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Section # A

Semster # 6th

Exam # Final Term

Paper # Highway & Traffic Engineering

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Q No1 :- What is the difference between flexible & rigid pavement?

Ans

Flexible Pavements	Rigid Pavements
1) Grain to grain load transfer	1) Slab action takes place
2) Initial cost is low	2) Initial cost is high
3) Joints are not required	3) Joints are required
4) Durability is less	4) Durability is high
5) Good subgrade is required	5) Good subgrade is not required
6) Temperature variation has no any effect on the stress. variation.	6) Temperature variation effects the stress variation.
7) Life span is short ~ 15 years	7) Long life span ~ 30 years.
8) Repair work is easy	8) Repair work is tough.
9) Maintenance cost is high	9) Maintenance cost is low.
10) Requires less curing time	10) Requires much curing time.
11) Poor night visibility due to use of bitumen.	11) Good night visibility.
12) No glare due to sunlight	12) High glare due to sunlight.
13) Thickness is more	13) Thickness is less.
14) IRC 37	14) IRC 58

Q1

Part #b :- What are the advantages of water bound over wet mix macadam?

Ans:-

Advantages of water bound vs wet Mix Macadam:-

The main advantage of wet-mix macadam over water-bound macadam is that it is composed of a well-graded mixture. This ensures good interlock & high stability.

- Addition of water while mixing facilities & handling of the mixture. The operation of lying is much simpler than they of water bound macadam, where the screeenings & binding material is used, there is no possibility of plastic fines entering into the mixture.
- The compaction is greatly facilitated by the moisture added which lubricated the individual Particles.

Q1)
Part c:- What is the difference between asphalt & bitumen?

Ans

Asphalt	Bitumen
1) Asphalt pavements are durable with a layer depth of 25-40mm & life span of 20+ years	Bitumen pavements are less durable; with a layer depth of 10-20 mm lifespan of 5 - 10 years.
2) Surface made of asphalt is smoother & more skid-resistant, ensuring the driver's safety & minimal noise.	The loose fragments on bitumen pavements make the driving experience noiser & can wear down tires consequently causing safety issuses.
3) Reduced friction between tire & car; meaning better fuel economy & minimization of carbon dioxide emission.	Higher frictional resistance of a bitumen pavements means less efficiency in energy utilization.
4) Asphalt is an impermeable material, thus the pavements do not leach. Therefore they have a lesser chance of infiltrating & polluting the groundwater.	Exposure to bitumen leaching may cause deterioration of soil & groundwater quality.
5) Less sensitive to temperature compared to bitumen pavements Negative impacts are seen only in extremely high or low temperature.	Pavements are susceptible to high temperature, which can make it slick and soft.

6) Installation is comparatively costlier.	cheap to install compared to asphalt.
7) Cost effective An asphalt surface doesn't require regular maintenance like bitumen surface, rather a routine check periodically is enough.	They require regular maintenance, especially when resurfacing a pavement with greater traffic volume. So not cost effective in the long run.

Q No 2) A crest vertical curve joining & a -4 percent grade is to be designed for 75 mi/h. if the tangents at station (345 + 60.00) at an elevation of 250 ft. . . . . ?

Ans :- Given:-

For a design speed of 75 mi/h,

K = 312

Solution:-

$$\text{Minimum length} = 312 \times [3 - (-4)]$$
$$= 2184 \text{ ft}$$

$$\text{Station of BVC} = (345 + 60) - \left(\frac{21 + 84}{2}\right)$$
$$= 334 + 68$$

$$\text{Station of EVC} = (334 + 68) + (21 + 84)$$
$$= 356 + 52$$

$$\text{Elevation of BVC} = 250 - \left(0.03 \times \frac{21 + 84}{2}\right)$$
$$= 217.24 \text{ ft.}$$

Stations	Distance from BVC (x)(ft)	Tangent Elevation (ft)	offset $\left[r = \frac{Ax^2}{200}\right]$	
BVC 334 + 68	0	217.24	0.01	217.84
BVC 335 + 00	32	$217.24 + \frac{32}{100} \times 3 = 218.20$	0.02	218.18
BVC 336 + 00	132	221.20	0.28	220.92
BVC 337 + 00	232	224.20	0.86	223.34
BVC 338 + 00	332	227.20	1.77	225.43
BVC 339 + 00	432	230.20	2.99	227.21
BVC 340 + 00	532	233.20	4.54	228.66
BVC 341 + 00	632	236.20	6.40	229.80
BVC 342 + 00	732	239.20	8.59	230.61
BVC 343 + 00	832	242.20	11.09	231.11
BVC 344 + 00	932	245.20	13.92	231.28
BVC 345 + 00	1032	248.20	17.07	231.13
BVC 346 + 00	1132	251.20	20.54	230.66
BVC 347 + 00	1232	254.20	24.32	229.88
BVC 348 + 00	1332	257.20	28.43	228.77
BVC 349 + 00	1432	260.20	32.86	227.34
BVC 350 + 00	1532	263.20	37.61	225.59
BVC 351 + 00	1632	266.20	42.68	223.52
BVC 352 + 00	1732	269.20	48.07	221.13
BVC 353 + 00	1832	272.20	53.79	218.41
BVC 354 + 00	1932	275.20	59.82	215.38
BVC 355 + 00	2032	278.20	66.17	212.03
BVC 356 + 00	2132	281.20	72.84	208.36
EVC 356 + 52	2184	282.76	76.44	206.32

Scanned with CamScanner

Q3) A Flexible highway is to be designed to carry a design Esal of 2x 10^6 - It is estimated that it takes about a week for water to be drained from within the pavement & the pavements structure . . . . ?

Ans:- Draw a line Joining the reliability level of 99 % & the over all Standared divation So of 0.49, & extend line to intersect the first TL at Point A.

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

Step# 3 Draw a line joining point B and resilient modulus (Mr) of base course and extend this line of intersect the design serviceability loss short at point C.

Step# 4 Draw a horizontal line from point C to intersect the design serviceability
→ loss (PSI) curve at point D, so here

$$\Delta PSI = 4.5 - 2.5 = 2$$

Step# 5 The structure number require to protect the base course & to find the thickness D_1 of the surface course is 2.6.

Step 6:-

Determine the appropriate structure layer co-efficient for each construction material

Resilient value of asphalt = 450,000 lb/in^2

therefore a_1 0.44

$$D_1 = SN_1 / a_1$$

$$2.6 / 0.44 = 5.9$$

Thickness should be taken to be nearest 0.5 inches so the thickness of the surface course is 6".

$$SN_1 = D_1 \times a_1$$

$$= 6 \times 0.44 = 2.64$$

Now find SN_2 and D_2 (Base course)

find the value of a_2 from layers coefficient table & m_2 from drainage co-efficient table.

→ Thickness of base course (D_2)

$$D_2 = (SN_2 - SN_1)\ a_2 m_2$$

$$D_2 = (3.8 - 2.64).14 \times 0.80$$

$$D_2 = 10.36''$$

use 12"

So the thickness of base course is 12"

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

$$SN_2 = 1.34 + 2.64$$

$$SN_2 = 3.98$$

→ Finding SN_3 & D_3 (subbase course) and also layer coefficent a_3 & drainage coefficent m_3 from their respective table.

$D_3 (SN_3 - SN_2) / a_3 m_3$

$D_3 (4.4 - 3.98) / 0.10 \times 0.80$

$D_3 = 5.24''$

We will use 6" as a sub base

$SN_3 = 2.64 + \underline{1}.34 + 6' \times 0.10 \times 0.80$

$SN_3 = 4.46 > 4.4$ okay.

Final design:-

Surface Course = 6"

-> Base Course = 12'

-> Sub base = 6"

-> Total Pavement thickness = 24"

Q No 4) What are the different distresses? Explain in detail?

Ans:- **Pavement Distress:-** Distress is a condition of the Pavement structure that reduces serviceability or leads to a reduction in service life.

- Distress could occur in a pavement due to;

-> unstable mixes
-> Higher wheel loads than those considered in design.

Alligator (Fatigue) cracking:-

Possible causes.

-> over loading
-> Inadequate structural design
-> Poor construction.

Repair:- crack sealing is in effective
-> Dig out & replace area of poor subgrade.

Block cracking:-

Problem: Allows moisture infiltration possible causes.

-> HMA shrinkage
-> Asphalt binder aging
-> poor choice of asphalt binder in the mix design.

Repair:-
Low severity crack (< ½ inch wide). crack Seal to parent entry of moisture.
-> High severity cracks (> ½ inch wide and craks with raveled edges). Remore and replace the cracked Parement layer with an overlay.

Potholes:- small bowl shaped depressions in the Parement surface that penetrate all the way through the HMA layers down to the base course.
-> potholes are most likely to accurr on roads with thin HMA surfaces (1 to 2 inches) and seldom occurs on roads with 4 inches or deeper HMA surfaces.

Problem:-
Roughness (serious vehicular damage can be result from driving across potholes at higher speeds. moisture infiltration.

Possible Causes:-
Generally potholes are the end result of fatigue cracking. As fatigue cracking becomes severe, the inter connected cracks create small chunks of parements, which can be dislodged as vehicles drive over them.

Repair:- Patching techniques.

Rutting:- surface depression in the wheel Path are particularly evident after a rain when they are filled with water.

surface depression in the wheel path are Particularly.

Possible Causes:-
Insufficient Compaction of HMA layers during construction.
Subgrade rutting (e.g excessively) high asphalt content, ex excessive mineral filler, insufficient amount of angular aggregate particales)

Repair:-
Slight ruts (< 1/3 inch deep) can generally be left untreated pavement with deeper ruts should be leveled oveload.

Bleeding:-
Problem: loss of skid resistance wet.
Possible causes.
-> Excessive asphalt binder in HMA.
-> Excessive application of asphalt binder during BST application.
-> Low HMA air void content.

Polished Aggregates:-
Possible Causes:- Repeated traffic application this can over occur quicker if the aggregate is susceptible to abrasion.

Repair:- Apply a skid-resistant slurry seal BST or non-structural over lay.

Ravelling:- Lose debris on the pavement which increases Pavements roughness & loss of Skid resistance.

Possible causes:-

Asphalt binder aging.

Aggregate segregation: If fine particles are missing from the aggregate materials.

-> Inadequate compaction during construction.

Repair:- Fog seal / Slurry or Remove the damaged Pavement and overlay.