Some important point

lecture (7)
22/04/19

(1) Capacity of lane = Green Ratio x Saturation flow Rate

$$C = \left(\frac{G_i}{T} \times \frac{3600}{(h_i)} \right)$$

(2) Cycle time on the basis of startup lost time

$$\boxed{T = \left(\frac{n\, t_{sl}}{1 - \Sigma \frac{V_{ci}}{S_i}} \right)}$$

G_i = effective green time, $T \rightarrow$ cycle time, H_i = saturation time headway

C = traffic capacity of lane in (vehicle/hr)

n = No. of Phase

t_{sl} = startup lost time

V_{ci} = critical lane volm

S_i = ~~$~~ saturation flow rate $\left(S_i = \frac{3600}{h_i} \right)$

(47) $T = 60$ sec

$G_i = G + A - (t_{sl} + t_e) = 27 + 4 - (2+1) = 28$ sec.

$h_i = 2.4$ sec

$C = \left(\frac{C_i}{T} \times \frac{3600}{h_i} \right) = \frac{28}{60} \cdot \frac{3600}{2.4} = 700$ veh/hr.

(48)

P-1 P-2

$V_{c1} = 575$

$V_{c2} = 650$

$\Sigma \frac{V_{ci}}{S_i} = \frac{575}{\left(\frac{3600}{2.3}\right)} + \frac{650}{\left(\frac{3600}{2.3}\right)}$

$T = \left(\frac{n\, t_{sl}}{1 - \Sigma \frac{V_{ci}}{S_i}} \right) = \frac{2 \times 3}{1 - \left(\frac{575 + 600}{\left(\frac{3600}{2.3}\right)} \right)}$

$= 27.6$ sec

- **Design of signal timings → by**

Webster method → this method is based on total lost time

As per this method

optimum cycle time

$$C_o = \left(\frac{1.5L + 5}{1 - Y} \right) \text{sec}$$

when, L = total lost time (including all phase)

$L = (2n + R)$, n → No. of Phase, R → All Red time

Y = sum of critical flow ratio

$Y = y_1 + y_2 =$ for 2 Phase

$y_1 + y_2 + y_3 + y_4 =$ 4 Phases

y_e critical flow Ratio = $\left(\frac{\text{Normal traffic flow}}{\text{saturation flow Rate}} \right)$

Green time

$$\left.\begin{aligned} G_1 &= \frac{y_1}{\cancel{y}}(C_0 - L) \\ G_2 &= \frac{y_2}{y}(C_0 - L) \end{aligned}\right\}$$ as per the new min amber time

= 2 sec per phase

Pb (50) $L = (2n + R) = 2\times2 + 12 = 16$ sec

$y = y_1 + y_2$

$= \frac{400}{1250} + \frac{250}{1000} = 0.32 + 0.25$

$= 0.57$

optimum cycle time

$C_0 = \left(\frac{1.5L + 5}{1 - y} \right) = \left(\frac{1.5 \times (16) + 5}{1 - 0.57} \right) = 67.44$ sec

Green time $G_1 = \frac{y_1}{y}(C_0 - L) = \frac{0.32}{0.57} \times (67.44 - 16) = (28.88$ sec$)$

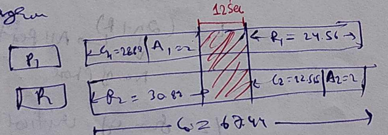
$G_2 = \frac{y_2}{y}(C_0 - L) = \frac{0.25}{0.57} (67.44 - 16)$

$= (22.56$ sec$)$

Amber time

= 2 sec (min)

Phase diagram



Pb - (51) $\frac{R}{n} = 3$ sec   trick

$R = 3n = 3 \times 2 = 6$ sec

$L = 2n + R = 2(2) + 6 = 10$ sec

$$y_{N-S} = \left\{ \begin{aligned} y_N &= \frac{1000}{3600} = \frac{1}{3} \\ y_S &= \frac{600}{2400} = \frac{1}{4} \end{aligned} \right\} \max = \frac{1}{3}$$

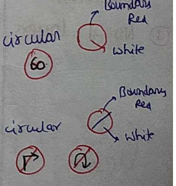
$$y_{E-W} = \left\{ \begin{aligned} y_E &= \frac{950}{3600} = 0.26 \\ y_W &= \frac{800}{2000} = \frac{2}{5} \end{aligned} \right\} \max = \frac{2}{5}$$

Optimum cycle time

$C_0 = \frac{1.5L + 5}{1 - y} = \frac{1.5(10) + 5}{1 - (\frac{1}{3} + \frac{2}{5})} = 75$ sec Ans

TRAFFIC SIGN

(1) Mandatory sign → Regulatory sign → shape circular; → Prohibitory sign → shape circular

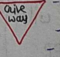


(1) Exceptional

(1) Stop sign

- Red background
- White boundary
- Octagonal

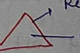
(2) Give way sign

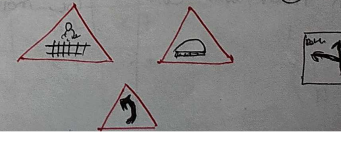


- Red Boundary
- White background
- inverted triangle

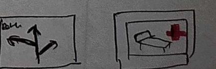
(3) Warning sign

Shape - triangular



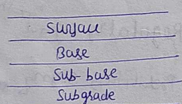
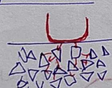
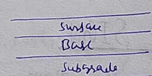


(3) Informatory sign

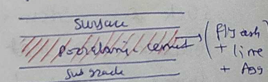


Pavement Design

1. Flexible Pavement
2. Rigid Pavement
3. Semi- Rigid Pavement
4. composite pavement

	Flexible	Rigid
1. flexible rigidity	very low or negligible	Significant
2. Load transformation	Through grain to grain contact.	layer to layer
3. No. of layers	 	
4. Failure	If there is any failure at bottom then the failure will appear at the top	If there is any failure at bottom then concrete slab will act as a bridge over small cavity
5. Joint	1. No joint required	1. expansion and contraction joint are provided
6. cost	low initial cost high maintain cost	1. High initial cost low maintenance cost.

3. **Semirigid Pavement** If subbase course and base course of flexible pavement is replaced by Pozzolanic concrete (Fly ash + lime + agg) then strength of pavement increases this strength is more than flexible pavement but less than rigid pavement.

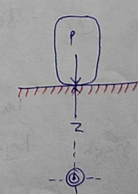


4. **Composite Pavement** If bituminous concrete is provide at top layer over cement concrete slab then is called composite pavement

design of flexible pavement:

1. Design Parameter :- 1. max std. axle load.
   = 8170 kg
   = 8.2 T
   = 80 kN

2. Stress at any depth



$$\sigma_z = p\left(1 - \frac{z^3}{(a^2+z^2)^{3/2}}\right)$$

p = contact Pressure $= \frac{P}{A}$

P = wheel load

A = contact area $= \pi a^2$

a = Radius of contact area

z = depth

3. Rigidity factor (R.F)

$$R.F = \left(\frac{\text{contact Pressure}}{\text{tyre Pressure}}\right)$$

For design : $C.P. = T.P = 7\ kg/cm^2$

RF	CP	TP
1	7	7
>1	>7	<7
<1	<7	>7

4. Mc load theorm

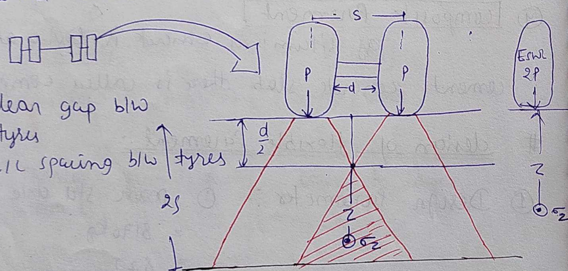
$$L \propto \frac{1}{N}$$

$$L_1 N_1 = L_2 N_2$$

(L = axle load, N = No. of repetation)

ESWL (Equivalent single wheel load)

Load on single tyre which will cause an equivalent magnitude of parameter such as stress - strain and deflection ~~at~~ to the given location to that resulting from multiple wheel load of same wheel load.



d = clear gap b/w tyres

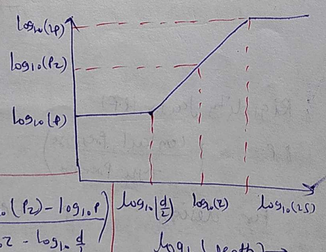
S = C/L spacing b/w tyres

Observation

① upto depth $\frac{d}{2}$
ESWL = P

② Beyond depth 2S
ESWL = 2P

③ $\frac{d}{2} < z < 2S$
ESWL from graph



$$\boxed{\frac{\log_{10}2P - \log_{10}P}{\log_{10}(2S) - \log_{10}\left(\frac{d}{2}\right)} = \frac{\log_{10}(P_2) - \log_{10}P}{\log_{10}z - \log_{10}\frac{d}{2}}}$$

Pb - 30

P = 2004 Kg
S = 27 cm
d = 11 cm
z_1 = 5 cm, z_3 = 60 cm
z_2 = 30 cm

ⓐ At z = 5 cm < $\frac{d}{2}$
ESWL = P = 2004 Kg

ⓒ At z = 60 cm > 2S
ESWL = ~~2(2004)~~ 2P = 2×2004
= 4008 Kg

ⓑ $\frac{d}{2} < z_2 = 30\text{cm} < 2S$

$$\frac{\log_{10}(2\times2004) - \log_{10}(2004)}{\log_{10}(2\times27) - \log_{10}\left(\frac{11}{2}\right)} = \frac{\log_{10}(P_2) - \log_{10}(2004)}{\log_{10}30 - \log_{10}\left(\frac{11}{2}\right)}$$

$\log_{10} P_2 = 3.525$

$P_2 = 3353.24$ Kg.

Remember - $\log_{10}$ है तो Anti-log में change करेंगे

Design of Pavement thickness:

Method ① Group index method - this method is based on index property of soil.

① Index property are those which are used only for classification of soil such as liquid limit, plastic limit, plasticity index etc.

GI value = $0.2a + 0.005ac + 0.01bd$

$a = (P-35) \not> 40$	P = % finer passing 75μ sieve
$b = (P-15) \not> 40$	
$c = [W_L-40) \not> 20$	W_L = liquid limit
$d = (I_P-10) \not> 20$	I_P = Plasticity index
	$I_P = (W_L - W_P)$

Note: ① GI value lies b/w (0-20)

② higher the GI value poorer the soil Hence Heigher thickness of Pavement required.

③ total thickness of Pavement depend up on G.I. value Only. But thickness of surface coarse ~~and~~ and base coarse depend upon GI value and traffic volume both.

__Limitation:__ quality of pavement is not considered same thickness require it even if better quality of material used.