O and D study- lecture ⑥ 21/04/19

It is more essential in planning highway facility and improving existing road system

Method For O and D data collection :-

① Road side interview method :} use in india
② License plate method
③ Tag on car method
④ Written Post card method} use in foreign
⑤ Home interview method

Representation of O and D Data

① O & D table it shows no. of trip b/w different zone

② Desire line → it is straight line connecting origin to destination. it shows actual desire of road user

** Thickness of desire line ∝ No. of trips in both dirn

③ Pie chart → it is shown by circle in which diameter is being proportional to no. of trip in both dirn

★ Accident study :- ① When a moving vehicle collides with a parked vehicle

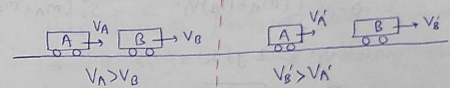
② Two vehicle approaching from different dirn collide with at intersection

③ head of collision b/w 2 cars

④ When moving car colloide with rigid structure.

Newton law of collision :-

Before collision | After collision



Co-eff. Restitution

$$e = \left(\frac{\text{Velo. of Separation}}{\text{vel. of Approach}}\right) = \left[\frac{V_B' - V_A'}{V_A - V_B}\right]$$

case ① Elastic collision

$e = 1$

vel of sep = vel. of Approach

$[V_B' - V_A'] = (V_A - V_B)$

case ② Perfectly Plastic collision

$e = 0$

velo. of sep. $= 0$

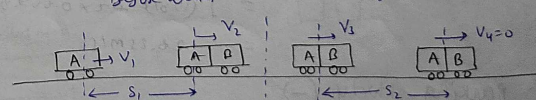
$[V_B' - V_A'] = 0$

$\underbrace{V_B' = V_A'}$

Both velocity will stick and will move together

When a moving vehicle collides with parked vehicle →

Assumption → vehicle A apply brake before collision braking efficiency is 100%, collision is perfectly plastic



1.	Initial speed	V_1	0	Skid resistance → f f
2.	speed just before collision	V_2	0	
3.	speed just after collision	V_3	V_3	
4.	Skid distance before collision	S_1	0	
5.	Skid distance after collision	S_2	S_2	
6.	Mass of veh.	m_A	m_B	

Step ① After collision

$\Delta KE = W.D$

$0 - \frac{1}{2}(m_A+m_B)V_3^2 = -S_2(m_A+m_B)g.f$

$V_3^2 = 2gfS_2$

$V_3 = \sqrt{2gfS_2}$

Step ② momentum eqn

momentum just before collision = momentum after collision

$m_A V_2 + m_B \cdot 0 = (m_A+m_B)V_3$

$V_2 = \left(\frac{m_A+m_B}{m_A}\right)V_3$

Step ③ Before collision

$\Delta KE = WD$

$\frac{1}{2}m_A V_2^2 = \frac{1}{2}m_A V_1^2$

$V_1^2 - V_2^2 = 2fgS_1$

$V_1 = \sqrt{V_2^2 + 2fgS_1}$

$= \sqrt{(19.01)^2 + 2\times 0.6\times 9.81\times 40}$

$= 26.85\ m/s$

Parking study (–)

① On street parking –

② Off street parking

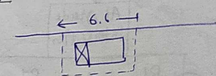
① On street parking :- when the parking facility is provided along ~~away~~ ~~for~~ kerb of road it is called onstreet parking / Kerb facility.

⇒ Angle parking are allowed in this type of parking facility and 45° angle is consider are best among all.

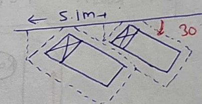
Note this type of parking facility may cause ~~condit~~ congestion and delay problem to the traffic.

• Various On Street Parking :-

1] Parallel Parking →

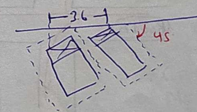


2] 30° Angle Parking →



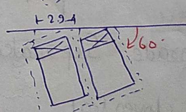
$N = \left(\frac{L-0.85}{5.1}\right)$

3] 45° Angle Parking →



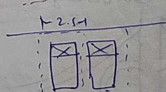
$N = \left(\frac{L-2}{3.6}\right)$

4] 60° Angle Parking →

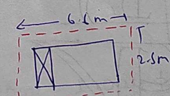


$N = \frac{L-2}{2.9}$

5] 90° Angle Parking →



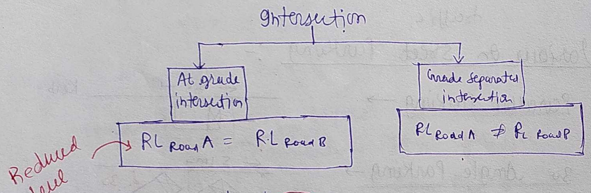
$N = \frac{L}{2.5}$

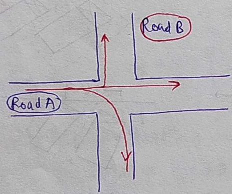


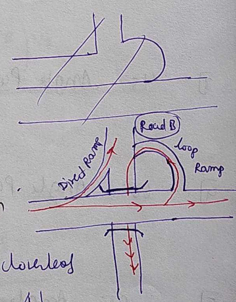
OFF-Street Parking When the parking facility provided away from curve of road. it is called off street parking there is no congestion and problem to the traffic due to this parking.

(C) Traffic control and devices →

1. Intersection
2. Traffic signal
3. Traffic sign

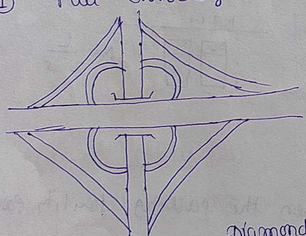




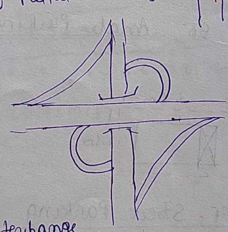


Various Grade Separated intersection

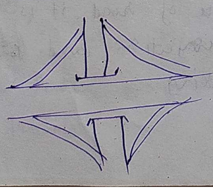
① Full cloverleaf



② Partial cloverleaf



Diamond interchange



(Right turn give more conjection) that's why it is not allow same time

At grade intersection →

Strong

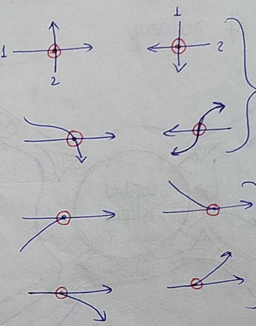
1] Crossing conflict

2] Weaving conflict

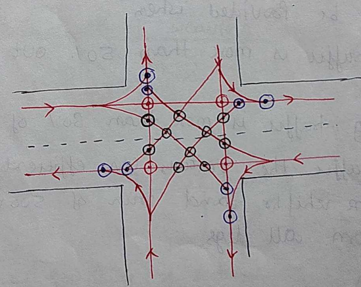
3] Merging conflict

4] Diverging conflict

Weak

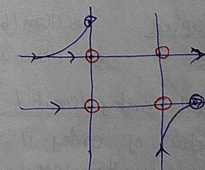


2 lane - 2 way Road →



C = 4
M = 4+4
W = 12
24

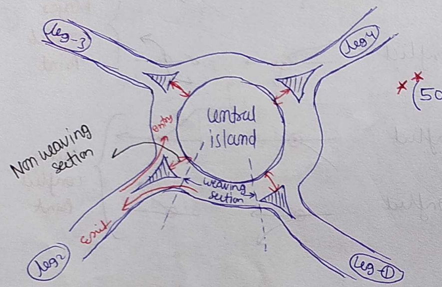
2 lane - 1 way traffic →



C = 4
M = 2
⑥

Design of Rotatary :-

Element of rotary



** (500 – 3000 veh/hr)

General guide line for design of rotary:

// rotary must be Provided when

(a) Intersecting traffic is more than 50% out of total traffic

(b) Right turning traffic is more than 30% of total traffic

(c) The max. traffic the rotary can efficiently handle is 3000 ~~km~~ vehi/hr. and min of 500 veh/hr. entering from all legs.

Design Parameter:

① Design speed : 30 km/hr and 40 km/hr
शहर Urban area — Rural area गाँव

② Radius at entry / exit / central island :-

① Radius of entry is always Provide with crv to reduce the speed of vehicle forcefully

② Superelevation in a rotary provided equal to camber but for radius calculation we assume it at '0'

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$$\cancel{e} + f = \frac{V^2}{127R} \quad \text{then} \quad \boxed{R_{entry} = \frac{V^2}{127 f}}$$

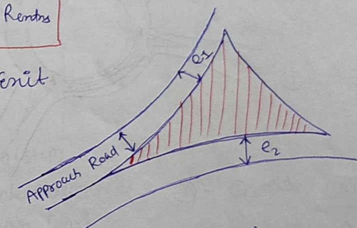
$$f = \frac{V^2}{127R}$$

$R_{exit} = (1.5 \text{ to } 2)\ R_{entry}$

R_{CI} = Radius of central traffic island

$$\boxed{R_{CI} = \frac{4}{3} R_{entry}}$$

③ Width of entry / Exit



Approach Road width	7	10.5	14	21
Width at entry (e_1)	6.5	7	8	13

$(e_2 \nless e_1)$

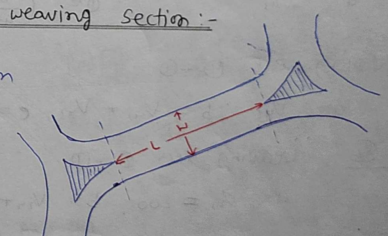
If data not given consider $(e_2 = e_1)$

④ Length of width of weaving section :-

$$W = \left(\frac{e_1 + e_2}{2} + 3.5\right) m$$

$L \nless 4W$

$\boxed{L \simeq 4W}$



⑤ Practical capacity of rotary →

$$Q_p = \left[\frac{280W\left(1 + \frac{e}{W}\right)\left(1 - \frac{P_{max}}{3}\right)}{\left(1 + \frac{W}{L}\right)}\right] \text{PCU/hr}$$

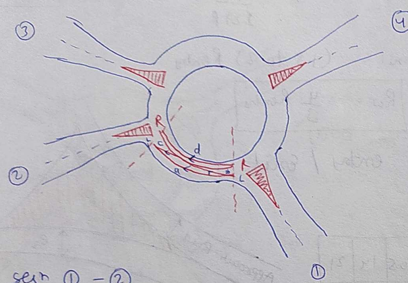
Where W = width of weaving secn

e = Avg entry width $\left(\frac{e_1 + e_2}{2}\right)$

L = length of weaving secn

P → weaving ratio (it is taken max. various weaving section)

Weaving rotary :-



weaving sec^n ① – ②

$a = V_{12}$

$b = V_{13} + V_{14}$

$c = V_{32} + V_{42}$

$d = V_{43}$

weaving ratio = $\left(\dfrac{\text{weaving traffic}}{(a+b+c+d)} \right)$ = total traffic

$P = \left(\dfrac{b+c}{a+b+c+d} \right)$

weaving sec^n ④ – ①

$a = V_{41}$, $b = V_{42} + V_{43}$, $c = V_{21} + V_{31}$, $d = V_{32}$

Pb - 52 Weaving sec^n ② – ③

$a = V_{23} = 200$, $b = V_{24} + V_{21} = 1400$, $c = V_{43} + V_{13} = 1050$

$d = V_{14} = 412$

$P = \dfrac{(1400 + 1050)}{(200 + 1400 + 1050 + 412)} = \boxed{0.8}$

Sec^n ③ and ④

$a = V_{34}, = 240$

$b = V_{31} + V_{32} = 1520 + 570 = 2090$

$c = V_{14} + V_{24} = 412 + 1090 = 1502$

$d = V_{21} = 310$

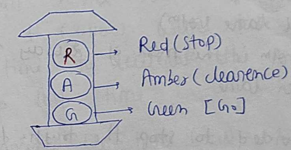
$P = \dfrac{2090 + 1502}{240 + 2090 + 1502 + 310} = 0.867$ Ans

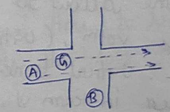
Pb - 53 capacity $= \left(\dfrac{280w\left(1 + \frac{e}{w}\right)\left(1 - \frac{p}{3}\right)}{\left(1 + \frac{w}{L}\right)} \right)$

$= \dfrac{280 \times 14 \left(1 + \frac{8.4}{14}\right)\left(1 - \frac{0.5}{3}\right)}{\left(1 + \frac{14}{35}\right)}$

$= 3733.33$ pcu/hr

* Traffic Signal :-

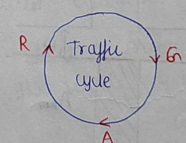


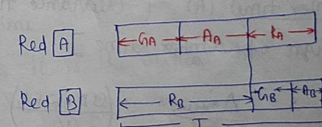


$G_A + A_A = R_B$

$G_B + A_B = R_A$

* Phase diagram

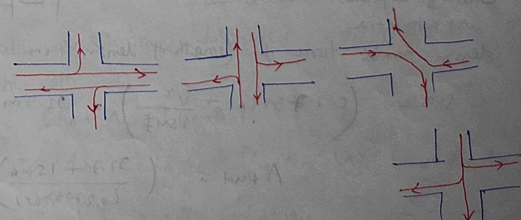




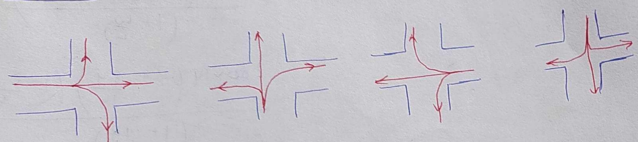
cycle time = $(G_A + A_A + R_A) = (G_B + A_B) + (G_B + A_B)$

Phase

Type ①



Type-②



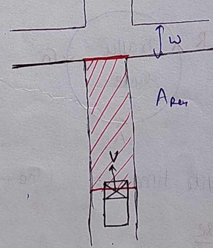
Important terminology

(Green time)
green time allow to traffic flow it is design on the bassis of traffic volm, (critical lane volm)
Note : critical lane volm is the max. of 2 way traffic considered in term of per lane

(Red time) Red time Provided to stop the traffic flow so that traffic on cross road can be started.

(amber time) (A) (clearance time provided after green time)

[Design of amber time]



$$\underbrace{A_{reqi}}_{\text{Amber required}} = \left(\frac{SSD+W+L}{\underbrace{V}_{\text{velocity}}}\right)$$

(Pb) V = 65 km/h
width of approach = 15 m at intersection
design amber time if length of design = 6m

$$SSD = \left(0.278 V t_R + \frac{V^2}{254 f}\right) \approx 92.7\,m$$

$$A_{reqd} = \left(\frac{92.7+15+6}{(0.2778 \times 65)}\right)$$

$$= 6.29 \text{ second}$$

(iv) Lost time (t) It is the time which is not utilise effectivelly for movement. Some time is lost during the beginning of green and some time is lost at the end of amber

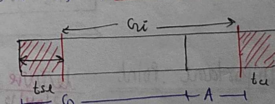
$$\boxed{t = \underbrace{t_{sl}}_{\text{Startup lost time}} + \underbrace{t_{cl}}_{\text{clearance lost time}}}$$

① Startup lost time (t_{sl}) :- When a signal for an approach road turns red to green the driver standing very near to the (Queue) usual take some time to react and some time to accelerate the vehicle. this lost time is called startup lost time.

② clearance lost time (t_{cl}) = when a signal for an approach road turns green to amber then due to Psychological reason little portion of amber time is not utilize effectively called clearance lost time.

③ Effective green time → it is the actual time available for the vehicle to cross the intersection

$$G_i = G + A - (t_{sl} + t_{cl}) \quad . \quad \boxed{G_i = G + A - t}$$



Note: Effective green time is distributed in the same ratio of traffic volm

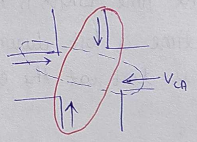
$$T = (G_A + A_A) + (G_B + A_B)$$

$$T - t_A - t_B = (G_A + A_A - t_A) + (G_B + A_B - t_B)$$

$$\Rightarrow (T - t_A - t_B) = G_{iA} + G_{iB}$$

$$G_{iA} + G_{iB} = (T - \text{total lost time})$$

V_c = critical lane vol^m (max traffic flow)



$$G_{iA} = \frac{V_{CA}}{(V_{CA} + V_{CB})}(G_{iA} + G_{iB})$$

$$G_{iB} = \frac{V_{CB}}{V_{CA} + V_{CB}} \times (G_{iA} + G_{iB})$$

Ans (45) $G_{iA} + G_{iB} = (T - \text{total lost time})$

$= 60 - 2.5 - 3.5$ (T = cycle time)

$= 54$ sec

500, 450 इन दोनो मे जो maximum होगा

$V_{CA} = 500$

300, 250 मे $V_{CB} = 300$

$$G_{iA} = \frac{V_{CA}}{V_{CA} + V_{CB}} * (G_{iA} + G_{iB}) = \frac{500}{500+300} \times (54) = 33.7 \text{ sec}$$

$$G_{iB} = \frac{V_{CB}}{V_{CA} + V_{CB}} [G_{iA} + G_{iB}] = \frac{300}{500+300} (54) = 20.25$$

$G_i = G + A - t$

$G_{iA} = G_A + 3 - 2.5$

$G_A = 33.25$ sec

$G_{iB} = G_B + A_B - t_B$

$20.25 = G_B + 4 - 3.5$

$\boxed{G_B = 19.75 \text{ sec}}$

Phase diagram

$G_A = 33.25$	$A_A = 3$	$R_A = 23.75$

$R_B = 36.25$	$G_B = 19.75$	$A_B = 4$

$T = 60$ sec