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Subject:- Highway & Traffic Engr.

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		Date : 13/04/2020

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Roll No: ...7209...

SEMSTER : 6th	TIME ALLOWED : 6 Days
Assignment/ Quiz	TOTAL MARKS : 30

- Instructions
- (i) Be brief and to the point
  - (ii) Attempt All Questions

1. Keeping in view different modes of Transportation compare railways with Highways. (5)
2. You are a Transportation engineer. You have been tasked to conduct office study as a preliminary step for design of new highway. What reference material you will study and what data you will extract (6)
3. What is importance of vehicle performance in highway design? (4)
4. Write short note on Directional distribution in design of highways (5)
5. Explain broad classification of surface distress modes. (2)
6. Explain ~~Alligator cracking~~, ~~block cracking~~, ~~Longitudinal cracking~~ and ~~Transverse cracking~~. (8)

Question # 01.

Modes of Transportation:-

Transportation modes are designed to either carry passengers or freight, but most modes can carry a combination of both. For instance, an automobile has a capacity to carry some freight while a passenger plane is used for luggage & cargo.

i) Railway Transportation:-

Railways are composed of a traced path on which wheeled vehicles are bound. In light of more recent technological developments, railway transportation also includes monorails & maglev. They have an average level of physical constraints linked to the type of locomotives & a low gradient is required, particularly for freight. Heavy industries are traditionally linked with rail transport system, although containerization has improved the flexibility of rail transportation by linking it with road & maritime modes. Rail is by far the land transportation mode offering the highest capacity with a 23,000 tons fully loaded coal unit train being the heaviest load ever carried. Gauges, however, vary around the world, often challenging the integration of rail system.

ii) Highway / Road Transportation:-

Road infrastructure are large consumers of space with the lowest level of physical constraints among transportation mode. However, physiographical constraints are

Significant in road Construction with Substantial additional Costs to Overcome Features Such as river or rugged terrain. Road transportation has an average operational flexibility as vehicles can serve several Purpose but are rarely able to move outside roads. Road transport System have high maintenance Cost, both for the vehicles & Infrastructures. They are mainly linked to light industries where rapid movements of freight in small batches are the norm.



Question # 02:-

You are a transportation engineer. You have been give a tasked to Conduct office Study as a Preliminary Step for design of new highway.

Ans:- Office Study of Preliminary Step:-

- Data Examination (office Study):-

The first Phase in any highway Location Study is the examination of all available data of the area in which the road is to be constructed.

This Phase is usually Carried out Prior to any field or Photogrammetric investigation.

- Data Sources:-

- (National / Provincial department transportation, agriculture, geology, hydrology, & mining).

- Existing engineering reports.
- Maps.
- Aerial Photographs.
- Charts.

### Area Characteristics Covered in data Collection:-

- Engineering, including topograph, geology, climate, & traffic Volume.
- Social & demographic, including land Use Zoning Patterns.
- Environmental, including types of wild life; location of recreational; historic & archeological sites, & the possible effect of air, noise, & water Pollution.
- Economic, including unit costs for construction & the trend of agricultural, commercial, & industrial activities.

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Question #04:- write a short note on Directional distribution in design of highway.

Ans) = Directional Distribution:-

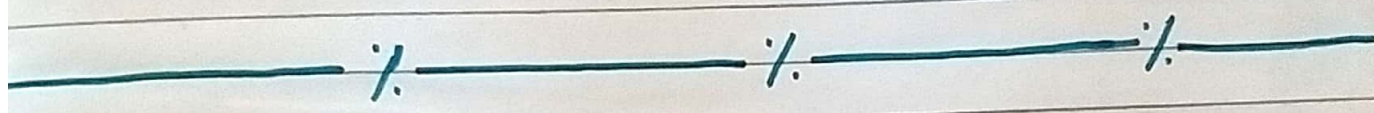
Usually to measure traffic for 2-lane highway using in both directions of travel. Knowledge of the hourly traffic load in each direction of travel for highway with more than 2-lanes is essential for design. In some cases traffic may be split 50-50 as two directions, but during most peak-hour periods it is common to find a large percentage of traffic movement in one direction.

Example for directional distribution:-

If traffic is directionally split 60/40, so, what is directional distribution of traffic for previous example (Design hourly volume = 420 veh/hr)?

Directionally Design Hourly Volume (DDHV) =  $0.6 \times 420 = 252 \text{ veh/hr}$ .

Notice we use 0.6 not 0.4.



Question # 05:-

Explain broad classification of surface distress modes.

Ans:- Surface distress is "Any indication of poor or unfavorable pavement performance or signs of impending failure, any unsatisfactory performance of a pavement short of failure". Surface distress modes can be broadly classified into the following three groups;

1) = Fracture:- This could be in the form of cracking or spalling resulting from sure things as excessive loading, fatigue, thermal changes, moisture damage, slippage or contraction.

2) = Distortion:- This is in the form of ~~stripping~~, ~~pavement~~ deformation, which can result from such things as excessive loading, creep, densification, consolidation, swelling, or frost action.

### 3) = Disintegration:-

This is in the form of Stripping, raveling or Spalling, which can result from such things as loss of bonding, chemical reactivity, traffic abrasion, aggregate degradation, poor Consolidation / Compaction or binder aging.

### Question #06:- Explain;

#### 1) = Alligator Cracking:-

Alligator cracking is also called Crocodile Cracking. & Perhaps misleadingly Fatigue Cracking, is a common type of distress in asphalt pavement. The following is more closely related to fatigue cracking which is characterized by interconnecting or interlaced cracking in the asphalt layer resembling the hide of a crocodile. Cell sizes can vary in size upto 11.80 in (300mm) across, but are typically less than 5.90 in (150mm) across. Fatigue cracking is generally a loading failure, but numerous factors can contribute to it. It is often a sign of sub-base failure, poor drainage, or repeated over-loadings. It is important to prevent fatigue cracking, & repair as soon as possible, as advanced cases can be very costly to repair & can lead to formation of potholes or premature pavement failure.

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## Longitudinal Cracking:-

Longitudinal Cracking is a cracking in the surface of road that runs longitudinally along the Pavement. It can consist of a single crack or as a series of parallel cracks.

### - Quantification:-

As with other sealed road failure modes there are two main attributes taken into account when measuring longitudinal cracking; extent & severity.

- Cracking Extent:- is the Percentage of the road surface subject to cracking.

- Cracking Severity:- is related to the width of cracks & is typically recorded as a number.

### - Causes:-

Longitudinal Cracking can occur for a number of reasons, including;

- The reflection of a crack or joint in the road pavement,
- Poorly constructed joints in the asphalt surface.
- Asphalt hardening.
- diurnal temperature fluctuations.

Where a number of cracks parallel exist, this may be the result of;

- an expensive clay sub-grade.
- a cyclical weakening of the pavement edge.
- Differential settlement between cut & fill.



## Block Cracking:-

Interconnected Cracks that divide the Pavement up into rectangular Pieces.

Blocks range in size from approximately  $0.1 \text{ m}^2$  ( $1 \text{ ft}^2$ ) to  $9 \text{ m}^2$  ( $100 \text{ ft}^2$ ). Large blocks are generally classified as longitudinal & transverse Cracking. Block cracking normally occurs over a large portion of Pavement area but sometimes will occur only in non-traffic areas.

- Problem: Allow moisture infiltration, roughness

- Possible Causes:

HMA Shrinkage & daily temperature cycling. Typically caused by an inability of asphalt binder to expand & contract with temperature cycles because of:

- Asphalt binder aging.
- Poor choice of asphalt binder in the mix design.

- Repair:-

Strategies depend upon the Severity & extent of the block cracking.

- Low Severity Cracks. ( $< 1/2$  inch wide).
- High Severity Cracks. ( $> 1/2$  inch wide).

## Transverse Cracking:-

Transverse Cracking was measured in six of the seven sites. At three of those locations, the amount of cracks were minimal & of shorter lengths. Two of those locations were within one crack observed difference & the difference were less than 6 feet apart.

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In the one instance where the Shoulder with RS had two more Cracks, the difference in total length was only ten feet. Over all, the Shoulders with RS has more transverse Cracks in total. Nonetheless, the total length of all of these Cracks tended to be shorter than the length total for the Shoulders with out RS.

Transverse Cracks with in the sections with RS in the Shoulders had shorter Cracks that typically started with in or were through out a RS depicts a location where the transverse crack spanned the entirety of the RS & continued outward. Due to the thinner cross section, the SRS sections may be more prone to shrinkage causing this cracking or reflective cracking to occur easier.

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Question # 03:-

What is the important of vehicle in highway design?

Ans:- For highway design & traffic analysis

braking characteristics are the most important aspect of vehical performance.

Braking behavior influences geometric design, signal timing, sign placement, accident avoidance systems, roadway surface design.

Performance of vehicles in design guideline:-

- length of acceleration / deceleration lanes.
- maximum grades.
- Stopping - sight distance
- Passing - sight distance
- Setting Speed limits
- timing of Signalized intersections.

Section 2.91 & Section 2.94, these sections deal more with how auto designer might approach braking principles or accident reconstruction if many variables are known, such as road adhesion, braking efficiency, air density, etc.

As highway designers, we have to generalize many of these factors in order to accommodate a variety of driver skills, vehical type, Pavement Condition & weather Condition.

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