Mohanad Shannak - 1181401

I Pledge not to use any help from anyone and not to Communicate about the exam through any form or media.

- Question 1. [Group D

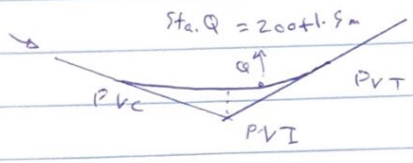
$LVC = 950\ m$

Sta. $PVT = 210 + 6.0\ m$

elevation $PVT = 620\ m$

$G_1 = -2\ \%$

$G_2 = +2.8\ \%$



$Sta\ PVC = Sta.\ PVT - LVC$
$= 162 + 16.0\ m$

$Sta\ PVI = Sta.\ PVT - \frac{LVC}{2}$
$= 186 + 11.0\ m$

elevation Q =

$E_{PVI} = E_{PVT} - (\frac{LVC}{2})\, G_2 = 606.7\ m$

$E_{PVC} = E_{PVI} + (\frac{LVC}{2})\, G_1 = 616.2\ m$

$Y = \left(\frac{G_2 - G_1}{2L}\right) X^2 + G_1 X + E_{PVC}$

$Y = \frac{0.024}{L} X^2 - 0.02 X + 616.2$

(a) $Sta.\ Q = 200 + 1.5\ m \rightarrow X = Sta.Q - Sta.PVC = 37 + 5.5\ m$
$= 745.5\ m$

$E_Q = Y_{(X = 745.5\ m)} = 615.3\ m$

(b) $\frac{dY}{dx} = 0 \Rightarrow \frac{0.048}{L} X - 0.02 = 0 \Rightarrow X = 395.8\ m$
$= 19 + 15.8\ m$
Station

Sta. Lowest Point = $Sta\ PVC + X = 182 + 11.8\ m$

$E_{Lo.p} = Y_{(X = 395.8)} = 612.2\ m$

Sta. highest point = Sta. $PVT = 210 + 6.0\ m$

$E_{h.p} = E_{PVT} = 620\ m.$

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Question 2 ° Group A.

ASD = 80 m.

f = 0.35

G = −0.07

V = ? ? design speed in Km/h
max. safe speed.

ASD > Min. req. stopping sight distance

MRSSD = Reaction distance + Braking distance

$80_m = d_r + d_b$

tr = 2.5 second according to AASHTO for unexpected reaction

$80_m = V_i * t_r + \frac{V_i^2}{2g(f \pm G)}$

$80 = V_i (2.5) + \frac{V_i^2}{2(9.81)(0.35 - 0.07)}$

$V_i^2 + 16.1865\, V_i - 517.968 = 0$

$V_i = 16.06$ m/s

$V = 57.8$ Km/h

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Question 3: Group A

design speed = 150 Km/h

inter City trains, most Comfortable → when latreal acceleration on Passengers of 0.03 g

$E = 150$ mm

$E_u = VB$ $E = 100$ mm

according to AREA.

$L_{spiral} = ??$

$$L_{min} = \max \{ 0.01216\, E_u V \;,\; 0.744\, E_a \}$$

$$\begin{cases} L = 0.01216\, E_u V = (0.01216)(100_{mm})(150_{Km/h}) = 182.4 \text{ m} \\ L = 0.744\, E_a = 0.744(150_{mm}) \end{cases}$$

$$= 111.6 \text{ m}$$

$$L_{spiral,\, minimum} = 182.4 \text{ m}$$