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Section A

Semester 6th

Subject:- Highway & Traffic Engr.

Flexible Pavement	Rigid Pavement
1. It consists of a series of layers with highest quality material at or near surface of pavement.	It consist of one layer Portland cement concrete slab or relatively high flexural strength.
2. Temperature variation due to change in atmospheric condition ~~due~~ do not produce stresses in flexible pavement.	Temperature changes induce heavy stresses in rigid pavement.
3. Flexible pavement have self healing properties due to heavier loads are recoverable due to some extent.	Any excessive deformation occuring due to heavier wheels loads are not recoverable.
4. Damaged by oils and Chemicals	No damage by oils and chemicals.
5. Maintenance cost is high.	Less maintenance cost.
6. Design life 10-15 years	Design life 20-30 years.
7. Initial cost of construction is low.	Initial cost of construction is high.
8. Load is transferred by grain to grain contact.	No such phenomena of grain to grain load transfer exists

Q1 (B):-

Advantages of WBM over WMM:-

1. The water bound macadam constuction of base course is less costly than wet mix macadam as its specification do not involve use of mixing plant & Power.

2. Water bound macadam is more time consuming.

3. Wet mix macadam roads are superior than water bound macadam in all aspects. WBM is old method. of constuction having low constuction cost because it has been traditionally a labour oriented specification.

Q1 (c)

Asphalt	Bitumen
1. Asphalt is a sticky black viscous liquid or semi solid obtained from petroleum	A black viscous mixture of hydrocarbons obtained naturally or residue from petroleum distillation.
2. Surface made of asphalt is smoother and more skid resistant ensuring driver safety and minimal noise.	The loose fragment on bitumen pavement make driving experience noiser and can wear down tires.
3. Reduced friction between tire and road meaning better fuel economy.	Higher frictional resistance means less efficiency in energy utilization.
4. Installation is comparatively costlier.	Cheap to install.
5. An asphalt surface does not require regular maintenance like bitumen surface.	They require regular maintenance.
6. Less sensitive to temperature. Negative impact are seen only in extremely high or low temperature.	Pavements are susceptible to high temperature, which make it stick and soft

Sol:-

For a design speed of 75min/h, k = 312
From table 15.5

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

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 ft.

Station	Distance from BVC	Tangent Elevation (ft)	Offset $[Y = \frac{A x^2}{200L}]$ (ft)	Curve Elevation (ft)
BVC 334 + 68	0	217.24	0.01	217.24
BVC 335 + 00	32	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	28.84	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

Step 1 :-

Draw a line joining the reliability level of 99% and overall standard deviation So of 0·49 and extend this line to intersect the first TL Line at point A.

Step 2:-

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

Step 3:-

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

Step 4:-

Draw horizontal line from point C to intersect design serviceability
> loss (PSI) curve at point D. In this problem

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

Step 5:- The structure number require to protect the base course and to find thickness D_1 of surface course is 2·6

Step 6 :-

Determine the appropiate structure layer co-efficient for each constuction material
Resilent value of asphalt = 450,000 lb/in³.
therefore a_1 0·44

$D_1 = SN_1 / a_1$

$2.6/0.44 = 5.9''$

Thickness should be taken to nearest 0.5".
So thickness of surface course is 6".

$SN_1 = D_1 \times a_1$

$SN_1 = 6 \times 0.44$

$= 2.64$.

Now find SN_2 and D_2 (Base course)
Find value of a_2 from layer co-efficient table and m_2 from drainage co-efficient table.

Thickness of base course (D_2)

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

$= (38 - 2.64)\, 14 \times 0.80$

$= 10.36"$

Use 12"

So thickness of base course is 12"

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

$= 1.34 + 2.64$

$= 3.98$

Finding SN_3 & D_3 and also layer co-efficient a_3 and drainage co-efficient a_3 from their respective table

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

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

$= 5.24"$

We will use 6" as a sub base

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

$= 4.46 > 4.4$ ok!

Final design

Surface course = 6"
Base course = 12"
Sub base = 6"

Total Pavement thickness = 24"

Pavement Distresses:-

Distress is a condition of pavement structure that reduces seviceability or lead to a reduction in service life.

Distress occurs in pavement due to

- Unstable mixes
- Higher wheels loads than those considered in design.

Different Pavement Distress:-

Alligator Cracking:-

Crocodile cracking is a common type of distress in asphalt pavement

Causes:-

Over loading
Indequate Structural design
Poor constuction.

Repair:-

Crack sealing is an effective
Dig out and replace area of poor subgrade.

Block Cracking:-

Block cracking are interconnected cracks that divide the pavement into approximately rectangular pieces. The block may range in size from approximately 1 by 1ft.

Causes:-

Poor choice of asphalt binder in mix design
HMA shrinkage.

Repair:-

Low severity cracks. Crack seal to prevent entry of moisture.

High severity cracks (> 1/2 inch wide and cracks with raveled edges)

Remove and replace the cracked pavement layer with an Overlay.

Rutting:-

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

Causes:-

Insufficient compaction of HMA layer.

Improper, mix design.

Repair:-

Slight ruts (< 1/3 inch deep) can gradually be left untreated.

Pavement with deeper should be leveled & overlayed.

Bleeding:-

Bleeding is shiny, black surface film of asphalt on road surface caused by upward movement of asphalt in pavement surface.

Causes:-

Excessive asphalt binder in HMA.

Low HMA air void content.

Polished aggregate:-

Polished aggregate is present when close examination of a pavement reveals the portion of aggregate extending above asphalt is very small.

Causes:-

Repeated traffic application.

Repair:-

Apply skid resistant slurry seal.

Raveling:-

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

Causes

Asphalt binder aging.

Aggregate segregation.

Repair:-

Remove damaged pavement & overlay.

Potholes:-

Bowl shaped depression in pavement surface.

Causes

Caused by fatique Cracking

Repair

Patching techniques