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Sec : B

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Subject: Highway & Transportation Engineering.

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Signature:

Q1(a) What are the difference b/w Flexible and rigid Pavement.

Ans:.

Flexible Pavement	Rigid Pavement
(1) Grain to Grain load transfer.	(1) Slab Action takes place.
(2) Joints are not required.	(2) Joints are required.
(3) Life Span is Short ~ 15 years	(3) Life Span is long ~ 30 years.
(4) Repair work is easy.	(4) Repair work is tough.
(5) Thickness is more.	(5) Thickness is Less
(6) Stability depends upons the aggregate interlocking, Particle friction and Cohesion.	(6) Stability depends upon the joints b/w the Slabs of Concrete.

Qno1:(b): What are the advantage of Water bound over wet mix macadam.

Ans: The main advantage of Wet mix macadam Over water-bound macadam is that, it is Composed of well-graded mixture.

This ensure the good interlocking and high Stability.

-> Addition of Water while mixing facilities the handling of mixture.

The opration of laying is much Simpler than that of water bound macadam.

-> Where the Screening and binding material have to be added in Stages and forced into voids.

-> The Compaction is greatly facilitates by the moisture added which lubricates the individual Particles.

→ One disadvantage is of the wet-mix is that it is S-lightly costlier than W.b macadam. this is because the Specification involves the use of mixing plant and Power.

→ On the other hand, Water bound maladam is been traditionaly a labour oriented Specification.

→ The aggreagate for wet mix macadam will have to be Crushed-run, Where as the aggregate for water bound macadam are generally hand-broked.

Qno1: (c): What is the difference b/w Asphalt and bitumen.

Ans: **Bitumen:** Bitumen is actually the liquid binder that holds asphalt together. The term bitumen is often mistakenly used to describe asphalt.

A bitumen - Sealed Road has a layer of bitumen Sprayed and then Covered with an aggregate. This is then repeated to given a two - Coat Seal.

Asphalt: It is produced in a plant that heats and dries & mixes aggregate, bitumen and 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 is also defined as "A black or dark brown Cementitious material in which the Predominating Constituents are bitumens, which occurs in nature or are obtained in fraction distillation of Petroleum (crued oil) along with Certain mineral.

-> in American terminology, Both asphalt & Bitumen are Same and are Called "Asphalt".

Qno 2: Example

Given data.

A Crest Vertical Curve joining a +3% and a 4% grade is to be designed for 75 mi/h. If tangent intersect at Station (345+60.00) at an elevation of 250 ft.

determine the Station and elevation of the BVC and EVC. Also ~~Sketch~~ of Calculate the elevation of intermediate Points on the Curve at the whole Station.

Solution:

For design Speed of 75 mi/h

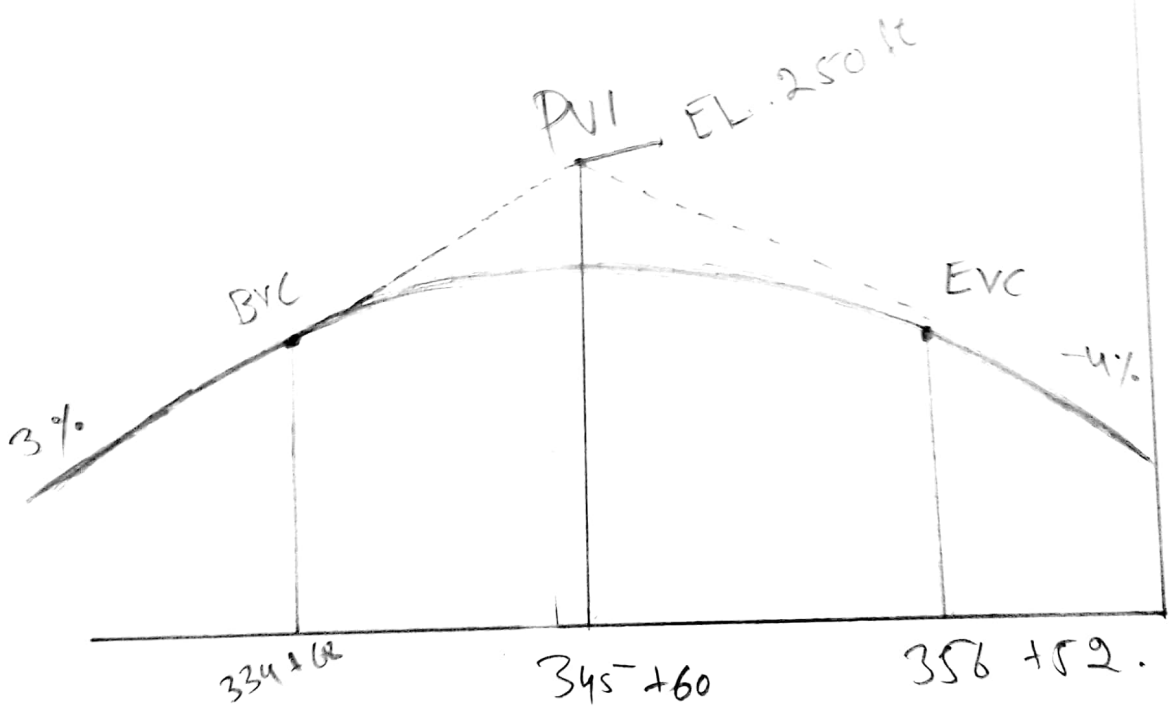
$K = 312$

Min 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



Qno3: Solution:

finding SN_1 and D_1

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 TL line at Point A.

Step-2: Draw a line joining Point A to the ESAL of 2×10^6, and extend this line to intersect the TL line at Point B.

Step-3: Draw a line joining Point B and Resillient modulus (Mr) 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. In this Problem, $\Delta PSI = 4.5 - 2.5 = 2$.

Step-5:

- So the Structure required to Protect the base Course and to find the thickness D1 of the Surface Course is 2.6.

Step - 6: Determine the appropriate structure layer coefficient for each construction material. Resillient value of asphalt = ~~45,000~~

Resillient value of asphalt = 450,000 lb/in^2

therefore

$a_1 = 0.44$.

Finding S_{N_2} and D_2 (Base Course).

$$D_2 = \frac{(S_{N_2} - S_{N_1})}{a_2 m_2}$$

$\therefore S_{N_2}$ from table = 3.8

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

$\therefore a_2 = 0.14$

$D_2 = 10.36''$.

$\therefore m_2 = 0.80$

use $12''$

So thickness of base course $12''$.

$S_{N_2} = 0.14 \times 0.80 \times 12 + S_{N_1}$

$S_{N_2} = 0.14 \times 0.80 \times 12 + S_{N_1}$

$S_{N_2} = 1.34 + 2.64$

$= 3.98$.

Finding S_{N_3} and D_3.

$$D_3 = \frac{(S_{N_3} - S_{N_2})}{a_3 m_3}$$

$\therefore S_{N_3} = 4.4$

$\therefore a_3 = 0.10$

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

$\therefore 0.80$

Thickness of Surface Course.

$D_1 = S_{N_1} / a_1$

$\frac{2.6}{0.4} = 5.9$

$\therefore S_{N_1} = 2.6$

$a_1 = 0.44$

Thickness Should be take to the nearest 0.5 inch.

So thickness of Surface Course is 6"

$S_{N_1} = D_1'' \times a_1 = 6 \times 0.44$

$S_{N_1} = 2.64.$

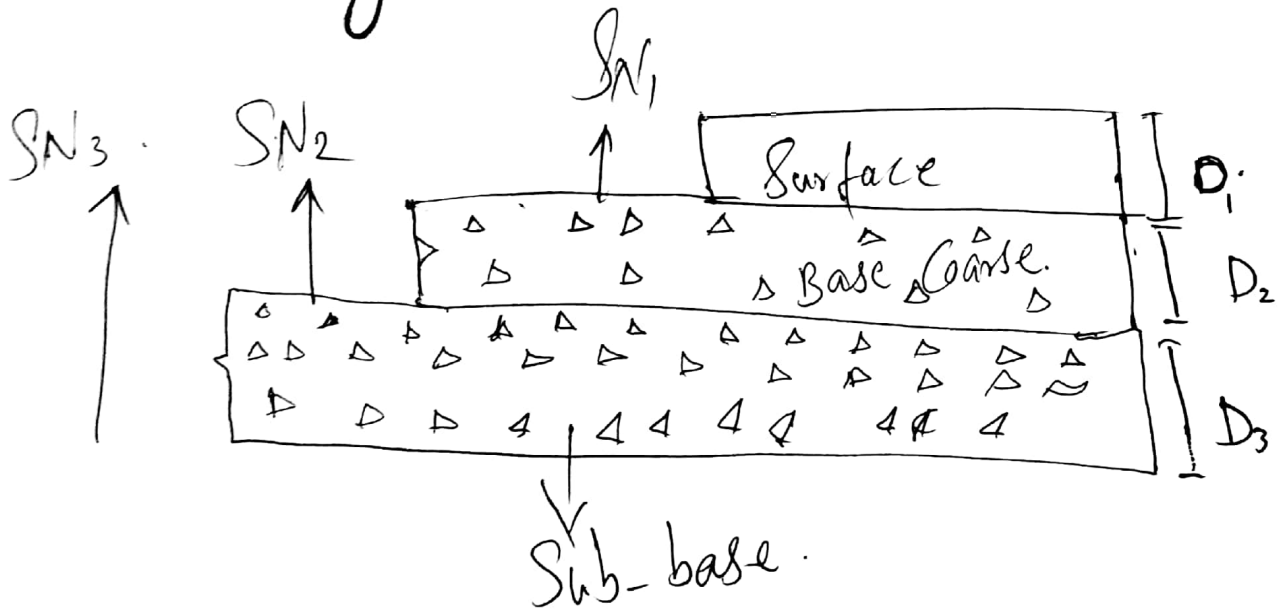
$D_3 = 5.25''$

We will use 6" as Sub-Base

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

$SN_3 = 4.46 > 4.4$ okay.

Final Design



Ashto Design Equation for SN.

$$\log_{10} W_{18} = Z_R S_o + 9.36 \log_{10}(SN+1) - 0.20 + \frac{\log_{10}(\Delta PSI / 4.1 - 1.5)}{0.40 + [1094/(SN+1)^{5.19}]} + 2.32 \log_{10} M_R - 8.07$$

Qno 4: What are the different Pavement Disstresses.

Ans: Pavement Distresses:

The Condition of the Pavement Structure that reduces Serviceabity or leads to a reduction in Service life.

→ They Can occur due to overloading, wet Subgrade or Substandard design.

→ Example of these distresses includes;

1. Alligator Cracking
2. Block Cracking
3. Potholes
4. Rutting
5. Bleeding

Alligator Cracking:

The Aligator Cracking Could Possibly be occur due to;

1). overloading
2). Inadequate Structural design
3). Poor Construction
4). Wheel load.

⇒ **Repair:** This Can be repaired as;

1). Crack Sealing is in effective.
(2) Dig out and replace the Area of Poor Subgrade.

Block Cracking:

The Problems in block Cracking are;

→ it Allows moisture infiltration.

Possible Causes are

- HMA Shrinkage
- Asphalt binder aging.
- Poor Choice of asphalt binder in the mix design

→ **Repair:**

Low Severity Crack (<1/2 inch wide).

Crack Seal to Prevent entry of moisture.

- High Severity Crack (>1/2 inch wide and Cracks with raveled edges).
- Remove and replace the Cracked Pavement layer with in overlay.

Potholes

Small, bowl shaped depression in the Pavement Surface that penetrates all the way through the ~~Hma~~ HMA layer down to base Course.

* Potholes are most likely to occure on Roads with thin HMA Surface (1 to 2 inches). and Seldom occurs on Roads with 4" or deeper HMA.

Problem: Roughness (Serious Vehicular damage Can result from driving accross Potholes at higher Speed. (Moisture infiltration).

Causes: They are Generally the end result of fatigue Cracking. As fatigue Cracking becomes Sevear, the Crack Creat Small Chunks.

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 Causes:

- Insufficient Compaction of HMA layer during Construction.
- Subgrade Rutting (e.g as a result of inadequate Pavement Structure).
- Improper mix design (e.g excessively high asphalt Content, excessive mineral filler & insufficient amount of angular aggregate Particles.

Bleeding:

Problem.

Loss of Skid resistance when wet.

Possible Cause:

- Excessive ~~Opptic~~ asphalt binder in the HMA
- Excessive application of asphalt binder during BST application.
- Low HMA air Void Content.

Polished aggregate

Possible Cause:

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

Repair: Apply a Skid resistant Slurry Seal, BST of non-structural overlay.

Raveling

→ Loose debris on the Pavement which increases Pavement roughness and loss of Skid resistance.

Possible Cause:

- Asphalt binder aging.
- Aggregate Segregation. If fine Particle are missing from the aggregate matrix.
- Inadequate Compaction during Construction.

Repair:

fog/Seal/Slurry seal or remove the damaged Pavement and overlay.