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Section A

Subject H. Transportation Engineering II

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Civil Engineering Department

Ans (a) 1

	Flexible Pavement	Rigid Pavement
1)	In flexible pavement Bitumen is used as a binder	1) In Rigid Pavement Cement is Used as a binder
2)	Load is transferred by grain to grain contact	2) No grain to grain load transfer exist
3)	life Span is about 10-15 years	3) life span is about more then 30 years.
4)	Its initial Cost is low but maintance Cost is high	4) Its initial Cost is high but maintance Cost is low
5)	Road Can be Used for traffic within 24 hours	5) Road Cannot be Used Untill 14 days of Curing.
6)	Deformation in Sub-grades is transferred to the upper layer	6) Deformation in the Sub grades is not transferred to Subsequents layers.

b) Advantages of Water bound over wet min Macadam.

1) The Construction Cost of WBM road is Comparatively low

2) Water Bound Macadam is Superior in quality because the material are Carefully graded & resulting mass is almost void less Compacted mass

3) In the Construction of WBM road no skilled labours are required

4) They are Constructed from locally available material

5) If the WBM roads are maintained properly & from time to time it Can resist load of traffic of about 900 tonnes per lane per day.

6) The Interlocking of Aggregate Particles imparts adequate strength of the material selected for filling the voids. These ensure non-entry of the plastic material of the sub grade into the voids.

c) **Bitumen:-**

Bitumen is a binder agent produced from Petroleum. Bitumen is known for being strongly adhesion & resistant to damage from water & oil spills. Bitumen is actually the liquid binder that holds asphalt togather.

A Bitumen - sealed Roads has a layer of bitumen sprayed & then Covered with an aggregate. This is then repeated to give a two Coat Seal.

Asphalt:-

Asphalt is produced in a plant that heats, dries & mixes Aggregate, bitumen & Sand into a Composite mix.

It is then applied through a paving machine on site as a solid material

at a nominated or required thickness, relative to the end use.

Asphalt result in a smoother & more durable asphalt road surface then a bitumen - sealed road.

Asphalt is commonly used as a surface for roads, car parks & driveways.

In American technology both Asphalt & Bitumen are same & are ASPHALT.

Any (2)

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 $= 250 - \left(0.03 \times \frac{2184}{2}\right) = 217.24$ ft

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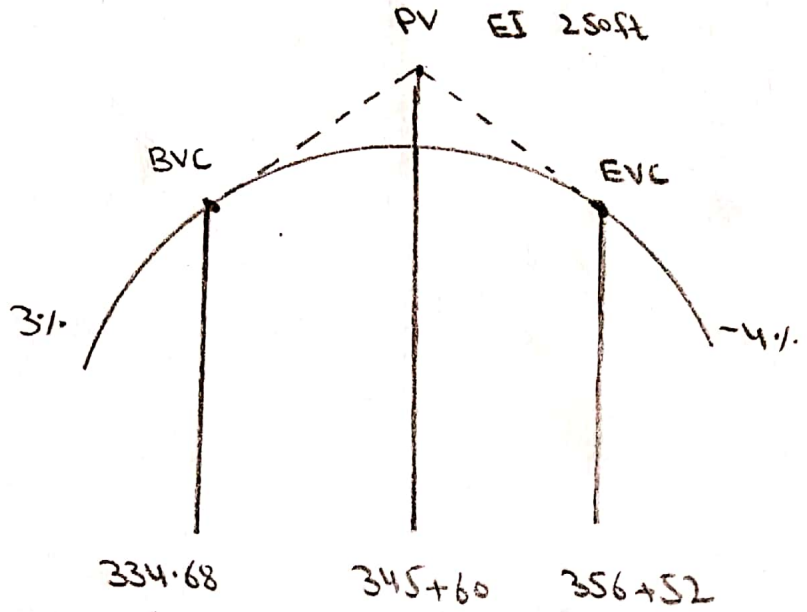
Station	Distance from BVC (m)(ft)	Tangent Elevation (ft)	offset $\left[r = \frac{Ax^2}{200L}\right]$ (ft)	Curve Elevation (ft) Tangent Elevation − offset
1. BVC 334+68	0	217.24	0.00	217.24
BVC 335+00	32	$217.24 + \frac{32}{100} \times 3 - 218.20$	0.02	218.18
BVC 336 +00	132	221.20	0.28	220.92
BVC 337 +00	232	224.20	0.86	223.34
BVC 338 +00	332	227.20	0.177	225.43
BVC 339 +00	432	230.20	2.99	227.21
BVC 340 +00	532	233.20	4.54	228.86
BVC 341 +00	632	236.20	8.59	229.80
BVC 342 +00	732	239.20	6.40	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	268.20	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	66.72	212.03
BVC 356 +00	2132	281.20	72.84	208.36
EVC 356 +52	2184	282.76	76.44	206.32



Ans (3)

Given Data:-

Resilient Modolus at 68°F 45000 lb/in²

CBR Value of base Coarse material 100 MR 31000 lb/in²

CBR Value of Subbase Coarse material 22 MR 13500 lb/in²

CBR Value of Subgrade material 6

MR of subgrade 6 × 1500 lb/in² = 9000 lb/in²

Moisture Content = 30%.

Solution:-

Reliability level (R) = 99%.

Standard deviation (S_o) = 0.49

intial Servicability index P_i = 4.5

Terminal Serviceability index P_t = 2.5

$\Delta PSI = 4.5 - 2.5 = 2.0$

Step#1

Finding SN_1 & D_1 (surface Coarse)

Draw the line Joining the reliability level of 99% & over all standard deviation S_o of 0.49.

Step #2

Draw a line joining Point A to the ESAL of 2×10^6

Step#3

Draw a line joining point B & resilient modulus (M_r) of base Coarse & extend this line

Step#4

Draw a horizental line from point C to Intersect design Servicability.

→ Loss (PSI) Curve at point D

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

→ D_1 of Surface Coarse is 2.6

Step#5

Finding SN_1 & D_1 (surface Coarse)

So the structure number required to protect the base Coarse & to find the thickness D_1 of the Surface Coarse is 2.6

Step#6

As the Percentage of time pavement structure exposed to moisture level approaching Saturation is 30% (ie. greater then 2.5.1)

So

Drainage Co-efficient $m_2 = 0.8$

From Chart

layer Co-efficient $a_2 = 0.14$

Thickness of Surface Coarse D_1

$$D_1 = SN_1 / a_1$$

$$2.6 / 0.44$$

$$= 5.9''$$

Thickness should be taken to the nearest 0.5"

So thickness of Surface Coarse is 6".

$$SN_1^* = D_1'' \times a_1$$

$$SN_1^* \quad 6 \times 0.44 = 2.64$$

Finding SN_2 & D_2 (Base Coarse)

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

$$= 3.8 - 2.64 / 0.14 \times 80$$

$$D_2 = 10.36''$$

Use 12"

So thickness of base Coarse 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 (Sub base Course)

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

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

$$D_3 = 5.25''$$

We will use 6" as a Sub base

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

$SN_3 = 4.467 \approx 4.4$ Okey.

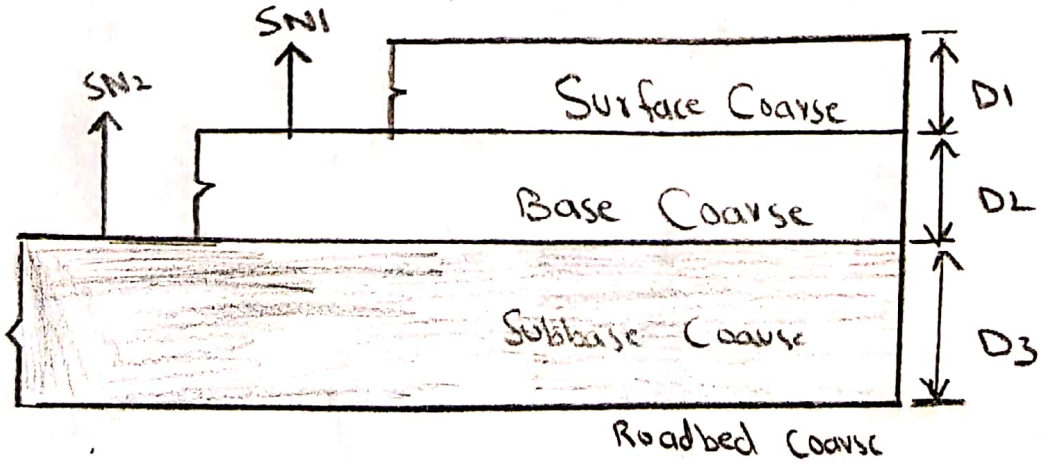
Final Design

Surface Coarse = 6"

Base Coarse = 12"

Subbase = 6"

Total Pavement thickness = 24"



Ans # 4

Following are the different types of Road or Pavement distresses.

1) Alligator Cracking:-

⇒ It is also known as map cracking or fatigue failure.

⇒ It is also similar as alligator skin so thats why it is called alligator cracking.

Reasons of Alligator Cracking:-

The main reasons are

(i) over loading
(ii) Poor Construction
(iii) Inadequate structural Design.

Method of Repairing:-

- Crack Sealing is effective
- Dig out & replace area of poor Subgrade.

2) Block Cracking:-

⇒ Block Cracking looks like large interconnected rectangulars (Roughly)

⇒ Causes of Block Cracking:-

- HMA Shrinkage
- Asphalt binder Aging
- Poor choice of Asphalt binder in mix design

Method of Repairing:-

- Low Severity Crakes < half Inch wide, Crack Seal to prevent entry of moistore
- High Severity Crakes ⩾ half Inch wide, Remove & Replace the crakeed pavement layer with an overlay.

3) Rutting

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

Reasons of Rutting:-

- Insufficient Compaction of HMA layer during construction.
- Sub grade Rutting
- Improper Mix design.

Method of Repairing:-

Slight ruts (< 1/3" deep) can generally be left untreated. Pavement with deeper ruts should be leveled & over layed.

4) Bleeding:-

Bleeding or flushing is shiny, black surface film of asphalt on the road surface caused by ~~upper~~ upward movement of Asphalt in pavement surface.

Causes of Bleeding:-

- Excessive asphalt binder in the HMA
- Low HMA air void Content.

5) Polished Aggregate

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

Method of Repairing:-

Apply a skin resistance slurry seal. BST or non structural overlay.

6) Potholes:-

Small bowl shaped depression in the pavement surface that penetrate all the way through the HMA layer down to the base coarse.

Causes:-

Generally Potholes are the end result of fatigue cracking.

Method of Repairing:-

- Patching techniques.

7) Longitudinal Cracking:

It occur parrell to the centre line of the pavement

Causes:

- Poor Constructed joints
- Shrinkage of Asphalt layer
- Cracks reflecting from Underlying layer

8) Transverse Cracking:

It is an Unconnected cracks that run across a road pavement, perpendicular to direction of road

Causes

- Shrinkage of Asphalt layer
- reflection from an existing crack

This is not load related.