Traffic

The Township City when it is fully developed will be subjected generally to light traffic. The heavy commercial vehicles will constitute largely school buses and a few trucks. The major traffic will have cars and vans which have least loading effect on the pavement. But during the initial construction period extending upto 5 years, there will be movement of heavy commercial vehicles constituting primarily construction traffic which will be heavier than standards axle of 10.2 tonnes permitted. Considering these aspects, a traffic volume of 5 million standard axles (msa) is considered for design for the main roads (30m and 45 m wide). For the service roads (5.5 m wide), a traffic of 2 mil. Standard axles are considered.

ANTICIPATED EMISISONS FROM LMV's (LIGHT MOTOR VEHICELS- (GVW ≤ 3,500 kg)**)**
(as per Bharat Stage IV standards)

	CO (g/ Km)	HC+NOx (g/ Km)	NOx (g/ Km)	PM (g/ Km)
Petrol	1.0	0.18	-	-
Diesel	0.50-0.74	0.30-0.46	0.25-0.39	0.025-0.06
Gasoline	1.0-2.27	HC Only=0.1-0.16	0.08-0.11	-

TRUCK & BUS ENGINES (GVW > 3,500 kg)

Diesel	CO (g/ Kwhr)	HC (g/ Kwhr)	NOx (g/ Kwhr)	PM (g/ Kwhr)
	1.5-4.0	0.96	3.5	0.02

2 & 3 WHEEL VEHICLES
(as per Bharat Stage III standards)

	CO (g/ Km)	HC+NOx (g/ Km)	HC (g/ Km)	PM (g/ Km)
2-wheel Gasoline	1.0	1.0	-	-
3-wheel Gasoline	1.25	1.25	-	-

ANTICIPATED EMISSION LOAD

(Ton/year) = Vehicles amount (vehicle/day) x Road length (km) x Emission factor (g/km/vehicle) x 10^{-6} (ton/g) x 365 (days/year)

Where,
Vehicle amount =21220 LMV's
Road Length =20000 LENGTH Zonal Roads (Approx.) =20 Km (Approx.).
Emission Factor (PM) =0.063 g/Km/Vehicles
Emission Load (PM) ton /year=$21220\times20\times0.063\times10^{-6}\times365$=**9.75 Ton /Year**
Emission Factor (NOx) =0.39 g/Km/vehicle
Emission Load (NOx) ton/yr=$21220\times20\times1\times10^{-6}\times365$=**60.41 Ton /Year**

Emission Factor (CO) =1.0 g/km/vehicle

Emission Load (CO) Ton/Year=21220×20×1×10^{-6}×365=**154 Ton/Year**

The quantity of dust emissions from vehicle on a paved road is calculated using

$E=k\ (sL/2)^{0.65}(W/3)^{1.5}$

Where

E=particulate emission factor (having units matching the units of K)

K=base emission factor for particle size range and units of interest

SL=road surface silt loading (grams per square meter) (g/m^2)

W=average Wt. in tons of the vehicles travelling on the road

Silt Loading: 0.02-400 g/m^2[0.03-570 grains /sq. Foot]

Mean vehicle Weight =2.0-42 tons

Mean vehicle speed=6-88 kilometers per hour (kph)

$=0.0690.02/20)^{0.65}(2/3)^{1.5}$

=0.06×0.05×0.54

=**0.001g/Km (Min.)-98.36 g/km (Max.)**

4.3.2.2 SOURCE- DIESEL GENRATORS

As per electrical load detail, the maximum demand load in is 213.90 MVA

Considering power back up of emergency areas like Hospital, Medicity, IIIT, & ATI the required electrical load is 54.99 MVA

Therefore anticipated capacity of DG set for Township would be at least 20 MVA

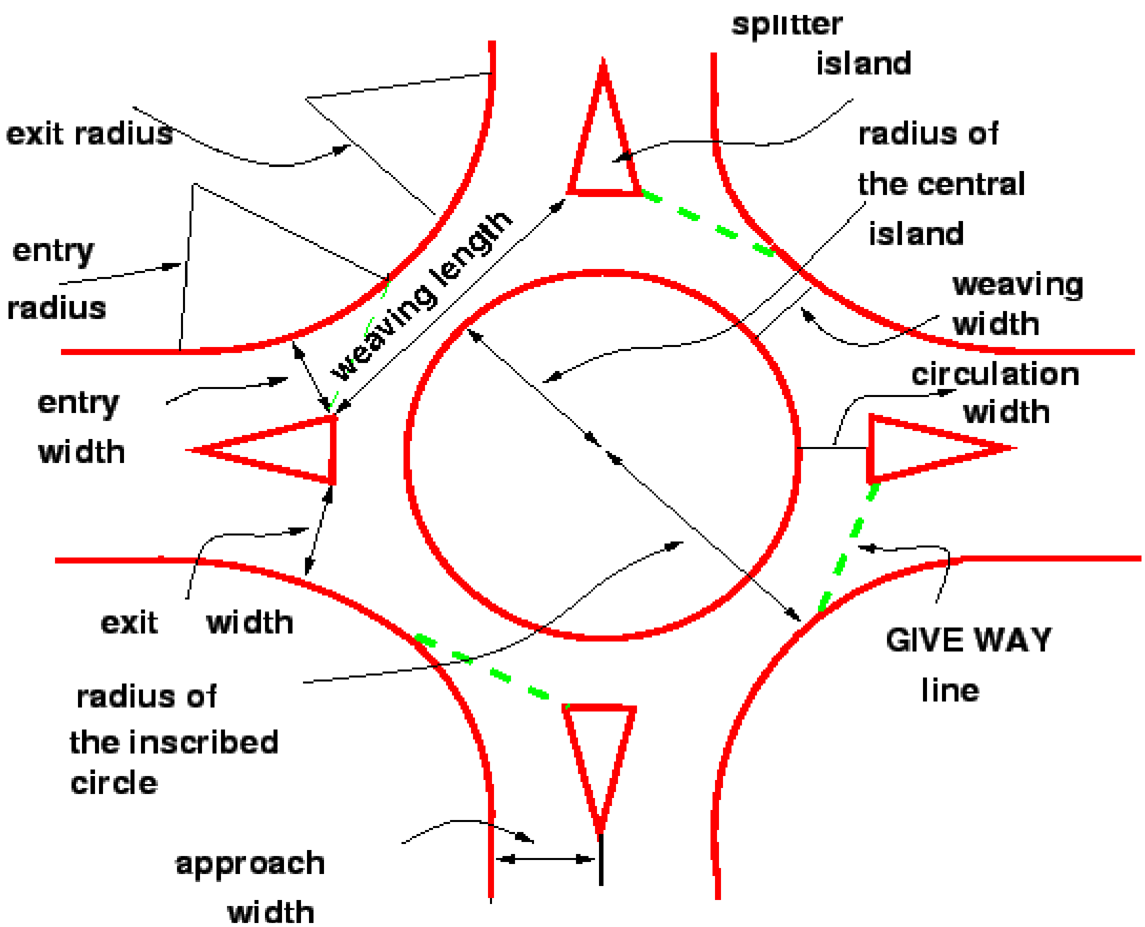
Total DG sets would be 03 nos. x 7000 KVA

Stack Detail					Emission Rate (g/s)		
Capacity	h (m)	d (m)	V (m/s)	T (K)	SPM	SO_2	NOx
7000 KVA	30	1.2	20.0	623	0.63	17.10	18.20

h – Stack height; d – stack internal diameter; V – stack gas exit velocity; T – stack gas Exit temperature

DESIGN OF ROTARIES:

Rotary intersections or round about are special form of at-grade intersections laid out for the movement of traffic in one direction around a central traffic island. Essentially all the major conflicts at an intersection namely the collision between through and right-turn movements are converted into milder conflicts namely merging and diverging. The vehicles entering the rotary are gently forced to move in a clockwise direction in orderly fashion. They then weave out of the rotary to the desired direction.



The key advantages of a rotary intersection are listed below:

1. Traffic flow is regulated to only one direction of movement, thus eliminating severe conflicts between crossing movements.
2. All the vehicles entering the rotary are gently forced to reduce the speed and continue to move at slower speed. Thus, none of the vehicles need to be stopped,unlike in a signalized intersection.
3. Because of lower speed of negotiation and elimination of severe conflicts, accidents and their severity are much less in rotaries.
4. Rotaries are self-governing and do not need practically any control by police or traffic signals.
5. They are ideally suited for moderate traffic, especially with irregular geometry, or intersections with more than three or four approaches.

Although rotaries offer some distinct advantages, there are few specific limitations for rotaries which are listed below.

1. All the vehicles are forced to slow down and negotiate the intersection. Therefore, the cumulative delay will be much higher than channelized intersection.
2. Even when there is relatively low traffic, the vehicles are forced to reduce their speed.
3. Rotaries require large area of relatively flat land making them costly at urban areas.

4. The vehicles do not usually stop at a rotary. They accelerate and exit the rotary at relatively high speed. Therefore, they are not suitable when there is high pedestrian movements.

Because of the above limitation, rotaries are not suitable for every location. There are few guidelines that help in deciding the suitability of a rotary. They are listed below.

1. Rotaries are suitable when the traffic entering from all the four approaches are relatively equal.
2. A total volume of about 3000 vehicles per hour can be considered as the upper limiting case and a volume of 500 vehicles per hour is the lower limit.
3. A rotary is very beneficial when the proportion of the right-turn traffic is very high; typically if it is more than 30 percent.
4. Rotaries are suitable when there are more than four approaches or if there is no separate lanes available for right-turn traffic. Rotaries are ideally suited if the intersection geometry is complex.

Traffic operations in a rotary

1. **Diverging**: It is a traffic operation when the vehicles moving in one direction is separated into different streams according to their destinations.
2. **Merging**: Merging is the opposite of diverging. Merging is referred to as the process of joining the traffic coming from different approaches and going to a common destination into a single stream.
3. **Weaving**: Weaving is the combined movement of both merging and diverging movements in the same direction.

Design elements

The design elements include design speed, radius at entry, exit and the central island, weaving length and width, entry and exit widths.

Design speed

All the vehicles are required to reduce their speed at a rotary. Therefore, the design speed of a rotary will be much lower than the roads leading to it. Although it is possible to design roundabout without much speed reduction, the geometry may lead to very large size incurring huge cost of construction. The normal practice is to keep the design speed as 30 and 40 kmph for urban and rural areas respectively.

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Entry, exit and island radius

The radius at the entry depends on various factors like design speed, super-elevation, and coefficient of friction. The entry to the rotary is not straight, but a small curvature is introduced. This will force the driver to reduce the speed. The entry radius of about 20 and 25 meters is ideal for an urban and rural design respectively.

The exit radius should be higher than the entry radius and the radius of the rotary island so that the vehicles will discharge from the rotary at a higher rate. A general practice is to keep the exit radius as 1.5 to 2 times the entry radius. However, if pedestrian movement is higher at the exit approach, then the exit radius could be set as same as that of the entry radius.

The radius of the central island is governed by the design speed, and the radius of the entry curve. The radius of the central island, in practice, is given a slightly higher radius so that the movement of the traffic already in the rotary will have priority. The radius of the central island which is about 1.3 times that of the entry curve is adequate for all practical purposes.

Width of the rotary

The entry width and exit width of the rotary is governed by the traffic entering and leaving the intersection and the width of the approaching road. The width of the carriageway at entry and exit will be lower than the width of the carriageway at the approaches to enable reduction of speed. IRC suggests that a two lane road of 7 m width should be kept as 7 m for urban roads and 6.5 m for rural roads. Further, a three lane road of 10.5 m is to be reduced to 7 m and 7.5 m respectively for urban and rural roads.

The width of the weaving section should be higher than the width at entry and exit. Normally this will be one lane more than the average entry and exit width. Thus weaving width is given as,

$$w_{\text{weaving}} = \left(\frac{e_1 + e_2}{2}\right) + 3.5m \tag{1}$$

Where e_1 is the width of the carriageway at the entry and e_2 is the carriageway width at exit.

Weaving length determines how smoothly the traffic can merge and diverge. It is decided based on many factors such as weaving width, proportion of weaving traffic to the non-weaving traffic etc. This can be best achieved by making the ratio of weaving length to the weaving width very high. A ratio of 4 is the minimum value suggested by IRC. Very large weaving length is also dangerous, as it may encourage over-speeding.

Capacity
The capacity of rotary is determined by the capacity of each weaving section. Transportation road research lab (TRL) proposed the following empirical formula to find the capacity of the weaving section.

$$Q_w = \frac{280w[1+\frac{e}{w}][1-\frac{p}{3}]}{1+\frac{w}{l}} \tag{2}$$

Where e is the average entry and exit width, i.e., $\frac{(e_1+e_2)}{2}$, w is the weaving width, l is the length of weaving, and p is the proportion of weaving traffic to the non-weaving traffic. Figure 3 shows four types of movements at a weaving section, a and d are the non-weaving traffic and b and c are the weaving traffic.

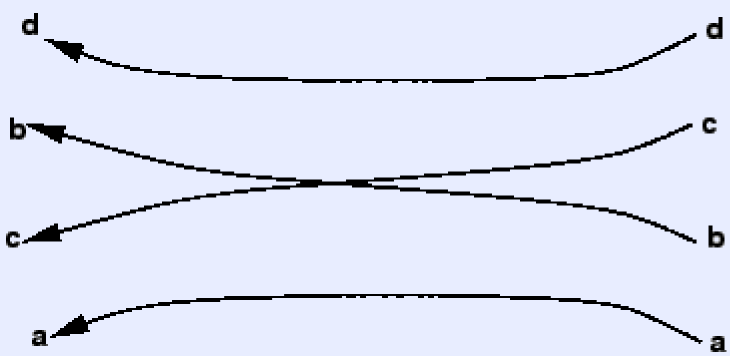

Figure 3: Weaving operation in a rotary

Therefore,

$$p = \frac{b+c}{a+b+c+d} \quad (3)$$

This capacity formula is valid only if the following conditions are satisfied.

1. Weaving width at the rotary is in between 6 and 18 meters.
2. The ratio of average width of the carriage way at entry and exit to the weaving width is in the range of 0.4 to 1.
3. The ratio of weaving width to weaving length of the roundabout is in between 0.12 and 0.4.
4. The proportion of weaving traffic to non-weaving traffic in the rotary is in the range of 0.4 and 1.
5. The weaving length available at the intersection is in between 18 and 90 m.

Numerical example

The width of a carriage way approaching an intersection is given as 15 m. The entry and exit width at the rotary is 10 m. The traffic approaching the intersection from the four sides is shown in the figure 4 below. Find the capacity of the rotary using the given data.

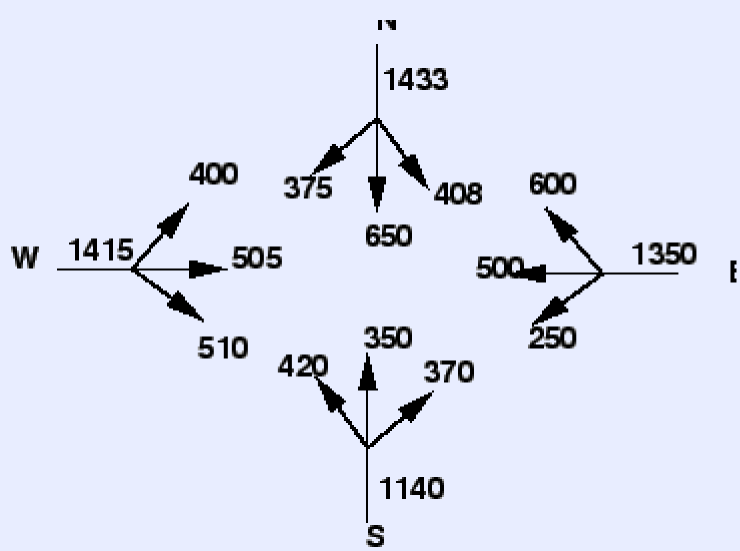

Figure 4: Traffic approaching the rotary

Solution

- The traffic from the four approaches negotiating through the roundabout is illustrated in figure 5.

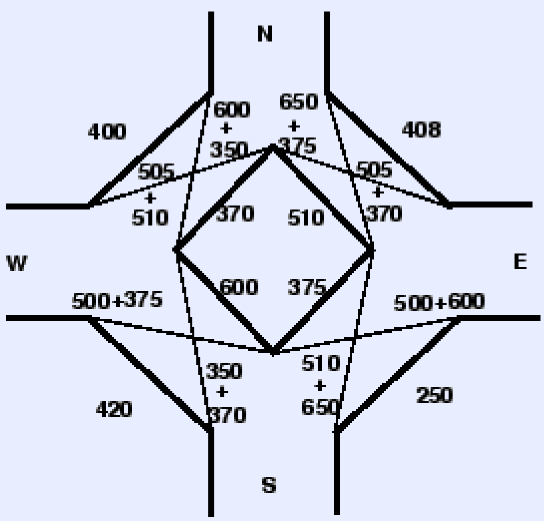

Figure 5: Traffic negotiating a rotary

- Weaving width is calculated as, w = $\left[\frac{e_1+e_2}{2}\right] + 3.5$ = 13.5 m
- Weaving length, l is calculated as = 4 $\times$ w = 54 m
- The proportion of weaving traffic to the non-weaving traffic in all the four approaches is found out first.

- It is clear from equation, that the highest proportion of weaving traffic to non-weaving traffic will give the minimum capacity. Let the proportion of weaving traffic to the non-weaving traffic in West-North direction be denoted as p_{WN}, in North-East direction as p_{NE}, in the East-South direction as p_{ES}, and finally in the South-West direction as p_{SW}.
- The weaving traffic movements in the East-South direction is shown in figure 6. Then using equation,

$$
\begin{aligned}
p_{ES} &= \frac{510+650+500+600}{510+650+500+600+250+375} = \frac{2260}{2885} = 0.783 \\
p_{WN} &= \frac{505+510+350+600}{505+510+350+600+400+370} = \frac{1965}{2735} = 0.718 \\
p_{NE} &= \frac{650+375+505+370}{650+375+505+370+510+408} = \frac{1900}{2818} = 0.674 \\
p_{SW} &= \frac{350+370+500+375}{350+370+500+375+420+600} = \frac{1595}{2615} = 0.6099
\end{aligned}
$$

- Thus the proportion of weaving traffic to non-weaving traffic is highest in the East-South direction.

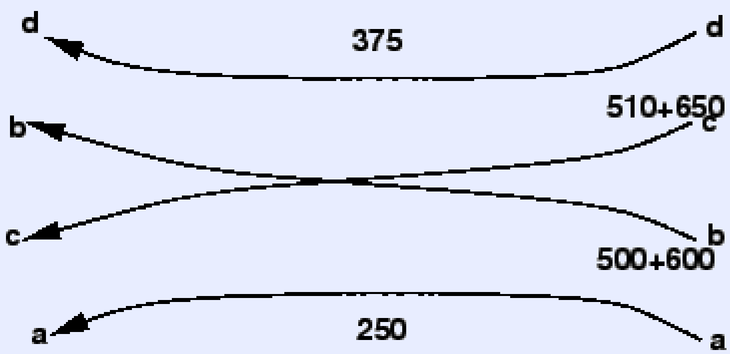

Figure 6: Traffic weaving in East-South direction

- Therefore, the capacity of the rotary will be capacity of this weaving section. From equation,

$$Q_{ES} = \frac{280 \times 13.5[1 + \frac{10}{13.5}][1 - \frac{0.783}{3}]}{1 + \frac{13.5}{54}} = 2161.2 \text{ veh/hr}. \quad (4)$$