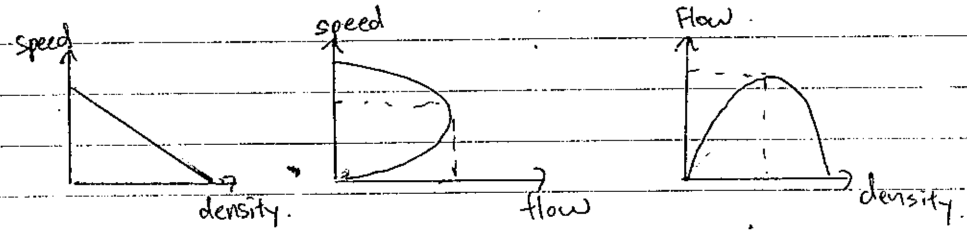
CV3014 2013-2014 sem1

1a. Greenshield's Model.
- K=0, V=A. A is the maximum or free-flow speed.
- V=0, K=A/B, which is jam density.
- maximum flow occurs at half the mean free speed.
- satisfies all 4 boundary conditions.
- poor statistical fit with real data.



Greenberg's Model.
- involves only 1 parameter, needs only 1 data point for calibration.
- better fit compared to Greenshield's.
- However, zero density at infinite speed.

$$VS = C\ln\left(\frac{K_j+\alpha}{K+\alpha}\right).$$

1b. user equilibrium: the travel time between a specified origin and destination on all used routes is equal.

System optimal: The speed of car which let the most amount of car pass by, ie. maximum density.

User equilibrium used when individual plan for travel, system optimal used when authority plan.

1c. - The R value must be close to 1.
- T value as big as possible.
- E to be small.
- Y to X correlation to be high.
- correlation between X to be low.

2. Passenger bus $= \frac{e^{-0.8t-1}}{e^{-0.8t-1}+e^{-0.8t}} \times 4000$

$= 1076$ pax.

$q_{car} = 4000 - 1076 = 2924.$

$t = 9 + (2924+100)/250$

$= 21$min.

passenger car $= \frac{e^{-0.8(9+q_c/400)-1}}{e^{-0.8(9+q_c/400)-1}+e^{-0.8(15)}}$

3 a) Link 1 = 1. $t_1 = 24 + 2(1) = 26.$ $t_1 = t_4.$

$x_2 + x_3 = x_4.$

$t_2 = t_3$

$12 + 2x_2 = 10 + x_3.$

$x_3 = 2 + 2x_2.$, $x_2 = \frac{x_3 - 2}{2}$ - ①

$x_2 + 2 + 2x_2 = x_4.$ $x_3 + \frac{x_3-2}{2} = x_4.$

$3x_2 + 2 = x_4.$

$t_2 + t_4 = t_1.$

$12 + 2x_2 + 8 + 3x_2 + 2 = 26$

$22 + 5x_2 = 26$

$x_2 = 0.8$

$x_3 = 3.6$

$x_4 = 4.2$

total = 5.5

b). Link 1 will be 0.

$D = x_4.$; $x_4 = 10 - 0.3t.$, $t = t_2 + t_4$ or $t = t_3 + t_4.$

$t_2 + t_4 = 22 + 5x_2$, $x_4 = 3x_2 + 2.$

$3x_2 + 2 = 10 - 0.3(22 + 5x_2)$

$x_2 = 0.311$

$x_3 = 2.622$

$x_4 = 2.94$

$t = 23.55$ < 24(t of lane 1)

4a) i) $\tan^{-1}\left(\frac{12}{120}\right) = 5.7^\circ$

$S = Vt_r + \frac{V^2}{2g(f \pm G)}$

$S = 15(2.5) + \frac{15^2}{2 \times 9.81(0.35 - 0.057)} = 76.6m.$

assume $S \leq L$.

$L_{min} = \frac{5.7 \times 70.8^2}{200(\sqrt{1.05} + \sqrt{0.15})^2} = 84 < 120 \therefore$ ok.

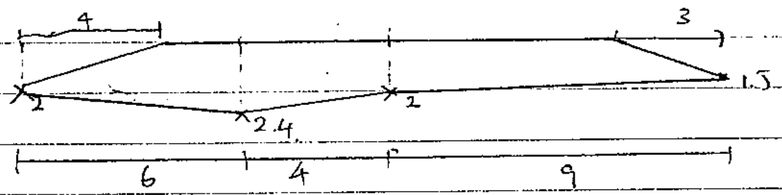
ii). comfort : increase L.

Apperance critirea : increase L.

b) $R = \frac{V^2}{127(f+e)} = \frac{70^2}{127(0.11+0.05)} = 241 > 200 \therefore$ Not ok.

- reduce speed
- increase R.
- increase elevation.

5a)

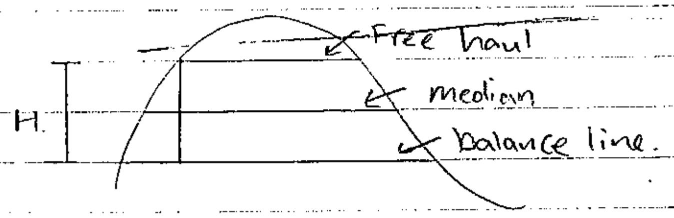


$6 \times \left(\frac{2+2.4}{2}\right) + 4 \times \left(\frac{2+2.4}{2}\right) + 9 \times \left(\frac{1.5+2}{2}\right) - 0.5 \times 4 \times 2 - 0.5 \times 3 \times 1.5$

$= 31.5 m^3$ (Fill).

Free haul: distance travel free of charge to remove excavated material

overhaul: distance outside free-haul.



overhaul = median × H.

6a) $ESAL / day = 900 \times 0.45 + 350 \times 0.8 + 160 \times 1.25 + 200 \times 2$
$= 1285.$

$ESAL/ year = 1285 \times 365$
$= 469025.$

$Eg = \frac{(1+g)^n}{g} = \frac{(1+0.02)^{20}}{0.02} = 74.3$

Design ESAL = 74.3×469025 = 34.8 mil ESAL.

b). 1. Curling stress.
- Results from temp differential across thickness of slab.
- Daytime Top expands, tendency to hog.
- Night time, tendency to dish.
- Tendency to curl is resisted by load-tranfer device/ friction at joints and dead weight of slab → curling stress.
- Control measure: warping joint designed to permit angular rotation along joints but tied together.

2. Temperature-friction stress.
- stress arising from expansion or contraction of slab.
- when slab heats-up → expansion, if inadequate gap, 'blow ups'
- when slab cools → Contraction retrained by slab-foundation friction, tensile stress lead to crack in mid span.
- control measures: steel reinforcement.