14CE701

Hall Ticket Number:

IV/IV B. Tech (Regular/Supplementary) DEGREE EXAMINATION

November 2017 — **Civil Engineering**

Seventh Semester — **Transportation Engineering-1**

Time: Three Hours — **Maximum :** 60 Marks

Answer Question No.1 compulsorily. (1X12 = 12 Marks)

Answer ONE question from each unit. (4X12=48)

Note: Use of Highway Pavement design charts is allowed

1. Define the following: (12X1=12 Marks)

a) Define NTPC
b) Explain about land acquisition plans?
c) Write down the formula for Lag distance in SSD?
d) Define ROW?
e) What is the test conducted to define toughness of aggregate?
f) Differentiate between Tar and Emulsion?
g) Write down the semi-empirical methods of flexible pavement?
h) Write down the equation of westergaard's interior load stress formula?
i) Define tack coat?
j) What is the highest level of ground water level table below subgrade?
k) What is the formula for capacity of rotary intersection?
l) Draw a neat sketch of narrow bridge?

UNIT – I

2. a) What are the requirements of an ideal alignment? (6M)
b) Draw neat sketches of different road patterns? (6M)

(OR)

3. a)Explain briefly about calculation of length of transition curve? (6M)
b) Explain different types of gradients in vertical alignment? (6M)

UNIT – II

4. a) Explain the laboratory test of ductility with neat sketch? (6M)
b) Write a short note on shape test? (6M)

(OR)

5. a) Discuss the advantages and limitations of CBR method of design? (6M)
b) Explain design considerations of expansion joints? (6M)

UNIT – III

6. a) Enumerate the steps involved in construction of bituminous concrete? (6M)
b) Write a short note on map cracking and shear failure with neat sketch? (6M)

(OR)

7. a) Explain hydrologic analysis of surface drainage system? (6M)
b) Explain briefly about control of capillary rise? (6M)

UNIT – IV

8. a) Write a descriptive note on level of service? (6M)
b) Discuss the various traffic studies and their importance? (6M)

(OR)

9. a) Explain different types of traffic signals? Describe? (6M)
b) Draw neat sketches of regulatory signs? (6M)

14CE701

SCHEME OF EVALUATION

IV/IV B.Tech DEGREE EXAMINATION,

November, 2017 **Civil Engineering**
Seventh Semester **Transportation Engineering - I**

Answer Question No.1 compulsorily
Answer ONE question from each unit.

1. a) Define NTPC **(12x1=12 Marks)**

Sol:

Nation Transport Policy Committee: The Govt. of India appointed the Nation Transport Policy Committee (NTPC) in the year 1978 to prepare a comprehensive national transport policy for the country for the next decade or so, keeping in view the objectives and priorities set out in the five years plan.

b) Explain about land acquisition plans?

Sol: Land acquisition plans are usually prepared from the survey drawings for land acquisition details. These plans show all general details such as buildings, wells, nature of gradients and other details required for assessing the values. The scale adopted may be 1 cm = 40m or less.

c) Write down the formula for Lag distance in SSD?

Sol: Lag distance = v*t, where v = Speed in m/s and t = reaction time of driver

d) Define ROW?

Sol: Right of Way is the area of land acquired for the road, along its alignment. The width of the acquired land for right of way is known as land width and its depends on the importance of the road and possible future development.

e) What is the test conducted to define toughness of aggregate?

Sol: Aggregate Impact Value test.

f) Differentiate between Tar and Emulsion?

Sol: Tar: It is obtained from Destructive Distillation (Burning in Specific Condition of Temperature, Without Presence of Oxygen) of Bituminous Coal.

Emulsion: Bitumen emulsion is a liquid product in which bitumen is suspended in a finely divided condition in an aqueous medium and stabilized by suitable material. Normally cationic type emulsions are used in India. The bitumen content in the emulsion is around 60% and the remaining is water.

g) Write down the semi-empirical methods of flexible pavement?

Sol: 1) Triaxial test method

2) California R value or Stabilometer method

h) Write down the equation of westergaard's interior load stress formula?

Sol: Westergaard developed relationship for the stress at interior region denoted as σ_i in kg/cm^2

$$\sigma_i = \frac{0.316\ P}{h^2}\left[4\ \log_{10}\left(\frac{l}{b}\right) + 1.069\right]$$

i) Define tack coat?

Sol: Tack coat is a very light application of asphalt, usually asphalt emulsion diluted with water. It provides proper bonding between two layers of binder course and must be thin, uniformly cover the entire surface, and set very fast.

j) What is the highest level of ground water level table below subgrade?

Sol: 1.2m

k) What is the formula for capacity of rotary intersection?

Sol:

$$Q_w = \frac{280w[1+\frac{e}{w}][1-\frac{p}{3}]}{1+\frac{w}{l}}$$

l) Draw a neat sketch of narrow bridge?

Sol:

UNIT – I

2. a) What are the requirements of an ideal alignment?

Sol:

The basic requirements of an ideal alignment between two terminal stations are that it should be:

i. Short
ii. Easy
iii. Safe &
iv. Economical.

Short: It is desirable to have a short (or shortest) alignment between two terminal stations. A straight alignment would be the shortest; through there may be several practical considerations which would cause deviations from the shortest path.

Easy: The alignment should be such that it is easy to construct and maintain the road with minimum problems. Also the alignment should be easy for the operation of vehicles with easy gradients and curves. **(3M)**

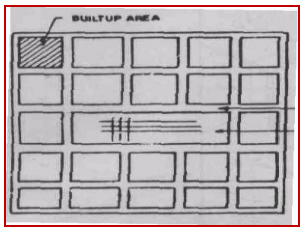
Safe: The alignment should be safe enough for construction and maintenance from the view point of stability of natural hill slopes, embankment and cut slopes and foundation of embankments. Also it should be safe for the traffic operation with safe geometric features.

Economical: The road alignment could be considered economical only if the total life cycle cost considering the initial cost, maintenance cost and vehicle operation cost is lowest. All these factors should be given due consideration before working out the economics of each alignment. **(3M)**

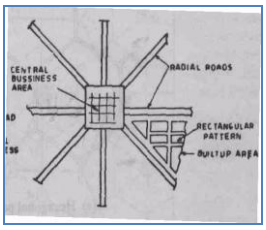
b) Draw neat sketches of different road patterns?

Sol: The various road patterns may be classified as follows:

i. Rectangular or block pattern

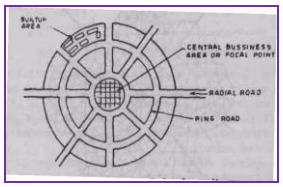


ii. Radial or star and block pattern

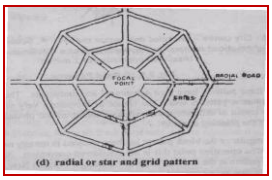


(2M)

iii. Radial or star and circular pattern

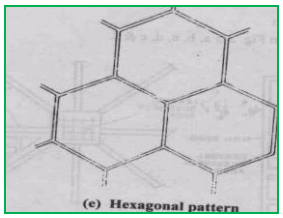


iv. Radial or star and grid pattern



(2M)

v. Hexagonal pattern



Each of these patterns has its own advantages and limitations. There can be a number of other geometric patterns also. The choice of the pattern very much depends on the locality, the layout of different towns, villages, industrial and production centres and on the choice of the planning engineer. **(2M)**

(OR)

3. a) Explain briefly about calculation of length of transition curve?

Sol: Calculation of Length of Transition Curve (L_s)

The length of the transition curve should be determined as the maximum of the following three criteria:

1. Rate of change of centrifugal acceleration

$L_s = 0.0215V^3/CR$ (V is in Kmph)

where C = 80 / (75 + V) and 0.5 < C < 0.8 (V is in Kmph) **(2M)**

2. Rate of change of super elevation

- Raise (E) of the outer edge with respect to inner edge is given by E = e*B = e (W+We).

• The rate of change of this raise from‘0toE’is achieved gradually with a gradient of 1inN over the length of the transition curve (typical range of N is 60-150).

• 60inhills, 100 in built up areas and150 in plains Therefore, the length of the transition curve L_s is:

$L_s = Ne(W + W_e)$ W.r.to inner edge.

(or)

$L_s = Ne(W + W_e)/2$ W.r.to centre Line. **(2M)**

3. An empirical formula given by IRC.

(i) For a plain and rolling terrain $L_s = 2.7\ V^2/R$

(or)

(ii) For mountainous and steep terrain $L_s = V^2/R$ (V is in Kmph) **(2M)**

b) Explain different types of gradients in vertical alignment?

Sol: The various types of gradients are:

1. Ruling Gradient: The ruling gradient or the design gradient is the maximum gradient with which the designer attempts to design the vertical profile of the road. This depends on the terrain, length of the grade, speed, pulling power of the vehicle and the presence of the horizontal curve. In flatter terrain, it may be possible to provide at gradients, but in hilly terrain it is not economical and sometimes not possible also. The ruling gradient is adopted by the designer by considering a particular speed as the design speed and for a design vehicle with standard dimensions. But our country has a heterogeneous traffic and hence it is not possible to lay down precise standards for the country as a whole. **(2M)**

2. Limiting Gradient: This gradient is adopted when the ruling gradient results in enormous increase in cost of construction. on rolling terrain and hilly terrain it may be frequently necessary to adopt limiting gradient. But the length of the limiting gradient stretches should be limited and must be sandwiched by either straight roads or easier grades.

3. Exceptional Gradient: Exceptional gradient are very steeper gradients given at unavoidable situations. They should be limited for short stretches not exceeding about 100 metres at a stretch. In mountainous and steep terrain, successive exceptional gradients must be separated by a minimum 100 metre length gentler gradient. At hairpin bends, the gradient is restricted to 2.5%. **(3M)**

4. Minimum Gradient: This is important only at locations where surface drainage is important. Camber will take care of the lateral drainage. But the longitudinal drainage along the side drains requires some slope for smooth flow of water.

Therefore minimum gradient is provided for drainage purpose and it depends on the rain fall, type of soil and other site conditions. A minimum of 1 in 500 may be sufficient for concrete drain and 1 in 200 for open soil drains are found to give satisfactory performance. **(1M)**

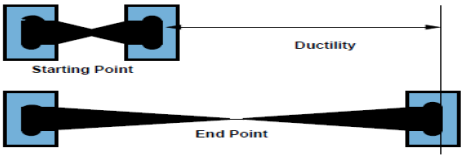
UNIT –II

4. a) Explain the laboratory test of ductility with neat sketch?

Sol:

- Ductility is the property of bitumen that permits it to undergo great deformation or elongation.
- Ductility is defined as the distance in cm, to which a standard sample or briquette of the material will be elongated without breaking.
- Dimension of the briquette thus formed is exactly 1 cm square.
- The bitumen sample is heated and poured in the mould assembly placed on a plate. These samples with moulds are cooled in the air and then in water bath at 27^0C temperature. **(2M)**

- The excess bitumen is cut and the surface is leveled using a hot knife. Then the mould with assembly containing sample is kept in water bath of the ductility machine for about 90 minutes.
- The sides of the moulds are removed, the clips are hooked on the machine and the machine is operated. The distance up to the point of breaking of thread is the ductility value which is reported in cm.
- The ductility value gets affected by factors such as pouring temperature, test temperature, rate of pulling etc. **(2M)**
- A minimum ductility value of 75 cm has been specified by the BIS. The below Figure shows ductility moulds to be filled with bitumen.



(2M)

b) Write a short note on shape test?

Sol:

- The particle shape of the aggregate mass is determined by the percentage of flaky and elongated particles in it.
- Aggregates which are flaky or elongated are detrimental to higher workability and stability of mixes.
- The flakiness index is defined as the percentage by weight of aggregate particles whose least dimension is less than 0.6 times their mean size. Test procedure had been standardized in India (IS:2386 part-I).
- The IRC has suggested that the FI of aggregates used in bituminous concrete and surface dressing should not exceed 25%; the aggregates used in WBM and BM should not exceed 15%. **(3M)**
- The elongation index of an aggregate is defined as the percentage by weight of particles whose greatest dimension (length) is 1.8 times their mean dimension. This test is applicable to aggregates larger than 6.3 mm.
- This test is also specified in (IS:2386 Part-I).
- FI and EI values in excess of 15% are generally considered undesirable; however there are no recognized limits for the elongation index. **(3M)**

(OR)

5. a) Discuss the advantages and limitations of CBR method of design?

Sol:

Advantages of CBR method:

One the main advantage is the simplicity of the conducting CBR test in the laboratory as well as the method of pavement design using simple design charts. The CBR method of flexible pavement design was being extensively used in different countries of the world for quite a long period of time. However based on the local design requirements (such as traffic, climate and environmental factors) each country developed their own design charts. For example the UK and several states in the USA

developed their own empirical pavement design charts making use of the CBR value of the subgrade soil. **(2M)**

Limitations of CBR method:

There are several limitations of both the CBR test and the design method. Some these are given below

a) It is the important to understand the limitations of the CBR test itself on subgrade soil, which is an empirical penetration test for assigning the strength characteristics the CBR value, does not represent any of the basic strength properties of the soil.

b) The punching shear under the CBR test condition does not in any way represent the strength on the subgrade through the flexible pavement layers due to the traffic wheel loads.

c) It is necessary to judiciously decide the soaking requirements are the testing moisture content while determining the CBR value of subgrade soil. for example in an arid region with very scanty rainfall and if the sub surface water level is very deep below the ground level, there is no need to soak the subgrade soil before testing, as the field moisture content may never exceed the OMC at which the soil is compacted. **(2M)**

d) The specified four days soaking period may not be sufficient in some highly clayey soils to represent the worst field moisture content in areas with water logging.

e) The utmost caution is to be exercised while making use of the design charts in the new location.

f) The total thickness of flexible pavement designed by the CBR method depends only on the CBR value of the subgrade soil. The total thickness remains the same. Irrespective of the type of materials used in different pavement layers.

g) The CBR design chart developed in a certain region or country based on performance studies represent the other design factors such as traffic loads/intensity, materials used in different pavements layers, climatic, drainage and other environmental factors pertaining to that region.yhe same design chart may not be suitable I another region with different set of design factors. **(2M)**

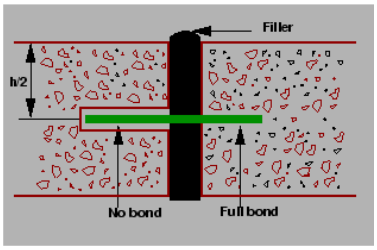
b) Explain design considerations of expansion joints?

Sol:

Expansion joints are transverse joints to allow expansion of concrete slab due to rise in average temperature in summer months. These joints difficult to maintain and they get filled up with dirt and other incompressible materials causing locking of the joints and preventing expansion of concrete slabs. They are no longer in use except near permanent structure like bridges and culverts which may be damaged by the thrust of the expanding concrete slab due to rise in temperatures. **(3M)**

The design considerations are:

- Provided along the transverse direction.
- Design involves finding the joint spacing for a given expansion joint thickness (say 2.5 cm specified by IRC) subjected to some maximum spacing (say 140 as per IRC).



Expansion Joint **(3M)**

UNIT –III

6. a) Enumerate the steps involved in construction of bituminous concrete?

Sol:

Construction steps:

I. The receiving surface on which the dense graded bituminous mix is to be laid(such as existing bituminous surface course or bituminous base/binder course)is prepared by patching the pot holes, sealing the cracks and filling up the depressions; a geo-synthetic layer or stress absorbing layer may be laid if required.

II. If the profile correction required exceeds 40 mm, a profile corrective course is laid separately using a mechanical paver and is compacted; if the correction required is less than 40 mm, the pavement layer is spread with provision for the addition quantity of the mix to meet the profile correction requirement.

III. The laying of dense graded bituminous work is to be taken up during dry weather, free from dampness on the receiving surface and atmospheric temperature is higher than 10^0 C.

IV. The receiving surface is cleaned with a mechanical broom to remove loose materials and dust and tack coat is applied as specified. **(2M)**

V. The dense graded bituminous mix fulfilling the job mix formula is prepared at specified mixing temperature in an approved hot mix plant; the hot mix is transported to the construction site in insulated covered vehicles

VI. The mix is spread using a hydrostatic paver finisher with sensor at specified paving temperature; a diagram of mechanical paver finisher.

VII. Rolling is started as soon as laying is done for short stretches; rolling is done in three stages : (a) initial or break down rolling using a tandem–wheel vibratory roller of dead weight 8-10 tonnes , set with high frequency and low amplitude of vibration (b) intermediate rolling using a pneumatic roller, with tyre pressure more than 5.6 kg/cm^2 and of weight 12-15 tonnes; a vibratory roller may also be used if pneumatic tyred roller is not available and (c) final rolling with 6-8 tonnes smooth wheel roller, until roller marks are not seen on the surface; the rolling speed is in all cases shall not be more than 5kmph.

VIII. The compacted density is achieved is checked by taking 150 mm diameter core samples; the density achieved shall preferably 92% of theoretical maximum density of mix , so that the initial voids in the mix is about 7-8% and due to traffic induced secondary compaction during the design life, the final voids in the mix is not lower than 4% . **(2M)**

IX. The finished surface shall not be open to the traffic until the entire depth of the bituminous layer cools down to temperature below 60^0C

X. The finished surface is checked using a 3-m straight edge; the maximum permissible undulations for finished BC surface shall not exceed 5.0mm in longitudinal profile and 4.0 mm in transverse profile the maximum permissible number of surface unevenness of 3-5mm depth and 3m straight edge in each 300m stretch measured as above in the case of BC surface for national and state highways is 15.

XI. The average unevenness index roughness index for the finished BC surface measured along the wheel path of each lane of the road using a bump integrator shall not exceed 2000mm per km. **(2M)**

b) Write a short note on map cracking and shear failure with neat sketch?

Sol:

1.Alligator cracking (or) Map Cracking:

An existing bituminous pavement surface that has developed extensive cracks which are interconnected forming a number of blocks, the crack pattern resembles the skin of an alligator; therefore such crack pattern of pavement surface is called 'alligator cracking' or 'map cracking'.

Followings are the primary causes of this type of failure.

- Relative movement of pavement layer material
- Repeated application of heavy wheel loads
- Swelling or shrinkage of subgrade or other layers due to moisture variation

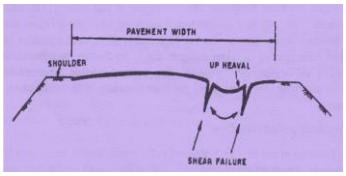
Map Cracking **(3M)**

2. Shear Failure Cracking

Shear failure causes upheaval of pavement material by forming a fracture or cracking.

Followings are the primary causes of shear failure cracking.

- Excessive wheel loading
- Low shearing resistance of pavement mixture



Shear Failure **(3M)**

(OR)

7. a) Explain hydrologic analysis of surface drainage system?

Sol: The design of surface drainage system may be divided into two phases:

- Hydrologic analysis
- Hydraulic analysis

Hydrologic analysis

- The main objective of hydrologic analysis is to estimate the maximum quantity of water expected to reach the element of the drainage system under consideration.
- A portion of the precipitation during the rain fall infiltrates into the ground as ground water and a small portion gets evaporated.

The remaining portion of water which flows over the surface is termed as run-off. **(3M)**

- The rational formula, in its simplest form to estimate the run off water for highway drainage is given by :

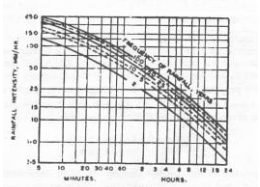
where

Q = run-off, m^3 /sec

C = run-off coefficient, expressed as a ratio of run-off to rate of rain fall

i = intensity of rain fall, mm/sec.

Ad = drainage area in 1000 m^2



ig. 11.4 Typical Rainfall Intensity Duration Curve

- The value of run-off coefficient C depends mainly on the type of surface and its slope. The C-values may be taken as 0.8 to 0.9 for bituminous and cement concrete pavements, 0.35 to 0.70 for gravel and WBM pavements, 0.40 to 0.65.

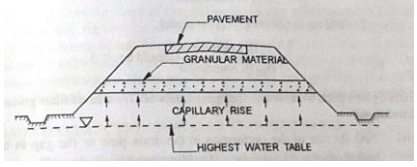
$$C = (A_1C_1+A_2C_2+A_3C_3\ldots) / (A_1+A_2+A_3\ldots)$$ **(3M)**

b) Explain briefly about control of capillary rise?

Sol: If the water reaching the subgrade due to capillary rise is likely to be detrimental, it is possible to solve the problem by arresting the capillary rise instead of lowering the water table. The capillary rise may be checked by providing a suitable capillary cut-off by one of the methods: namely, (i) Granular capillary cut-off and (ii) Impermeable capillary cut-off.

1. Granular capillary cut-off:

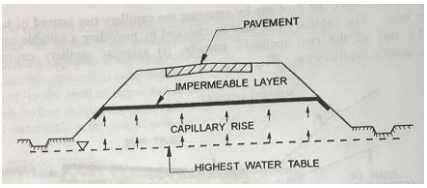
A layer of granular material of suitable thickness is provided during the construction of embankment, between the subgrade and the highest level of subsurface water table. The thickness of the granular capillary cut-off layer should be sufficiently higher than the anticipated capillary rise within the granular layer so that the capillary water cannot rise above the cut-off layer.



Granular capillary cut-off **(3M)**

2. Impermeable capillary cut-off:

In this method, an impermeable membrane or a bituminous layer is inserted in the place of granular blanket during the construction of the embankment.



Impermeable capillary cut-off **(3M)**

UNIT-IV

8. a) Write a descriptive note on level of service?

Sol:

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. A service volume is the maximum number of vehicles, passengers, or the like, which can be accommodated by a given facility or system under given conditions at a given level of service.

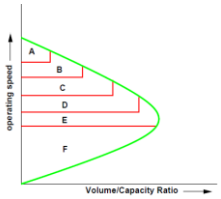
For a given road or facility, capacity could be constant. But actual flow will be different for different days and different times in a day itself. The intention of LOS is to relate the traffic service quality to a given flow rate of traffic. It is a term that designates a range of operating conditions on a particular type of facility. Highway capacity manual (HCM) developed by the transportation research board of USA provides some procedure to determine level of service. It divides the quality of traffic into six levels ranging from level A to level F. Level A represents the best quality of traffic where the driver has the freedom to drive with free flow speed and level F represents the worst quality of traffic. Level of service is defined based on the measure of effectiveness or (MOE). Typically three parameters are used under this and they are speed and travel time, density, and delay. **(2M)**

One of the important measures of service quality is the amount of time spent in travel. Therefore, speed and travel time are considered to be more effective in defining LOS of a facility. Density gives the proximity of other vehicles in the stream. Since it affects the ability of the driver to maneuver in the traffic stream, it is also used to describe LOS. Delay is a term that describes excess or unexpected time spent in travel. Many specific delay measures are defined and used as MOE's in the highway capacity manual.

Factors affecting level of service:

Level of service was introduced in Highway capacity manual (HCM) to denote the level of service one can derive from a road under different operating characteristics and traffic volumes. The factors affecting level of service (LOS) can be listed as follows:

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



Level of Service A to F **(4M)**

b) Discuss the various traffic studies and their importance?

Sol: The different traffic engineering studies generally carried out are:

1. Traffic Volume studies: Traffic volume is a measure to quantify the traffic flow. Traffic volume is expressed as the number of vehicles that pass across a given transverse line of the road during unit time. The traffic volume is generally expressed as the number of vehicles per hour or per day, per traffic lane.

- Traffic volume counts may be carried out either manually or by using mechanical or automatic counters.
- These studies are useful for geometric design of roadway facilities, for computing roadway capacity, for analysis of traffic patterns, trends and rate of growth of each vehicle class and projecting future traffic volume etc.

2. Spot Speed Studies: When we measure the traffic parameter over a short distance, we generally measure the spot speed. A spot speed is made by measuring the individual speeds of a sample of the vehicle passing a given spot on a street or highway. Spot speed studies are used to determine the speed distribution of a traffic stream at a specific location. The data gathered in spot speed studies are used to determine vehicle speed percentiles, which are useful in making many speed-related decisions. Spot speed data have a number of safety applications, including the following 1. Speed trends, 2. Traffic control planning, 3. Accidental analysis, 4. Geometric design, 5. Research studies. **(2M)**
3. Speed and Delay Studies: The speed and delay studies give the prticulars of running speeds or the fluctuations in speeds, the locations and duration of delays or stoppages and the overall travel speed between two desired locations along a road. They also give the information such as the type of delay, location, causes, duration and frequency of such delays.
    - The different methods of carrying out speed and delay studies are
        1. Floating car method 2. License plate method 3. Intervie technique 4. Elevated observations 5. Photographic technique
4. Origin and Destination Studies: O & D studies give the information on the actual location or zone of origin of travel of vehicles or individual passenger trips and their destination; these studies provide details such as direction of travel, selection of routes, trip length and the frequency and number of such trips. **(2M)**
5. Parking Studies: The demand by automobile users for parking space is one of the major problems of highway transportation, especially in metropolitan cities. In industrial, commercial and residential places with multi-storeyed buildings, parking demand is particularly high.

   Different aspects to be covered during parking studies are:
    - Study of existing parking characteristics and the facilities available.

- Inventory of additional parking space that could be availed.
- Determination of the actual parking demand during different periods of the day.

6. Accident studies: The accident studies pertain to the road accidents that can occur from time to time on an existing road system. Though road accidents cannot be totally prevented, the accident rate can be decreased by suitable traffic engineering and management measures. Therefore the traffic engineer has to carry out systematic accident studies to investigate the causes of accidents and to take preventive measures in terms of design and control. **(2M)**

(OR)

9. a) Explain different types of traffic signals? Describe?

Sol: Types of traffic signals:

The signals are classified into the following types:

(i) Traffic control signals
  (a) Fixed-time signal
  (b) Manually operated signal
  (c) Traffic actuated (Automatic) Signal
(ii) Pedestrian signal
(iii) Special traffic signal

(i) Traffic control signals

a) Fixed –time signal or pre-timed signals are set to repeat regularly a cycle of red, amber and green lights.

b) Manually operated signals:

When traffic less, traffic police operates signal phases **(2M)**

c) Traffic actuated signals are those in which the timings of the phase and cycle are changed according to traffic demand.

- In semi-actuated signals the normal green phase of an approach may be extended upto a certain period of time for allowing a few more vehicles approaching closely, to clear off the intersection with the help of detectors installed at the approaches.
- In fully-actuated signals the detectors and a computer assigns the right of way for various traffic movements on the basis of demand and pre-determined programming. But these are very costly to be installed at all intersections. **(2M)**

ii) Pedestrian signal: These are meant to give the right of way to pedestrians to cross a road during the 'walk period' when the vehicular traffic shall be stopped by red or stop signal on the traffic signals of the road.

iii) Special traffic signal: Such as flashing beacons may be installed at certain locations in order to warn the traffic of certain situations. **(2M)**

b) Draw neat sketches of regulatory signs?

Sol: Regulatory or mandatory signs are meant to inform the road users of certain laws, regulations and prohibitions; the violation of these signs is legal offence.

The regulatory signs are classified under the following sub-heads

(i) Stop and Give-way signs
(ii) Prohibitory signs
(iii) No parking and No Stopping signs
(iv) Speed Limit and Vehicle Control Signs
(v) Restriction Ends sign
(vi) Compulsory Direction Control and other signs **2M**

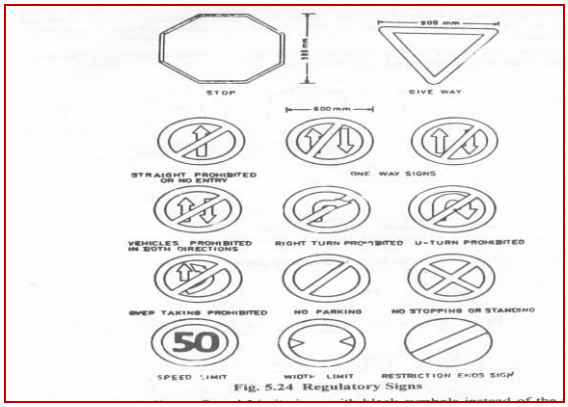
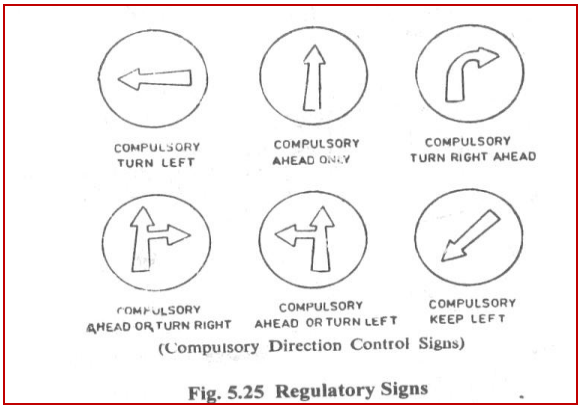


Fig. 5.24 Regulatory Signs



(Compulsory Direction Control Signs)

Fig. 5.25 Regulatory Signs **4M**

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