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Sec # B

Sub # Highway & Traffic Engineering

Q:. 1

Flexible Pavements:-

⇒ Flexible Pavements typically distribute wheel loads to lower layer of the pavement Section and Consists generally of bituminous material.

⇒ Bitumen is used a binder in flexible Pavement.

⇒ Deformation in the sub grade is transferred to the upper layer.

⇒ load is transferred by grain to grain contact.

⇒ Have low life span usually 10-15 years

⇒ Road Can be for traffic within 24 hours

⇒ Surfacing Cannot be laid directly on the sub grade but a sub base is needed.

⇒ flexible Pavements have low initial Construction Cost but have high maintenance

Rigid Pavement:-

Rigid pavements are ~~generally~~ typically distribute wheel loads over a wide area of the subgrade and Consists generally of Cement Concrete and may be reinforced with Steel.

⇒ Cement is used as a binder in rigid pavement.

=> Deformation in the Sub grade is not transferred to subsequent layers.

⇒ No such phenomenon of grain to grain load transfer exist.

⇒ life span is more as compare to flexible usually 30+ years.

⇒ Road cannot be used until 14 day of curing

⇒ Surfacing can be directly laid on the sub grade.

⇒ Rigid pavements have low maintenance cost but have high intial construction cost.

Q:1 (b)

Ans:: 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 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 is used, there is no possibility of plastic fines entering into the mixture.

- The Compaction is greatly facilitated by the moisture added which lubricates the individual particles.

Q1 ⓒ

Ans:-

Asphalt

⇒ Asphalt is generally used as a term to refer to the Combination of bitumen and gravel specifically for road Construction.

Bitumen

⇒ in some literature bitumen is actually the liquid binder that holds asphalt together.

Bitumen:-

A Clan of black cementitious Substance natural, or manufactured, Composed of high molecular weight hydrocarbon found in Asphalts. Tars, pitches,

Asphalt:-

A dark brown to black cementitious material in which the predominating Constituents are bitumens which occurs in nature.

Q:- 2:-

Sol:-

For a design Speed of 75 mi/h.

K = 312 from table 15.5

Minimum length = 312 [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 $= 250 - \left(0.03 \times \frac{2184}{2}\right)$

$= 217.24 ft$

Q:3:-

Sol:-

Reliability level (R) = 99%

Standard deviation (S_d) = 0.49

Initial Serviceability Index (P_i) = 4.5

Terminal Serviceability Index (P_i) = 2.5

$\Delta PSI = 4.5 - 2.5 = 2.0$

Thickness of Surface Course 01

$D_1 = SN_1/a_1$

$2.6/0.44 = 5.9''$

Thickness should be taken to the nearest 0.5 inches

So the thickness of the surface course is 6"

$SN_1 = D_1 \times a_1$

$SN_1 = 6 \times 0.44 = 2.64$

Thickness of base course D_2

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

$$D_2 = \frac{(3.8 - 2.64)}{0.14 \times 0.80}$$

$$D_2 = 10.36''$$

Use 12"

So thickness of base Course is 12"

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

$$SN_2^* = 1.34 + 2.64$$

$$SN_2^* = 3.98$$

Thickness of Sub base Course D_3

$$D_3 = \left(\frac{SN_3 - SN_2}{a_3 \cdot m_3}\right)$$

$$D_3 = \left(\frac{4.4 - 3.98}{0.10 \cdot 0.80}\right)$$

$$D_3 = 5.25''$$

We 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

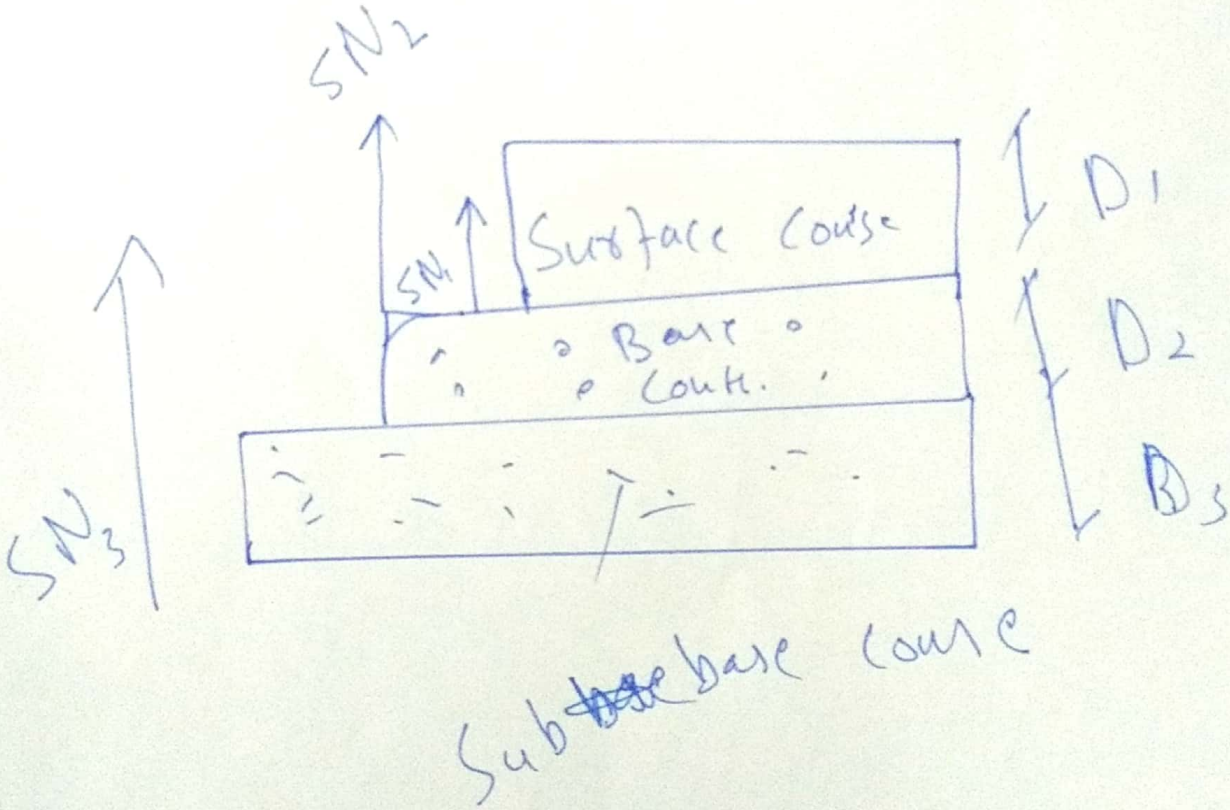
Surface Course = 6"

Base Course = 12"

Sub base = 6"

Total Pavement thickness = 24"

final design



Q: 4

Ans ⇒ Pavement Distresses

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

⇒ Distresses could occur in a pavement due to:

* unstable mixes
* Higher wheel loads than those considered in design

Alligator (fatigue) cracking :-

⇒ Possible Causes:

* overloading
* Inadequate Structural design
* Poor Construction

⇒ Repair:

* Crack Sealing is in effective
* Dig out and replace area of Poor Subgrade

⇒ Problem:

Allow moisture infiltration.

⇒ Possible Causes:

* HMA shrinkage
* Asphalt binder aging
* Poor choice of asphalt binder in the mix design

⇒ Repair:

* low Severity cracks (<1/2 inch wide)

Crack Seal to prevent entry of moisture

* High Severity (>1/2 inch wide and Cracks with raveled edges)

Remove and replace the cracked pavement layer with an overlay.

⇒ Potholes:-

* Small, bowl-shaped depressions in the pavement's surface

that penetrate all the way through the HMA layer down to base Course

* Potholes are most likely to occur on roads with thin HMA surfaces (1 to 2 inches) and seldom occur on roads with 4 inch or deeper HMA surfaces

⇒ Problem: Roughness, moisture infiltration.

⇒ Possible Causes:

Generally, potholes are end result of fatigue cracking. As fatigue cracking becomes severe, the interconnected cracks create small chunks of pavement, which can be disloged vechicle

drive over them.

⇒ Repair:

* Patching techniques

⇒ Rutting :-

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

and overlayed.

⟹ Bleeding :-

⇒ Problem: * loss of Skid resistance when wet

⇒ Possible Cause:

* Excessive asphalt binder in the HMA.
* Excessive application of asphalt binder during BST application
* low

* Possible Cause:
  * Insufficient Compaction of HMA layers during Construction
  * Subgrade rutting
  * Improper mix design

⇒ Repair:
  * Slight ruts (<1/3 inch deep) can generally be left untreated. Pavement with deeper ruts should be leveled

Polished Aggregate

⇒ Possible Cause:

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

⇒ Repair:

* Apply a skid-resistant slurry seal. BST or non-structural overlay.

⟹ Raveling:-

* loose debris on the pavement which increase pavement roughness and loss of skid resistance

⇒ Possible Causes:-

* ~~ASP~~ Asphalt binder aging
* Aggregate segregation. if fine particles are mixing from the aggregate

* Inadequate Compaction during Construction

⇒ Repair:

* Fog/ Slurry Seal Seal

or Remove the damaged Pavement and overlay.