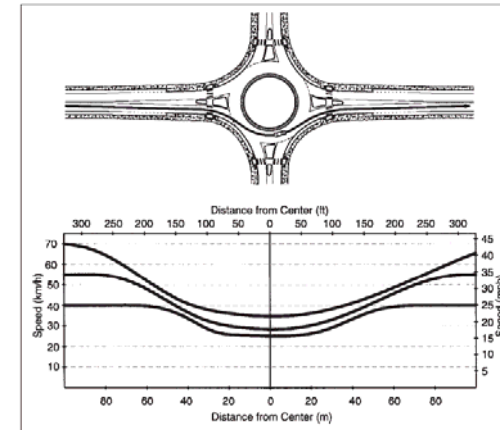
- Queuing delay is the delay to drivers waiting to accept a gap in the circulating traffic.

### Geometric delay

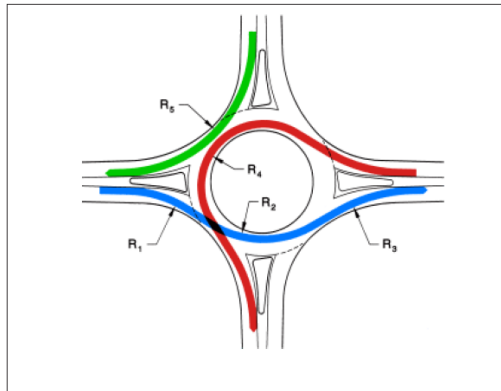
- The delay to drivers slowing down to the negotiation speed, proceeding through the roundabout and then accelerating back to normal operating speed
- The delay to drivers slowing down to stop at the end of the queue and, after accepting a gap, accelerating to the negotiation speed, proceeding through the roundabout and then finally accelerating further to reach normal operating speed. It excludes the time to wait for an acceptable gap.

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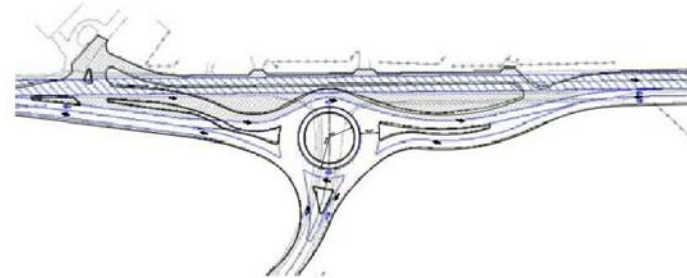
## Sample Theoretical Speed Profile



## Vehicle Path Radii



## Redesign of intersection considering speed reduction



## Roundabout – When and Where ?

### Roundabouts at Highways



### Roundabouts at Highways

- Better than signalization at relatively lower flow
- Larger diameter to accommodate Multi axle vehicle
- Truck apron shall be provided on smaller diameter roundabout
- High visibility should be ensured (irrespective of landscaping)

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### Roundabouts at Highways

- Higher Deflection to reduce entry speed through deflection island and channelization
- Compulsory illumination with suitable signage
- Virtual roundabout at mid-block sections to reduce speed at the approach of settlements
- Should not be provided at high speed corridors

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### Roundabouts in Urban area

- At intersections of Arterial /Sub arterial and lower hierarchy roads
- Or
- At intersection of only lower hierarchy roads
- Not to be provided at intersection of higher only hierarchy roads
- Not to be provided at intersections of higher entry flow

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### Roundabouts in Urban area

- Roundabout with at least 50 m diameter shall be provided
- NMT facilities should be integrated
- Apron shall be provided at smaller diameter roundabouts
- Different pavement material at circulatory section to control speeds

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### Acknowledgements –

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Thank you for your attention

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