1. Please download the vissim network at the following link:

https://www.dropbox.com/s/h0kzkcs2s6uq6z8/HW5_Problem_1.inpx?dl=0

(1) Please show the network information using snapshot for the required operations, such as, link information, connector information, vehicle input information, etc., so that you can be familiar with this network.

Count: 39	No	Name	LinkBehavType	DisplayType	Level	NumLanes	Length2D	IsConn	FromLink	ToLink	HasOvtLn
1	1		1: Urban (motorized)	1: Road gray	1: Base	1	183.702	☐			☐
2	2		1: Urban (motorized)	1: Road gray	1: Base	2	272.597	☐			☐
3	3		1: Urban (motorized)	1: Road gray	1: Base	1	216.197	☐			☐
4	4		1: Urban (motorized)	1: Road gray	1: Base	2	355.162	☐			☐
5	5		1: Urban (motorized)	1: Road gray	1: Base	1	235.738	☐			☐
6	6		1: Urban (motorized)	1: Road gray	1: Base	1	196.614	☐			☐
7	7		1: Urban (motorized)	1: Road gray	1: Base	1	137.410	☐			☐
8	8		1: Urban (motorized)	1: Road gray	1: Base	2	160.107	☐			☐
9	9		1: Urban (motorized)	1: Road gray	1: Base	2	159.804	☐			☐
10	10		1: Urban (motorized)	1: Road gray	1: Base	2	67.732	☐			☐
11	11		1: Urban (motorized)	1: Road gray	1: Base	1	85.468	☐			☐
12	12		1: Urban (motorized)	1: Road gray	1: Base	1	227.695	☐			☐
13	13		1: Urban (motorized)	1: Road gray	1: Base	2	145.528	☐			☐
14	14		1: Urban (motorized)	1: Road gray	1: Base	1	179.486	☐			☐
15	15		1: Urban (motorized)	1: Road gray	1: Base	3	239.438	☐			☐
16	16		1: Urban (motorized)	1: Road gray	1: Base	2	280.253	☐			☐
17	17		1: Urban (motorized)	1: Road gray	1: Base	2	241.751	☐			☐
18	10000		1: Urban (motorized)	1: Road gray		1	63.155	☑	1	17	☐
19	10001		1: Urban (motorized)	1: Road gray		1	35.451	☑	12	1	☐
20	10002		1: Urban (motorized)	1: Road gray		1	91.384	☑	4	5	☐
21	10003		1: Urban (motorized)	1: Road gray		1	64.998	☑	4	6	☐
22	10004		1: Urban (motorized)	1: Road gray		2	51.519	☑	10	8	☐

Conflict Areas | Links / Lanes | Vehicle Types

22	10004		1: Urban (motorized)	1: Road gray		2	51.519	☑	10	8	☐
23	10005		1: Urban (motorized)	1: Road gray		2	55.205	☑	10	9	☐
24	10006		1: Urban (motorized)	1: Road gray		1	37.581	☑	8	11	☐
25	10007		1: Urban (motorized)	1: Road gray		2	141.049	☑	2	17	☐
26	10008		1: Urban (motorized)	1: Road gray		1	59.707	☑	12	13	☐
27	10009		1: Urban (motorized)	1: Road gray		1	62.750	☑	12	13	☐
28	10010		1: Urban (motorized)	1: Road gray		2	125.689	☑	13	16	☐
29	10011		1: Urban (motorized)	1: Road gray		1	131.447	☑	12	7	☐
30	10012		1: Urban (motorized)	1: Road gray		1	27.166	☑	2	3	☐
31	10013		1: Urban (motorized)	1: Road gray		1	55.210	☑	5	7	☐
32	10014		1: Urban (motorized)	1: Road gray		2	132.320	☑	4	16	☐
33	10015		1: Urban (motorized)	1: Road gray		1	117.547	☑	6	15	☐
34	10016		1: Urban (motorized)	1: Road gray		1	72.036	☑	3	15	☐
35	10017		1: Urban (motorized)	1: Road gray		1	61.094	☑	2	14	☐
36	10018		1: Urban (motorized)	1: Road gray		2	132.022	☑	8	15	☐
37	10019		1: Urban (motorized)	1: Road gray		1	46.212	☑	11	16	☐
38	10020		1: Urban (motorized)	1: Road gray		2	108.967	☑	9	17	☐
39	10021		1: Urban (motorized)	1: Road gray		1	133.550	☑	14	7	☐

Conflict Areas | Links / Lanes | Vehicle Types

Vehicle Types

Select layout... <Single List>

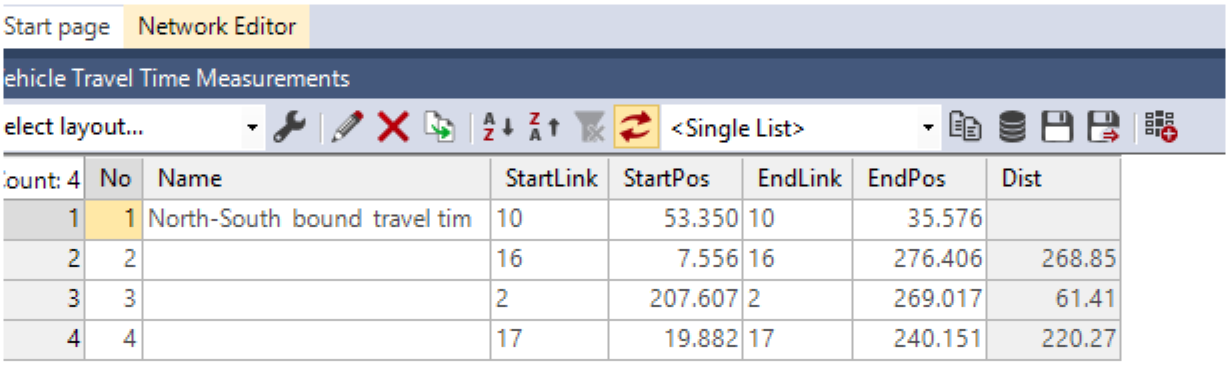
Count: 7	No	Name	Category	Model2D3DDistr	ColorDistr1	OccupDistr	Capacity
1	100	Car	Car	10: Car	1: Default	1: Single Occupancy	0
2	200	HGV	HGV	20: HGV	1: Default		0
3	300	Bus	Bus	30: Bus	1: Default	1: Single Occupancy	110
4	400	Tram	Tram	40: Tram	1: Default	1: Single Occupancy	215
5	510	Man	Pedestrian	100: Man	101: Shirt Man		0
6	520	Woman	Pedestrian	200: Woman	201: Shirt Woman		0
7	600	Bike	Bike	60: Bike	101: Shirt Man		0

(2) Please choose three paths defined by yourself randomly, and check their travel time measures following the instructions:

1. Decide where to analyze the travel time
2. Select **Travel Time Sections** Icon 
3. Left click on the starting link of the travel time section to select
4. Right click at the exact start point to place start line
5. Right click at the exact end point to place travel time end line
6. Complete the **Travel Time Measurement** window

Then run the simulation and make sure the simulation is finished.

After that, go to “Evaluation” in the menu to “Result Lists” → “Vehicle Travel Time Result”, to show your result.



:ount: 4	No	Name	StartLink	StartPos	EndLink	EndPos	Dist
1	1	North-South bound travel tim	10	53.350	10	35.576	
2	2		16	7.556	16	276.406	268.85
3	3		2	207.607	2	269.017	61.41
4	4		17	19.882	17	240.151	220.27

(13)

$$\ddot{x}_{n+1}(t+\Delta t) = \frac{\alpha_0}{(x_n(t) - x_{n+1}(t))}\left[\dot{x}_n(t) - \dot{x}_{n+1}(t)\right]$$

$$U = x_n(t) - x_{n+1}(t) \qquad \frac{du}{dt} = \dot{x}_n(t) - \dot{x}_{n+1}(t)$$

$$\int \ddot{x}_{n+1}(t+\Delta t)\,dt = \int \frac{\alpha_0}{x_n(t) - x_{n+1}(t)}\left[\dot{x}_n(t) - \dot{x}_{n+1}(t)\right]dt$$

$$\dot{x}_{n+1} = \alpha_0 \ln(u) + c_1$$

$$\dot{x}_{n+1} = \alpha_0 \ln\left[x_n(t) - x_{n+1}(t)\right] + c_1$$

$$u = \alpha_0 \ln\left(\frac{1}{k}\right) + C_1 \qquad u = \alpha_0 \ln\left(\frac{C_2}{k}\right)$$

when $k = k_j$ $u = 0$ (vehicle bumper to bumper but no movement)

$$0 = \alpha_0 \ln\left(\frac{C_1}{k_j}\right)$$

$$C_1 = \alpha_0 \ln C_2$$

$$\alpha_0 \ln\left(\frac{1}{k_j}\right) + \alpha_0 \ln C_2 = 0$$

$$\ln\left(\frac{C_2}{k_j}\right) = 0 \qquad \frac{C_2}{k_j} = 1 \qquad C_2 = k_j$$

$$u = \alpha_0 \ln\left(\frac{1}{k}\right) + \alpha_0 \ln(k_j)$$

Greenberg's equation:

$$u = \alpha_0 \ln\left(\frac{k_j}{k}\right)$$

Q4) Based on Little's law derive why $Q = KV$

The number of customers (queue length) in the system an anytime (t)

$$L(t) = A(t) - D(t)$$

$A(t)$ = cumulative arrivals from time 0 to time t

$D(t)$ = cumulative departures from the system from time 0 to time t

The total time (total waiting time)

$$W(t) = \int_0^t L(\tau)\, d\tau = \int_0^t (A(\tau) - D(\tau))\, d\tau$$

Average queue length: $\bar{L}(t) = \frac{W(t)}{t}$

the average waiting time $\bar{w}(t) = \frac{W(t)}{A(t)}$

$Q = kv \longrightarrow$ flow = density × speed

$$\frac{\bar{L}(t)}{L} = \frac{A(t)}{t} \times \frac{\bar{w}(t)}{L}$$

$\frac{\bar{L}(t)}{L}$ = Density (veh/length)

$\frac{A(t)}{t}$ = flow (veh./time)

$\frac{L}{w(t)} = v$ speed (distance/time)

$\therefore \boxed{Q = k \cdot v}$