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Subject : Highway and traffic Eng

Section : "B"

Semester : "6th"

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"Question No 1"

"Part "a"

Flexible Pavement	Rigid Pavement
① Bitumen is used a binder in flexible Pavement.	① cement is used as a binder in rigid Pavements
② Deformation in the sub grade is transferred to the upper Layers.	② Deformation in the sub grade is not transferred to Subsequent Layyers
③ Load is transferred by grain to grain contact	③ No such Phenomenon of grain to grain load transfer exists
④ Flexible Pavements have low intial construction costs but have high maintence cost	④ Rigid Pavements have low maintenance cost but have high initial construction costs
⑤ Have low life span usally 10-15 years	⑤ Life span is more as compare to flexible usually 30+ years
⑥ Road ~~Earwat~~ can be used for traffic within 24 hours.	

⑦ Surfacing cannot be laid directly on the sub grade but a sub base is needed	⑥ Road cannot be used until 14 days of curing ⑦ Surfacing can be directly laid on the sub grade.

Question No 1

"Part "b"

Advantages of water bound over wet mix macadam :-

① The 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 have to added in

Stages and forced into voids. if a crusher run material is used, there in no possibilty of plastic fines entering into the mixture.

③ The compaction is greatly facilited by the moisture added which lubricates the individual particles.

④ The aggregates for wet mix macadam will have to be crusher-run whereas the aggregets for water-bound macadam are generally hand-broken.

⑤

Question No 1

"Part "c"

Difference between asphalt and bitumen:-

Bitumen:-

A class of black or dark-colored (solid, semi-solid or viscous) cementitious substances, natural or manufactured.

composed Principally of high molecular weight hydrocarbons found in Asphalts, Tars, Pitches, and Asphalties are typical

⇒ In some literature Bitumen is actually the liquid binder that holds asphalt together.

ASPHALT :-

A dark brown to black cementitions material in which the predominating constituents are bituments which occur in nature or are obtained in fractional distillation of Petroleum (crude oil) along with certain mineral matter.

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

Asphalt composition:-

According to Simpson Asphalt generally consist of:

Carbon (70 - 85 %)

Hydrogen (7 - 17 %)

nitrogen (0 - 7 %)

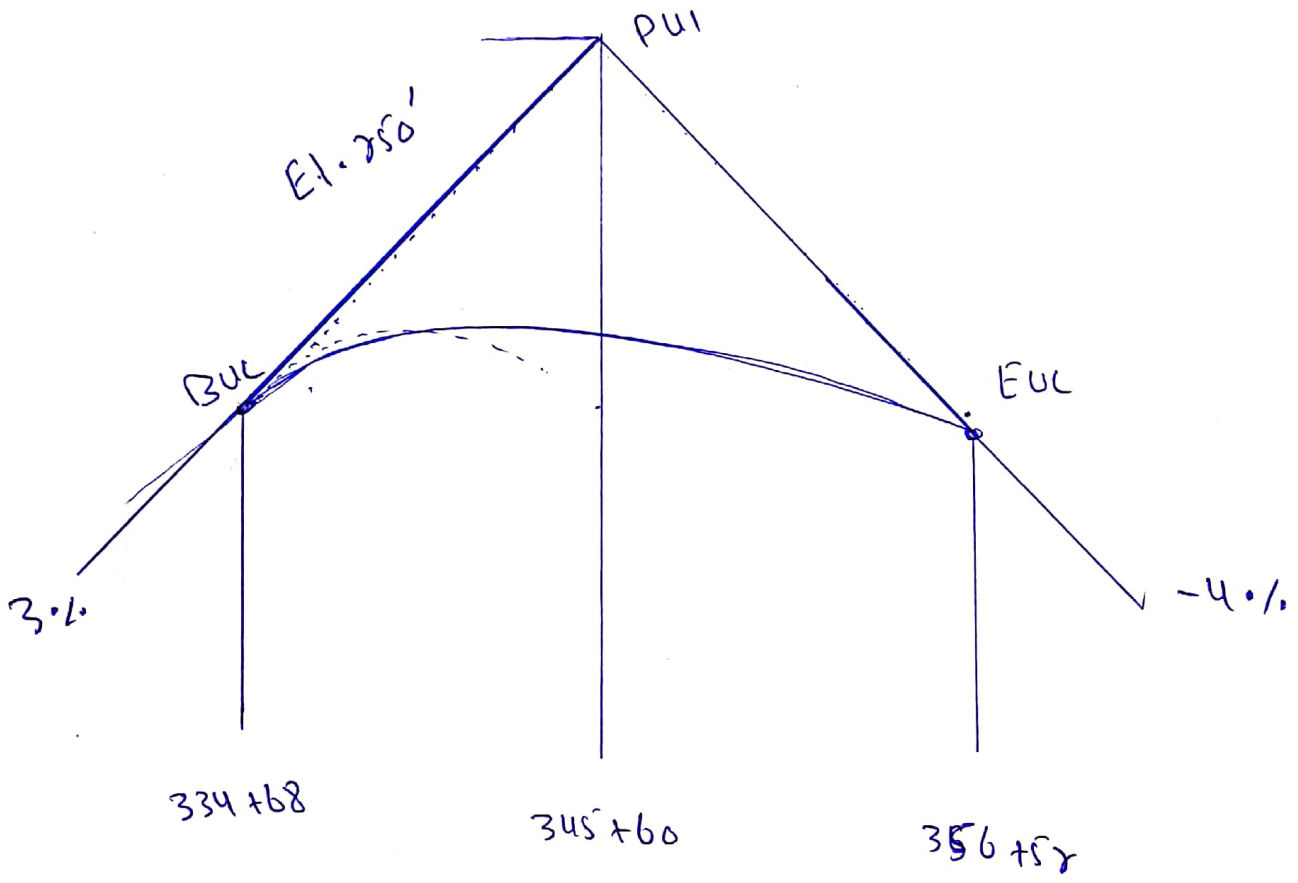
sulfur (1 - 7 %)

oxygen (0 - 5 %)

and some small amount of metals.

"Question no "07"

A crest verticle curve joining a + 3 % and -4 % grade is to be desiged for 75 mi/h. if the tangents intersects at station (345 + 60.00) at an elevations of 850 ft determine the station and elevations of the BVC and EVC. Also calculate the elevations of intermediate points on the curve at the whole station.



Solution :-

For a design speed of 75 mi/h

$K_v = 312$

* Minimum Length $= 312 * (3 - (-4)) =$ 2184ft

* Station of BVC $= (345+60) - \left(\frac{216+84}{2}\right) =$ 334+68

* Station of EVC $= (334+68) + (216+84) =$ 356+52

* Elevation of BVC $= 250 - \left(0.03 \times \frac{2184}{2}\right) =$ 217.84ft

"Question No "3"

Solution :-

Reliability level (R) = 99%.

Standard deviation (S_o) = 0.49

Initial serviceability index P_i = 4.5

Terminal serviceability index P_t = 2.5

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

To Find SN1 and D_1

Step 01 :- Draw a line joining the reliability level of 99% and the overall standard deviation S_o = 0.49 and extend this line to intersect the first TL line to Point A

step 02 :- Draw a line joining Point A to the ESAL of $2 * 10^6$ and extend this line to intersect the second TL 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 serviceability loss chart at Point C.

Step : 04 :-

Draw a horizontal line from Point C to intersect the design serviceability loss (P_{SI}) curve at Point D. In this Problem. $\Delta PSI = 4.5 - 2.5 = 2$

Step : 05 :-

So the structure number recuried to protect the base course and to find the thickness D_1 of the surface course is 2.6.

Step : 06 :-

Determine the appropriate structure layer cofficient for each construction

material. Resilient value of asphalt = 450,000 lb/in², therefore a_1 = 0.44.

Thickness of surface course D1:-

$$D_1 = SN_1 / a_1$$

$$2.6 / 0.44 = 5.9''$$

* Thickness should be taken to the nearest 0.5 inches.

* So thickness of surface course is 6"

$$SN_1 = D_1 * a_1$$

$$SN_1 = 6 \times 0.44$$

$$SN_1 = 2.64$$

Thickness of Base course D2:-

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

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

$$\boxed{D_2 = 10.36''}$$

=> use 12"

So thickness of base course is 12"

$SN_2^* = 13 + 11$

$SN_2^* = 0.11 \times 0.80 \times 12 + SN_1^*$

$SN_2^* = 1.34 + 2.64$

$\boxed{SN_2 = 3.98}$

Thickness of Subbase Course D_3:

$D_3 = (SN_3 - SN_2^*) / a_3 \cdot m_3$

$D_3 = (4.4 - 3.98) / 0.10 \times 0.80$

$\boxed{D_3 = 5.25''}$

=> we will use 6" as a sub base

$SN_3^* = 3\ 2.64 + 1.34 + 6'' * 0.10 + 0.80$

$\boxed{SN_3^* = 4.46 > 4.4}$

Design:-

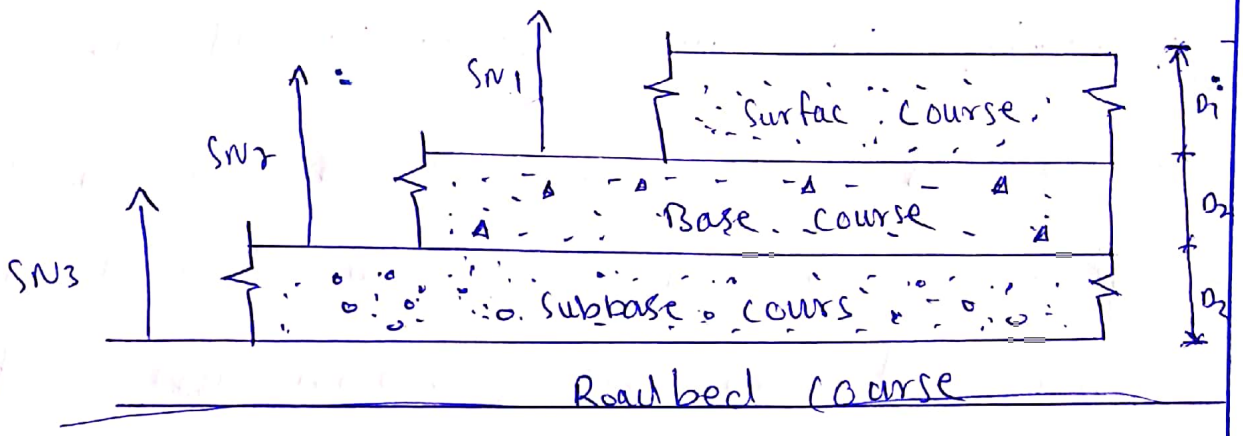
Surface course = 6"

Base course = 12"

sub base = 6"

Total Pavement Thickness = 24"

Final Design :



Question No "4"

Distress:-

Pavement structures often have distresses and Distress is a conclition of the Pavement structur that reduces serviceability or leads to a reduction in service life.

⇒ Distress could occur in a Pavement due to

* unstable mixes

* Higher wheel loads then those considered in design.

Types :-

Alligator (Fatigue) cracking :- It is a series of interconnected cracks of various types / stages of development. It is considered as the combination of fatigue and block cracking. It occures due to repeated trafic loadings.

Repair :-

① crack sealing is in effective

② Digout and area replacement of Poor subgrade.

② Block Cracking :-

It is a Pattern of creacks that divides the Pavement into approximately rectangular Pieces with sides generally longer then one foot. its main Problm

is that it allows moisture infiltration.

Repair:-

① Low severity cracks (< ½ inch wide): crack seal to Prevent entry of moisture.

② High severity cracks (> ½ inch wide and crack with raveled edges. Remove and replace the cracked Pavement layer with an overlay.

③ Pothles :

It is small, bowl shaped depression in the pavement surface that penetrate, all the way through the HMA layer down to the bas course.

Repair:-

Patching techniques.

Rutting :-

surface depression in the wheel Path, are Particularly evident

After a rain when they're filled with water.

Repair:-

① Slight ruts (< 1/3 inch deep) can generally be left untreated. Pavement with deeper ruts should be levelled and over layed.