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Sec :- "B"

Semister :- 6th

Subject :- Highway And Traffic Engineering

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Question No # 01 Part (A)

What is the difference b/w Flexible and rigid Pavement

Answer # No 1

	Flexible Pavement	Rigid Pavement.
1)	Bitumen is used a binder in Flexible Pavement.	+ Cement is used as a binder in rigid Pavements.
2)	Deformation in the sub grade is transfered to the upper layers.	+ Deformation in the sub grade is not transfered to subsequent layer.
3)	Load is transferred by grain to grain contact	+ No such Phenomenon of grain to grain load transfer exist.
4)	Flexible Pavements have low intial construction costs but have high maintainance cost.	+ Rigid Pavement have low maintainance cost but have intial construction costs.
5)	Have low life span usually 10-15 year	+ life span is more as compare to flexible usually 30 + year.
6)	Surface cannot be laid directly on the sub grade but a sub base is needed.	+ surface can be directly laid on the sub grade.

Q No 1 (2)

(b)

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

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.

Addition of water while mixing facilities 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.

The campaction is greatly facilitated by the moisture added which lubricate the individual particles.

Q No 1 "C"

What is the difference between asphalt and bitumen?

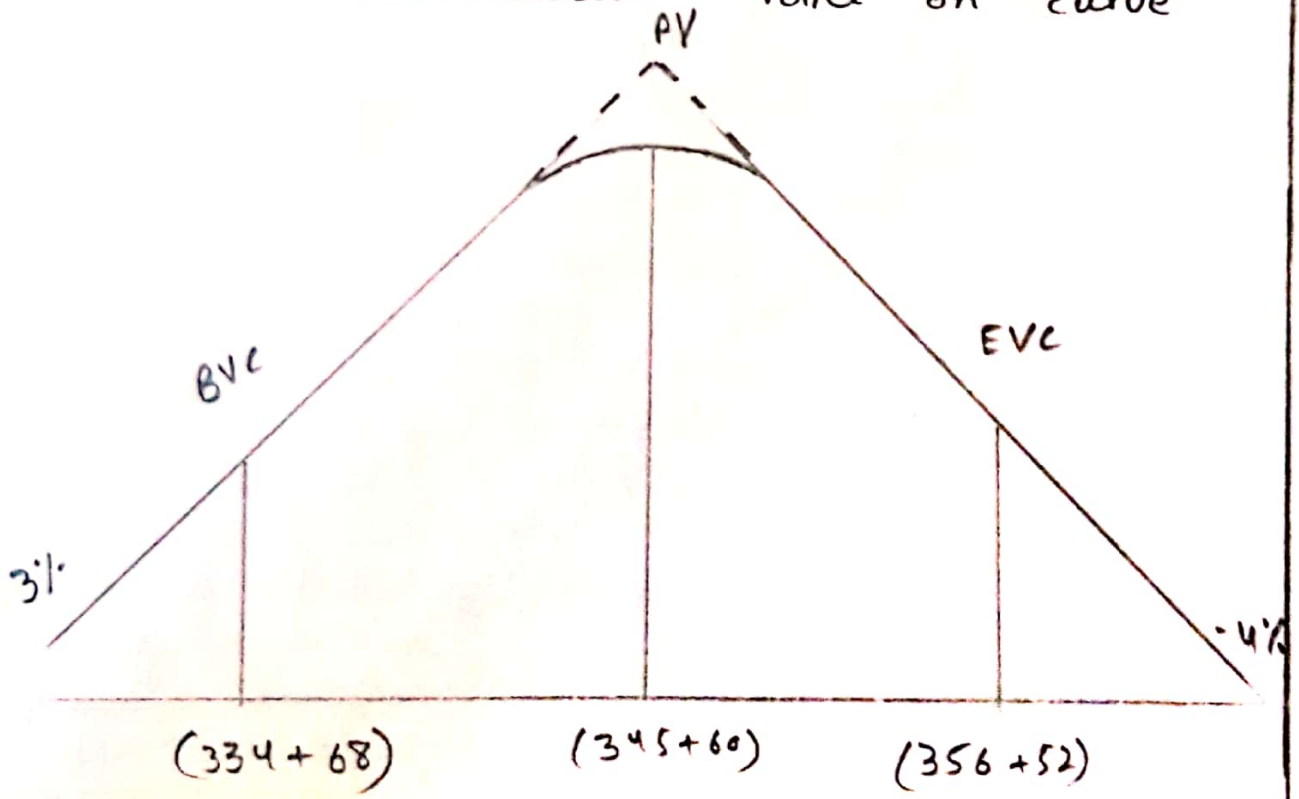
Answer :-

Difference between Asphalt and Bitumen.

Bitumen	Asphalt :
1) A class of black or dark - colored (solid, semi-solid, or viscouse) cementitous substances, natural or manufa- ctured. composed of highly molecular weight.	1) A dark brown to black cementitious material in which the predominating constituents are bitumen which occurs in nature or obtained by frictional distillation.
2) In some literature Bitumen is actually the liquid binder that hold asphalt together	3) Asphalt is generally used as term refer to the combination and graved 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 mi/h

value of k from table

$K = 312$

(5)

Minimum Length:

$K \times (3-(-4))$

$\because K = 312$

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

$= 2184$ ft

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

$= (345+60)$

station of BVC $= (345+60) - \frac{21+84}{2} = 334+68$

Station of EVC $= (334+68)+(21+84) = 356+52$

Elevation of BVC $= 250 - (0.03 \times \frac{2184}{2})$

$= 217.24$ ft

Question No : 03

A Flexible highway is to be designed to carry a design ESAL of 2×10^6. It is estimated that it takes about a week for water to be drained from with in the Pavement and the Pavement structure will be exposed to moisture levels approaching saturation for 30% of the time. The following additional information is available :

→ Resident modulus of asphalt concrete at 68°F 450,000 lb/in^2.

→ CBR value of base course material 100, Mr 31,000 lb/in^2

→ CBR value of subbase curse material 22, 13500, lb/in^2

→ CBR value of subgrade material 6.

→ Mr of subgrade $6 \times 15,000\ lb/in^2 = 9000\ lb/in^2$

Solution :-

Flexible Pavement Design.

- Reliability level (R) = 99%.
- Standard deviation So = 0.49
- Intial Serviceability Index, $P_i = 4.5$

Terminal Serviceability index, $P_t = 2.5$

$\Delta PSI = 4.5 - 2.5 = 2.0$

Step : 1

Draw a line joining the reliability level of 99% and the overall standard deviation so 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 : 02

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

step : 03

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

step : 04

- Draw a horizontal line from Point C to intersect the design service
- loss (PSI) curve at Point D_1

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

Step : 05

So the structure number required to Protect the base course and to find the thickness D1 of surface course is 2.6

Step : 06

Determine the appropriate structure layer coefficient for each construction material. Resilient value of asphalt = 450,000 lb/in^2, there for $a_1 = 0.44$

Thickness of surface coarse D_1 :

$$D_1 = SN_1 / a_1 \quad \because SN_1 = 2.6, \; a_1 = 0.44$$

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

$$= 5.9''$$

Thickness should be taken to the nearest 0.5 inch

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)

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

$\because SN_2$ from table $= 3.8$

$\because a_2 = 0.14$

$\because m_2 = 0.80$

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

$$D_2 = 10.36''$$

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

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

$\because SN_3 = 4.4$

$\because a_3 = 0.10$

$$= (4.4 - 3.98)/0.10 \times 0.8$$

$\because m_3 = 0.80$

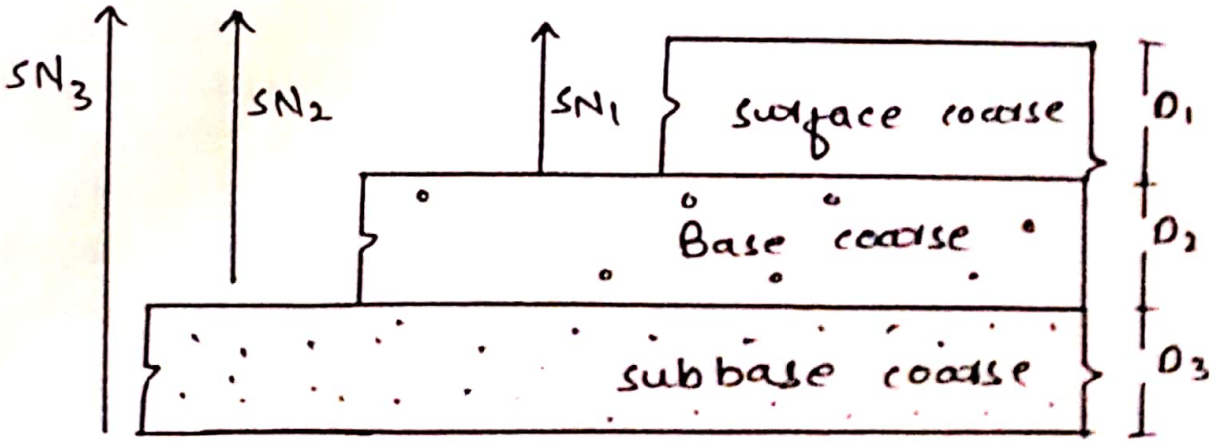
$$D_3 = 5.25''$$

We will use 6" as sub base

$SN_3 = 2.64 + 1.34 + \frac{6}{2} \times 0.10 \times 0.80$

$SN_3 = 4.46 > 4.4$ okay

Final Design:



Question No : 04

What are different Pavement distress? Explain in detail.

Answer No : 04

Pavement Distress :-

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

Distress in Pave occur due to

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

Aligator 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 (< 1/2 inch wide). crack seal to Prevent entry of moisture.

High severity crack (> 1/2 inch wide and crack with revealed edges.

Remove and replace the cracked Pavement layer with an overlay.

Potholes:

- small bowl Shaped depression in the Pavement surface that Pentrates 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 4 inch or deeper. HMA surfaces.

Repair

Patching techniques.

Rutting

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

→ 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 construction.
- Improper mix design (e.g as a result inadequate Pavement structure.
- subgrade rutting (as a result of inadequate Pavement structure).

Repair:

slight ruts (< 1/3 inch deep) can generally be left untreated.

Bleeding :-

Problem :

→ Loss of skid resistance when wet.

Possible cause :-

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

Raveling :

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

Possible cause.

Asphalt binder aging.

Inadequate compaction during construction

Repair :

Fog seal / slurry seal or Remove the damaged Pavement over lay.