signt distances improved

formation width
shoulder
pavement
ditch

sideslope
Angle of repose.

natural surface

crown
edge
straight line
Parabola
straight line
straight line
straight line
straight line

natural surface

Sight distance

driving ಮಾಡುವಾಗ ಚಾಲಕನಿಗೆ ಕಾಣುವ ದೂರ

Stopping sight dist:

Passing ~~dis~~ sight distance.

Analysis Stopping sight distance ಕುರಿತು

Stopping sight distance = Reaction distance + Braking distance

reaction distance = distance ~~travelled~~ covered during the reaction time of driver.

reaction time = perception time + foot reaction time.

Reaction ~~it de~~ Time

It depends on the speed of the vehicle.

Reaction time = 1 sec

Speed of vehicle = V mph

reaction distance = $1.47 V t$ (ft)

$1 mph = 1.47 ft/sec.$

Braking distance -

tyre - roughened surface - 1

road surface - roughened surface 2.25

3rd Overtaken method | A Bus runs at V (V - m) speed mph
a = acc. elevation mph/sec
Diagram: d_2 = t = sec
mus speed ft/sec = (u - m') a'' = acc. ft/sec² t = sec

$$\therefore \boxed{d_2 = (u - m') \times t + \tfrac{1}{2} a'' \times t^2}$$

$(u - m') = ft/sec$
$a' = ft/sec^2$
$t = sec$ //

$S = ut + \frac{1}{2} at^2$ | $S = d_2$ | $t = t$ | $a = a'$

$\therefore d_2 = (u - m') t + \frac{1}{2} a' t^2$ //

$(u - m') t = (V - m) t$

$(u - m') = ft/sec$

$V - m = mph$

$$\boxed{t = \sqrt{\frac{4S}{a''}}}$$

$S = ft$
$a'' = ft/sec^2$
$t = sec$

~~$S = \frac{1}{4} \pi D^2 S$~~ a'' 64 ft/sec² mph/sec²

(ft/sec^2)

$$\boxed{t = \sqrt{\frac{2 \cdot 735}{a}}}$$

$a = mph$
$S = ft$
$t = sec$

d_2 ~~$= d_1 + d_3$~~ $d_1 = S + ut + (v - m) t + q$
$d_2 = (u - m') t + \frac{1}{2} a'' t^2$ Jab ye equation ko solve kro

$t = 2\sqrt{S/a}$ or $t = \sqrt{\frac{2 \cdot 735}{a}}$ //

Ex (6) $V = 30$ mph $m = 10$ mph
$a = 2.5$ mph/sec $V - m = 30 - 10 = 20$ mph.
to = 2 sec ahead
$d_1 = 1.47 (V - m) t_0 = 1.47 \times 20 \times 2 = 58.8$ ft

$d_2 = 1.47 (V - m) t + 1.2 S$
$= 1.47 (20) \times \sqrt{\frac{2 \cdot 735}{a}} + 2 \times [20 + (V - m)]$ //

(9) Strength of steel and concrete. Tensile of the concrete in compression and the steel in tension is expressed in kg per square inch (psi) or kg/cm²
ultimate
~~ultimate~~ stress are approximately 3,000 psi for concrete and 72000 psi for steel it would be unsafe to load a beam right up to these limits is allowed to be loaded to only a quarter of the breaking load (ie) 750psi and 18000 psi respectively. Safety factor (4)

ultimate stress of 1/4 for in order of design of RC

Highways and Railways Notes

31-7-84

Highway Engineering

Roads and Highways.

all way

B:Q Highways

Express Highways (or) expressway (or) Super highway.

fence line

High speed automobile.

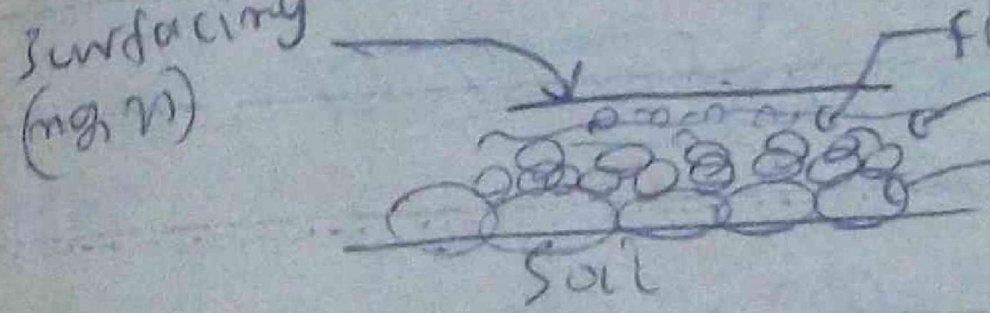
Existing road (or) Modify (or) Bypass

[1] Highway Study. (Page ①)

* road Inventory Study - modify-ed ಸಿ
* Traffic Studies
  - No: of traffic
  - Speed of traffic
  - accidence experience (ಅಪಘಾತ ಪ್ರಮಾಣ)
  - directional distribution
    (ಎರಡೂ ಕಡೆಯ ವಾಹನಗಳ ಸಂಚಾರ ಪ್ರಮಾಣ)
* Economic and financial Planning Study
  - main cost
    - capital cost → government ← Department state and ಡಿವಿಜನ್
    - maintenance (cost) → department
      → users
      construction corporations (RCDC)
      ಉದಾ. GI
      ಉದಾ. ಆರ್

Road inventory study

① demarcation - ಭೂಪ್ರದೇಶವನ್ನು ಭೂಪ್ರದೇಶದಲ್ಲಿರುವ construction materials. (soil, bolders, gravel



② manor ಗಳನ್ನು ಗುರುತಿಸಲು ಅಧ್ಯಯನ ಮಾಡಿದ ಪ್ರದೇಶ
↓
ananacle
natural

adjacent - ಪಕ್ಕದಲ್ಲಿ, ಅಕ್ಕಪಕ್ಕ

fence line - ಅಡ್ಡಗಟ್ಟು ಗಡಿ ಗುರುತಿಸಲು ಬಳಸುವ ಸಾಲು

courses - ಪದರುಗಳು

~~ಅ~~ High bridge ಮತ್ತು ಕಿರು bridge ಗಳನ್ನು ಗುರುತಿಸಿ

③ Highways plan ಮಾಡಲು ಅವಶ್ಯಕವಾದ ರಸ್ತೆಯ description of geometrical of highway.

cut section

~~Filled~~

[1] Highway Study. (Page ①)

* road Inventory Study - mobility of
* Traffic Studies
  - No: of traffic
  - Speed of traffic
  - accidence experience (safety of
  - directional distribution

(area's survey information roads number)

* Economic and financial Planning Study

main cost { capital cost → government ← Department state and division
maintenance cost → department
→ users

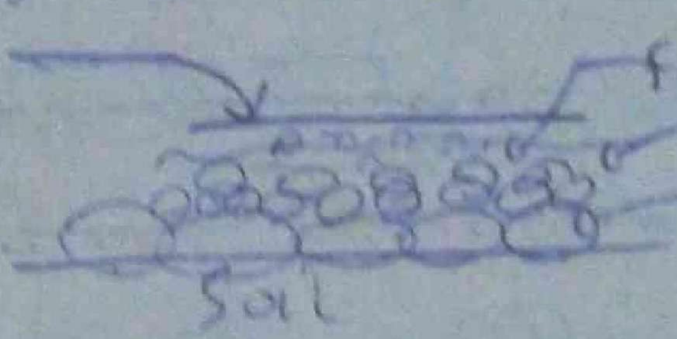
construction corporations (RCPC)

@ 61 @ 60

Road inventory studs

(1) demarcation - ...

...



(2) ... natural
manmade

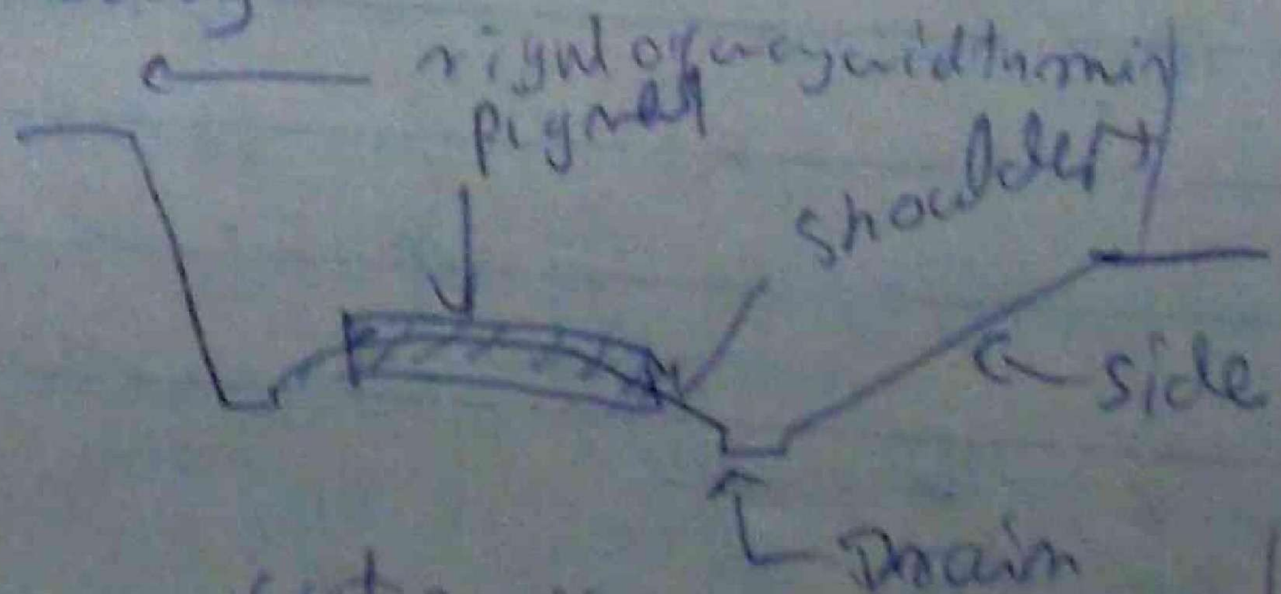
adjacent - ...

fence line - ...

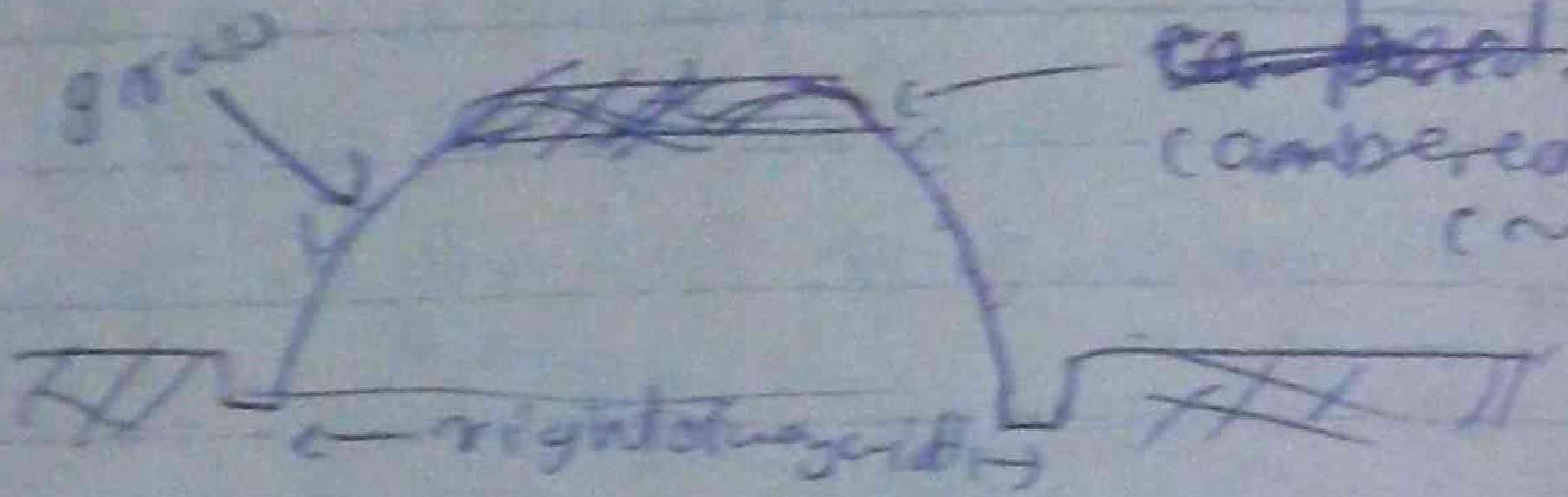
courses - ...

... High bridges ... water courses ...

(3) Highways plan - ... description of geometrical of highway.



Filled section



roadway width — [illegible]

right of way width — [illegible]

right of way [illegible] furlong / miles

right slope angle (angle of repose) [illegible] erosion [illegible] velocity of water [illegible]

[illegible]

sight distance

[illegible]

Stopping sight distance — [illegible]

Passing sight distance [illegible] sight distance [illegible]

[illegible] (perception time / dist: [illegible])

— foot reaction time / dist

accelerating brake [illegible]

brake — | —

brake [illegible]

vertical curve - gradient. / road camber.

④ ~~Open~~ ~~X~~ ~~road~~ roadway ~~of~~ ~~re~~ ~~fi~~ alignment,
information about the ~~de~~ natural component of
Powered ~~de~~ design
gravel / Boulder ~~if~~ ~~y~~ ?
~~a~~ ~~pro~~ ~~vi~~ ~~ma~~ ~~ce~~
information

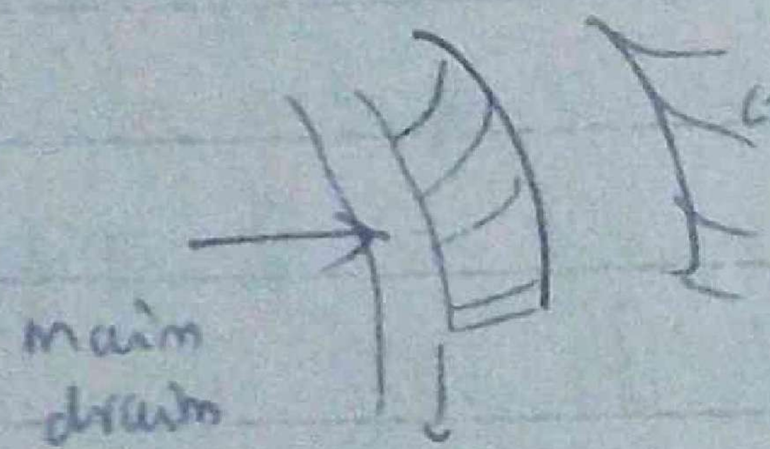
Powered

Typical surface.

Cross section / Soil characteristics ~~of~~ ~~ro~~ ~~fi~~
~~s~~ ~~pro~~ ~~fi~~

(5) Roadway condition – surface ಮೇಲ್ಮೈ: ಅಂಕುಡೊಂಕು
ಗುಂಡಿಗಳು / ಉಬ್ಬು ತಗ್ಗುಗಳು ಇರಬಾರದು:
riding qualities – ಪ್ರಯಾಣಕ್ಕೆ ಅನುಕೂಲವಾಗಿರಬೇಕು

(6)



to the watercourse.

drainage structure / span / ಅಡ್ಡ ಅಳತೆ
drain width roadway surface ಮೇಲೆ, structure
ಮೇಲಿನ ಅಡ್ಡ ಅಳತೆ / ~~ಎತ್ತರ~~ vertical clearance.
ಅಡ್ಡಲಾಗಿ / ಪ್ರವಾಹಕ್ಕೆ waterway ಮೇಲೆ ಅಡ್ಡಲಾಗಿ
ಹರಿಯುವ ನೀರಿನ ಅಳತೆ

(7) ಇದು ಒಂದು ಮುಖ್ಯ ಅಂಶವಾಗಿದೆ:
ಅಡ್ಡಲಾಗಿ ಹಾದು ಹೋಗುವ Highway ಮತ್ತು ಪ್ರಮುಖ
ಅಥವಾ ಪ್ರಮುಖ ~~ಅಂಶವಾಗಿದೆ~~ ನಡುವೆ, ಅಥವಾ / angle of crossing
(60°) - curvature / sight distance
ಇದು ಪ್ರಮುಖ ಅಂಶವಾಗಿದೆ.

(8) ~~ಅ~~ level crossing (9) over crossing

Let f_f = of vehicle brake

D = braking dist: (ft)

μ = coeff. friction

v = speed of vehicle (ft/sec)

After brake apply

W = weight of vehicle (lb)

g = acc. (32.2 ft/sec^2)

$W_3 = W \times \mu \times D$ ——▷ equation ①

W = lb
μ = ft-lb μ = D = ft

$W \times \mu \times D = \frac{W}{g} \times \frac{v^2}{2}$ or $W \mu D = W \times \frac{v^2}{2g}$ ②

$$\boxed{D = \frac{v^2}{2g\mu}}$$ ——— ③

D = ft
v = ft/sec
g = 32.2 ft/sec^2

V = rpm (velocity

D = ft

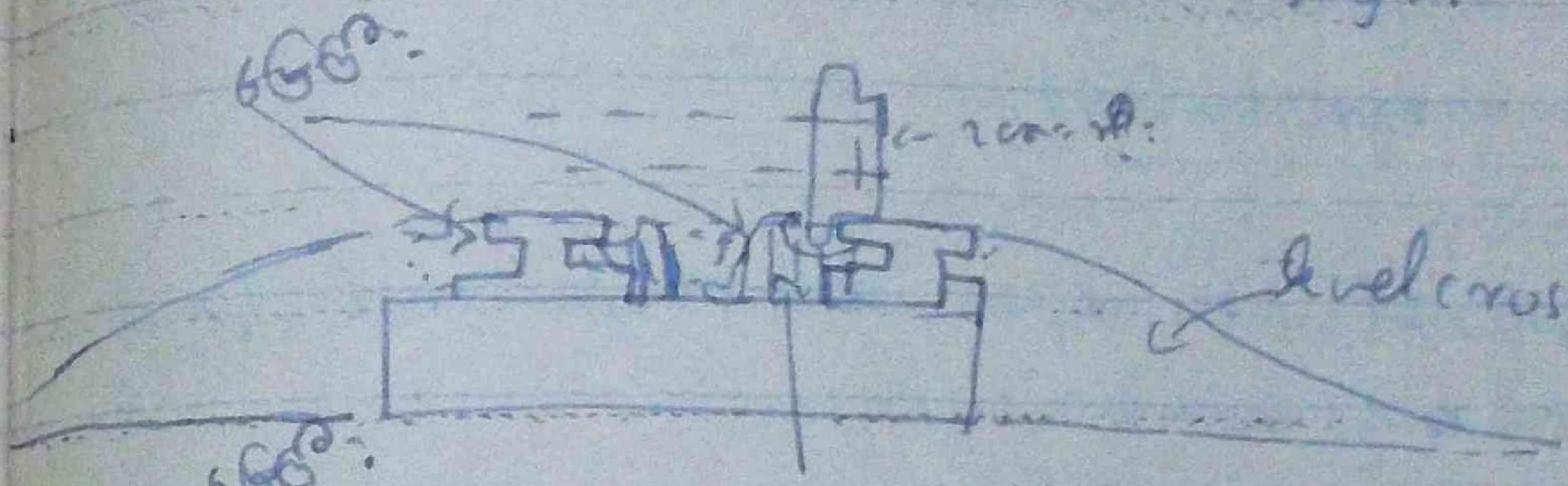
Method

$$\boxed{D = \frac{V^2}{30\mu}}$$

Con te level surface

(5) undercrossing and under path.

level crossing — special design.



overPass- ...

underPass- ... } cost less.

(6) ... agricultural ... accident ...

(7) ... accident ...

(8) ... accident (accident/year)

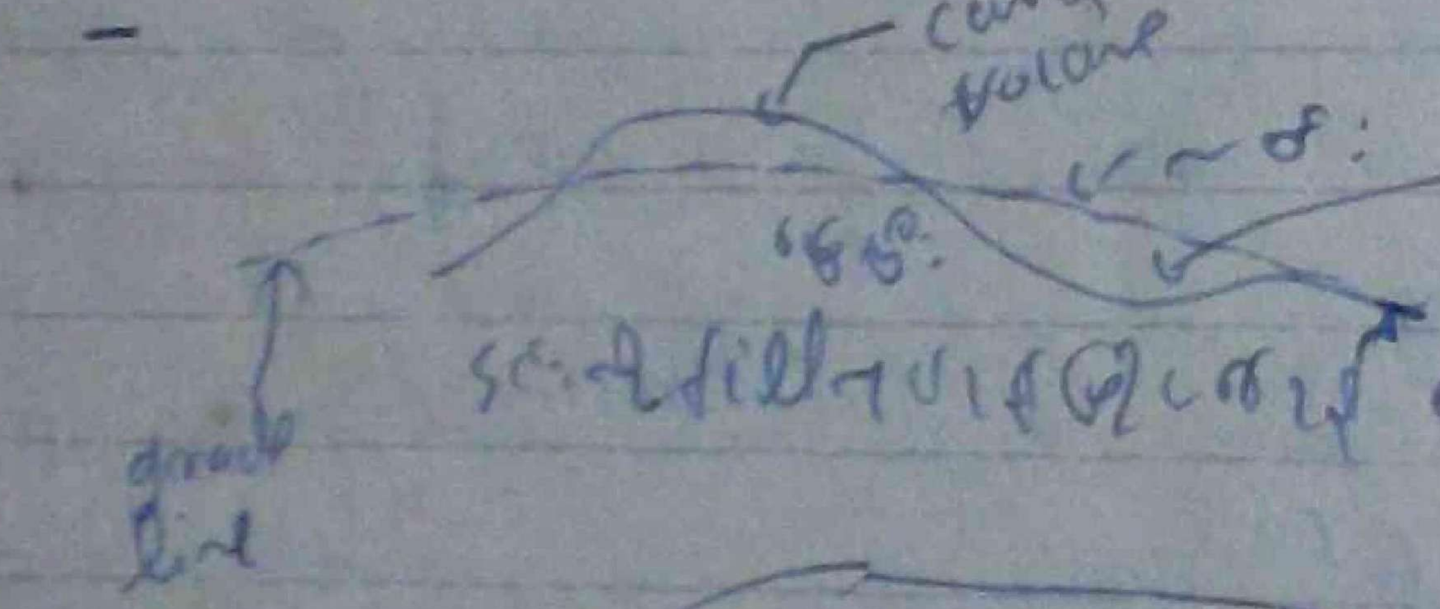
(11) maintance cost ...

criteria

min. design standard

- High speed ... curve, slope, cost standard

-



foundation condition

- Sub soil condition ... road ...

(d) geog: condition

Sedimentary rock - ...

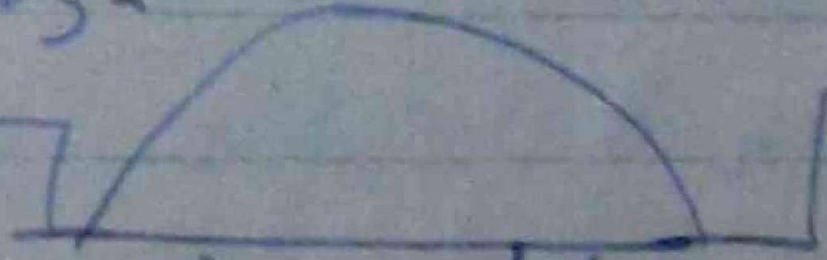
⟹ Si: ... avenue for landslide ...

Si: ... earthquake ...

Earthquake fault. ...

Drainage condition ...

Right of way.



... right of way ...

Si: right of way ... maintain ...

[illegible]

[illegible] Total [illegible]

[illegible] 365×24 [illegible]

[illegible] lowest [illegible]

[illegible] highest peak Hour Traffic [illegible] design [illegible]

~~30rd~~ design - 30th highest. [illegible]

30 H.V.

Traffic study

<u>Capacity</u>

no: of cars / laying / hour.

Speed = <u>design speed</u>.

Reaction time. perception reaction time.

Reaction distance = 1.47 × V × t

V = mph   t = sec

<u>car</u>   reaction distance in feet

car A driver break [illegible] driver [illegible]

[illegible] ~~of~~ zone

Forward

clear Spacing = $l + V t$

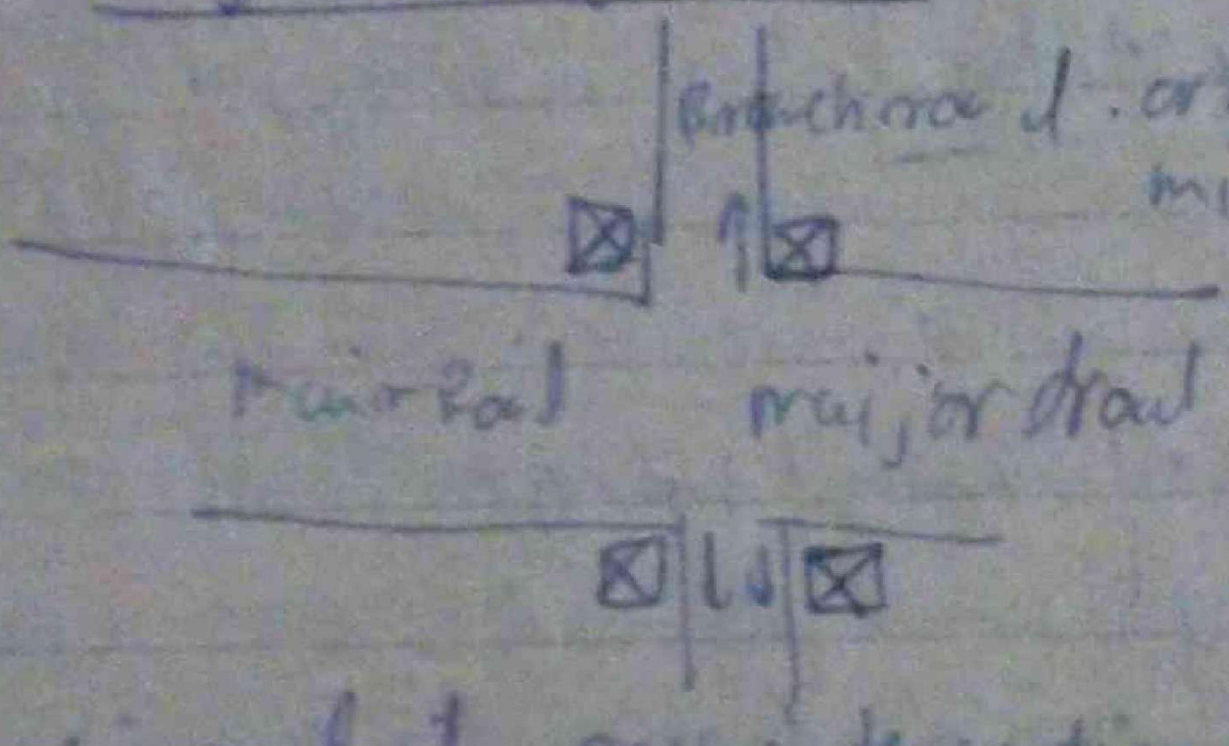
centre to centre spacing = 183 + 15 = 198 ft.

Number of cars passing point

in a hour per lane = $\frac{5280 \times V}{\text{c/c of spacing}} = \frac{5280 \times 50}{200}$

$= 1320$

Signalised Junction



Signal at each intersection

green light - main road - 30 sec (

" mixed 2 " "

green → red

(5 sec. Amber)

during yellow

Equivalent Traffic

motorvehicles — 1   Buses - 2

cycles — 0.5   [illegible] - 4

pedestrians - [illegible] 0.1

Speed of vehicle

High way [illegible]

[illegible]

[illegible]

[illegible]

Railway Engg.

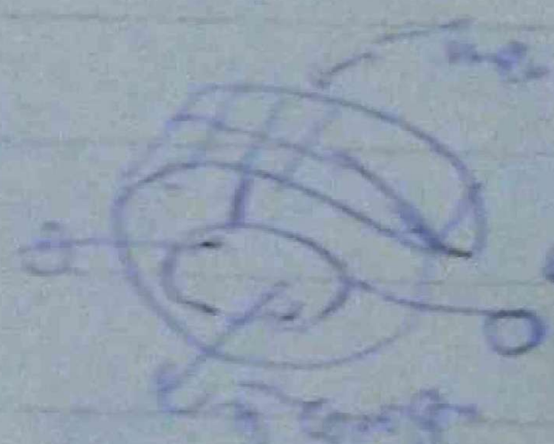
(3) Tread of wheel [illegible], Top of [illegible] force [illegible] tractive force [illegible] gradient [illegible] sleeper [illegible] (1% gradient [illegible])

(4) [illegible] rail vehicles [illegible] flange [illegible] special arrangement [illegible]

Cat point (crossing)

Turning moment

Time taken for change of velocity from initial to final velocity

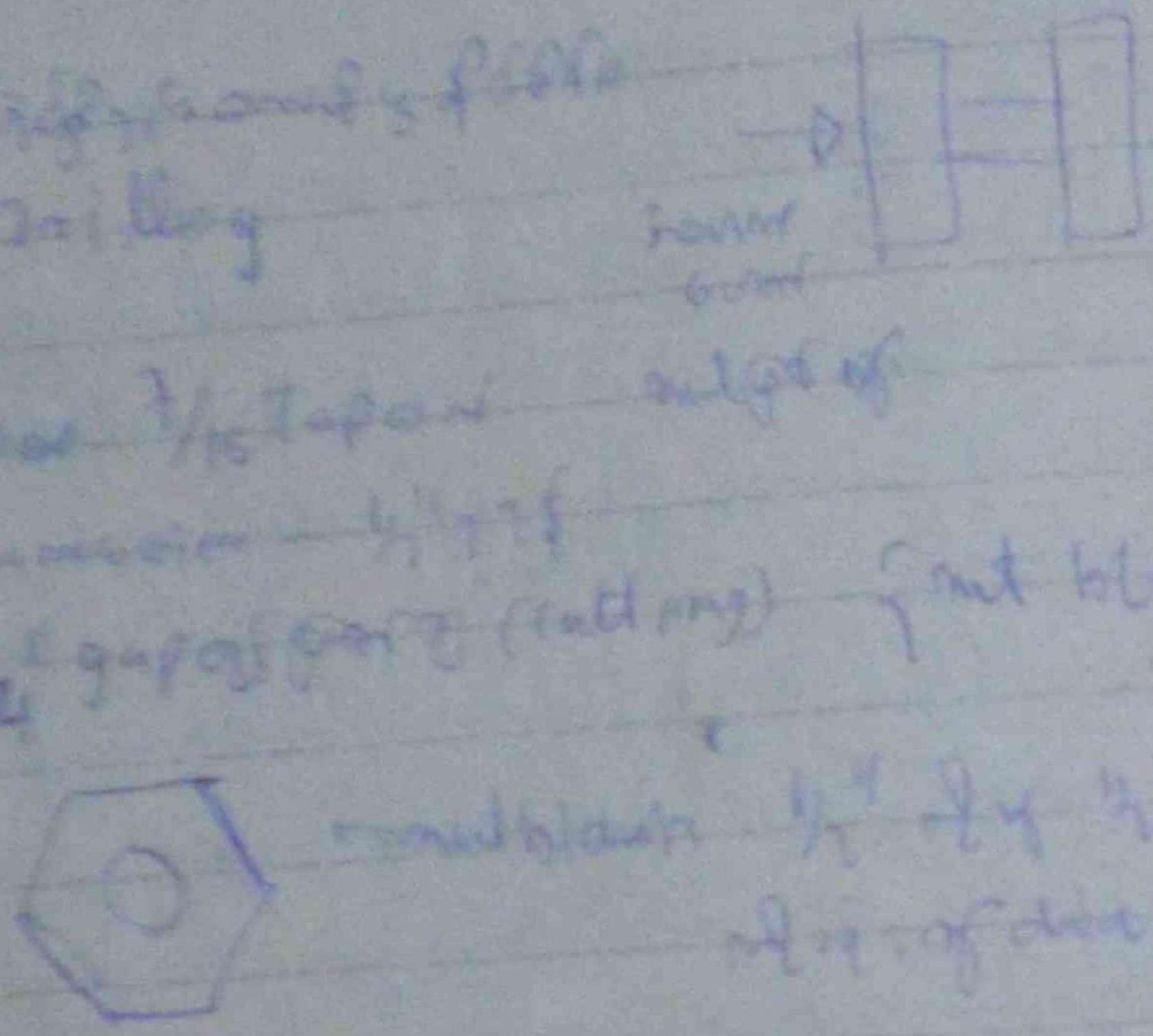


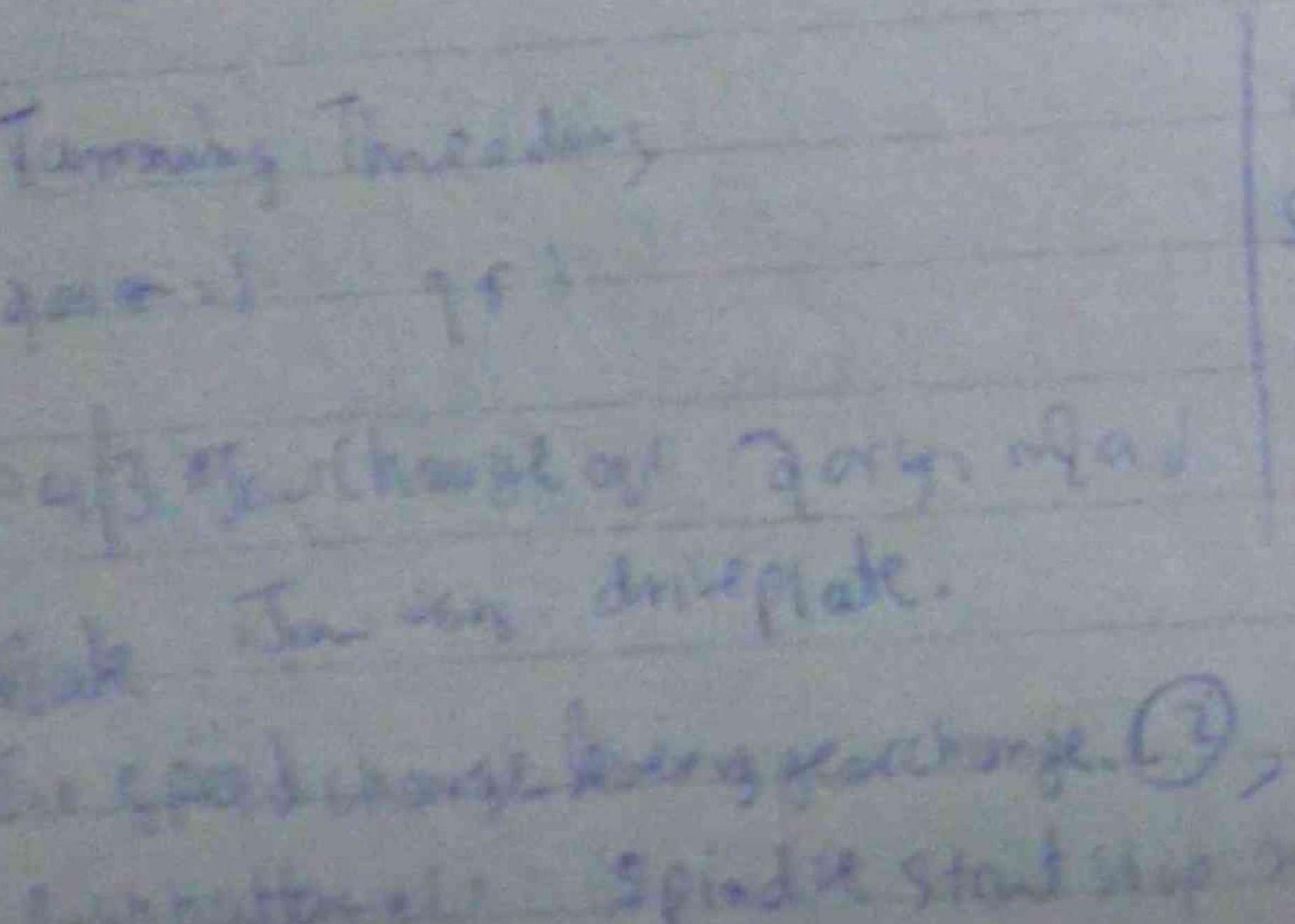
Pitch

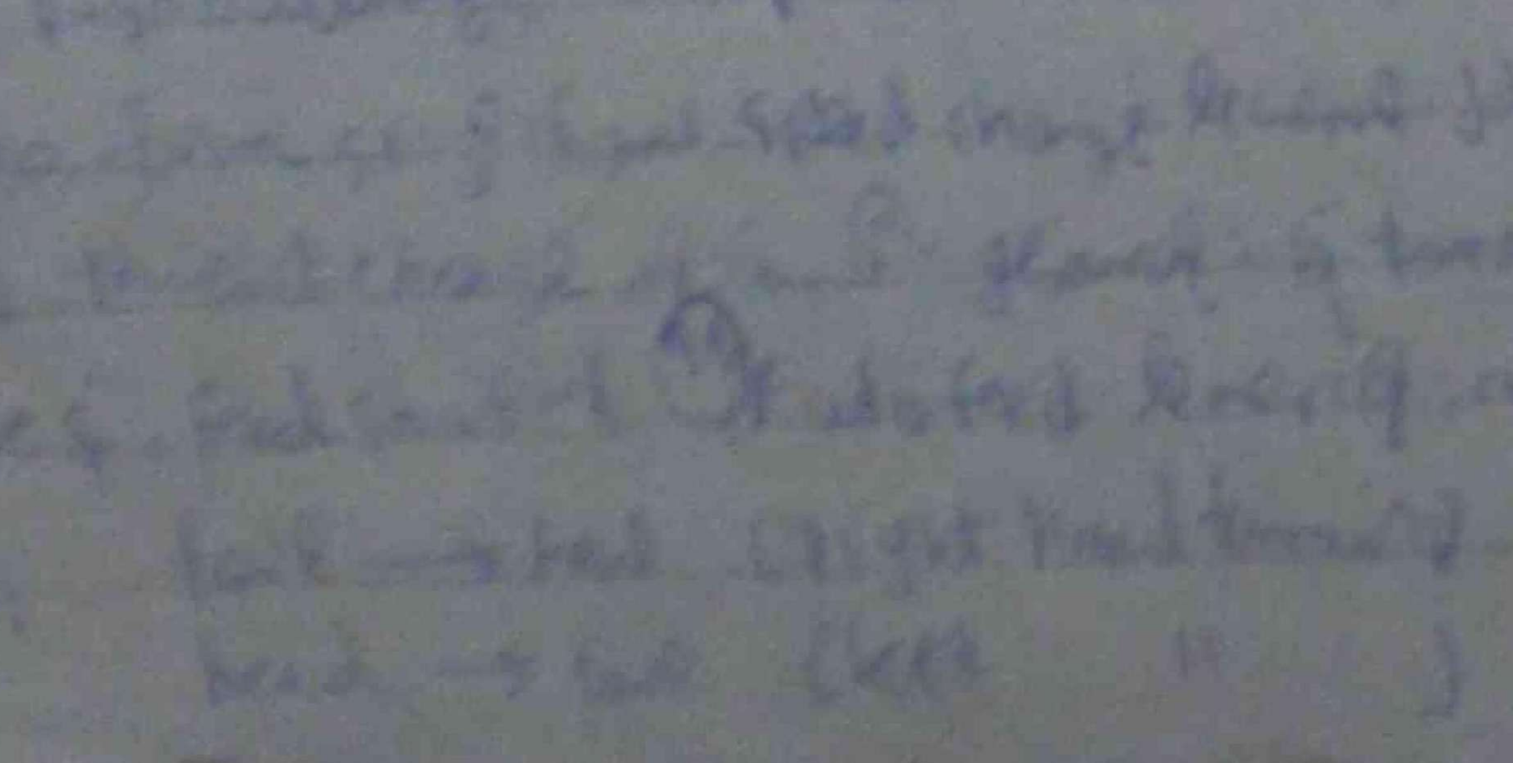
Longitudinal force

Tractive force

Thrust







D = braking dist = (ft)

η = effcy of vehicle (%)

− g = deceleration due to gravity 100% brake effy

V = final speed (mph)

Acc produced by effcy of η = $-g \times \frac{\eta}{100}$ ft/sec²

$v^2 - u^2 = 2fs$

$[-g\frac{\eta}{100}]$ → f ← D

v = final speed
u = initial speed
f = acceleration
s = dist covered

$v^2 - u^2 = 2 \times \left(-g \times \frac{\eta}{100}\right) D$

$0 - u^2 = 2\left(-g \times \frac{\eta}{100}\right) D$

$$D = \frac{V^2}{30\left(\eta/100\right)}$$

Level surface.

V = speed of vehicle at the time brake are applied (mph)

η = % effy.

D = ft

$$\mu = \frac{\eta}{100}$$

Machine 2-1-4

① Turning to length 4" (approx)

②

(Between centre method)

③

④

⑤ Hexagon - Bolt head, nut on milling machine

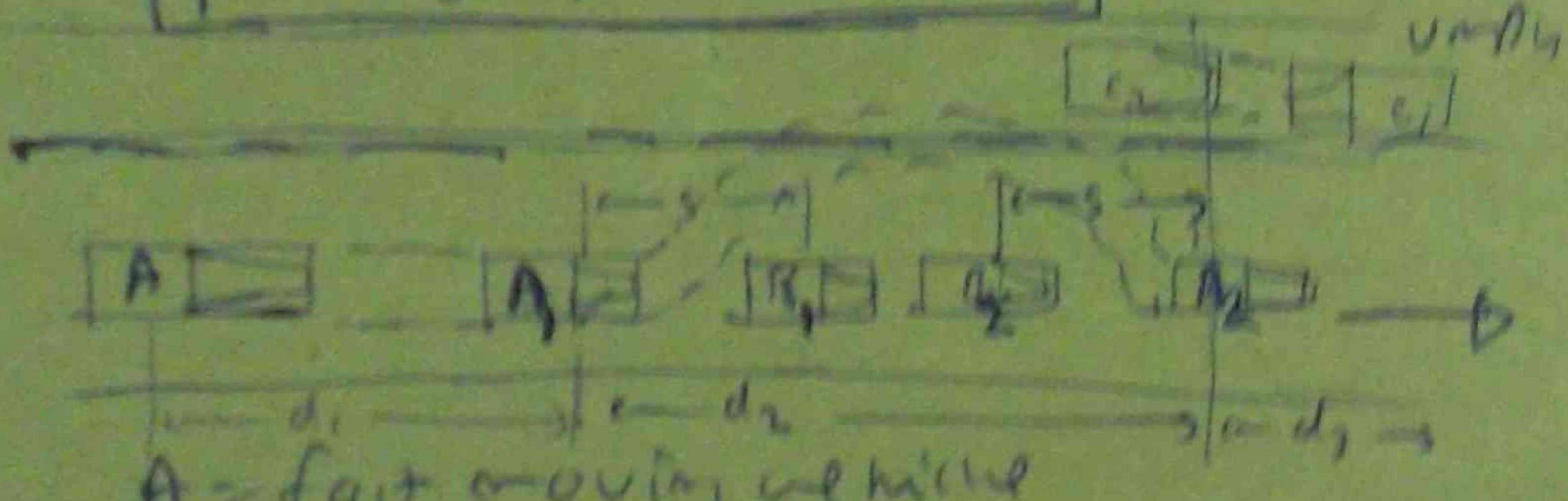
⑥ Threading (1/4" BSW) (TPI 22)

Thread on Bolt

⑦

Total = 102.9 + 92.8 = 195.7 m *

Passing sight Distance



A = fast moving vehicle

B = slow moving vehicle

C = design speed vehicle (in the opposite)

(d_1) → B accelerates to design speed, distance travelled during perception time (1 sec)

d_2 → B travels during actual overtaking time (t)

d_3 → Distance between B & C after overtaking

∴ Passing sight dist = $d_1 + d_2 + d_3$

Perception reaction

d_0 → d_1 → designed

t → d_2 → reaction-distance

$(\ )$ → d_3 → safety zone

V = speed of designed (mph) $\quad V = (d_1/t)$

m = A & B relative speed difference (mph → ft/sec)

$\therefore V_A - V_B = m$ (mph) $\quad [V = m \cdot t]$

$\therefore$ Speed of slow moving car $V =$ [illegible]

* (Speed of slow moving car $V =$ [illegible] speed of f: mph/sec

a = [illegible] speed of f: mph/sec

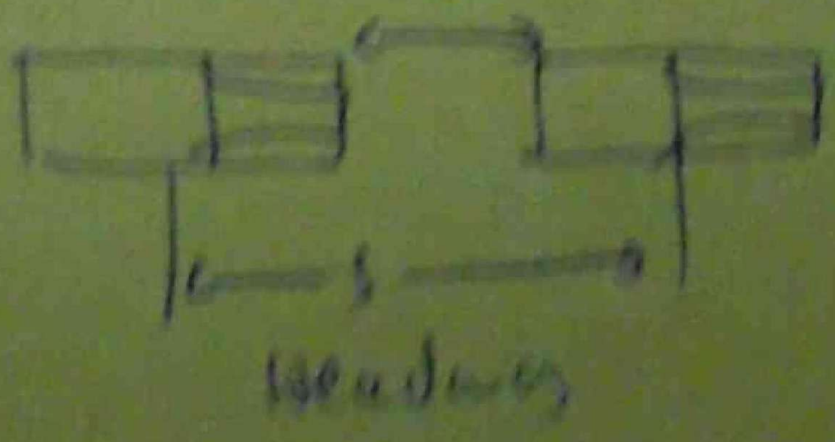
a'' = a'' (ft/sec/sec)

t = overtaking time

Headway S = [illegible]

t_0 = overtaken time → Perception time

Headway



Headway

Headway = $1.47 \times V \times t_0$

Headway in sec of t_0 (Perception time) = 0.75 sec

centre to centre spacing (S) = clear distance + length of the average car

↓ ↓ ↓

$S = \cancel{V.t_0} + 20ft$

$1.47(V-m)t_0$

$\therefore S = 1.47(V-m)t_0 + 20$

$S = [1.47(V-m)0.78] + 20$

$\therefore \boxed{S = V - m + 20}$ (ft)

(V-m) mph

* $20 = ft$
$V - m = mph$ *

Headways.

$\boxed{d_1 = 1.47(V-m)t_0}$ ← distance travelled

$d_2 = 2 \times S + \cancel{\text{distance travelled}}$

$\boxed{d_2 = 2(ft + 1.47(V-m)t}$ ← distance

$\boxed{d_3 = 1.47(V)t}$ ← distance travelled

$\therefore \boxed{D = d_1 + d_2 + d_3}$ *

Another method A Br rr rp: (V - m) speed mph
a rau: elevation mph/sec

drawing: d_2 = t = sec

runner speed ft/sec = (u - m') a'' = acc: ft/sec² t = sec

$$\therefore \boxed{d_2 = (u - m') \times t + \tfrac{1}{2} a'' \times t^2}$$

(u - m') = ft/sec
a' = ft/sec²
t = sec

(or) 1.47 (V - m)

$s = ut + \frac{1}{2} at^2$ $s = d_2$ $t = t$ $u = (V - m')$ $a = a'$

$$\therefore d_2 = (V - m')t + \tfrac{1}{2} a' t^2$$

$1.47 (V - m) t = V - m', t$

ft/sec (u - m') = ft/sec

V - max = mph

$$\boxed{t = R \sqrt{\frac{4S}{a''}}}$$

s = ft

a'' = ft/sec²

t = sec

drawing time:

~~s'' 64 n a r~~ a'' 64 n a r mph/sec sec.

(ft/sec²)

$$\boxed{t = \sqrt{\frac{2.73\,S}{a}}}$$

a = mph
s = ft
t = sec.

$\therefore d_2$ ~~f d~~ 3 g m n a)

$d_2 = 2S + 1.47 (V - m) t + 4$

$d_2 = (u - m') t + \frac{1}{2} a'' t^2$]ft: 0 f: a m r ft d

$t = 2 \sqrt{S/a''}$ or $t = \sqrt{\frac{2.73\,S}{a}}$ ✻

Ex ⑤ V = 30 mph m = 10 mph

a = 2.5 mph/sec V - m = 30 - 10 = 20 mph.

to = 2 sec assumed

$d_1 = 1.47 (V - m) t_0 = 1.47 \times 20 \times 2 = 58.8$ ft

$d_2 = 1.47 (V - m) t + 2 \times S$

$= 1.47 (20) \times \sqrt{\frac{2.73\,S}{a}} + 2 \times [20 + (V - m)]$ ‖

$$d_2 = 1.47 \times 10 \times \sqrt{\frac{2 \cdot 13 \times 40}{2 \cdot 5}} + 2\left[20 + 10\right]$$

$$= 280 \text{ ft}$$

$$d_3 = 1.47 \times V \times t$$

$$= 1.47 \times 20 \times (6 \cdot 0)$$

$$= 280 \text{ ft}$$

$$\therefore d = d_1 + d_2 + d_3 = 58.8 + 270 + 286 = 600'$$

(1) Highways — capacity determining factor
Stopping sight dist.
Passing sight dist. } Same

Questions

Theory Short Notes

On the gradient

$$D = \frac{V^2}{30\left(\frac{n}{100} \pm s\right)}$$

(or)

$$D = \frac{V^2}{30(\mu \pm s)}$$

V = mph

ts = upslope (raw)

$-s$ = downslope (mod:)

Ex① page 22

$V = 30$ mph $\quad \mu = 0.4 \quad t = 3$ sec

Level

Reaction dist $(D_1) = 1.47 \, V \times t$

$= 1.47 \times 30 \times 3$

Braking dist $D_2 = \frac{V^2}{30(\mu)} = \frac{30^2}{30 \times .4}$

$D_1 + D_2 =$ Total

Ex② P12 (b) Braking dist: $\frac{V^2}{30(\frac{n}{100}) \pm s}$

Ex ② P23

$$D = \frac{v^2}{30f}$$

$f = 0.42 \quad v = 60$

Braking dist: $D = \frac{v^2}{30f} = \frac{60^2}{30 \times .42}$

reaction time 2 sec assumed usually

reaction dist: $= 1.47 \, vt$

$D_2 = 1.47 \times 60 \times 2$

$\therefore D = D_1 + D_2$

Ex ③ $\eta = 6\%$ $v = 35$ mph

$f = 0.5$ $\frac{\eta}{100} = \frac{6}{100}$ (down)

(f) reaction time $= \frac{140}{35 + v} = \frac{140}{35 + 35} = 2$ sec

reaction dist: $= 1.47 \, vt = 1.47 \times 35 \times 2$

$= 102.90$ ft

Braking dist: $= \frac{v^2}{30(f - \frac{\eta}{100})}$

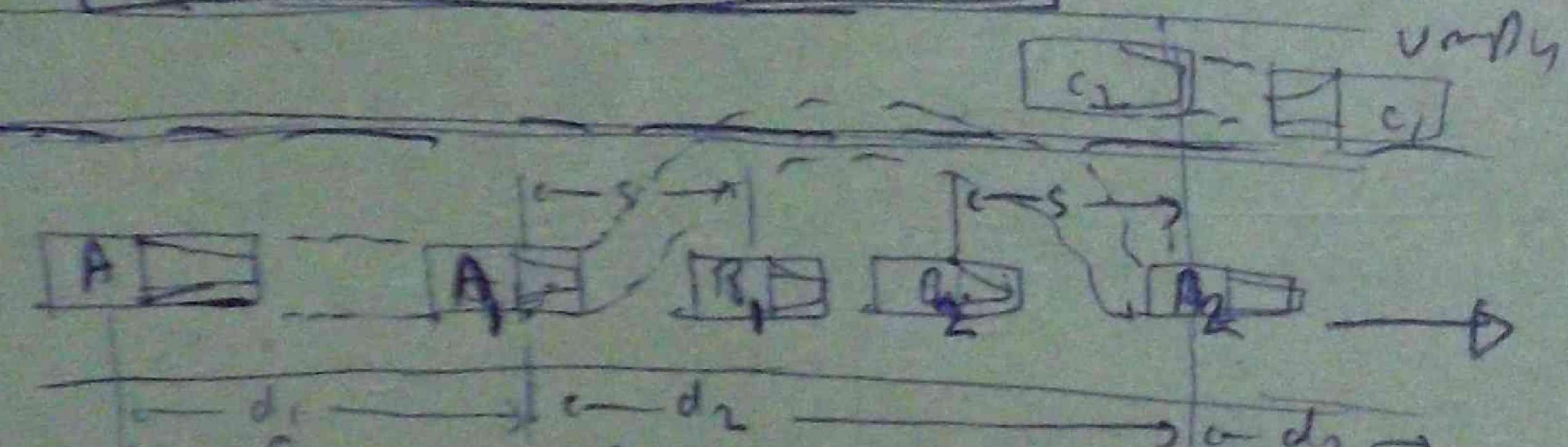
$= \frac{60^2}{30(0.5 - \frac{0.6}{100})} = 92.8$ ft

Total = 102.9 + 92.8 = 195.7 ft ✱

min 1 ft.

passing 1 ft
on passing 1 ft

Passing sight Distance



A = fast moving vehicle

B = slow moving vehicle

C = designspeed vehicle (in the opposite)

(d1) → B ආරම්භ වන විට A පැමිණීමට ඇති දුර

d2 → B හා designspeed ගැටීමට ගතවන කාලය

[during ~~the~~ percition ~~the~~ time (t2)]

d2 → ~~overtaking~~ during overtaking time (t)

d3 → ~~overtaking~~ A ආරක්ෂිත ලෙස පසු කිරීමට ගතවන දුර

∴ passing sight dist = $d_1 + d_2 + d_3$

Pass වෙන්න ඕන දුර

→ d_1 → B designspeed

→ d_2 → rate ~~of dation~~ of acceleration.

→ d_3 → c_1 & c_2 2 m 60°

V = road or designspeed (mph) u = (ft/sec)

m = A & B vehicle ka speed difference (mi → ft/sec)

$\therefore V_A - V_B = m$ # (mph) [u − m] ft/sec

$\therefore$ V − m = speed of slow moving car.

(speed of slow moving car w.r.t) V − m ~~of~~ of relative.

a = ~~acc~~ (sec ka speed : GG ... ft/sec, mph/sec

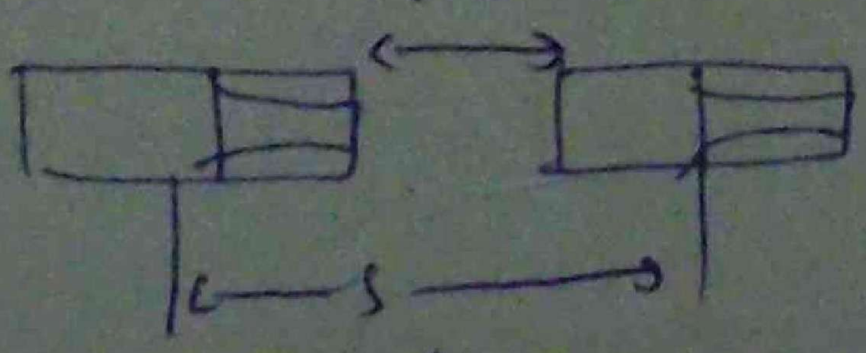
a'' = a'' (ft/sec/sec)

t = overtaking time

Headway S = ~~average speed~~ ka matlab distance

B: A & B ke beech: ka time

t_0 = overtake ka time → Perception time.



clear distance = 1·47 × V × t_0

Headway ka (perception time) = 0.78 sec

center to center spacing (S) = clear distance + length of the average car

$S = 1.47(V-m)t_0 + 20$ ft

$\therefore S = 1.47(V-m) + 20$ (V-m) mph

$S = [1.47(V-m) \cdot 78] + 20$ ft

$\therefore \boxed{S = V - m + 20}$ (ft)

* 20 = ft *
V - m = mph

$d_1 = 1.47(V-m)t_0$ ← braking distance

$d_2 = 2 \cdot S +$ [illegible]

$d_2 = 2(V)t + 1.47(V-m)t$ ← stopping

$d_3 = 1.47(V)t$ ← stopping distance

$\therefore \boxed{D = d_1 + d_2 + d_3}$ *

Another method | A Bus moving with (V - m) speed mph
diagonistic | d_2 = a = acc: elevation mph/sec
t = sec
moving speed ft/sec = (u - m') a'' = acc: ft/sec² t = sec

$$\therefore \boxed{d_2 = (u - m') \times t + \tfrac{1}{2} a'' \times t^2}$$

$(u - m') = ft/sec$
$a' = ft/sec^2$
$t = sec$ ✱

$s = ut + \frac{1}{2}at^2$ | $[(u-m) + \frac{1}{2}a(v-m)]$
$s = d_2$ | $t = t$
$u = (u - m')$ | $a = a'$

$\therefore d_2 = (u - m')t + \frac{1}{2}a't^2$ //

$\underbrace{(u - m')t}_{ft/sec} = (v - m)t$
$(u - m') = ft/sec$

$v - m$ = mph

$$\boxed{t = n\sqrt{\frac{4s}{a''}}}$$

$s = ft$
$a'' = ft/sec^2$
$t = sec$

~~$s = \frac{1}{4}\pi d^2 s$~~ a'' = 64 ft acc mph/sec sec.
(ft/sec^2)

$$\boxed{t = \sqrt{\frac{2 \cdot 735}{a}}}$$

a = mph
s = ft
t = sec.

d_2 = $d_1 = 25 + 1.47(v - m)t + t^2$
$d_2 = (u - m')t + \frac{1}{2}a''t^2$ Just the opposite
$t = 2\sqrt{\frac{s}{a}}$ or $t = \sqrt{\frac{2 \cdot 735}{a}}$ ✱

Ex ① $V = 30$ mph $m = 10$ mph
$a = 2.5$ mph/sec $V - m = 30 - 10 = 20$ mph.

$t_0 = 2$ sec assumed
$d_1 = 1.47(v - m)t_0 = 1.47 \times 20 \times 2 = 58.8$ ft

$d_2 = 1.47(v - m)t + t^2 \times s$
$= 1.47(20) \times \sqrt{\frac{2 \cdot 735}{a}} + 2 \times [20 + (v - m)]$