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Section	B
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Q1. Part (a)

What is the difference b/w Flexible and Right Pavement

Answer:.

	Flexible Pavement	Rigid Pavement
1.	Bitumen is used as binder in Pavement.	• Cement is used as a binder in rigid Pavements.
2.	Have low life span usually 10-15 years	• Life span is more as compare to flexible usually 30+ years.
3.	Road can be used for traffic with in 24 hours	• Roads cannot be used until 14 days of curing.
4.	Deformation in the sub-grade is transferred to the upper layers	• Deformation in sub grade is not transferred to subsequent layers.
5.	Flexible Pavements have low Initial construction costs but have high maintenance cost	• Rigid Pavements have low maintenance cost but have high initial construction costs.

Q1 Part (b)

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

Answer:1. 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 and high stability.

2. Addition of water while mixing facilitates the handling of the mixture. The operation of laying is much simpler than that of water-bound macadam. where the screenings and binding material have to be added in stages and forced into voids. If a crusher-run material ~~have~~ is used, there is no possibility of Plastic fines entering into the mixture.

3. The compaction is greatly facilitated by the moisture added which lubricates the individual Particles.

4. One disadvantage of the wet-mix macadam is that it is slightly costlier than water-bound macadam. This is because the specification involves the use of mixing plant and Paver. On the other hand, water-bound macadam has been traditionally a labour-oriented specification.

5. The aggregates for wet macadam will have to be crusher-run whereas the aggregates for water-bound macadam are generally hand-broken.

Q:1

Part (c)

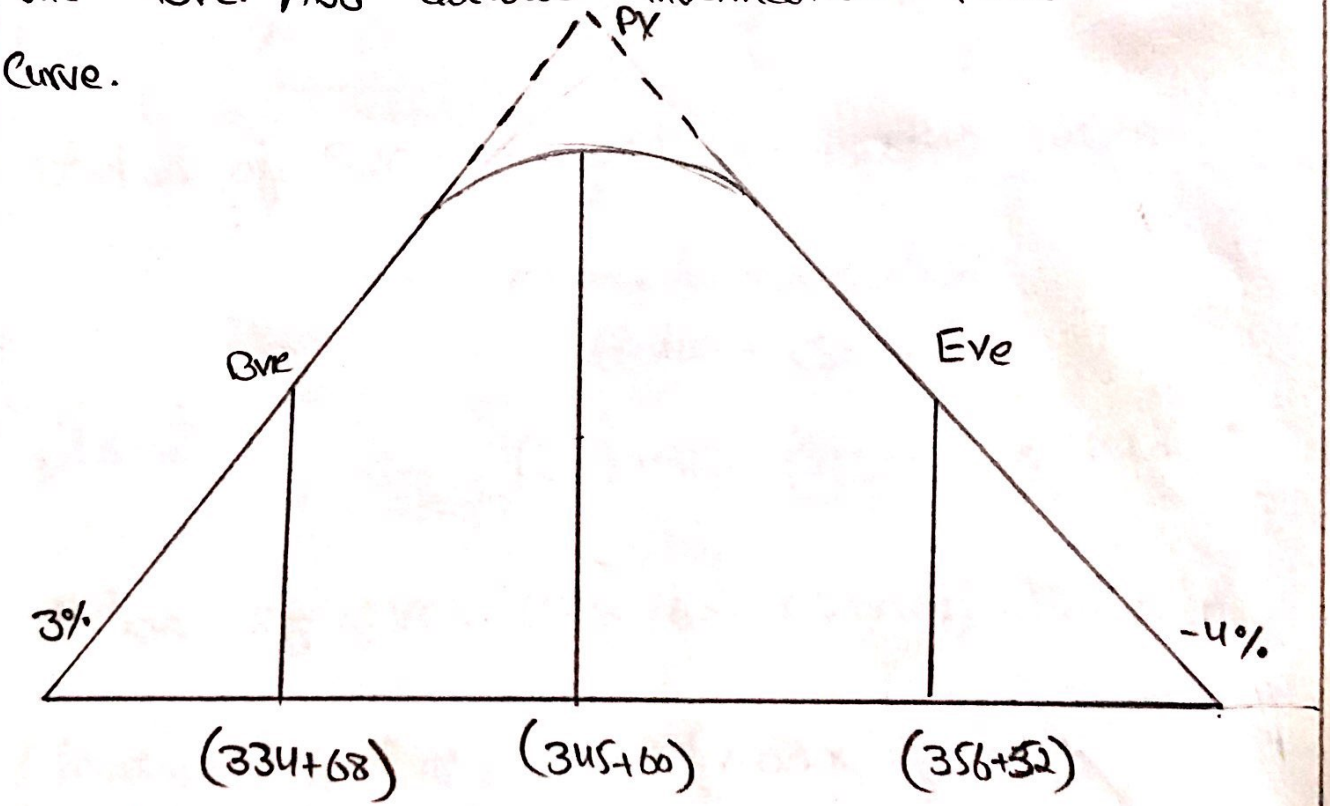
Answer:

What is the difference between Asphalt and Bitumen?

	Bitumen	Asphalt
1-	A class of black or dark colored (Solid, Semi Solid or Viscous) Cementitious Substance natural or manufactured, Composed of high molecular weight	A dark Brown to black Cementitious material in which Predominating Constituent are bitumen which occur in nature or obtained by frictional distillation.
	In American Terminology both asphalt and Bitumen are same.	
2.	In some literature Bitumen is actually the liquid binder that hold asphalt together.	• Asphalt is generally used as term refer to the Combination and gravel specifically for road Construction.

Question No # 02.

A crest vertical curve joining +3 Percent and a-4 Percent grade is to be design for 75 mi/h. If the tangent (345+60.00) at an elevation 250 ft. Determine the station and elevation of the BVC. Also calculate intermediate Point on Curve.



Solution:

For design speed of 75 mil/h

value of K from table

$K = 312$

Minimum Length:

$Kx(3-(-4)$ $\quad \therefore K = 312$

$= 312 \times (3-(-4))$

$= 2184\,ft$

Station of BVC = Tangent intersection station $-\left(\frac{21+84}{2}\right)$

$\therefore$ tangent intersection station = $(345+60)$

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

$= 217.24\,ft$

Question No: 03

Answer:
Flexible Pavement Design.

Reliability level CR = 99%

Standard deviation S_o = 0.49

Initial Serviceability Index, P_i = 4.5

Terminal Servicability Index, P_t = 2.5

$\Delta PSI = 4.5 - 2.5 = 2.0$.

Step 1.

Draw a line joining the reliability of 99% and the overall standard deviation S_o of 0.49, and extend this line to intersect the first T_L at Point A.

Find value of SN_1 and D_1:

Step 2:

Draw a line joining Point A to the ESAL 2×10^6, and the this line to intersect the second T_L line at Point B.

Step: 3

Draw a line joining Point B and resilient modulus (M_r) of base course and extend this line to intersect the design serviceability loss chart at Point C.

Step: 4

- Draw a horizontal line from Point C to intersect the design serviceability loss (PSI) curve at Point D.

$$\Delta PSi = P_i - P_t = 4.5 - 2.5 = 2.0$$

Step: 5

So the structure number required to Protect the base course and to find the thickness of surface course is.

2.6

Step: 06

Determine the appropriate structure layer Co-efficient for each construction material.

Resilient value of asphalt = **450,000 lb/in2**

therefore $a_1 = 0.44$

Thickness of Surface Coarse D_1:

$$D_1 = SN_1 / a_1$$

$\therefore SN_1 = 2.6$

$a_1 = 0.44$

$$= \frac{2.6}{0.4}$$

$$= 5.9''$$

Thickness should be taken to the nearest 0.5inch

So, Thickness of Surface Coarse is 6"

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

$$= 6 \times 0.44$$

$$SN_1 = 2.64$$

Finding SN_2 and D_2 (Base Course).

$D_2 = (SN_2 - SN_1 / a^2 m^2)$

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

$D_2 = 10.36''$

$\therefore SN_2$ from table $= 3.8$

$\therefore a_2 = 0.14$

$\therefore m_2 = 0.80.$

Use 12"

So thickness of base Course 12"

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

$SN_2 = 1.34 + 2.64$

$= 3.98$

Finding SN_3 and D_3.

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

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

$D_3 = 5.25''$

$\therefore SN_3 = 4.4$

$\therefore a_3 = 0.10$

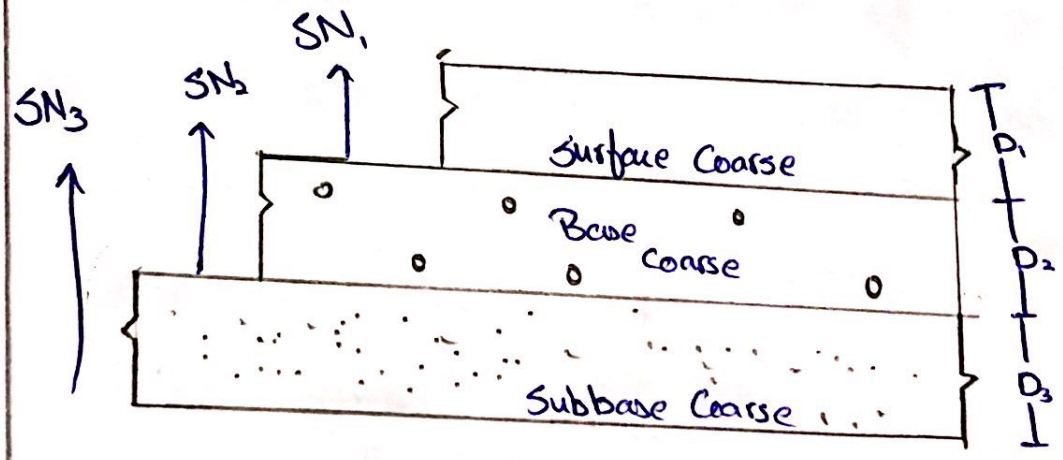
$\therefore m_3 = 0.80$

We will use 6" as sub base

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

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

Final Design



Question No: 04

Question: What are different Pavement distress? Explain in detail.

Answer

Pavement Distress:

Distress is a condition of the Pavement structure that reduces serviceability or lead to reduction in services life.

Distress in Pave occur due to

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

Alligator Cracking:

Cause:

- Over loading
- Inadequate structure.

Repair:

- Crack sealing is in effective.
- Dig out and replace poor area.

Block Cracking:

Problem: Allow moisture infiltration

Possible Cause:

- HMA shrinkage
- Asphalt Binder aging.

Repair:

Low severity crack (<½ inch wide). crack seal to Prevent entry of moisture. high severity crack (> ½ inch wide) and crack with revealed edges. Remove and replace the cracked Pavement layer with an overlay.

Potholes:

Small bowlshaped depression in the Pavement surface that Penetrates all the way through HMA. layer down to the base course.

- Potholes are most likely to occur on road with the HMA surface (1 to 2 inch) and seldom occur on road with 4inch or deeper HMA surface.

Repair

Patching Techniques.

Rutting

→ Surface depression in the wheel Path, are Particularly evident after a rain when they are filled with water.

Possible Cause:

- In sufficient Compaction of HMA layer during Consdruction.
- Improper mix design (eg as a result inadequate Pavement sdructure.
- Subgrade rutting (as a result of inadequate Pavement structure).

Repair:

Slight ruts (< 1/3 inch deep) can generally be left unbreated.

Bleeding:-

Problem:

→ Loss of skid resistance when wet

Possible Cause:

- Excessive asphalt blinder in the HMA.
- Low HMA air void.

Rave ling:

Loose debris on the Pavement which increase Pavement roughnes and loss of skid resistance.

Possible Cause

Asphalt binder aging.
In adquate compaction during Construction.

Repair:

Fog seal/ slurry seal or Remove the damaged Pavement overlay.