University of Technology

Building and Construction Engineering Department

Final Exam 2013-2014

Subject: Traffic Engineering
Division: Highway & bridge division
Examiner: Dr.Hasan Hamodi Al- Baidhani

Year: Third class
Time: 3 hr.
Date: 29 / 05 /2014

Answer Five Questions Only (including question No.1)

Q1) For 3-phase signal intersection, calculate cycle time C_o and draw the timing diagram for number of vehicles given below, knowing that: ts/phase =2 seconds, all red=1 seconds, Amber =3 seconds?

	Phase 1		Phase 2		Phase 3	
Flow, pcu/hr	Straight	right	straight	right	straight	right
	740	100	200	90	700	80
Lane width,m	6	4	3.5	3.5	6	4

(20 mark)

Q2) A-What are the purposes for spot speed studies?

B- Determine the DDHV for a two –way urban highway if the current traffic volume is 3000 veh./day in both direction, the design life is 20 years, annual growth rate of traffic is 8% , and the construction period 5 years. (20 mark)

Q3)A-Determine the length of acceleration and deceleration lane for major and minor road if the Design speed for major road is 120 kph and Design speed for minor road is 60 kph , knowing that acceleration and deceleration rates were 5.5 and 8 m/sec^2 respectively.

B-What are the variables that influences the speed in traffic stream? (20 mark)

Q4) A-What's the definition of parking? List it's types with sketches?

B-Calculate the approach capacity of an approach of intersection with good environmental condition and downhill gradient of 3 %, where all vehicles discharge straight across the intersection, knowing that approach width = 4.0 m? (20 mark)

Q5) A-what is the jam density (Dj) for a relationship between volume and density at give headway is given below :

$$Q = 65\ D - 0.7 * D^2$$

B-What's the meaning of highway capacity and level of service? Sketch the relation between them? (20 mark)

Q6) A-Explain briefly the types of Grade separated intersections with sketches?

B-What's the factors affecting on the level of service of highways? (20 mark)

GOOD LUCK

Solutions for Traffic Engineering Final Exam

Q1:

	Phase 1		Phase 2		Phase 3	
Flow, pcu/hr	740	100	200	90	700	80
W, (m)	6	4	3.5	3.5	6.0	4.0
S	3150	1975	1825	1875	3150	1975
Y max. = q /S	0.23		0.12		0.2	

L=no. of phase (ts+all red) = 3 (2+1) 9 sec.

Y_{Total} = 0.23 +0.12 + 0.2 =0.55

C0 = 1.5*9+5 / 1-0.55 = 41 sec

gT=41-9=32 sec., g1=0.23/0.55=13 sec, g2=7 sec. , g3=12 sec

G1=13-3+2=12sec., G2=7-3+2=6sec., G3=12-3+2=11sec.

G1					1	1	1	1	R						
R									G2	1	1	1	1	R	
R														G3	1	1	1	1

Q2:A-

The speed distribution obtained from such studies have many application:

1. Speed Trends:
   Can be determined by periodic sampling at selected locations .
2. Traffic Control Planning :
   The variability in speed values affects the capacity and safety. If all vehicles travelled at the same speed, the capacity would be at max and accidents would be minimized due to rear end collisions and overtaking , it is used in speed limit determination , posting safe speed at curves, signs locations, no parking zones.
3. Accident analysis of problem :
   The locations of accidents usually includes data of spot speed .
4. Geometric Design :
   Are used in determining the radius and super elevation (e) of curves , length of acceleration and deceleration lanes, etc.
5. Research Studies :
   a.study the capacity in relation to speed
   b.analysis of speed flow relation.

B- Future AADT = Current AADT * F

= 3000 * $(1+0.08)^{20+5}$ = 20550 veh/d

DHV = ADT * K = 20550 * 0.12 = 2466 veh./hr

D: Directional distribution = 55% of total volume

DDHV= 2466* 0.55 = 1356 veh./hr

Q3-A-

$L_1 = 0.278\ V_1\ t = 0.287 * 120 * 4.5 = 150.12$ m

$L_2 = \frac{V_1^2 - V_2^2}{7.2\ (a)} = \frac{120^2 - 60^2}{7.2 * 5.5} = 272.7$ m

A.L= $L_1 + L_2$ (acceleration length) مسافة التسارع

$= 150.12 + 272.7 = 422.8$ m

D.L = $L_1 + L_2$ (deceleration length) مسافة التباطؤ

$L_2 = \frac{V_1^2 - V_2^2}{7.2\ (d)} = \frac{120^2 - 60^2}{7.2 * 8} = 187.5$ m

So , D.L = 150.12 + 187.5 = 337.62 m

B- Variables that influence Speed are:

1. Physical conditions:

   Curvature, grade, sight distance, pavement roughness, spacing of intersections, etc.

2. Environments:

   Type of driver, time of day, weather, visibility, etc.

3. Traffic flow :

   Volumes, classification, pedestrian , turning movements, etc.

Q4-A- Parking is one of the major problems that is created by the increasing road traffic. It is an impact of transport development.

- Parallel parking:

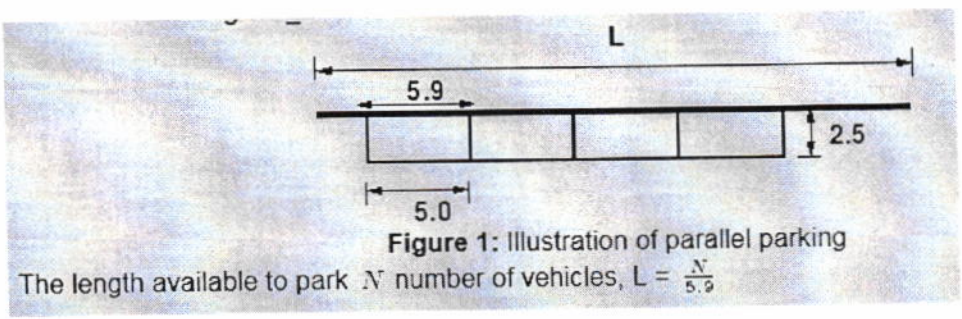

Figure 1: Illustration of parallel parking

The length available to park N number of vehicles, $L = \frac{N}{5.9}$

- 30° parking:

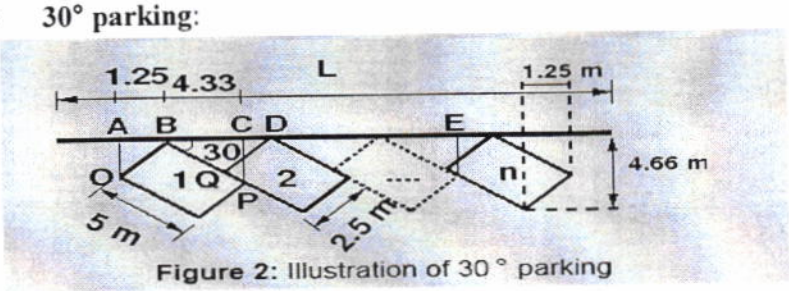

Figure 2: Illustration of 30 ° parking

- **45° parking:**

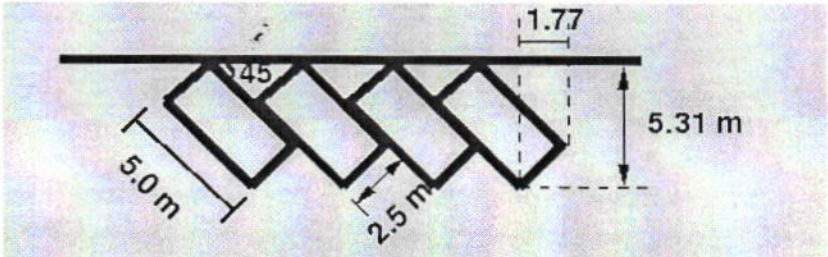

Figure 3: Illustration of 45 ° parking

- **60 ° parking:**

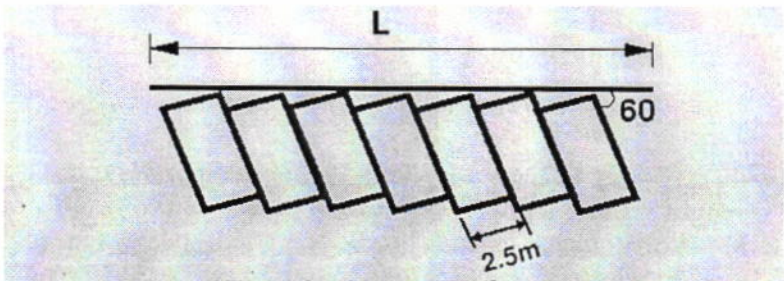

Figure 4: Illustration of 60 ° parking

- **Right angle parking:**

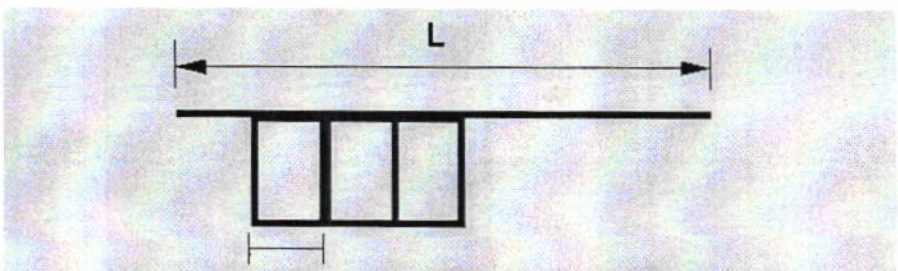

Figure 5: Illustration of 90 ° parking

B- As width (w) ≤ 5.5 m, then S will be obtained from table, S= 1975 pcu/h

+ Environmental effect of 20% = 1975 *1.20 =2370 pcu/ hr

+gradient effect of 4 * 3% = 2370 * 1.12 = 2654 pcu/hr

Q5-A- $Q = 65\ D - 0.7 * D^2$

By Derivation to D:

$$\frac{dQ}{dD} = 65 - 1.4 * D$$

$$\frac{dQ}{dD} = 0 \qquad \therefore Dmax = \frac{65}{1.4} = 46.4 \text{ vpk}$$

$$Dmax = \frac{Dj}{2} \qquad \therefore Dj = 92.8\ vpk$$

OR: D =Dj when Q= 0, $Q = 60\ D - 0.8 * D^2$

$0 = D\ (65 - 0.7 * Dj)$

$Dj = 65/0.7 = 92.8\ vpk$

B- Capacity is defined as the maximum number of vehicles, passengers, or the like, per unit time, which can be accommodated under given conditions with a reasonable expectation of occurrence

Level of service A term closely related to capacity and often confused with it is service volume. When capacity gives a quantitative measure of traffic, level of service or LOS tries to give a qualitative measure

Q6-A-

1. **Trumpet interchange: Trumpet interchange is a popular form of three leg interchange. If one of the legs of the interchange meets a highway at some angle but does not cross it, then the interchange is called trumpet interchange. A typical layout of trumpet interchange is shown in figure**

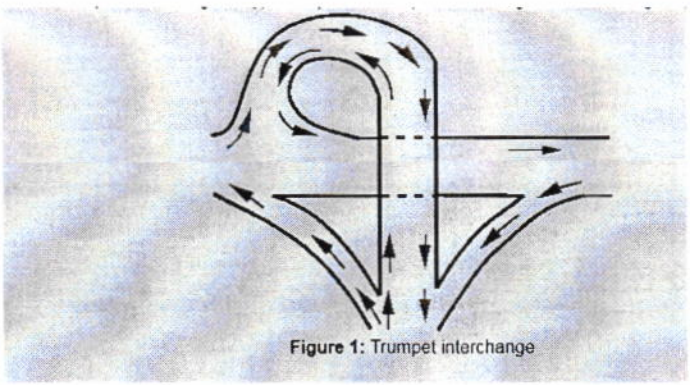

Figure 1: Trumpet interchange

2- Diamond interchange: Diamond interchange is a popular form of four-leg interchange found in the urban locations where major and minor roads crosses. The important feature of this interchange is that it can be designed even if the major road is relatively narrow. A typical layout of diamond interchange is shown in figure 1.

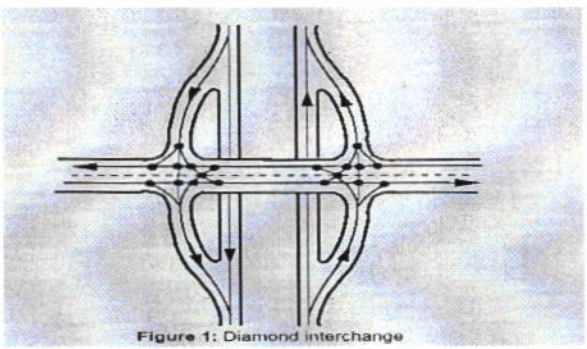

Figure 1: Diamond interchange

3- Clover leaf interchange: It is also a four leg interchange and is used when two highways of high volume and speed intersect each other with considerable turning movements. The main advantage of cloverleaf intersection is that it provides complete

separation of traffic. In addition, high speed at intersections can be achieved. However, the disadvantage is that large area of land is required. Therefore, cloverleaf interchanges are provided mainly in rural areas. A typical layout of this type of interchange is shown in figure 2.

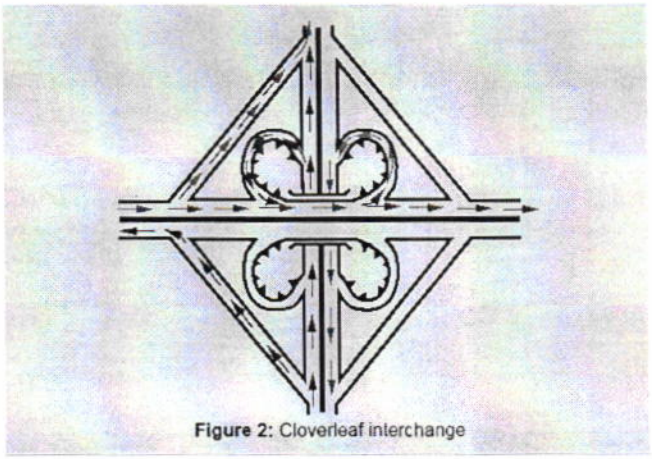

Figure 2: Cloverleaf interchange

4- Channelized intersection

Vehicles approaching an intersection are directed to definite paths by islands, marking etc. and this method of control is called channelization. Channelized intersection provides more safety and efficiency. It reduces the number of possible conflicts by reducing the area of conflicts available in the carriageway. If no channelizing is provided the driver will have less tendency to reduce the speed while entering the intersection from the carriageway. The presence of traffic islands, markings etc. forces the driver to reduce the speed and becomes more cautious while maneuvering the intersection. A channelizing island also serves as a refuge for pedestrians and makes pedestrian crossing safer. Channelization of traffic through a three-legged intersection (refer figure 1) and a four-legged intersection (refer figure 2) is shown in the figure.

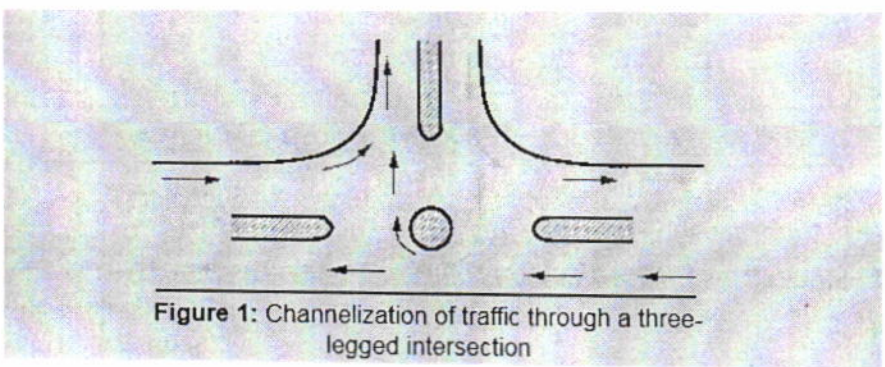

Figure 1: Channelization of traffic through a three-legged intersection

B-

1. Speed and travel time
2. Traffic interruptions/restrictions
3. Freedom to travel with desired speed
4. Driver comfort and convenience
5. Operating cost.