



MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

(Autonomous)
(ISO/IEC-27001-2005 Certified)

WINTER-12 EXAMINATION

Subject Code: 12139

Model Answer

Page No: 01

Q. 1. a) Attempt any three of the following: (12)

i) Classification of road according to third road development plan. (02)

- **Primary System**

Express ways

National High ways

- **Secondary system**

State High ways

Major District Roads

- **Tertiary System (Rural Roads)**

Other District Roads

Village Roads

Explanation of any one of the above roads (02)

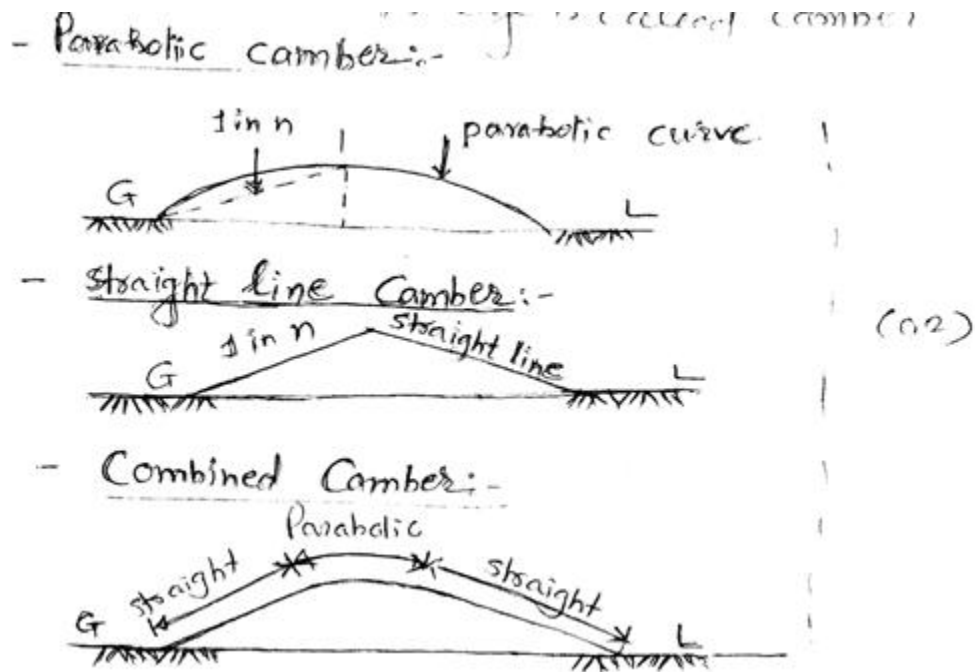
ii) Importance of roads in India (any four points i.e. 4 x 1 = 4)

- It contributes to the economic, industrial, social and cultural development of a nation.
- It helps primarily in linking production and consumption centers.
- By moving peoples across the country, transportation brings about national integration and understanding of different culture.
- Transportation is also an essential aspect in military operations.
- They serve as feeder lines for railways, waterways and air ways.
- They provide good commercial links between cities.

iii) **Key map:** This map shows the proposed and existing roads and also important places to be connected. (02)

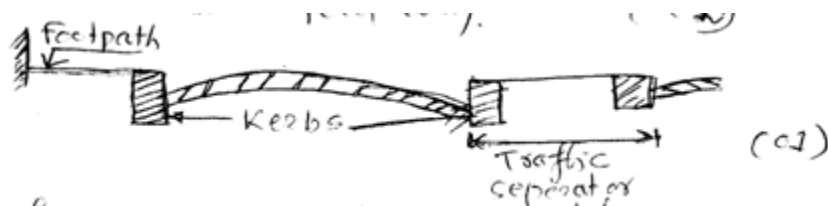
Index Map: This map shows the general topography of the area and the details are represented symbolically. (02)

iv) **Camber:** The rise given to the centre of carriage way with reference to its edge is called camber. (02)

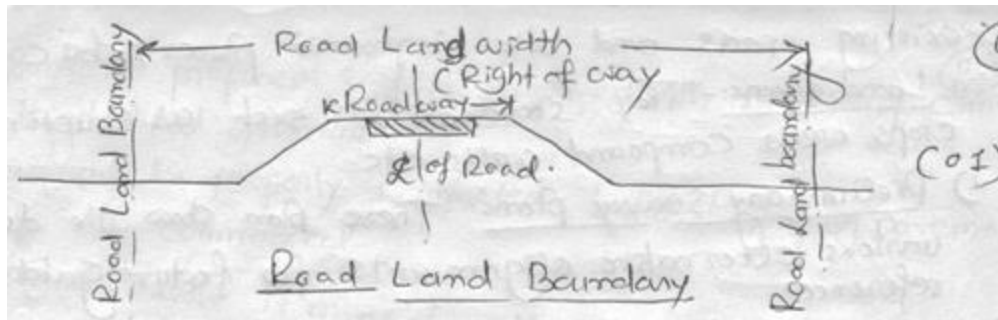


Q. 1. b) Attempt any one (06)

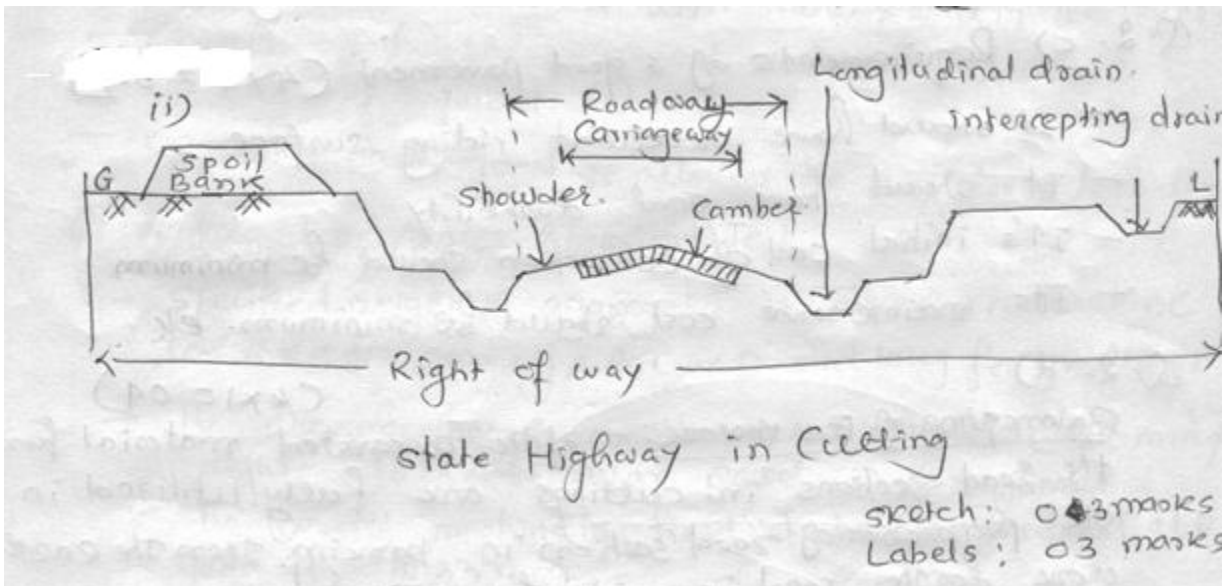
i) **Kerb road margin:** The edge where a raised pavement / side walk / foot path, road median or road shoulder meets an unraised street or other road way. (02)



ii) **Right of way:** It is the width of land to be acquired along the road alignment by the highway organization. (02)



Q. 1. b) ii)



Q.2. Attempt any four (16)

a) Purpose of reconnaissance survey (04)

- To obtain general knowledge of the whole territory.
 - To obtain information regarding the salient features of the territory.
 - Aerial reconnaissance is helpful to provide bird's eye view to study various decision making factors for the rejection or modification of alignments.
 - Preservation of environment and maintenance of ecological balance.
- (Or any other related points.)

b) Various plans prepared for road project (04)

i) Detailed drawings: The detailed plan showing contours, longitudinal sections, cross sections, design of structures etc. are prepared with convenient scale.

ii) Index map: This map shows the general topography of the area and the details are

represented symbolically.

iii) **Key map:** This map shows the proposed and existing roads and also important places to be connected.

iv) **Land Plans:** They show details such as structures, standing crops, wells, compound walls, etc.

v) **Preliminary survey plans:** These plan show details of various alternative alignments for future guidance and reference.

c) Requirements of good pavement: (04)

- It should have excellent riding surface.
 - It should have good durability.
 - Its initial cost of construction should be minimum.
 - Its maintenance cost should be minimum.
- (Or any other related points.)

d) Balancing of earth work: If the excavated material from the road section in cuttings is fully utilized in the preparation of road section in banking, then the earth work for the road is said to be the balance earth work. (01)

Lead and lift: The earth works are estimated for 30 m horizontal distance called as lead and 1.5 m height or depth called lift. (01)

Borrow pits: These are usually prismoidal shaped cuts dug out in the road land at some distance from the toe of an embankment. The earth obtained from these cuts is used for the construction of road banks. (01)

Spoil bank: These are nearly 1.5 m high heaps formed by depositing unutilized excavated earth. These are parallel to the length of cutting in the form of banks at some distance away from top edge of cutting. (01)

e) Steps for earth road construction: (04)

- Soil survey and laboratory investigation are carried out.
- Ground is cleared of shrubs, trees, grass and other organic matter.
- Sub grade is prepared and it is provided with necessary camber and longitudinal gradient.
- The sub grade is properly compacted before laying of pavement layers is commenced.
- Prepared earth is mixed with water and laid in two layers.
- Camber of finished pavement surface is checked and corrected if required.
- Compacted earth road is allowed to dry for 5 to 10 days.

f) Procedure of Los Angeles abrasion test

(04)

- Specified weight of aggregate is placed in machine i.e. 5 kg for grading A, B, C, or D and 10 kg for grading E, F, or G.
- The abrasion charge consisting of C.I. cylinders (48 mm diameter and weight 390 – 445 gm) are placed in the machine cylinder.
- The cover of machine is fixed dust tight and rotated at a speed of 30 to 33 rpm.
- The machine is stopped and material is taken out. It is sieved on 1.7 mm IS sieve and weight of material retained on sieve is found out.

$$\text{Percentage wear} = \frac{W_1 - W_2}{W_1} \times 100$$

Where W_1 = Original weight of aggregate

W_2 = Weight of material retained on sieve.

- From Table of specification for Los Angeles Test, abrasion value is calculated.

Q.3. Attempt any four

(16)

a) Soil Stabilized Roads: When natural soil is not suitable for construction of earth roads, different types of soil are blended together in appropriate proportions, so that its properties are improved and it can withstand the effect of weather and traffic better than natural soil.

Sometimes, admixtures are used with soil.

(01)

Purpose: Improvement in strength, durability, resistance to wear, water tightness, prevention of dust nuisance, etc.

(01)

Types: i) Mechanical stabilization

ii) Cement Stabilization

iii) Bituminous stabilization

iv) Thermal stabilization

v) Electrical stabilization

vi) Chemical stabilization

vii) Composite stabilization.

(02)

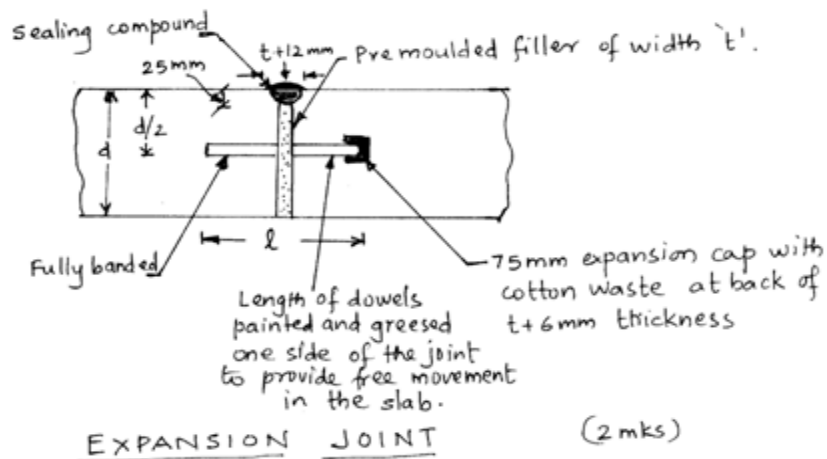
b) Construction procedure of bituminous roads:

No bituminous material should be applied when the surface materials are damp or weather is foggy or is raining.

- i) **Preparation of surface:** Repairing existing surface by filling depressions, pot holes, grade checking and camber. Application of suitable primer.
- ii) **Application of bituminous material:** Rate of application of bituminous material and aggregate as per requirement.
- iii) **Application of cover coat:** Cover material is spread by hand or by mechanical gritter to cover the whole surface.
- iv) **Rolling cover material:** The surface is rolled using a suitable roller and taking all precautions while rolling.
- v) **Finishing:** When tested with template and straight edge, the variation should not be greater than 6mm from the straight over a length of 3 m. If multiple coats are to be used, each coat is followed by subsequent coats of bituminous material and coarse aggregate with a time interval of 24 hours.
- vi) **Opening to traffic:** For straight run bitumen construction, road can be opened to traffic the next day but if cut back bitumen or emulsion is used, sufficient curing should be done. (04)

c) Necessity of joints in cement concrete roads: Concrete pavements are exposed to severe temperature and moisture conditions- produces stresses causing the slab to crack (warping). Due to this warping, slab is raised off the sub grade and if the length is long, a thin slab will not be able to take the self weight. Direct tension due to contraction also causes cracks. Compression failures and buckling or blow up occurs because of expansion of the slab. Therefore, continuous slab will crack under these conditions and wheel load at fairly regular intervals of 5 m to 7 m.

To prevent progressive cracking up of pavement and for control of expansion and contraction, longitudinal and transverse joints are provided. (02)



d) Difference between Surface drainage and sub surface drainage**(04)**

Surface drainage	Sub surface drainage
i) Surface drainage deals with removal of water from surface of road, adjoining land.	i) Deals with lowering of ground water table to safe limits (1 to 1.2 m below sub grade).
ii) By cambering road surface, sloping shoulders	ii) Providing sub pervious base over sub grade, gravel layer to prevent capillarity.
iii) Side drains are provided	iii) Trench on hilly road to intercept water.
iv) Surface water causes early wearing out of road surface.	iv) Sub soil water decreases bearing capacity of soil.
v) Best alignment along water shed	v) Depends on soil types and slopes.

(Any four points)**e) Highway drainage: Importance**

- i) Single factor greatly influencing stability of road
- ii) Excessive moisture getting into foundation soil has detrimental effect on superstructure.
- iii) Affects safety of road users.
- iv) Gradual wearing of road surface- Pot holes, removal of road metals and finish, weakening of entire structure.
- v) Accidents may increase- Loss of life and vehicles and property.
- vi) Restriction on speed – High fuel consumption, time loss etc.
- vii) Flooding of roads can be prevented by proper drainage.

(Any four points) (04)**Q. No 4 a) Attempt any Three****4 x 3 =12****i) IRC specifications/recommendations of camber for different types of roads**

Sr No	Type of road surface	Camber
1	Earth road, footpath	3 to 4 % (1 in 20 to 24)
2	Gravel, WBM road surface	2.5 to 3%(1 in 36 to 48)
3	Thin Bituminous surfacing	2.5%
4	High type Bituminous surfacing or Cement concrete surface	2%

(1x4=4)

ii) **Necessity of providing Curves on highways:**

- To lay the road according to topography of the country.
 - To provide access to the particular place.
 - To avoid costly land.
 - To avoid excessive cutting or filling.
 - To avoid certain religious, monumental or other important structures.
 - To make use of existing bridge.
 - To make use of existing right of way.
 - To keep driver alert by making change in the direction of road.
 - To avoid mental strain caused by the monotony of continuous journey along a straight route.
 - To check the tendency of the driver to increase the speed of his vehicle beyond the safe limits on straight routs.
- (Any four- 1 mark each= 4)

iii) **Stopping sight Distance:** It is also called non passing sight distance-

The distance traveled by a vehicle from the time, a danger is realized by the driver to the actual stop. OR It is the distance traveled by the vehicle during perception time and the brake reaction time plus braking distance. (1)

Factors affecting stopping sight distance

- Speed of vehicle
 - Total reaction time taken by the driver of the vehicle
 - Efficiency of brakes
 - Tractive resistance of the road surface
 - Slope of the road
 - Height of driver's eye
 - Weather conditions, efficiency of wipers during rain, effective lighting system during night hours
- (Any three = 3 Marks)

iv) **Defects in WBM roads**

In WBM roads the aggregates are keyed together and prevented from moving out simply by means of slurry of screenings, sand and clay, since no other binding material is used. Binding effect of slurry mostly depends on presence of moisture.

The WBM road surface deteriorates mainly due to

- Fast moving vehicles

- Grinding of stones
- Hoops of the animals

(1)

The defects observed are- potholes, ruts, surface become very rough, thickness of pavement reduces.

(1)

Remedies:- Defects can be removed during day to day maintenance, through surface renewal.

Potholes are repaired by patch work, rut-filling and resurfacing

Resurfacing- When pot hole occurs on more than 1/3 rd area of the road surface in a particular reach, the repair work done in that case is resurfacing.

Renewal:- It is necessary after the useful life period of road or when the surface has worn out to such an extent that it cannot be repaired by patch work.

(2)

b) Attempt any one

(6)

i) Amount of super elevation $e=?$

$$R = 200 \text{ m}$$

$$V = 50 \text{ kmph}$$

$$e = \frac{V^2}{225 R}$$

(1)

$$e = \frac{50^2}{225 \times 200}$$

$$e = 0.0556$$

(1)

$$e = 0.0556 < 0.067 \quad 1^{\text{st}} \text{ Check}$$

(1)

2nd Check for “f”

For $e = 0.0556$

$$e + f = \frac{V^2}{127 R}$$

(1)

$$0.0556 + f = \frac{\left(\frac{4}{3} \times 50\right)^2}{127 \times 200}$$

$$f = 0.1193 < 0.15$$

(1)

Therefore adopt $e = 0.0556$ (1)

ii) Stopping sight distance for two way traffic =?

Design speed = 70 kmph

Reaction time = 2.5 sec

Coefficient of friction = 0.6

$$\text{Length of SSD} = \frac{V^2}{254f} + 0.278Vt \quad (1)$$

$$= \frac{70^2}{254 \times 0.6} + [0.278 \times 70 \times 2.5] \quad (2)$$

$$= 80.80 \text{ m} \quad (1)$$

Therefore SSD for two way traffic in a single lane road = $2 \times 80.80 = 161.6 \text{ m}$ (2)

Q.5 Attempt any four

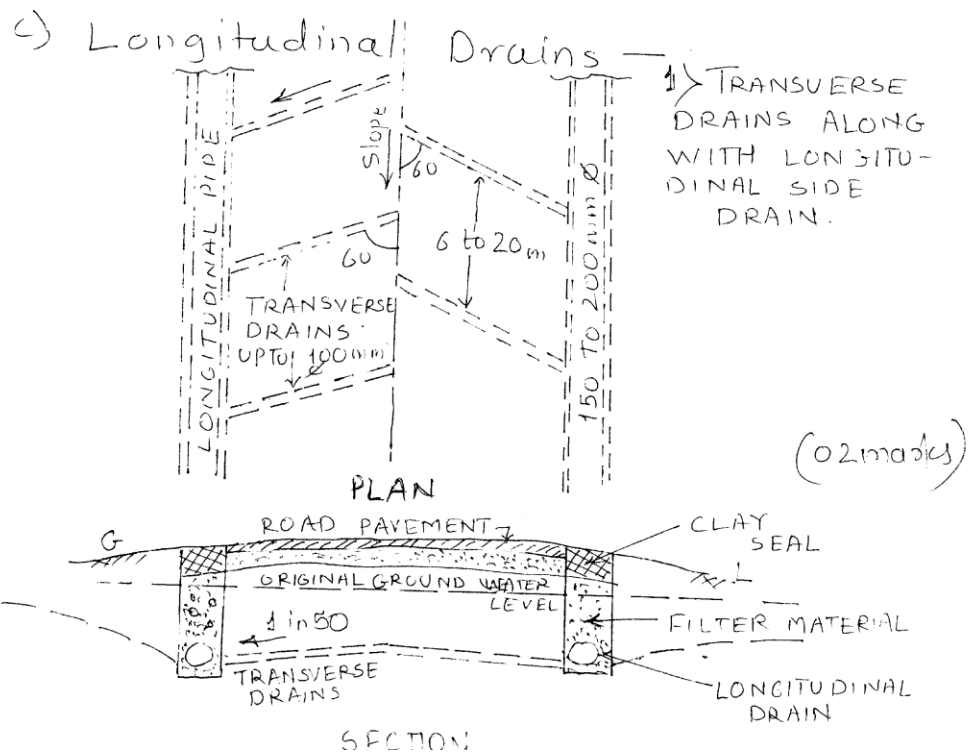
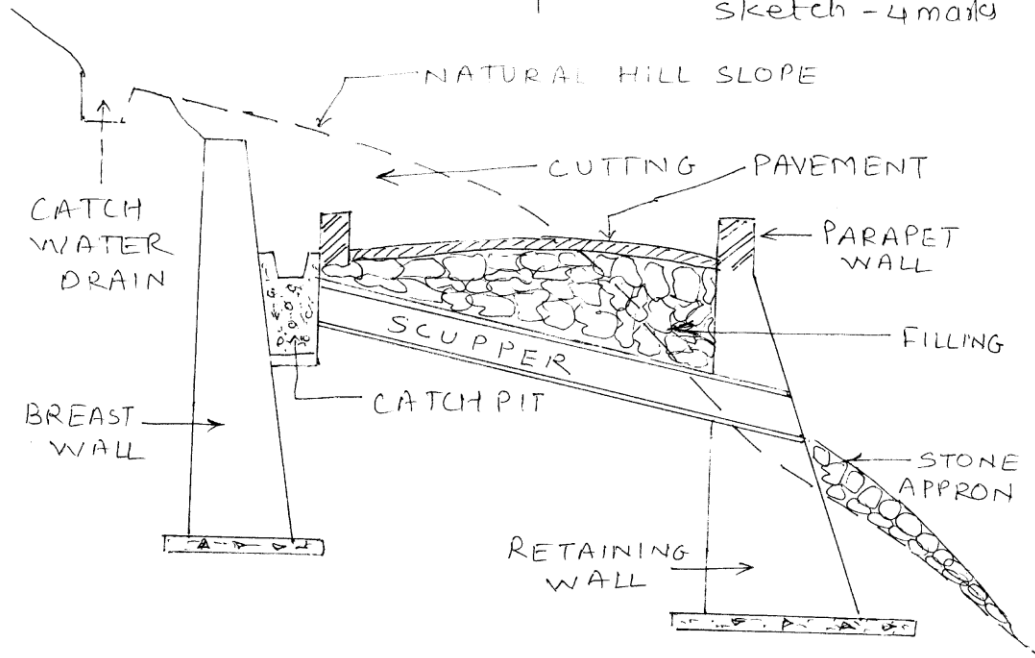
4 x 4 = 16

a) Preventive measures for landslides in hilly area

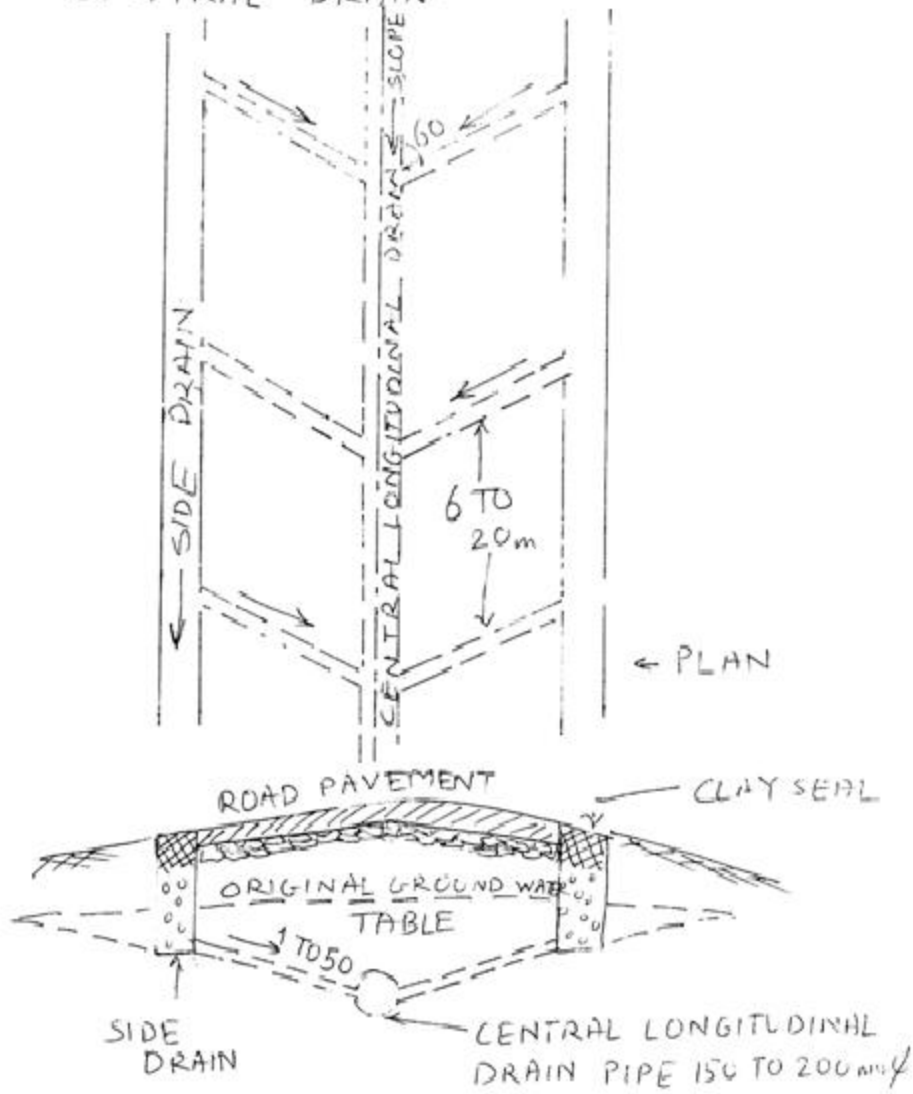
- By efficient surface and cross drainage
- By providing sub surface drains at foot of the hill slope to control seepage flow
- By benching of soil slope
- By reducing the angle of slope or providing breast wall and retaining wall
- By constructing buttresses at toe of hill slope
- By slope treatment to minimize the erosion and to improve the stability of hill side

(Any four one mark each = 4)

Q.5 b) $\frac{1}{2}$ of a hill road showing its various parts - Neat labelled sketch - 4 marks

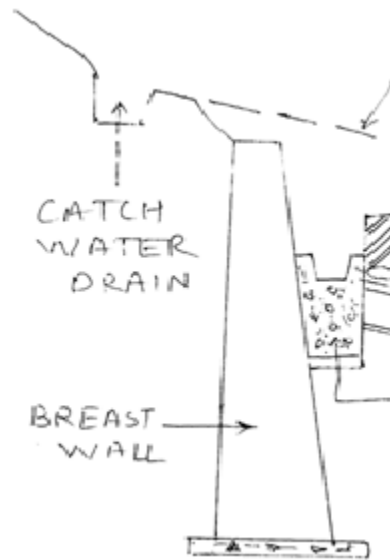


2> TRANSVERSE DRAINS AND A LONGITUDINAL CENTRAL DRAIN.



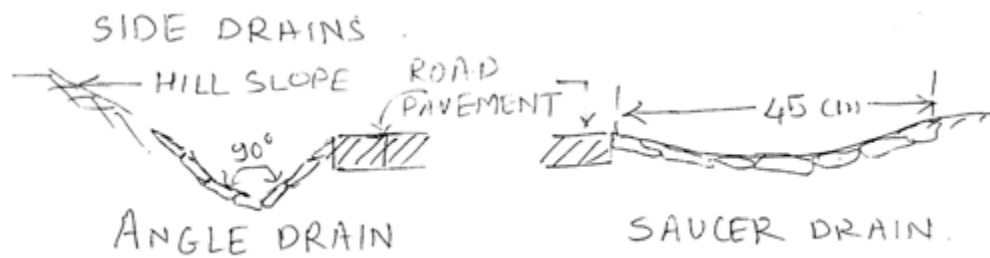
(2 Marks)

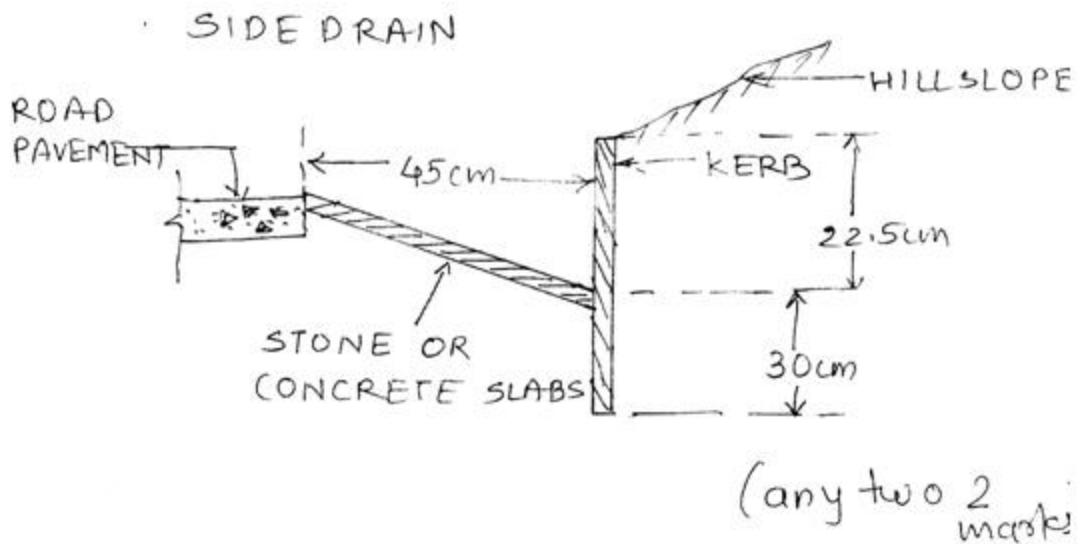
d)



Portion of hill road showing catch water drain

(2)





Kerb and Channel

e) Defects in concrete roads

- Mud pumping
- Scaling of cement concrete
- Shrinkage cracks
- Spalling of joints
- Structural cracks
- Warping cracks
- Patch hole

(Any four one mark each =4)

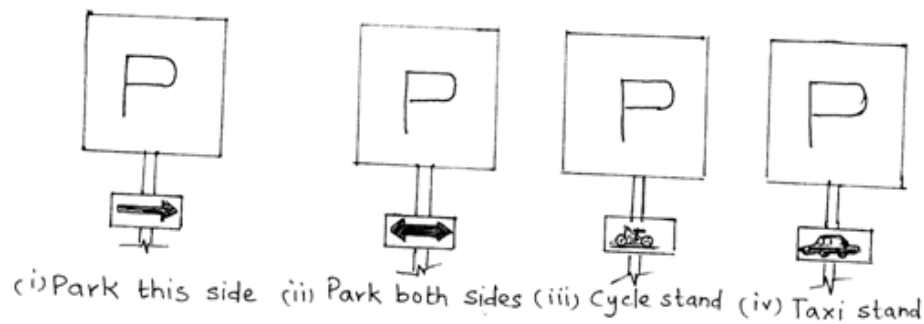
f) Necessity of road maintenance

- To keep upkeep the various components of the road
- To provide safe and convenient movements of passengers and goods at all the times
- To increase useful life of the road
- If repairs are neglected in early stage they may result into very extensive repairs.

(4)

Q.6 Attempt any four of the following**(16)**

Q6a) Any four parking signs



(One mark each figure =4)

b) Causes of road accident:**i) Factors attributed to roads:**

Improper geometrical design.

- Inadequate width, sight distance.
- Sharp curves, insufficient super-elevation.
- Steep gradients, lack of warning or precautionary signs, lighting during night.
- Ill maintenance of roads.

ii) Factors attributed to vehicles:

- Failure of brakes.
- Poor lights, faulty steering, worn out or damaged tyres and wipers, driver seat not at proper position

iii) Human factors

- Poorly trained drivers
- Defective eye sight, under influence of liquor, overstrained, over-crowded vehicle, noise, projecting materials
- Carelessness of pedestrians

iv) Environmental Factors

- Mist, fog, glare, dust storms etc.

v) Miscellaneous Causes

- Failure of signals
- Slippery road surface
- Boarding or alighting from moving vehicles

(4)

c) Objects or purposes of traffic volume study

- To decide priority for improvement and expansion of a road and to allot funds accordingly.
- Plan and design new facilities of traffic operations
- Establish relative importance of any road or road facility
- Analyze traffic pattern and trend on the road
- For structural design of road
- To plan one way street and other regulatory measure, road intersections, signal timing settings etc.
- Planning sidewalks, cross walks, pedestrian signals
- Economic study

Uses:

- Better utilization of roads by smooth flow of traffic
- Reduces congestion, jams, accidents
- Safe pedestrian movement or cross over.
- Improved life of road etc.

(4)

d) Any four prohibitory signs

(One mark for each = 4)



e) Objects of planting trees along roadsides

- i) Stabilization of formation due to roots of trees
 - ii) Provision of shade to travelers
 - iii) Source of revenues
 - iv) Beautifies the roads
 - v) Protects road surface (bituminous) from bleeding during severe summer temperatures (4)
-