Selection Guide

Description	Page
* تصميم وهندسة الطرق *	
* صنان فارق فرح *	
... أسئلة سوات سريعة	

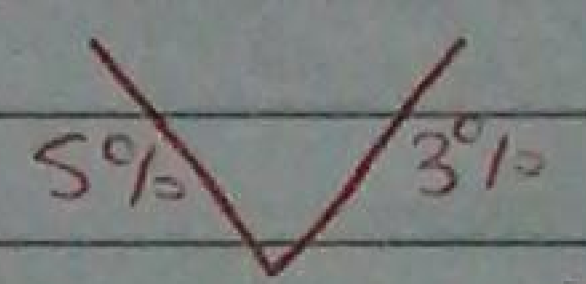
Ex:

* determine the value of (SSD) on a (−3.5%) grade for a design speed of (110 Km/h) and the value of ($f = 0.28$)?

*** دائماً تلاقي مسائل فيها (SSD) إذا كان فيه :

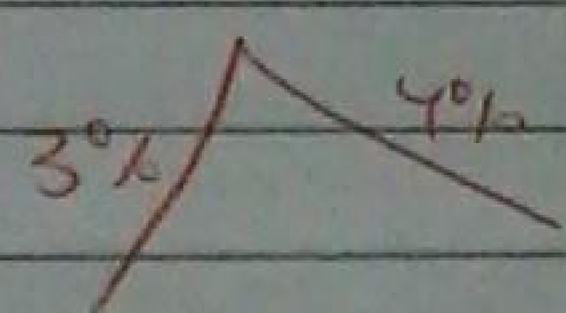
(± slope) ← بناخد (النازل) مع اتجاه مساري

طبعاً...



اتجاه مساري →

(هوت أخذت الـ 5%)



اتجاه مساري →

(هوت أخذت الـ 4%)

* Solution: *

$SSD = d_r + d_b$

→ $d_r = v * t_r$

$d_r = \left(110 \frac{Km}{h} * \frac{1000}{3600} \frac{m}{s}\right) * 2.5\, s$

$\therefore d_r = \left(\frac{110 * 1000}{3600}\right) * 2.5$

$\therefore d_r = 76.4\ m$

→ $d_b = \frac{\Delta v^2}{254(f \pm G)}$

$\therefore d_b = \frac{(110)^2}{254(0.28 - \frac{3.5}{100})}$

$\therefore d_b = 194.43\ m$

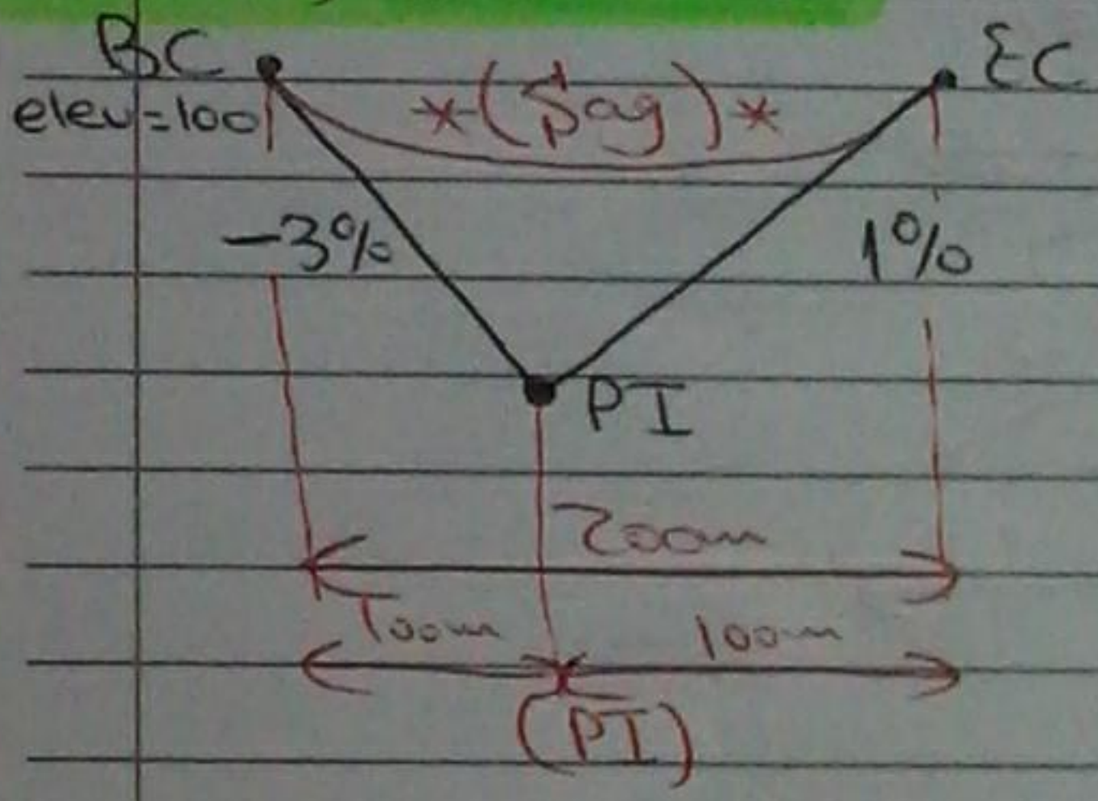
No

$\therefore SSD = 76.4 + 194.4$

$\boxed{SSD = 270.8\ m}$

Ex8o a (-3%) grade is connected to (1%) by means of $(200m)$ v. curve, if the elevation at the curve is $(100m)$. find the elevation of the curve at $(20m)$ interval.

Solution:



The value of $a = \left|\frac{g_1 - g_2}{2L}\right|$

$a = \left|\frac{-0.03 - 0.01}{2 * 200}\right| = \boxed{0.0001}$

The value of $(y = ax^2)$...

(BC) $y_0 = (0)$ → Coordinate of (BC)

$y_{20} = 0.0001(20)^2 = 0.04$

$y_{40} = 0.0001(40)^2 = 0.16$

$y_{60} = 0.0001(60)^2 = 0.36$

$y_{80} = 0.0001(80)^2 = 0.64$

(PI) $y_{100} = 0.0001(100)^2 = 1$

(mirror)

(mirror)

No

Station	Grade	Tangent elev	offset	Profile level
0+00 (BC)	-3%	100 (start)	0	100
0+20	-3%	$\left(\frac{(20-0)*-3}{100}\right)+100 = 99.4$	0.04	99.44
0+40	-3%	$\left(\frac{(40-0)*-3}{100}\right)+100 = 98.8$	0.16	98.96
0+60	-3%	$\left(\frac{(60-0)*-3}{100}\right)+100 = 98.2$	0.36	98.56
0+80	-3%	$\left(\frac{(80-0)*-3}{100}\right)+100 = 97.6$	0.64	98.24
1+00 (PI)	-3%	$((100-0)*\frac{-3}{100})+100 = 97$	1	98
1+20	1%	$((120-100)*\frac{1}{100})+97 = 97.2$	0.64	97.84
1+40	1%	$((140-100)*\frac{1}{100})+97 = 97.4$	0.36	97.76
1+60	1%	$((160-100)*\frac{1}{100})+97 = 97.6$	0.16	97.76
1+80	1%	$((180-100)*\frac{1}{100})+97 = 97.8$	0.04	97.84
2+00 (EC)	1%	$((200-100)*\frac{1}{100})+97 = 98$	0	98

+ ما أنه (sag)...
طرح إذا كانت (crest)...

هاي لمعدار elevation to (EC)

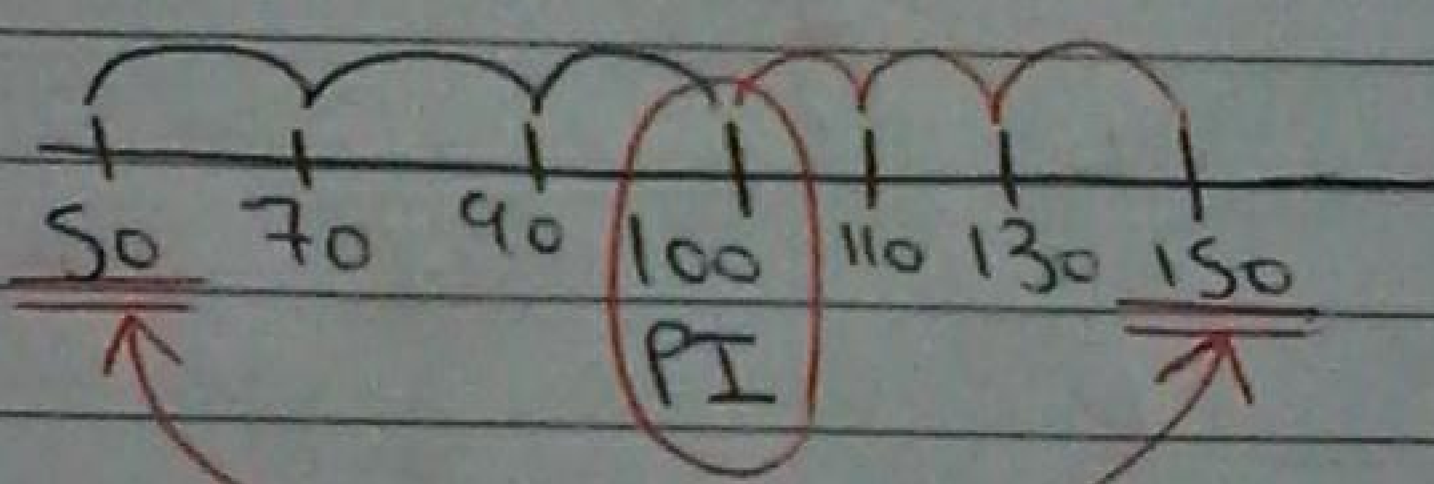
To find the value of $X_m = \left(\frac{g_1 * L}{g_2 - g_1} \right)$

$\therefore X_m \rightsquigarrow$ min. point

$X_m = \left| \left(\frac{(-3/100) * 200}{(1/100) - (-3/100)} \right) \right|$

$\therefore X_m = 150\ m$

هاي مو
ال (PI)
فهي قيمة ما
مع ال (mirror)



mirror

$\therefore$ The value of $(X_m = 50)$ $\rightsquigarrow$ offset

$y = ax^2$

$y_{50} = (0.0001)(50)^2$

$y_{50} = y_{150} = 0.25$

(150 − 100) → (PI)

$\rightsquigarrow$ Tangent elevation $= \left((150 - 100) * \frac{1}{100} \right) + 97$

Tangent elevation $= 97.5\ m$

$\rightsquigarrow$ Profile level $= 97.5 + 0.25 = 97.75\ m$

$98 - \left((200-150) * \frac{1}{100} \right)$ [illegible]

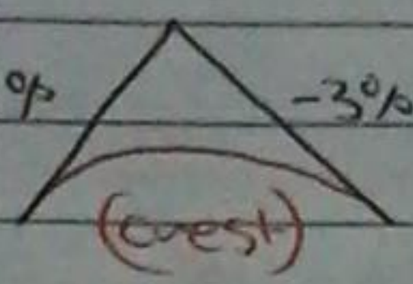
* Ecc * * *

equal (97.5)

No

Exe a highway is being designed to AASHTO standards with (120 Km/h) design speed and at one section an equal tangent U.curve must be designed to connect grade of (1%) and (-3%), determine the (min. length) of the U.curve. take (δ=0.28) and (t_r=2.5 sec) ???

Solution



The value of (SSD = $d_r + d_b$)

$d_r = U * t_r$

$d_r = \frac{(120 * 1000}{3600} * 2.5$

$\boxed{d_r = 83.33 \text{ m}}$

$d_b = \frac{\Delta U^2}{254(\delta \pm G)}$

$d_b = \frac{(120)^2}{254(0.28 - \frac{3}{100})}$

$\boxed{d_b = 226.53 \text{m}}$

$\therefore SSD = 226.53 + 83.33 = \boxed{309 \text{ m}}$

No

→ assume $\$ \leq L$:

$L_{min} = \frac{6\$^2}{404} = \frac{(1-{-3}) * (309)^2}{404} = \boxed{945\ m}$ ✓

$\therefore \$ \leq L$ → **ok**

→ assume $S \geq L$:

$L_{min} = 2\$ - \frac{404}{G} = (2 * 309) - \frac{404}{(1-{-3})} = \boxed{517}$ ✗

$\therefore \$ \leq L$ → **NOT ok**

→ **based on (P$D)** :

→ at $V = 120$ Km/h (from table)
the value of ($P\$D = 792\ m$)

$P\$D \leq L$ → $L_{min} = \frac{G\$^2}{946}$

$\therefore L_{min} = \frac{(1-{-3})(792)^2}{946}$ → $(309)^2$

$\boxed{L_{min} = 2652.3\ m}$ → **(ok)** → $\boxed{507.65}$

$P\$D \geq L$ → $L_{min} = 2\$ - \frac{946}{G}$ ← (309)

$\therefore L_{min} = (2 * 792) - \frac{946}{(1-{-3})}$

$\boxed{L_{min} = 1377.5\ m}$ → **(NOT ok)**
381.5

(*) (L) [illegible]

* * * *

→ $BC = \text{Station PI} - \frac{945}{2}$

→ $EC = \text{Station PI} + \frac{945}{2}$

No

Ex80 Given a hor. curve with a Radius (410m) and a deflection angle ($\Delta = 32°$) and the PI station of (1+120.774). compute the curve data and the station of (BC) and (Ec). compute the deflection angle at every (20m) station... (scale 1:1000)

Solution

* $L = R\Delta_{rad} = 410 * (32°) * \frac{\pi}{180}$

$\therefore L = 229m$

* $T = R\tan\left(\frac{\Delta}{2}\right) = 410 * \tan\left(\frac{32°}{2}\right)$

$\therefore T = 117.56m$

* Station (BC) = station PI − T

Station (BC) = 1120.774 − 117.56

Station (BC) = 1003.184

$\therefore$ Station (BC) = 1+003.184

* Station (Ec) = Station BC + L

Station (Ec) = 1003.184 + 229

Station (Ec) = 1232.184

$\therefore$ Station (Ec) = 1+232.184

* $M = R - R\cos\left(\frac{\Delta}{2}\right)$

$M = 410 - (410 * \cos\left(\frac{32°}{2}\right))$

$M = 15.88m$

No

* $E = \frac{R}{\cos(\frac{\Delta}{2})} - R$

$E = \frac{410}{\cos(\frac{32^\circ}{2})} - 410$

$\therefore E = 16.523$

* $C = 2R\sin(\frac{\Delta}{2}) = 2 * 410 * \sin(\frac{32^\circ}{2})$

$\therefore C = 226.023\ m$

* Station	X	$dx = (\frac{x}{2R}) * \frac{180}{\pi}$	$Cx = 2R\sin(dx^\circ)$
(Bc) 1+023.187	0	0	0
1+043.187	20	1.39°	19.89
1+063.187	40	2.79°	39.9
1+083.187	60	4.19°	59.9
1+103.187	80	5.59°	79.8
1+123.187	100	6.98°	99.6
1+143.187	120	8.38°	119.5
1+163.187	140	9.78°	139.3
1+183.187	160	11.18°	158.9
1+203.187	180	12.58°	178.6
1+223.187	200	13.97°	197.9
1+243.187	220	15.3°	216.4
(Ec) 1+243.187	240	16.7°	235.6
	↳ (L)	↳ $(\frac{\Delta}{2})$	↳ (C)

Ex 8

① find the rate of superelevation on a (H. curve) having a (R = 90 m). The design speed is (50 Km/h). assume (f = 0.15) ???

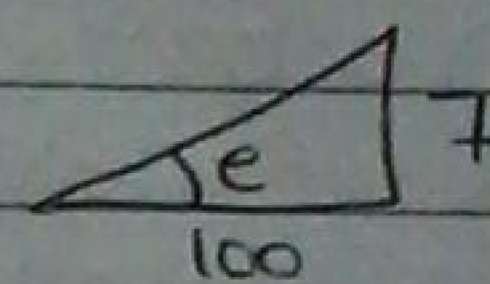
$$* \; e + f = \frac{v^2}{127R}$$

$$e + 0.15 = \frac{(50)^2}{127(90)}$$

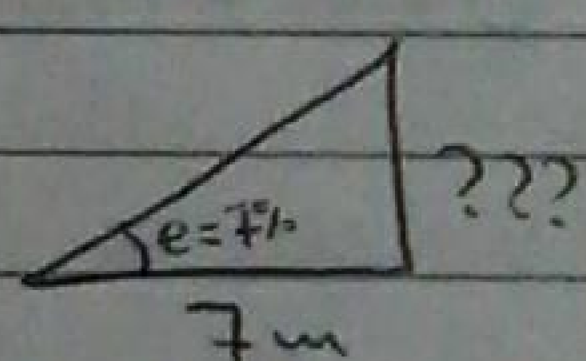
$$e = \frac{(50)^2}{127(90)} - 0.15$$

$$\therefore e = 6.8\ \%$$

$$\boxed{e \simeq 7\%}$$



② if the road width is (7 m) calc. the rise of banking due to the superelevation...



$$* \; ??? = e * w \rightsquigarrow e = \frac{H}{B}$$

$$H = e * w$$

$$\therefore H = 0.07 * 7\ m$$ ← * لازم اضربها في عدد الـ (lane)

$$\boxed{\therefore H = 0.49\ m}$$

③ if the max. superelevation is (1:15) and (f = 0.15) calc. the permissible speed on a curve of (R = 180 m) ???

$$* \; e = \frac{1}{15} = 0.067$$

$$e + f = \frac{v^2}{127R} \rightsquigarrow 0.067 + 0.15 = \frac{v^2}{127 * 180}$$

$$\therefore v = \sqrt{(0.067 + 0.15) * 127 * 180}$$

$$\boxed{v = 70.43\ Km/h}$$

ناخدها اقل عشان الـ
(Safety ≃ 70)

No

Ex8a: is the (AADT = 10,000 vehicles) and the percentage of the (30th hour) is (20%) of the AADT. for both direction. and the traffic volume in one direction is (60%). find the # of lanes if the lane capacity is (600ve/h)...

→ D = directional distribution...
(D = 60%)
→ K = % of the peak hour...
(K = 20%)
→ AADT = 10,000...

The value of (DDHV = D * K * AADT)

equal (60% * 20% * 10,000) = 1200 veh/h

∴ # lane in each direction = 1200 / 600 = (2)

∴ Total (4)

Ex8a: design period = (20 year)
ADT = (5000 veh/h) in the (1st year)
Normal growth = (50%)
Generated traffic = (30%)
Growth due to developing = (1000 ve)
Find (ADT), after (20 year)???
Now → (5000 * 50%) + (5000 * 30%) + 1000 = 5000 ve

∴ 5000 + 5000 = 10,000 ve/h

No. [illegible]

Question one

(A) The functional classification of the street network is composed of ...

* freeway – arterial – collector – local road...

(B) where and when should you use (a climbing lane)...

* when heavy vehicles drop in speed while climbing on 2-lane. hwy. (uphill) to help other vehicles pass heavy vehicles.
when the (L_T / L_c)...

(C) 1) what are the problems of using a reversed horizontal curve?

* dangerous...
* Sudden change in super elevation...
* Sudden change in grades...
* Not easy to provide the super elevation...

2) what is the engineering action you should take to avoid these problem? (design standard of the road etc)...

* provide a straight line between the curve...

3) To increase safety at horizontal curves, what action would you take if you were limited to max. super elevation???

* ↑ (R) of curve...
* limit the speed...
* ↓ friction ...

No

(xxx Question two xxx)

a highway reconstruction project is being undertaken to reduce accidents at (a crest vertical curve) ... The reconstruction involves a major realignment of the way such that a (100 Km/h) design speed is attained. The station of BC + EC is (1+300) and (1+545) respectively. measurements show that at station (1+407.29), the vertical curve offset is (1m). if the required (SSD = 205m)! assess the adequacy of this existing curve in light of the reconstruction. if the existing curve is inadequate, compute the curve length to provide the required SSD???

(Solution)

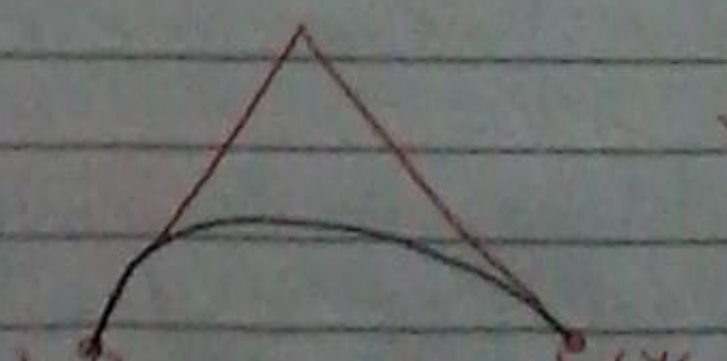
$V = 100 Km/h$

$SSD = 205m$

@ station = $1+407.29 \rightsquigarrow$ (offset = 1m = y)

BC $\rightsquigarrow$ 1+300

EC $\rightsquigarrow$ 1+545



$\rightsquigarrow L = 1545 - 1300$

$L = 245 m$

$\therefore PI = 1300 + \frac{245}{2}$

$PI = 1422.5$

$PI = 1+422.5$

$\rightsquigarrow y = ax^2 \rightsquigarrow 1 = a(1407.29 - 1300)$

$\therefore a = 8.68 * 10^{-3}$

$\therefore a = \left| \frac{g_1 - g_2}{2L} \right| \rightsquigarrow g_1 - g_2 = 8.68 * 10^{-3} * 2 * 245$

$|g_1 - g_2 = 0.043| * 100 \rightsquigarrow |g_1 - g_2 = 4.3\%|$

No

$\rightsquigarrow L = 245\,m$

$\therefore SSD = 220$

$* SRL \rightsquigarrow \frac{GS^2}{404} = \frac{4.3 * S^2}{404} = 245$

$\therefore S = 151.72 < SSD_{req}$ X

$* SAL \rightsquigarrow 2S = \frac{G}{404} = 2*S - \frac{4.3}{404}$

$\therefore S = 122 < SSD_{req}$ X

$\therefore$ use the value of $(SSD = 205m)$ $\therefore$

$L_{min} \begin{cases} \rightsquigarrow SRL \rightsquigarrow \frac{4.3*(205)^2}{404} = 447.3m \\ \rightsquigarrow SAL \rightsquigarrow (2*205) = \frac{4.3}{404} = 491.9 \end{cases}$ ✓ X

$L = 447.3m$ (OK)

No

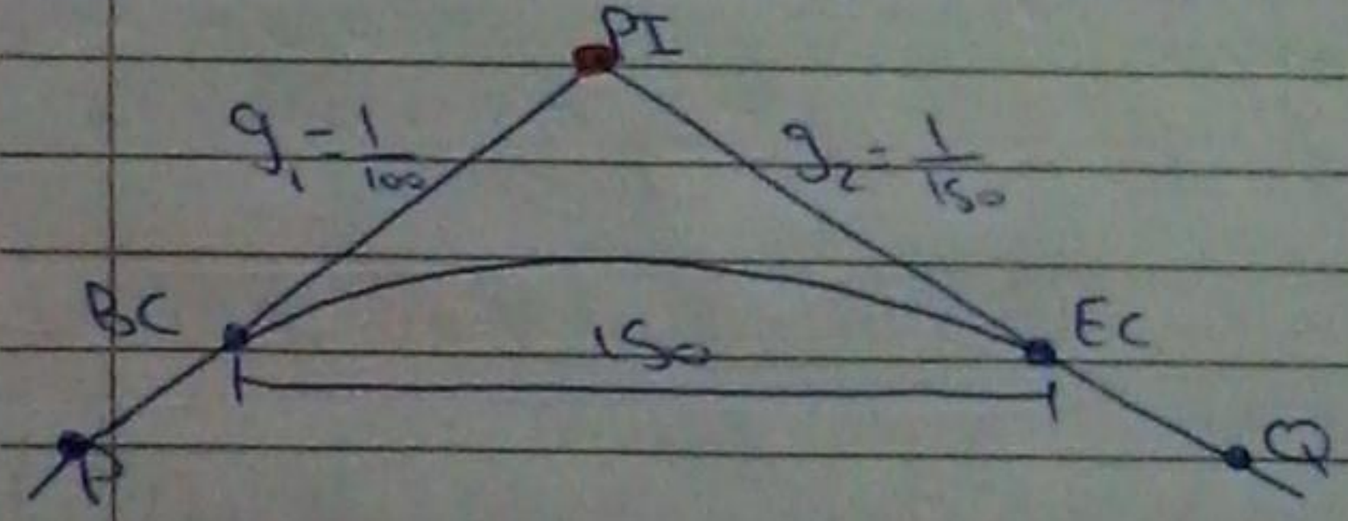
*** Question Three ***

one a straight portion of anew road, an upward gradient of (1:100) was connected to a downward gradient of (1:150) by a crest vertical curve 150m long at point P at station (5910) on the first gradient was found to have an elevation of (45.12m) and Point (Q) at station (6210.m) at the second tangent of an elevation of (44.95m) as in the figure below.

find the

(a) Station of (Bc) and (Ec).

(b) elevation of (Bc) and (Ec).



Station of P = 5+910

elev @ P = 45.12m

Station of Q = 6+210

elev @ Q = 44.95m

*** Solution ***

$45.12 + (X - 5910.0) * \frac{1}{100} = 44.95 + (6210.00 - X)\frac{1}{150}$

$\therefore X = 6019.8\,m$

Is station of (PI) ...

No

* The station of $\left(BC = 6019.8 - \frac{150}{2}\right)$

$$\therefore BC = 5944.8\ m$$

* The station of $\left(EC = 6019.8 + \frac{150}{2}\right)$

$$\therefore EC = 6094.8\ m$$

* The elevation of $\left(BC = 45.12 + \left(\frac{5944.8 - 5910.0}{100}\right)\right)$

$$\therefore \text{elev@}BC = 45.468\ m$$

* The elevation of $\left(EC = 44.95 + (6210.0 - 6094.8)\frac{1}{150}\right)$

$$\therefore \text{elev@}EC = 45.718\ m$$

$$X_m = \frac{g_1 L}{g_1 - g_2} = \frac{\frac{1}{100} * 150}{\frac{1}{100} - -\frac{1}{150}}$$

$$X_m = 90\ m$$

* Check on (Q)*

No

***Question (7) 80 ***

(A) A young driver with a reaction time of (2.5sec) is traveling in his car on a two lane highway with a down hill gradient of (0.01 cm/cm) and up grade gradient of (0.02 cm/cm) at a speed of (60 K/hr). A child steps out suddenly from behind a parked car on the downhill grade into the path of the car at (distance of 85m). Can the driver stop in time without hitting the child? take coefficient of friction as (0.28)?

Solution

$d_r = v * t_r$

$d_r = 60 * \frac{1000}{3600} * 2$

$\therefore d_r = 33.3\ m$

$d_b = \frac{v^2}{2g(f \pm G)}$

$d_b = \frac{(60 * \frac{1000}{3600})^2}{2 * 9.81(0.28 - 0.01)}$

$\therefore d_b = 58.99 \approx 59\ m$

$\therefore SSD = d_r + d_b = 33.3 + 59$

$\therefore SSD = 92.3\ m \approx 785\ m$ ✓

∴ The driver will trip the child...

(B) What length of curve would you recommended for the above???

$L_{min} = \frac{GS^2}{404} = \frac{6 * (92.3)^2}{404} = 126.5\ m$

$SSD < L \longrightarrow$ SSD is valid

No

(C) Make a suggestion to the geometric design to improve sight distance ???

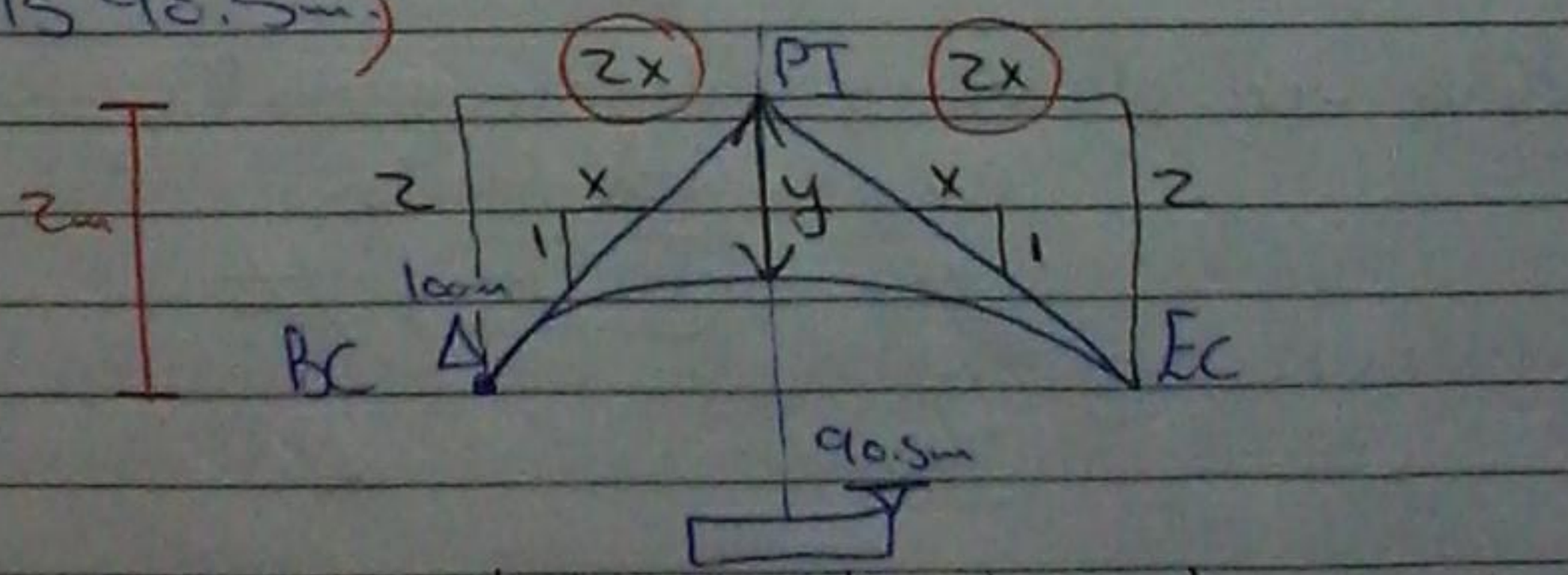
provide longer curve and (reduce) the grade To improve sight distance. (But it more cost)...

~~Question Five Bo~~

(A) define critical curve length?

The max. length that allows ahuy aheavy vehicles to climb up without a significant drop in speed...

(B) Two equal tangent with equal slope (1v) and (1H) connecting (a vertical curve) to be used (as a crest curve), with the highest point coming out exactly over the (center line) of the crossroads. The (elevation) at (BC) is (100) and (PT) is (2m) higher than (BC). Find the (max. vertical clearance) between the profile grade on the vertical curve and the center line of the cross roads. The (elevation of the crossroads is 90.5m)



$$* X_m = \left|\frac{g_1 L}{g_1 - g_2}\right| = \left|\frac{\frac{1}{x} * 4x}{\frac{1}{x} + \frac{1}{x}}\right| = \left|\frac{4}{\frac{2}{x}}\right| = 2x \text{ (max high point)}$$

$$* a = \left|\frac{g_1 - g_2}{2L}\right| = \left|\frac{\frac{1}{x} + \frac{1}{x}}{2 * 4x}\right| = \left|\frac{\frac{2}{x}}{8x}\right| = \boxed{\frac{1}{4x^2}}$$

No

$y_{2x} = cx^2$

$y_{2x} = \left(\frac{1}{4x^2}\right)(2x)^2$

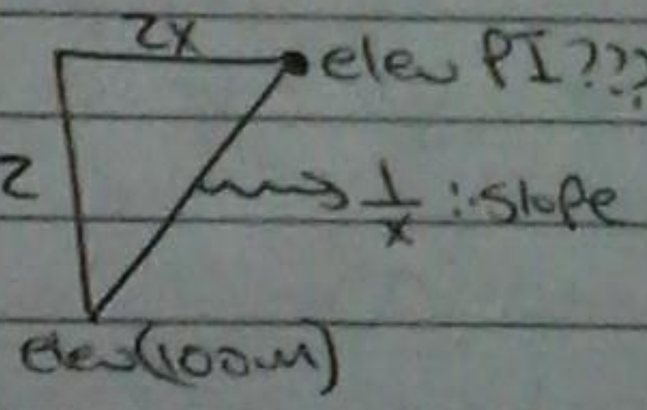
$y_{2x} = \frac{1}{4x^2} * 4x^2$

$y_{2x} = 1$ ~~m~~ (offset)

∴ elevation of PI = $100 + \left(2x * \frac{1}{x}\right)$

elevation of PI = $100 + 2$

elevation of PI = 102 m



∴ Profile elevation = 102 − 1 = 101 m ...
(crest)

∴ Max. ver. clearness = Profile elev. PI − cross road elev

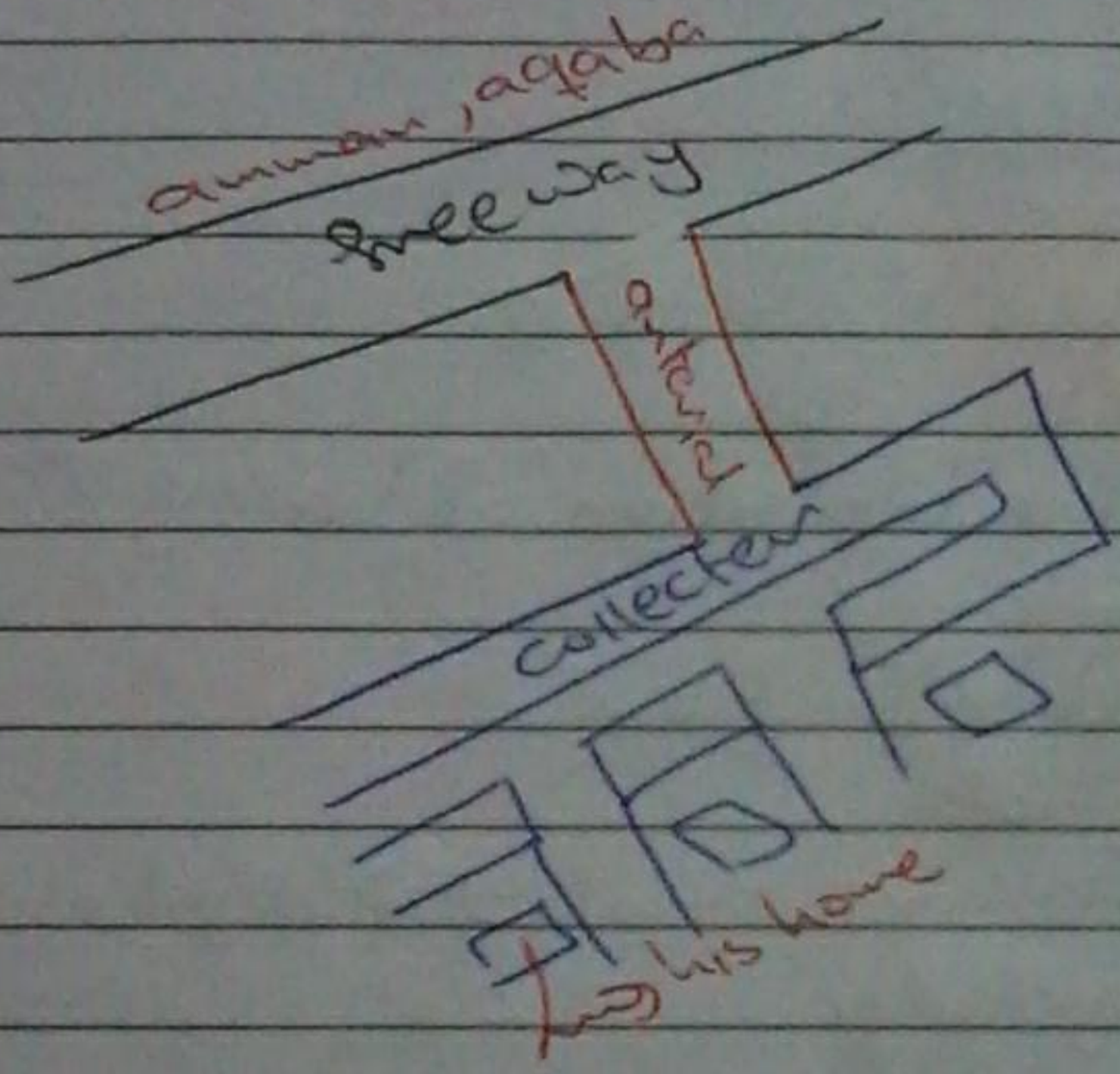
" = 101 − 90.5

" = 10.5m #

No

Question six

(A) aman is traveling by car on a freeway connecting amman and aqaba. he lives in a town halfway between them now using a drawing how would you connect him from the freeway to this house???



(B) what are the types of lanes which are only provided at interchanges???

* acceleration lane...
* deceleration lane...

(C) what are the two types of lanes which are only provided on vertical curve???

* climbing lane...
* escaping lane...

No

(d) what are the operational characteristic of the design vehicles which effect the geometric design???

* wheel base... ⊛(weight + height + length + wheel base + width)... etc
* acceleration...
* deceleration...
* speed...

Question (7) 8o

(A) what are the limitation of having ??? (hwy)

(1) max. up grade...
(power/weight) ratio...

(2) max. down grade...
(sight distance and stop sight distance)...

(3) min. down grade...
(To provide the drainage)...

(B) what are the (4) component of reaction time? (PIEO)

(1) perception...
(2) emotion...
(3) volition...
(4) intellection...

(C) what engineering modification would you suggest if the vertical curve length is longer than the critical length???

(1) adding a climbing lane...
(2) decrease the grade...
(3) abrupt change in rate of grade...

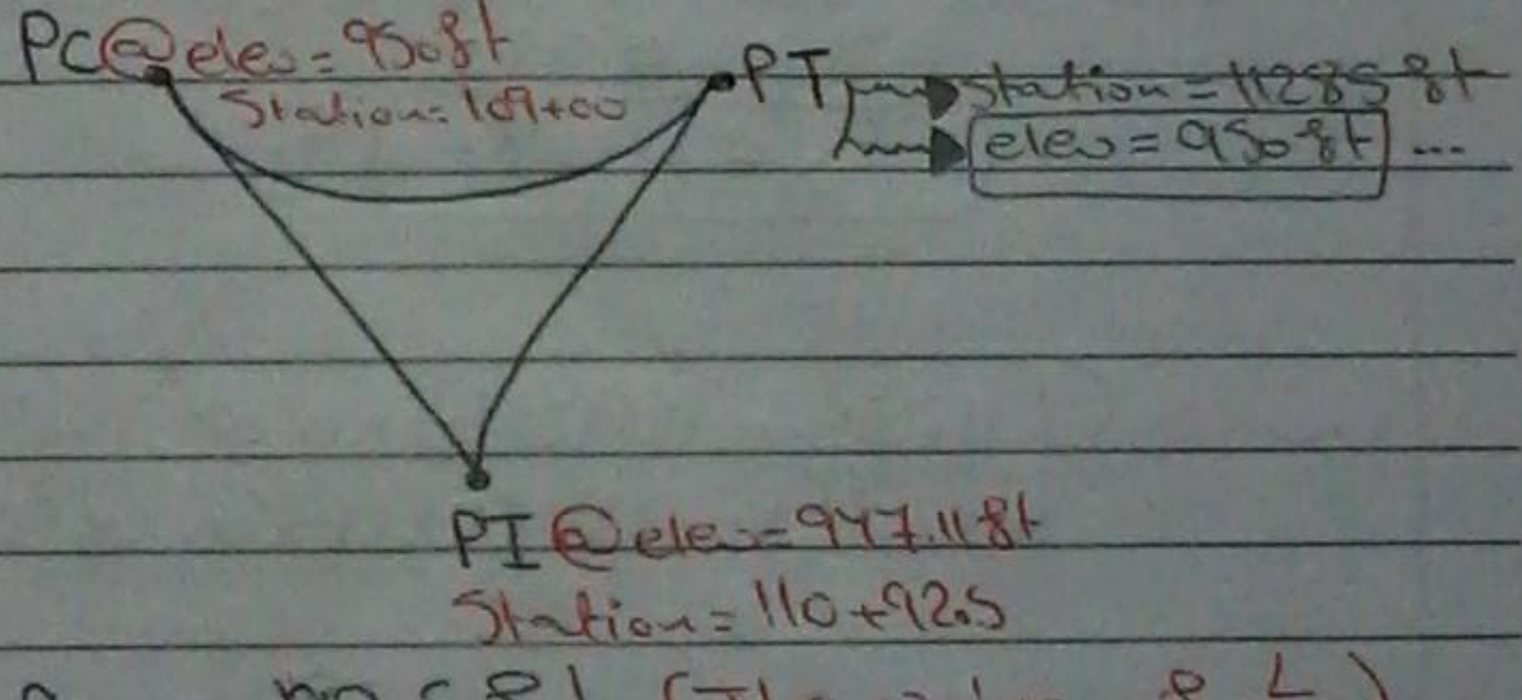
No

Question (8)

Find the
Length of vertical curve ???
initial (g) ???
elevation of lowest point ???

Final *

Point	elevation	Station
PC	950 ft	109+00
PI	947.11 ft	110+92.5
lowest point	(946.7 ft) ← (target) 947.9 ft (possible end)	110+65



⇝ 11092.5 − 10900 = 192.5 ft (The value of $\frac{L}{2}$)

$\therefore \frac{L}{2} = 192.5$ ft ⇝ $L = 385$ ft

∴ The station of PT = 10900 + 385

The station of PT = 11285 ft

⇝ $((11092.5 - 10900)x - x) + 950 = 947.11$

$-192.5x + 950 = 947.11$

$x = \left(\frac{947.11 - 950}{192.5}\right)$

$\therefore x = -0.02\%$

$x = -2\%$ #

No

$$\rightsquigarrow X_m = \left|\frac{g_1 - L}{g_1 - g_2}\right|$$

$$11065 = \left|\frac{g_1 - L}{g_1 - g_2}\right|$$

$$11065 = \left|\frac{-0.02 - 385}{-0.02 - g_2}\right|$$

$$11065 \not= \frac{385.02}{0.02 + g_2}$$

$$(0.02 + g_2) * 11065 = 385.02$$

$$0.02 + g_2 = 0.035$$

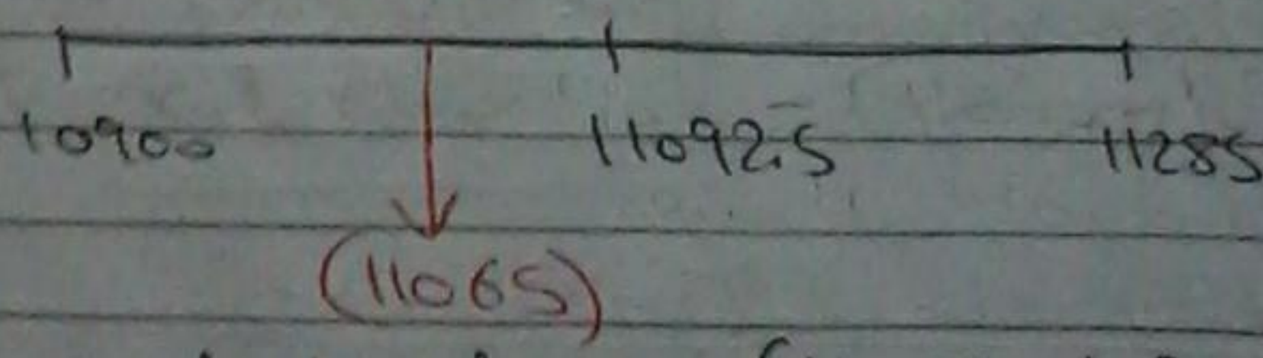
$$\therefore g_2 = 0.035 - 0.02$$

$$\therefore g_2 = 0.015$$

$$\therefore g_2 = 1.5\%$$

$$\rightsquigarrow ((11285 - 11092.5) * 0.015) + 947.11$$

$$\text{qual}(PT = 949.9175 \simeq 950 ft)$$



$$\therefore \text{Target elevation} = (11065 - 10900) * -0.02 + 950$$

$$\rightsquigarrow (\text{Target elevation} = 946.7 ft)$$

$$\rightsquigarrow y = ax^2 \rightsquigarrow a = \left|\frac{-0.02 - 0.015}{2 * 385}\right|$$

$$\boxed{a = 4.55 * 10^{-5}}$$

$$y = 4.55 * 10^{-5} \left(\begin{matrix}11065)^2 \\ (-10900)\end{matrix}\right. = 1.239$$

$$\therefore \text{Probable level} = 946.7 + 1.239$$

$$\text{Probable level} = \boxed{947.94 ft}$$

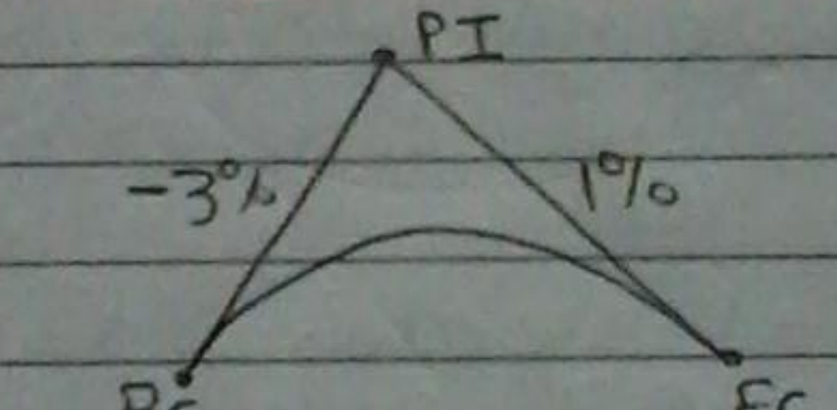
No

Question (9)

A) The figure attached shows a profile of an existing natural ground level, it is required to design a profile for a hoo lave hwy. The vertical curve is to connect a (-3%) grade to a (1%) upgrade. The beginning of the curve is at station (0+00) with an elevation (100m) above the sea level and the end of the curve is at station (200)..

B) if the center line of a crossroad comes exactly over the lowest point on the curve. what is the (max. height between the curve and the crossroad)??

Solve



$$* a = \left| \frac{g_1 - g_2}{2L} \right|$$

$$\therefore a = \left| \frac{-0.03 - 0.01}{2 * 200} \right| = \boxed{0.0001}$$

$$y_0 = y_{200} = (\text{zero}) \longrightarrow y_{100} = (1)$$

∴ Tangent elev = Profile level ... → for (BC, EC)..

∴ for PI → Station = 100m

$$\therefore \text{Tangent. elev} = \left((100 - 0) * \frac{-3}{100} \right) + 100 = 97$$

∴ Profile level = 97 + 1 = (98)

No

→ EC i:

$\left(\left(200-100\right)*\frac{1}{100}\right)+97=(98)$

→ $X_m=\left(\frac{g_1*L}{g_2-g_1}\right)$

$\boxed{X_m=150m}$ → at (50 m)

$\boxed{y_{50}=0.25}$

↳ Tangent elev $=\left(\left(150-100\right)*\frac{1}{100}\right)+97$

$\boxed{\text{equal } 97.5}$

↳ Profile level $= 97.5+0.25=\boxed{97.75}$

∴ max. height = Profile elev of PI − cross road elev (↳ lowest point)

$= 98-97.75$

$=(0.25)$

(OR) $98-97.5$ equal (0.5)

No

Question (6)

(A) what are the limitation of having?

(1) min. Radius of (H) curves...

* limit value of superelevation... * (see)

(2) max. super elevation...

* limit the value of speed... and the value of SSD... ↓friction... ↑R...

(3) min. laugth of (V) curves...

* limit the value of SSD and PSD...

(B) as an engineering what would you do in the following cases??

(1) To avoid erosion in the side slope...

* using Rip Rap...

(2) In the case of a sudden change of alignment...

* not using the reverse horizantal curve...

(3) -barrier ↑width of lane ↑shoulder ↑sight distance...
where the height of the embankment is 72.4...

* ↓slope and the friction...

No

Question (11)

a horizontal curve on a two lane highway (3.6m each lane) connecting two tangent. The first tangent runs in the north east direction and the second runs directly east. The (PC) and (PT) are (150m) apart...

A) what is the length of the horizontal curve???

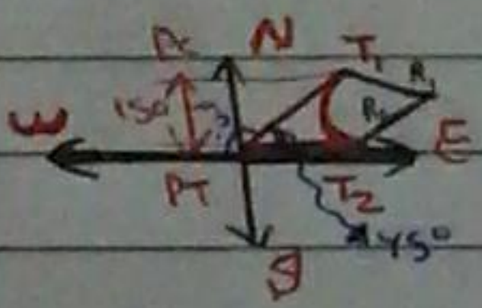
B) if (PI) is at station (1+200), find the location (station) of (PC) and (PT).

C) Regardless to your answer, assume the curve has a (R = 240m). if the design speed proposed is (120 Km/hr) and the permissible super elevation is (15%) and the (f_s = 0.2) using the data, is the curve safe? and why? if not, what should you suggest to increase safety of this curve (show your calculation)...

d) what is the rise on banking for the outer edge of this curve???

Sol:

(a)



$\Rightarrow \Delta = 180° - 45° = 135°$ $\Rightarrow$ (C = 150m)

$\Rightarrow C = 2R \sin(\frac{\Delta}{2}) \Rightarrow 150 = 2R \sin(\frac{135}{2}) \Rightarrow$ R = 81.1

$\Rightarrow \therefore L = R \cdot \Delta = 81.1 * 135 * \frac{\pi}{180} =$ 191.1m

(b) $T = R \cdot \tan(\frac{\Delta}{2}) = 81.1 * \tan(\frac{135}{2}) =$ 196m

$PC = PI - T = 1200 - 196 =$ 1004.2 $\Rightarrow$ (1+4.2)

$PT = PC + L = 1004.2 + 191.1 =$ 1195.3 $\Rightarrow$ (1+195.3)

(c) $e + f = \frac{v^2}{127R} \Rightarrow e + 0.2 = \frac{(120)^2}{127 * 240} \Rightarrow$ e = 27.27% (>15%)

Not (OK) $\Rightarrow$ ↑R to (324)

(d) $H = e \cdot w = 0.15 * 7.2 =$ 1.08m...

(3.6 * 2)

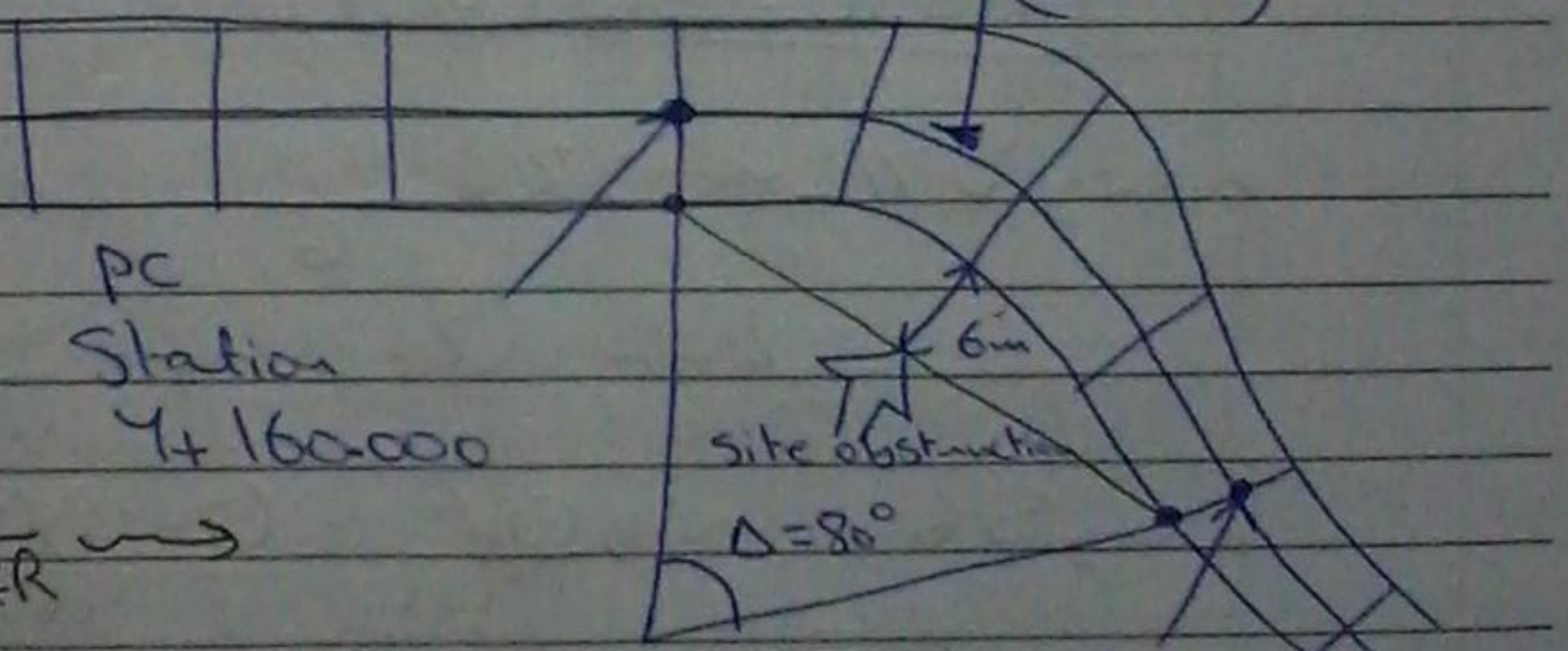
Question (12)

an existing (2-lane) highway (3.6m each lane) was built in amountainous terrain. due to the expensive excavation required the lateral clearance provided at the horizontal curve was (6m) as shown. the figure. The curve has a posted speed limit of (120km/h). many traffic accident have occured with drivers travelling east at the horizontal and vertical curve shown below. check the existing data and establish what might have caused these accident on bothe sides suggest any measures to improve the road safety of these site.

$f = 0.28$ ...

$t_r = 2.5$ sec ...

Site (A)



* $e+f = \frac{v^2}{127R}$ ⇝

$R = \frac{v^2}{127(e+f)} = \frac{(120)^2}{127(0.08+0.28)} = 315m$ ⇝ $315 < 315.15$ (ok)

* $L = Ec - Bc = 4600 - 4160$

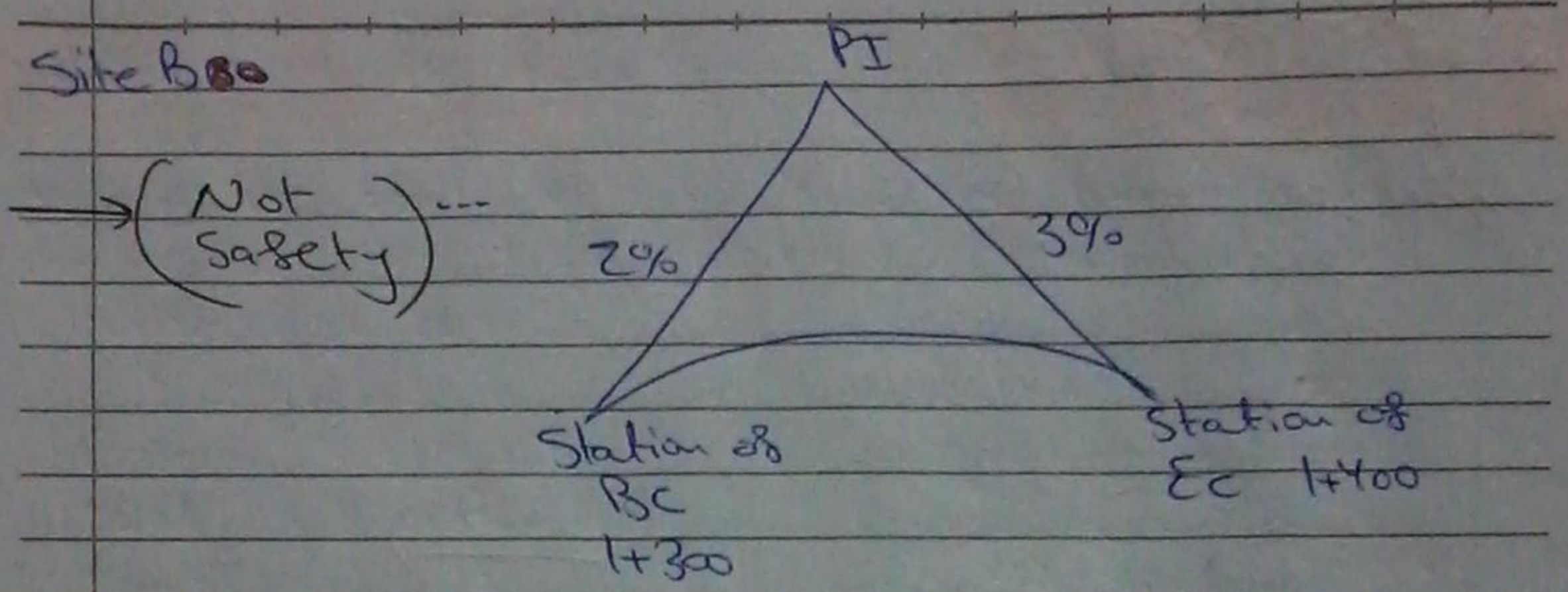
$L = 440m$

* $\Delta = 80° * \frac{\pi}{180°} = 1.396$ rad ⇝ $R = \frac{L}{\Delta} = 315.13$ m (ok)

safe ✓ (أمن) (ok) (more safe)

No

Site Boo



Sol:- The value of $L = 1400 - 1300$

$L = 100\ m \rightarrow L < L_{min}$

$$SSD = v * t_r + \frac{v^2}{254(g \pm G)}$$

$$SSD = \left(120 * \frac{1000}{3600} * 2.5\right) + \frac{(120)^2}{254(0.28 - 003)}$$

$$SSD = 83.33 + 226.772$$

$\therefore SSD = 310.1\ m$

$\rightarrow SSD > L \rightarrow SSD - \frac{A^2}{G}$

$$L_{min} = (2 * 310.1) - \frac{A^2}{(2-3)} = 539.4 \quad X$$

$\rightarrow SSD < L \rightarrow \frac{GSS^2}{A^2} = \frac{(2--3)(310.1)^2}{A^2}$

$\therefore L_{min} = 1190.14 \rightarrow (OK)$

$\rightarrow$ but $(L_{min} > L) \rightarrow$ (NOT OK)

$\rightarrow$ use $L = 1190.14 \rightarrow$ and Ec @ station $= 2 + 990.14$

↓ speed

↓ (slope)

* Question (13) *

(A) The standard width of hwy is (3.6m). what are the cases when there is need to increase the standard width???

* change the direction of the (H.curve). (see)

(B) what are the factors giving the number and the width of lanes???

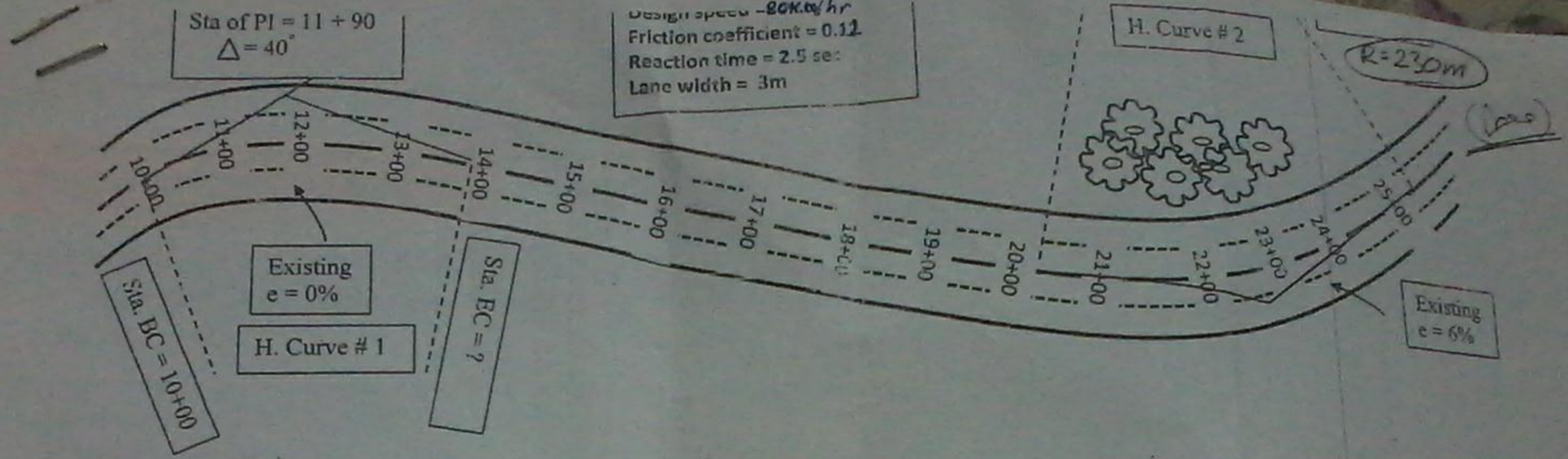
(1) volume traffic...
(2) the design speed... (see)

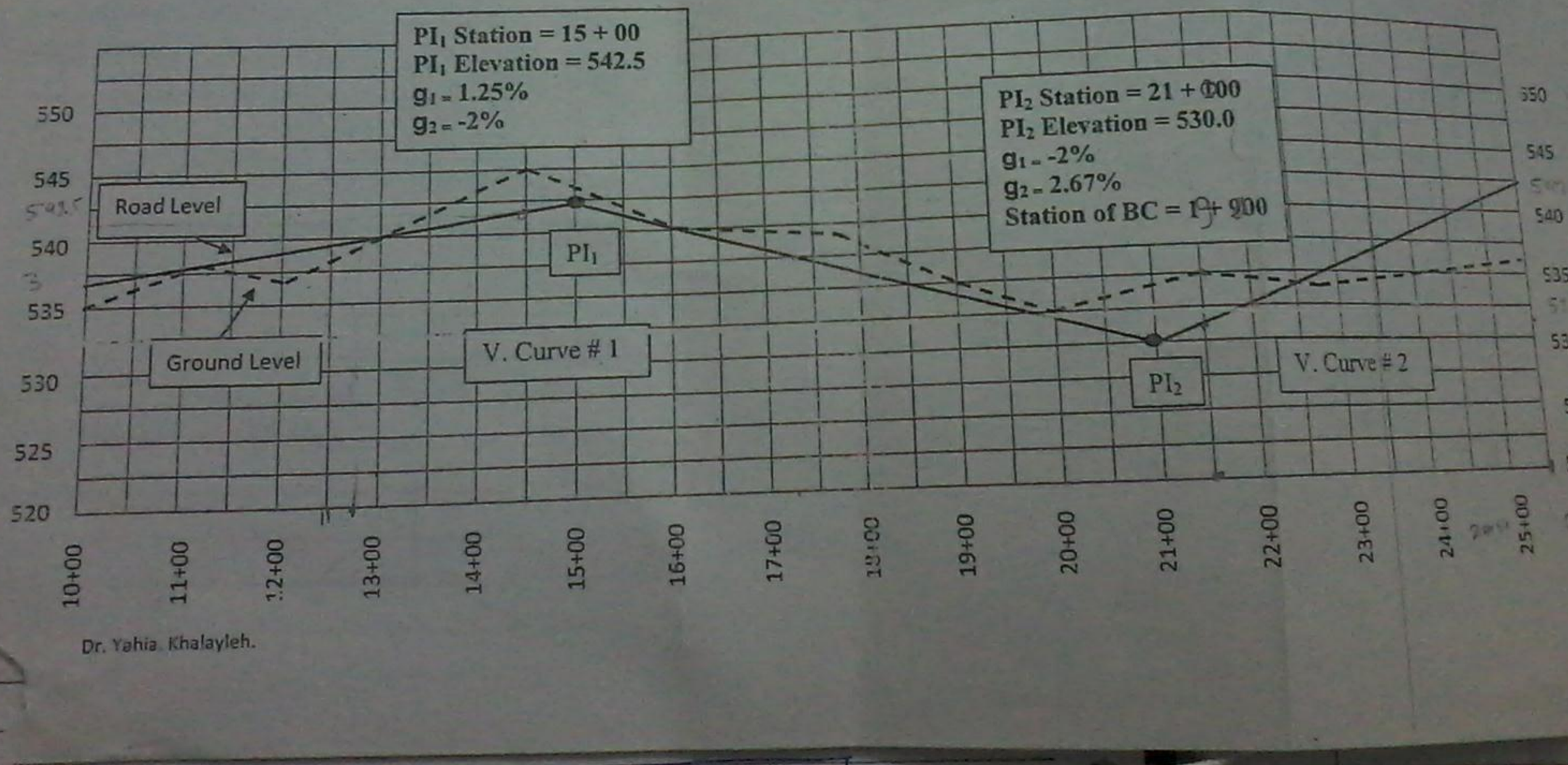
(C) Parent cross of roadway are raised at the center? what are the cases where you would avoid raising the center line of the road??? (see)

(1) one way hwy...
(2) 2-way hwy divided by middle strip...

(D) as an engineer what would you do in the following case...
- where fill 7 2.4m in height... (see)
Put Barriers (guard rails)...

* * * * *





Dr. Yahia Khalayleh.

No

(Question)(Project)*

*** The results of geometric design are set of coordinate through which the road way will pass to connect specified starting and ending points. The figure below shows the plan and profile of an alignment that requires both horizontal and vertical change in roadway direction and elevation... (Study this design and answer question Three and choose either question one or two???)

---> Q(1)

(1) A) Find station of (BC) and (EC) of U. curve #1???
(1) B) Find elevation of (BC) and (EC) of U. curve #1???

Sol:: for the crest::

$$\text{SSD} = (0.t_r) + \frac{v^2}{254(f \pm G)}$$

$$\therefore SSD = \left(80 * \frac{1000}{3600} * 2.5\right) + \left(\frac{(80)^2}{254(0.12 \pm 0.02)}\right)$$

$$\therefore SSD = 307.5\,m$$

$$L_{min} = \left(\frac{GS^2}{407}\right) = \left(\frac{(1.25+2)(307.5)^2}{407}\right)$$

$$\therefore L_{min} = 760.7\,m \quad (OK)$$

$$\text{Station of (BC)} = \text{Station (PI)} - \frac{L_{min}}{2}$$

$$= 1500 + \frac{760.7}{2}$$

$$= 1119.65$$

$$= 11 + 19.65$$

$$\text{Station of (EC)} = 11 + 19.65 + 760.7 = 18 + 80.35$$

No

The elev @ BC = 538 (تقريبا) من (ف الرسمة)
The elev @ EC = 534 (تقريبا) من (ف الرسمة)

c) elevation and station of the highest point for U.curve #1???

$X_m = \left| \frac{g_1 \cdot L}{g_2 - g_1} \right|$

$\therefore X_m = \left| \frac{0.025 * 760.7}{(0.02 + 0.025} \right|$

$\therefore X_m = 292.576\ m$

$\Rightarrow 29 + 2.576 \Rightarrow$ elev (من graph) equal

$\Rightarrow$ =

d) if the (R) for U. H.curve #1 $\Rightarrow$ 300m what is the safe speed limit that should be imposed at this curve???

$e = 0\%$

$f = 0.12$

$U = \sqrt{127 * 0.12 * 300} = \boxed{67.62\ Km/h}$ #

e) if the super elevation is 6% for both H.curve what is the rise or banking of this curve?

$\Rightarrow H = e * w$

$H = 0.06 * 3 * 4$

$\boxed{H = 0.71}\ m$ /lane

No

→ Q2:

(A) Station of (EC) → H.curve

(B) the deflection angle at station (11+50)?

(C) is H.curve safe?? what action to improve Safety?? → for curve (2)

(D) if e=6%. what rise or breaking???

→ Sol:

→ H = ω * e

H = 0.06 * 3 * 4

H = 0.71

→ Station of PI = 11+90

Δ = 40°

e = 0%

BC = 10+00

→ Station BC = Station PI - T

10+00 = 11+90 - T

T = (11+90) - (10+00)

T = 190

→ $T = R \cdot \tan\left(\frac{\Delta}{2}\right)$

$190 = R \cdot \tan\left(\frac{40}{2}\right)$

$\therefore R = \frac{190}{\tan(20)} = 522.02\ m$ → Ans

→ $L = R * \Delta_{rad} = 522.02 * 40 * \frac{\pi}{180}$

$\therefore L = 364.44\ m$

→ EC = BC + L

EC = (10+00) + 364.44

EC = 13+64.4

No

$$e + f_s = \frac{v^2}{127R}$$

$$0 + 0.12 = \frac{(80)^2}{127R}$$

$$\therefore R = 419.94$$ < R → for curve (1) * (NOT safe) * (OK)

→ for (2) →

$$-0.06 + 0.12 = \frac{80^2}{127R}$$

$R = 279.965$ > $R = 230m$ ([illegible])

[illegible]

(safe)

→ ↑ e ...

→ ↓ v ...

(E) find the X_m for curve (2):

$$\left| \frac{g_1 \cdot L}{g_2 - g_1} \right|$$

* * * * *

([illegible]
* (Cut and fill) *
←)

No *(بدون عنوان)*

Question (1)

using the data below : find the quantity of cut and fill between station 22+00 and station 23+50...

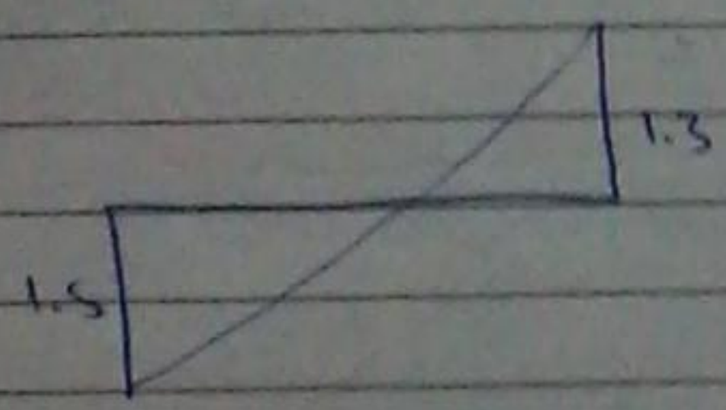
Ground level = 536
Side slope = 1:2
Back slope = 1:2
Station (22+50)

سؤال (1) بدون عنوان

Question (Project)

* GL = 536 ——————

Side slope and Back slope = 1:1
Station 22+50



GL = 535
Side slop = 1:2
Back slope = 1:2
Station = 21+50

* GL = 535 ——————

No

مطلوب في السؤال ال (cut, fill) من (Q?) تابع لها السؤال السابق:

Sol:

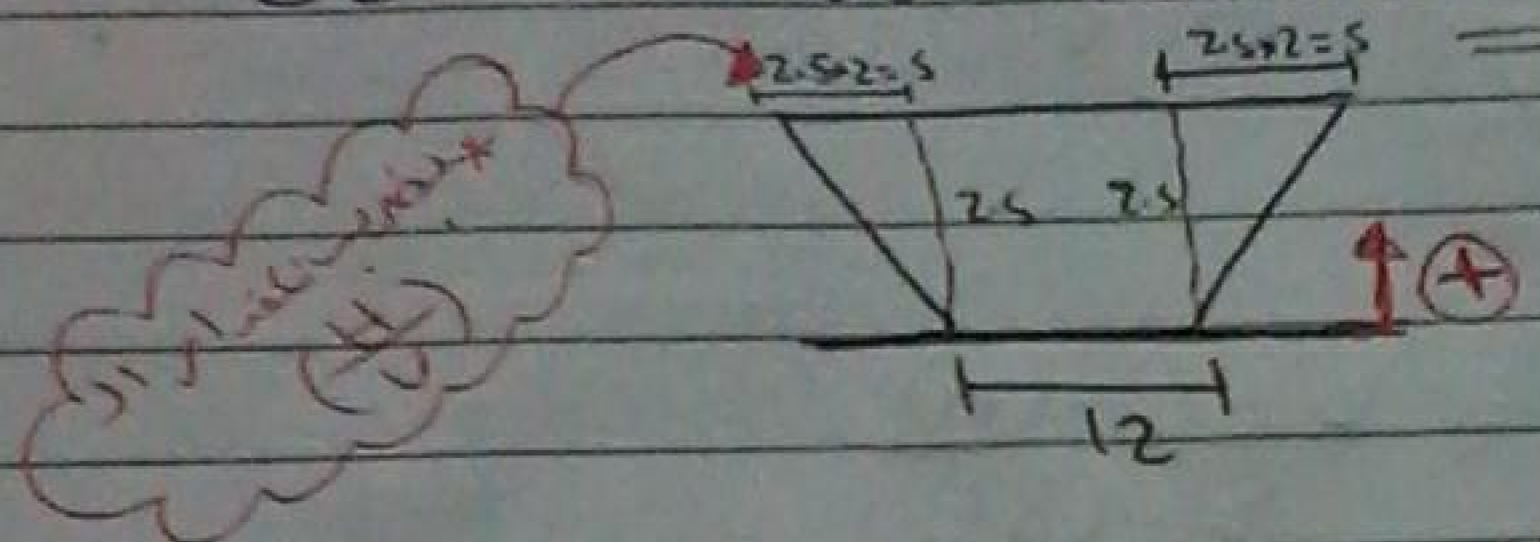
(*) @Station (22+00)

GL = 535

DL = 532.5 → from graph (التقاطع مع الخط المستقيم)

lane width = 3 * 4 = 12m
(4 → #lane)

GL − LL = 535 − 532.5 = 2.5 (cut)



(1:2) → H:V 2:1

∴ Area = (12*2.5) + 2($\frac{1}{2}$*5*2.5) = **42.5 m²**

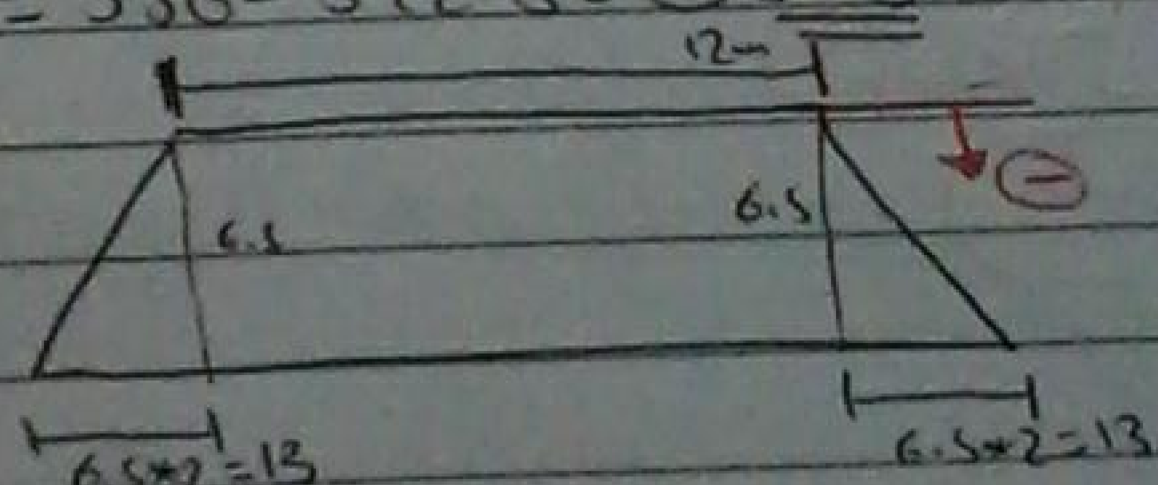
(*) @Station (25+50)

GL = 536

DL = 542.5 → from graph

lane width = 12m

GL − LL = 536 − 542.5 = (−)6.5 (fill)



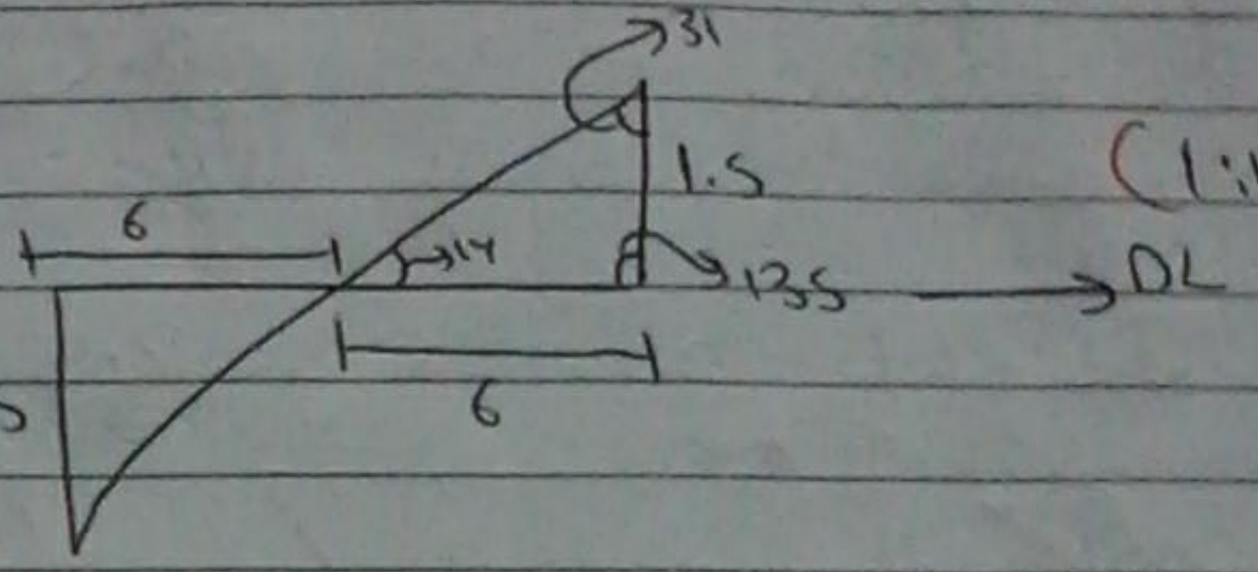
(1:2) → 2:1 H:V

∴ Area = (12*6.5) + (2*$\frac{1}{2}$*13*6.5) = **162.5 m²**

No

* @ station (22+50)

(cut (and) fill) ⟶



$C = 6$

$$A = \frac{C \cdot \sin(\alpha)}{\sin(C)} = \frac{6 * \sin(17)}{\sin(31)}$$

$\therefore A = 2.818 \, m^2$

$$\therefore Area = \frac{1}{2} * 6 * 2.818 * \sin(135)$$

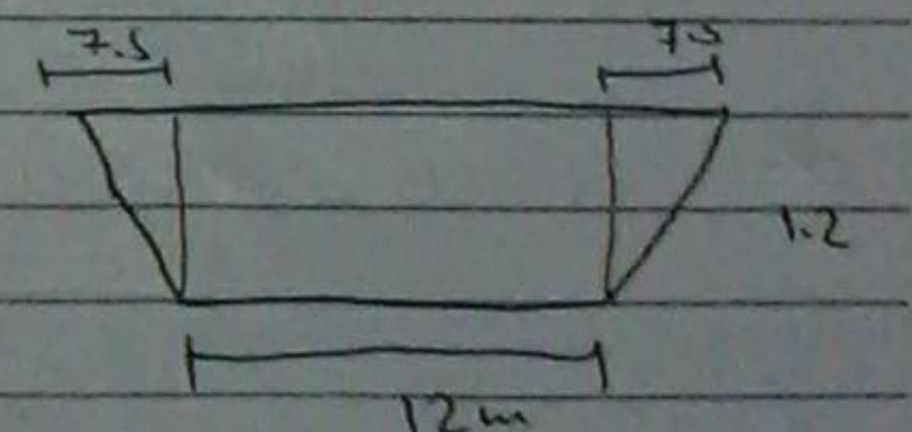
$\therefore Area = 5.98 \, m^2$

* @ station (21+50) ⟶ (cut)

GL = 535

DL = 531.25

Area = 73.13 m^2



* The quality :

⟶ 21+50 ⟶ A = 73.13 m^2 (cut) ⟶ (apt)

22+00 ⟶ A = 72.5 m^2 (cut)

22+50 ⟶ A = 5.98 m^2 (cut, fill) } (able)

25+50 ⟶ A = 162.5 m^2 (fill)

No

Station	area		volume	
	cut	fill	cut	fill
22+00	42.5	0	0	0
22+50	5.98	5.98	1212	149.5
25+50	0	162.5	897	25272

$$V = \left(\frac{A_1 + A_2}{2}\right) * (\Delta Station)$$

~~Solution~~

① Squared culvert...

② $A = 240{,}000\ m^2$

$T = 30\ min$

$V = 2\ m/s$

$C = 0.8$

design period = 10 years

→ at ($T = 30\ min$) and period design = 10 year

$\therefore I = \underset{\text{(from graph)}}{60\ mm/hr}$

*Solution → The value of ($Q = CIA$)

$$\therefore Q = \frac{0.8 * 60 * (240{,}000/10{,}000)}{(360)}$$

$\therefore Q = 3.2\ m^3/s$ #

(b) if the invert level (102.4) and road (107.1) and min. fill depth = 0.7) what would new dimension of culvert...

(OR)

*$Q = CIA$

$Q = \frac{0.8 * 60 * (1.19)}{360} = 0.158$

$0.158 = VA$

$0.158 = 2A$

$\therefore A = 0.079$

$\therefore L = 0.28\ m$

$(0.28 * 0.28\ m)$

$Q = VA$

$3.2 = 2A$

$A = 1.6$

$\therefore L = 1.26$

$(1.26 * 1.26\ m)$ #

No

(OR)

max. height of the culvert = 104.1 − 102.4

i.e. equal 1.7 m

∴ Area = (1.7 − 0.7) * w

min sill ↑ dept

1.6 = (1) w

w = 1.6 m

⇝ (1.6 * 1) (OK)

width ↵

1.6 = 1.7 * w

w = 1 m

(1.7 * 1) (OK)

(width)

(OR) A/2 = 1.6/2 = 0.8

(for one culvert)

L = √0.8

∴ L = 0.8944 m

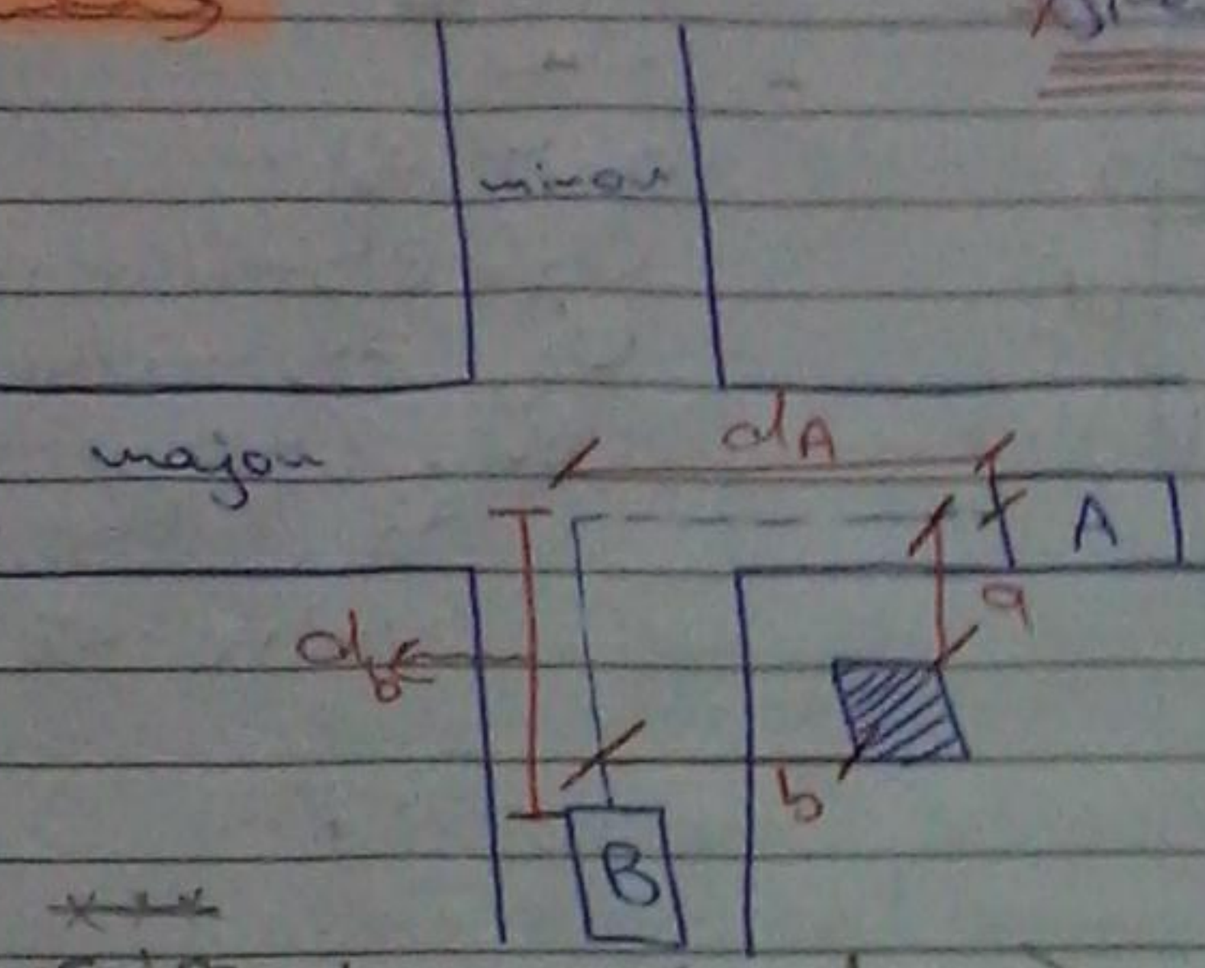
0.8944 * 0.8944

(OR)

≈ (1 * 1)

No

(2)



Given: $d_A = 75\,m$

$d_B = 105\,m$

$t_r = 3\,sec$

$a = 45\,m$

- Find the velocity of the two cars (max. speed limits)?

and find the distance (b) ???

$$d_b = a\left(\frac{d_a}{d_a - b}\right)$$

$$105 = 45\left(\frac{75}{75-b}\right)$$

$$\frac{105}{45} = \frac{75}{75-b} \longrightarrow 105(75-b) = 75*45$$

$$75-b = \frac{(75*45)}{105}$$

$$75 - \frac{(75*45)}{105} = b$$

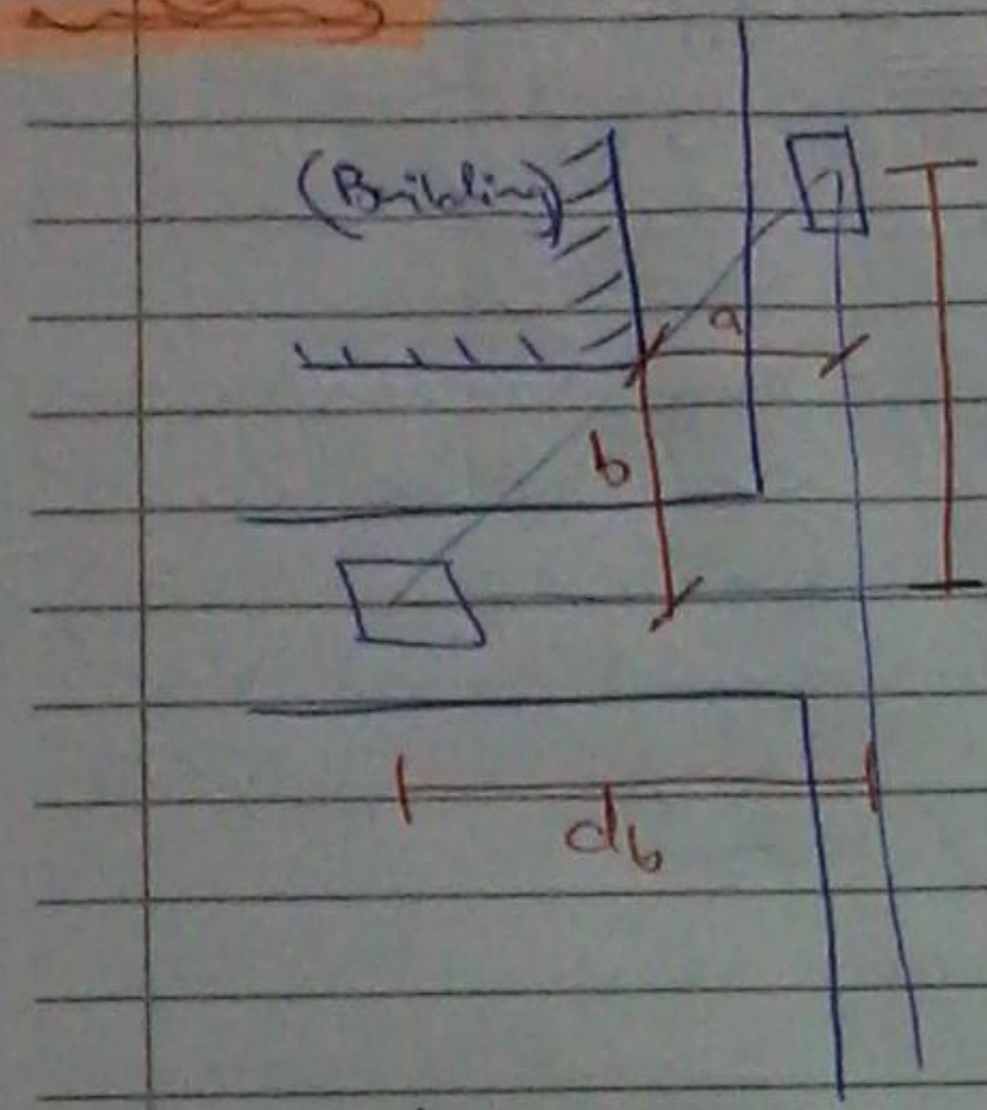
$$\therefore b = 42.86$$

$$\longrightarrow v_A = \frac{d_A}{t_r} = \frac{75}{3} = 25\,(m/sec)\ \#$$

$$\longrightarrow v_B = \frac{d_b}{t_r} = \frac{105}{3} = 35\,(m/sec)\ \#$$

No

(3)



given

$a = 45$ ft ...

$v_A = 25$ mi/hr ...

$v_B = 35$ mi/hr ...

$t_r = 3$ sec ...

find the value of (b)!!!

Solution

$\therefore d_a = SSD = 1.47 * v_A * t_r = 1.47 * 25 * 3 = 110.25$ ft

$\therefore d_b = SSD = 1.47 * v_B * t_r = 1.47 * 35 * 3 = 154.35$ ft

$$d_b = a\left(\frac{d_a}{d_a - b}\right)$$

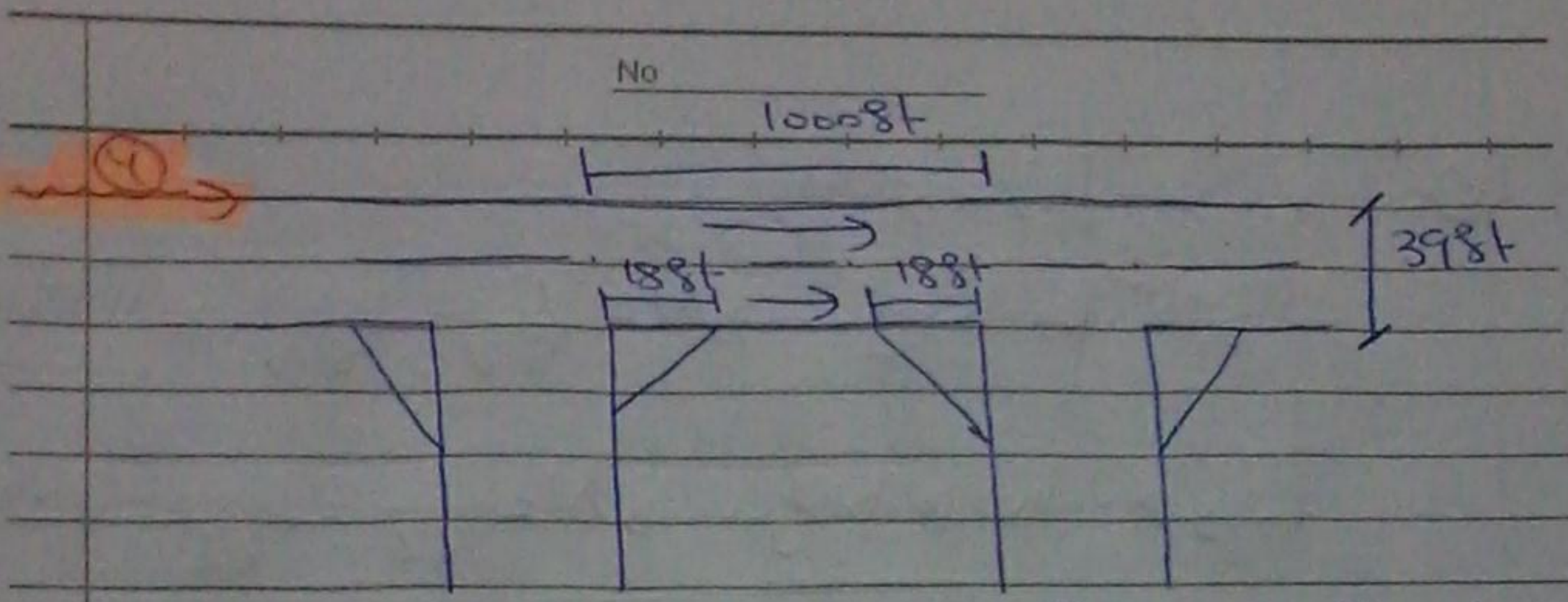
$$154.35 = 45\left(\frac{110.25}{110.25 - b}\right)$$

$$\frac{154.35}{45} = \frac{110.25}{110.25 - b} \quad \Rightarrow 154.35(110.25 - b) = 45 * 110.25$$

$$\therefore \frac{45 * 110.25}{154.35} = 110.25 - b$$

$$\therefore b = 110.25 - \frac{45 * 110.25}{154.35}$$

$$\therefore b = 78.12 \text{ ft}$$



(*) what is the max. number of cars parking in both side, if :
(1) The road is two lane (each lane 11ft)?
(2) The road is one lane (12ft width)?

(1)

*** Sol/80 $(39-(2*11)) = 17ft$

$\rightsquigarrow$ parallel parking $= N = \frac{L}{22} = \frac{1000}{22}$

$\therefore N = 45$ cars

$\rightsquigarrow$ Parallel parking $= N = \frac{L}{22}$

$\therefore N = \frac{(1000-(2*18))}{22}$

$\therefore N = 43$ cars

$\rightsquigarrow$ max No. of cars

$\therefore N = 45 + 43$

$N = 88$ cars

No

(2) → (39 − 12) = 27 st

→ 90° parking → $N = \frac{L}{8.5} = \frac{1000}{8.5}$ = 117 st

→ parallel parking → $N = \frac{L}{22} = \frac{1000}{22} - (2 \times 1)$

∴ N = 43 car

→ max. No. of car = 43 + 117

∴ max N = 160 car

#

(3) → section (@ 3+100) and (@ 2+100)

- min. right of way ???
- volume of cut and fill ???
- (cut, fill) ratio *

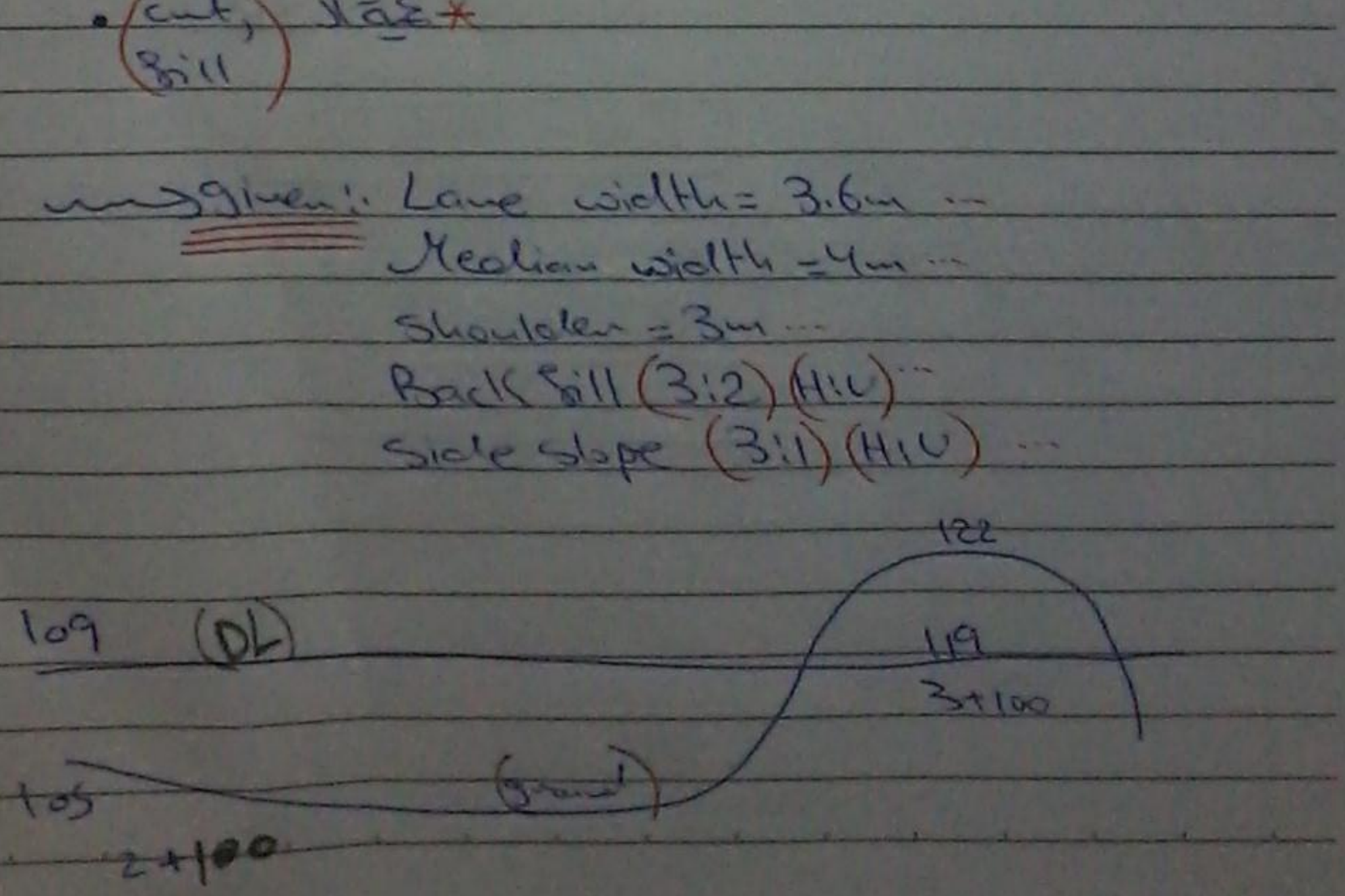
→ given: Lane width = 3.6m ...

Median width = 4m ...

Shoulder = 3m ...

Back fill (3:2) (H:V) ...

Side slope (3:1) (H:V) ...



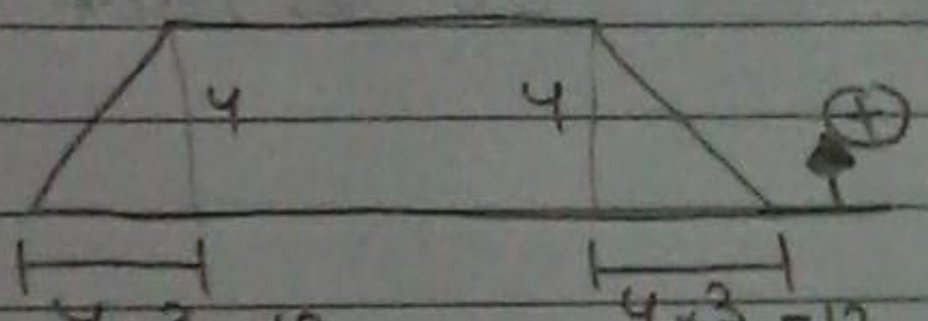
No

Sol ① Sketch the section @ (2+00) and @ (3+00)

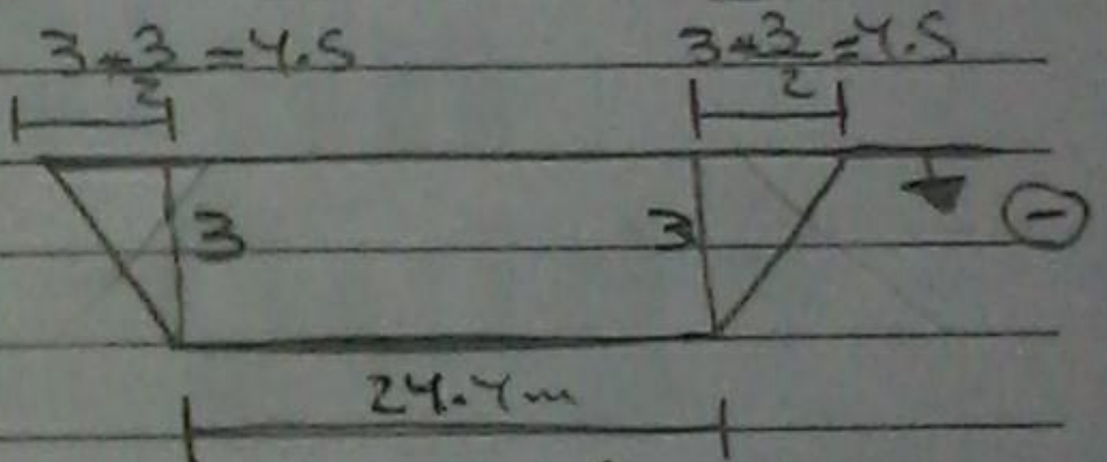
① → @ 2+100 → the value of (GL-DL) equal (121-105 = (+16) (Cut) ←

@ 3+100 → the value of (GL-DL) equal (119-122) = (-3) (Fill) ←

@ 2+100 (Cut)



@ 3+100 (Fill)



***The width of the Road =

(3.6*4) + (2*3) + (4) = 24.4 m

Sulder

median width

② → min. Right of way ???

24.4 + (2*12) = 48.4 m

(اكبر مسافات)

③ → Area ① = ((4*12)*2/2) + (4*24.4) = 145.6 m² = volume

Area ② = ((4.5*3)*2/2) + (3*24.4) = 86.7 m² = volume

#

امتحان الفاينل ...(3/1/2016)

***السؤال الاول ...

(عشرين علامة)...

سؤال عن ال mass diagram (مراجعتها

من مادة طرق تشييد للدكتور خالد الحياري)

ودراسة جميع الاسئله يلي ممكن تنطرح عليها

.... اسئله سهله جدا واجاباتها بتنطال من الرسمة

مباشرة ...

*** السؤال التاني ...(عشرين علامة)...

كان عبارة عن سؤال حفظ طالب منا نرسم ، مثلا

... انواع ال lane , ال round about , ال

unchanalized وال chanalized ....

الخ ... يعني لازم تحفظ كل الرسمات يلي بالمادة

منيح منيح ...

***السؤال التالت ...(عشرين علامة)...

كان اسئلة حفظ عدد من مادة الفاينل adv , و

disadv ... واسئله متنوعه حفظ (احفظ منيح)

...

*** السؤال الرابع...(عشرين علامة)

سؤال عن حساب قيمة ال Q ... موجود ضمن

الدفتر عند اسئلة الفاينل... بس كانت قيمة ال c

مو محسوبه وبحسبها من خلال قانون ال محصله

لل C*A مقسومة على محصلة ال A ... بكون

معطيني تلت قيم لل area وقيمة ال c لكل منها

...

السؤال الخامس ... عن مادة الميد ...

(عشرين علامه)...

كان في sag curve ...

-4% مع 4% ومطيني ال elevation عند

نقطة ال PI يساوي 100 ومعطيني انو في

نقطه اسمها p بتبعد عن ال Bc بمقدار 100

متر وال elevation عندها يساوي 133.4

على ما اعتقد ... ومطلوب اوجد قيمة ال elev

عند النقطه Bc ومقدار ال length ومقدار ال

Xm...