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SECTION B

MODULE 6th

SUBJECT Highway And Traffic Engineering.

SUBMITTED TO ENGR. ABDUL FARHAN

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Final Term Paper.

QUESTION 01 (a)

What is the difference b/w Flexible and rigid pavement?

FLEXIBLE PAVEMENT	RIGID PAVEMENT
1. Bitumen is used as binder	1. Cement is used as binder.
2. Deformation in the sub-grade is transferred to the upper layer.	2. Deformation in the sub grade is not transferred to subsequent layer.
3. Load is transferred by grain contact	3. No such phenomenon of grain load transfer exists.
4. Flexible pavement have low initial cost but have high maintainance cost.	4. Have low maintainance cost but have high initial cost.
5. Have low life span usually 10-15 years	5. Have more life span usually 30+ years.
6. Surface cannot be laid directly on the sub grade but a sub base is needed	6. Surface can be directly laid on the sub grade.
7. Road can be used for traffic within 24 hour.	7. Road cannot be used until 14 days of curing.

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Question 01 (b)

What are the advantages of water bound over wet mix macadam?

ANSWER:

- Water bound macadam is slightly cheaper than the wet mix mecadam. The reason is WBM requires general labour while wet mix macadam requires mixer plant and paver.

- The interlocking of aggregate particles imparts adequate strength of the materials for filling the voids. These ensure non entry of the plastic material of the sub grade into voids

- Aggregate of WBM are or can be broken by hands while the Wet mix macadam needs a crusher for the disintegration of aggregates.

QUESTION 01 (c)

What is the diffeuence b/w asphalt and Bitumen?

BITUMEN :

A class of black or dark-colored (solid, semi solid or viscous) cementitious substances, natural or manufactored, composed principally of high molecular weight hydrocarbons found in asphalts, Tars, pitches and Asphaltities are typical.

ASPHALT :

A dark brown to black cementitious material in which the predominating consituents are bituminous which occur in nature or are obtained in fractional distillation of petroleum along with certain mineral matter.

QUESTION 02:

A crest vertical curve joining a +3 percent and a -4 percent grade is to be designed for 75 mi/h. If the tangent intersect at station (345+60.00) at an elevation of 250 ft determine the stations and elevation of BVC and EVC. Also calculate the elevation of intermediate points on curve at whole station.

SOLUTION:

- For a design speed of 75 mi/h

  $K = 312$,

- Minimum length $= 312 \times [3-(-4)]$

  $= 2184 \text{ ft}$.

- Station of BVC $= 345+60 - \left(\frac{21+84}{2}\right)$

  $= 334+68$

- Station of EVC $= (334+68) + (21+84)$

  $= 356+52$

- Elevation of BVC $= 250 - \left(0.03 \times \frac{2184}{2}\right)$

  $= 217.24 \text{ ft}$

QUESTION 03:

SOLUTION:

- Reliability level (R) = 99%
- Standerd deviation (S_0) = 0.49
- Initial Serviceability Index pi = 4.5
- Terminal serviceability index pt = 2.5
- ΔPSI = 4.5 − 2.5 = 2.0.

Finding SN_1 and D_1 (Surface Course):

STEP 01:

Draw a line joining the reliability level of 99% and overall standerd deviation "S_0" of 0.49 and extend this line to intersect the first TL line at point A.

STEP 02:

Draw a line joining point A to the ESAL of 2×10^6 and extend this line to intersect the second TL line at point B.

STEP 03:

Draw a line joining point B and resilient modulus (Mr) of base course and extend this line to intersect the design serviceability loss chart at point C.

STEP 04:

Draw a horizental line from point C to intersect the design serviceability loss (PSI) curve at point D. In this problem $\Delta PSI = 4.5 - 2.5 = 2$.

STEP 05:

So the structure number required to protect the base course and to find the thickness DI of the surface coarse is 2.6.

Finding layer Coefficient a_1

STEP 06:

Determine the appropriate structure layer co-efficent for each construction material. Resilient value of asphalt = 450,000 lb/in², therefore $a_1 = 0.44$.

Thickness Of Surface Course D_1:

$$D_1 = SN_1 / a_1$$

$$= 2.6 / 0.44$$

$$\boxed{= 5.9''}$$

Thickness should be taken to nearest 0.5 inches.

So the thickness of surface course is 6"

$$SN_1 = D_1 \times a_1$$

$$= 6 \times 0.44$$

$$= 2.64.$$

Thickness Of Base Course D_2:

$$D_2 = (SN_2 - SN_1^*)/a_2 m_2$$

$$= (3.8 - 2.64)/0.14 \times 0.80$$

$$D_2 = 10.36''$$

Use 12"

So thickness of base course is 12"

$$SN_2^* = 0.14 \times 0.80 \times 12 + SN_1$$

$$SN_2^* = 1.34 + 2.64$$

$$SN_2 = 3.98.$$

Thickness Of Subbase Course D_3:

$$D_3 = (SN_3 - SN_2)/a_3 m_3$$

$$= (4.4 - 3.98)/0.10 \times 0.80$$

$$D_3 = 5.25''$$

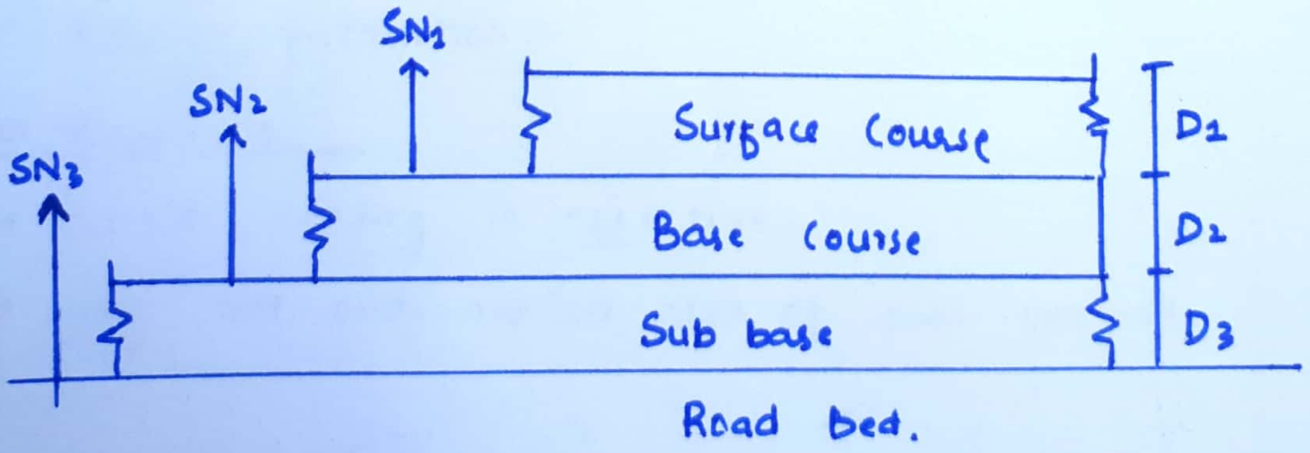
We will use 6" as a sub base

$SN_3 = (2.64 + 1.34 + 6) \times 0.10 \times 0.80$

$SN_3 = 4.46 > 4.4$ okay.

Final Design :

- Surface Course = 6"
- Base Course = 12"
- Sub Base = 6"
- Total pavement thickness = 24"



QUESTION 04:

What are different pavement distresses Explain in detail?

PAVEMENT DISTRESS:

Distress is a condition of the pavement structure that reduces serviceability or leads to a reduction in service life.

TYPES:

Following are the types of pavement distress.

1. Alligator Cracking:

⇒ Possible Causes:

- Overloading
- Inadequate structural design
- Poor construction.

⇒ Repair :

- Crack sealing in effective
- Dig out and replace area of poor subgrade

BLOCK CRACKING:

⇒ Problem :

- Allows moisture infiltration.

⇒ Possible Cause:

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

⇒ Repair :

- Low severity crack (< ½ inch wide) Crack seal to prevent entry of moisture.
- High severity crack (> ½ inch wide) and cracks with reveled edges). Remove and replace the cracked pavements layer with an overlay.

3. Potholes :

- Small bowl shaped depressions in the pavement surface that penetrate all the way through the HMA layer down to the base course.
- Potholes are most likely to occur on roads with thin HMA surface (1 to 2 inches) and seldom occur on roads with 4 inch or deeper HMA surfaces.

⇒ Problem:

Roughness (serious vehicular damage can result from driving crawl across potholes at higher speed), moisture infiltration.

⇒ Possible Causes:

Generally, potholes are the end result of fatigue cracking. As fatigue cracking become severe, the interconnected cracks create small chunks of pavement, which can be dislodged as vehicles drive over than.

⇒ Repair:

- Patching techniques.

4. Rutting:

Surface depression in the wheel path, are particularly evident after a rain when they are filled with water.

- ~~Surface~~

⇒ Possible Causes:

- Insufficient compaction of HMA layers during construction.
- Subgrade rutting.
- Improper mix design.

⇒ **Repair :**

- Slight ruts (< 1/3 inch deep) can generally be left untreated. Pavement with deeper ruts should be leveled and overlayed.

5. Bleeding:

⇒ **Problem :**

- Loss of skid resistance when wet.

⇒ **Possible Causes:**

- Excessive asphalt binder in the HMA.
- Excessive application of asphalt binder during BST application.
- Low HMA air void content.

6. Polished Aggregate:

⇒ **Possible Causes:**

Repeated traffic applications. This can occur quicker if the aggregate is susceptible to abrasion.

⇒ **Repair :**

Apply a skid resistance slurry seal, BST or non-structural overlay.

7. Revaling:

Loose debris on the pavement which increases pavement roughness and loss of skid resistance

⇒ Possible Causes:

- Asphalt binder aging.
- Aggregate segregation. If fine particles are missing from the aggregate matrix
- Inadequate compaction during construction.

⇒ Repair :

- Fog Seal / Slurry Seal or Remove the damaged pavement and overlay.