ID # 6938

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Section - A

Q No! 01

(a) Difference between flexible and rigid pavement ?

Flexible Pavement	Rigid pavement
• Bitumen is used a binder in flexible pavement.	• Cement is used as a binder in a rigid pavement.
• Deformation in the Sub grade is transferred to the upper layer.	• Deformation in the sub grade is not transferred to Subsequent layers.
• Load is transferred by grain to grain contact.	• Rigid pavements have no such phenomenon of grain to grain load transferred exists.
• Flexible pavement have low initial Construction Costs but have high maintance Cost.	• Rigid pavement have low maintance cost but have higher initial Construction cost.

• Have low life span usually 10–15 years.	• Life span is more as compare to flexible usually 30 plus years.
• Surfacing cannot be laid directly on the Sub grade but a base is needed.	• Surfacing can be directly laid on the Sub grade.
• In flexible pavement Strength of road highly dependent on strength of Sub grade.	• Strength of road less dependent on the strength of Sub grade in rigid Pavement.
• Road can be used for traffic with in 24 hours	• Road cannot be used until 14 days of curing.

Q.No! 01 Advantages of Water bound over Inlet mix Part-B :- macadam?

Advantages of W.B.M over M.M.M :

1). The water bound macadam Construction of base Course is less costly Than The wet mix macadam as its specifications do not involes The use of mixing plant and power.

2) Water bound macadam required more time for construction.

3)- wet mix macadam roads are superial The water bound macadam in all aspects but The WBM is The old method of

Construction having low Construction cost because it has been traditionally a labour oriented specifications.

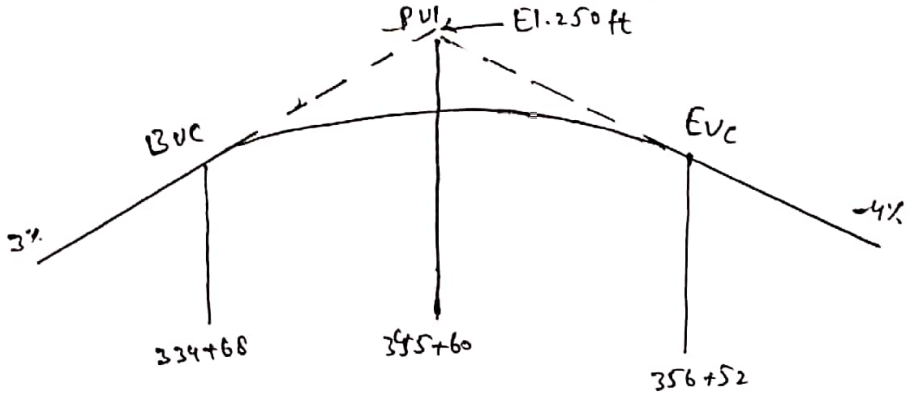
Q No! 01

Part- C Difference b/w asphalt and bitumen.

Asphalt	Bitumen
• Asphalt pavement are durable with a layer depth of 25-40 mm and life span of 20 plus years	• Bitumen pavemant are less durable with a layer depth of 10-20 mm and life span of 5-10 years
• Surface made of asphalt is smoother and more skid-resistant, ensuring the drivers safty and minimal noise	• The loose fragments on Bitumen pavement make the driving experience noisier and can wear down tires. Consequently causing safety issues.

Asphalt	Bitumen
• Reduced friction b/w tire and car; meaning better fuel economy and minimization of carbon dioxide emission	• Higher frictional resistance of Bitumen pavement means less efficiency in energy utilization.
• Installation is comparatively costlier.	• Cheap to install compared to asphalt.
• Cost effective. An asphalt surface doesn't require regular maintaince like bitumen surface, rather a routine check periodically is enough.	• They required regular maintenance especially a pavement with greater traffic volume. So not cost effective in the long run.

Q No/ 02



Solution

for a design speed of 75 mi/h, K = 312

minimum length = $312 \times [3-(-4)] = 2184$ 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 = $250 - \left(0.03 \times \frac{2184}{2}\right) = 217.94$ ft

Station	Distance from BVC (x) (ft)	tangent Elevation (ft)	offset $\left[y = \frac{Ax^2}{200L}\right]$ (ft)	Curve elevation (Tangent elevation − offset) (ft)
BVC 334+68	0	217.24	0.01	217.24
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	228.61
BVC 341+00	632	236.20	6.40	230.61
BVC 342+00	732	239.20	8.59	230.61
BVC 343+00	832	242.20	11.09	231.28
BVC 344+00	932	245.20	13.92	231.13
BVC 345+00	1032	248.20	17.07	230.66
BVC 346+00	1132	251.20	20.54	229.88
BVC 347+00	1232	254.20	24.32	228.77
BVC 348+00	1332	257.20	28.43	227.34
BVC 349+00	1432	260.20	32.86	225.89
BVC 350+00	1532	263.20	37.61	225.59

	.1632	266.20	42.68	223.52
BVC 351+00				
	1732	269.20	48.07	221.13
BVC 352+00				
	1832	272.20	53.76	218.41
BVC 353+00				
	1932	275.20	59.82	215.38
BVC 354+00				
	2032	278.20	66.17	212.03
BVC 355+00				
	2132	281.20	72.84	208.36
BVC 356+00				
	2184	282.76	76.44	206.32
EVC 356+52				

Q NO! 03

Solution :- Step #01

Draw a line joining the reliability level of 99% & the overall standard diviation so of 0.49. and extend line to interseet FL line at point A.

Step #02

Draw a line joint A to the ESAL of 2×10^6 and extend this line to interseet the first FL line at point B.

Step #03

Draw a line joining point B and resilent modulus (Mr) of Sub Couse and extend this line to interseet the dssign Serviceability loss chart at C.

Step # 04.

Draw a horizental 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 #05.

The structure number required to protect the base Course and to find the Thickness D1 of the Surface Course is 2.6

Step #06

Determine the appropriate structure layer Co-efficent for each Construction materal

Resilient value 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 the 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 the layer coefficient Table and 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"

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

$$SN_2 = 1.34 + 2.64$$

$$SN_2 = 3.98$$

Find SN_3 & D_3 (subbase Course) and also layer co-efficint a_3 and drainage Co-efficint m_2 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

$$SN_3 = 2.64 + 1.34 + 6'' \times 0.10 \times 0.80$$

$$SN_3 = 4.46 > 4.4 \quad \text{Okay}$$

Final design.

Surface Course = 6"

Base Course = 12"

Sub base = 6"

Total Pavement Thickness = 24"

Q No: 04 "Different pavement distrees"

Ans:-

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
* High wheel loads than those considered in design.

1. Alligator (Fatigue) Cracking.

* Possible Causes

1- Over loading

2- Inadequate Structure design

3- Poor Construction .

* Repaire

1- Crack Sealing in is effective

2- Dig out and replace area of poor Subgrade.

2. Block Cracking

Problem:

. Allow moisture infiltration

Possible Causes:

1- HMA Shrinkage

2- Asphalt binder aging

3- Poor Choice of asphalt binder in The mix design .

Repair :

low severity (< ½ inch wide). crack seal to Prevent entry of misture.

High Severity (>½ inch wide and crack with ravelled edges).

Remove and replace the cracked pavement layer with an overlay.

3- Potholes :

Small, bowl-shaped depress in the pavement Surface that penetrate all the way through the HMA layer down on base course.

Potholes are most like to occur on road 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 result from driving across potholes at higher speeds), moisture infiltration.

Possible Causes:

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

Repair:

Patching techniques:

4- Rutting:

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

Possible Causes:

- Insufficient Compaction of HMA layer during Construction Subgrade rutting (e.g., as a result of inadequate pavement structure).

Improper mix design (e.g. excessively high asphalt content exeessive mineral filler. insufficient amount of angular aggregate Particles).

Repair: Slight ruts (< 1/3 deep) Can generally

be left untreated. Pavement with deeper ruts should be leveled and overlayed.

5- Bleeding :-

Problem; loss of ~~kind~~ skid resistance when wet.

Possible Cause:

1- Excessive asphalt binder in the HMA

2- Excessive application of asphalt binder during 1st application.

3- 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-resistant slurry seal, BBT or non-structural overlay.

7- Raveling :-

* loose debris on the pavement which increase pavement roughness and loss skid resistance

Possible Causes :

* Asphalt binder aging
* Aggregate segragation. If fine particles are missing from the aggregates matrix.
* Inadequate compaction during construction.

Repair :

Fog Seal / Surry Seal or Remove the damaged Pavement and overlay.

The End of Paper.