## Question No # 1

### Part No# (A)

what is difference between flexible pavement and rigid pavement.

**Answer :.**

| Flexible Pavement | Rigid Pavement. |
|---|---|
| Bitumen is used as a binder in flexible pavement | Cement is used as a binder in rigid pavement. |
| Load is transferred by grain to grain Contact | No such phenomenon of grain to grain transferred load. |

| flexible Pavement | Rigid Pavement. |
| --- | --- |
| Design is based on load distributing Charactheristics of the Components layer | Design is based on flexural strenght or slab action. |
| Have low flexural strenght | Have high flexural strenght |
| Low initial Construction cost but have high maintenace cost | Low maintenace cost but have high initial construction cost. |
| Damaged by oils and certain chemicals | No damaged by oils and other chemicals. |

## Question No #1

## Part No # (B)

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

**Answer:-**

**Advantage of W.B.M over W.M.M:-**

→ The water bound macadam Construction of base is less costly than the wet mix macadam as its specifications do not involve the use of mixing plant and paver

→ water bound macadam requires more time for Construction.

→ wet mix macadams roads are superior the water bound macadam inall aspects but the WBM is the old method of Construction having low construction cost because it has been traditionally a labour oriented specification.

## Question No# 1

### Part (C)

What is the difference between Asphalt and Bitumen.

**Answer**

| Property | Asphalt | Bitumen. |
|---|---|---|
| Colour | Blackish brown | Dark with slight reddish tinge |
| Carbon content | Low | Moderate |
| State | Solid or Semi Solid | Solid |
| Effect on heating | Burn with a smoke flame and become plastic | Melts. |

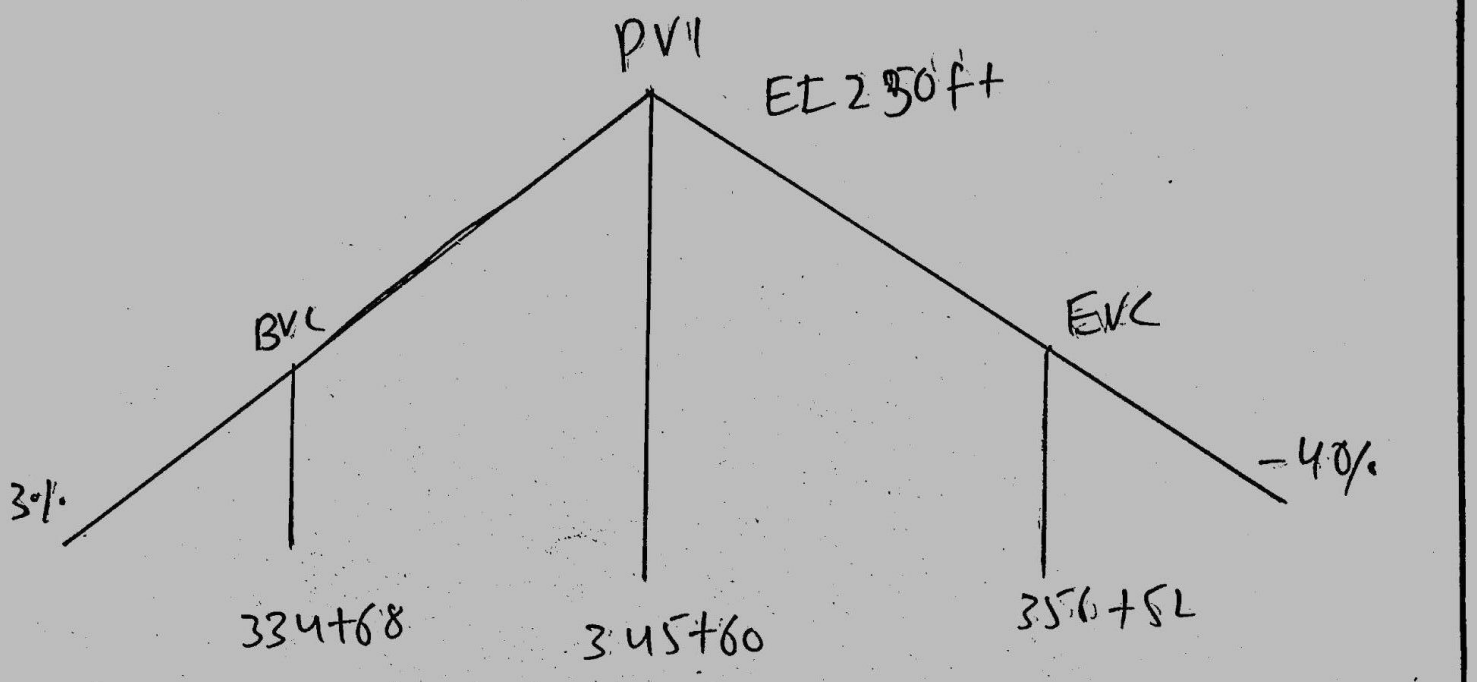
| Property | Asphalt | Bitumen |
|---|---|---|
| Setting time | Less | Less |
| Adhesive Power | Less | More |
| Resistance to acid | Less | More |
| Use | As damp proof course, ~~for~~ Paints as roofing felt and for road works. | As damp proof course and as roofing felt |

## Question No#2

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

P.T.O

(8)




Answer

For design of speed of 75mi/h,

K = 312

Minimum lenght = $312 \times [3 - (-4)] = 2184$ 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 = $250 - \left(0.03 \times \frac{218}{2}\right) = 217.4$ ft.

(8)

| Station | Distance from BVC (x) ft | Tangent elevation (ft) | offset $\left[r = \frac{Ax^2}{200L}\right]$ ft | Curve elevation (Tangent elevation − offset) ft |
|---|---|---|---|---|
| BVC 334+68 | 0 | 217.24 | 0.01 | 217.24 |
| BVC 335+00 | 32 | $217 + \frac{32}{100} \times 3 = 218.10$ | 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 | 66.84 | 212.03 |
| BVC 356+00 | 2132 | 281.20 | 72.84 | 208.36 |
| EVC 356+52 | 2184 | 282.76 | 76.44 | 206.32 |

(10)

## Question No# 3

A flexible highway is to be ~~to~~ designed to carry a design ESAL of $2 \times 10^6$. It is estimated that ~~its~~ it takes about a week for water to drained from within the pavement and the pavement structure will be exposed to moisture levels approaching saturation of 30% of the time. The following additional information is available.

→ Resilient modolus of asphat Concrete at 68°F 459000 lb/in²

(10)

→ CBR value of base course material 100, Mr 31,000 lb/in²

→ CBR value of subase course material 22, Mr 13,500 lb/in²

→ CBR value of subgrad material 6

→ Mr of subgrade 6 x 1500 lb/in²
= 9000 lb/in²

P.T.O

**Answer:-**

Reliability level (R) = 99%

standard deviation ($S_o$) = 0.49

Initial serviceability index $P_i$ = 4.5

Termined serviceability index $P_t$ = 25

$\Delta PSI$ = 4.5 - 2.5 = 20

Finding $SN_1$ and $D_1$ (surface course)

STEP No# 1

Draw the line joining the reliability level of 99% and the over all standard deviation so of 0.49.

## Step No# 2

Draw a line Joining ~~to~~ Point A to the ESAL of $2 \times 10^6$

## Step No# 3

Draw a line Joining Point B and resilind modouls (Mr) of Base Course and extent This line

## Step No# 4

Draw a horizontal line from the point c to intersect the design servicability.

→ Loss (PSI) curve at point D

$\Delta PSI = 45 - 25 = 2$

→ $D_1$ of surface course is 2.6

## Step No#6

Resilind value of Asphalt

= 450,000 lb/in²

Therfore a, 0.44

## Thickness of Surface Course A.

$D_1 = SN_1/a_1$

$= 2.6/0.44$

$= 5.91$

Thickness should be taken to the nearest 0.5"

So thickness of surface is 6"

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

$$SN_1' = 6 \times 0.44 = 2.64$$

## Finding $SN_2$ and $D_2$ (Base course)

$$D_2 = (SN_2 - SN_1') / a_2 m_2$$

$$D_2 = (3.8 - 2.64) / 0.14 \times 0.80$$

$$D_2 = 10.36"$$

Use 12"

So thickness of base is 12"

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

$$SN_2^* = 1.34 + 2.64$$

$$SN_2^* = 3.98$$

## Finding $SN_3$ and $D_3$ (sub base course)

$$D_3 = (SN_3 - SN_2^*)'$$

$$D_3 = 4.4 - 3.98 / 0.10 * 0.80$$

$$D_3 = 5.25''$$

we will use 6" as a sub base

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

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

## Final Design :-

Surface Course = 6"

Base Course = 12"

Subbase = 6"

Total pavement thickness = 24"

## Question No # 4

What are the different Pavement distresses? Explain in details?

**Answer::**

### Pavement Distvesses:-

It is defined as the indication on a performance of unfavourable pavement (unsatisfactory performance of the pavement) and it show the sign of upcomming failure. It is the irregularity of the ~~toad~~ road surface which it affects the user comfort and safety

## Rutting :.

Surface depression in the wheel path are particularly exicient after a rain whey they are filled with water. Rutting is cause due to in sufficient compaction of HMA layer during compaction or improper mixing. It can be repair by slight ruts.

## Bleeding :.

Possible causes are excessive asphalt binder in the HMA.

→ Excessive application of asphalt

binder during (20) BST application.

→ Low HMA air void content.

## Potholes:.

Small bowl shape depression in the pavement surface that penetrate down to the base

Generally potholes are the end result of the fatigue cracking A fatigue cracking become serve, the ~~inter mediate~~ inter connected cracks create small chunks of pavement which can be dislogded as vechile drive over them. (20)

# Polished Aggregate.

Possible Cause of are repeated traffic application this can occure if the aggregate is susceptiable to abrasion.

It can be repair by applying a skid resistance slurry st seal BST or nor structure over lay.

## Block Cracking:-

Block cracking is a series of large rectangular cracks on asphalt pavement surface. This type of cracking typically covers large areas and may occure in areas where there is no traffic. Block cracking is typically caused by shrinkage of the asphalt Pavement due to temperature cycles.

⇒ Distresses could occure in Pavement due to

⇒ Unstable mixes
⇒ Higher wheel load than those considered in design.

## Alligator (Fatigue) Cracking

⇒ It is a type of pavement distress and can cause due to over-loading, inadequate structural design and poor construction.

⇒ It can be repair by sealing the crack or by dig out and replace area of poor subgrade.

## Longitudinal cracking :-

longitudinal cracks occure Parallel to the centre line of the pavement. They can be caused by Poorly Constructed Joints, Shrinkage of the asphalt layer, cracks. Reflecting up from an underlying layer and longitudinal segregation due to improper paver operation. These cracks are not load related.

## Transverse Cracking:-

These cracks are roughly perpendicular to the centre line of the pavement.

These cracks may be caused due to the expansion and contraction of pavement materials, roadbed settlement, poorly constructed paving joints.