Subject :- Highway & Traffic Engineering

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Exam :- final term

Section :- A

Semester :- 6th

Instructor :- Dr. Nadeem Sir

Note:- Attempt all Questions:-

Q1

(a) What is the difference between Flexible and rigid pavement:-

Ans:- Flexible Pavement:- It is typically distribute Wheel loads to lower layer of the pavement section and consist generally of bituminous materials.

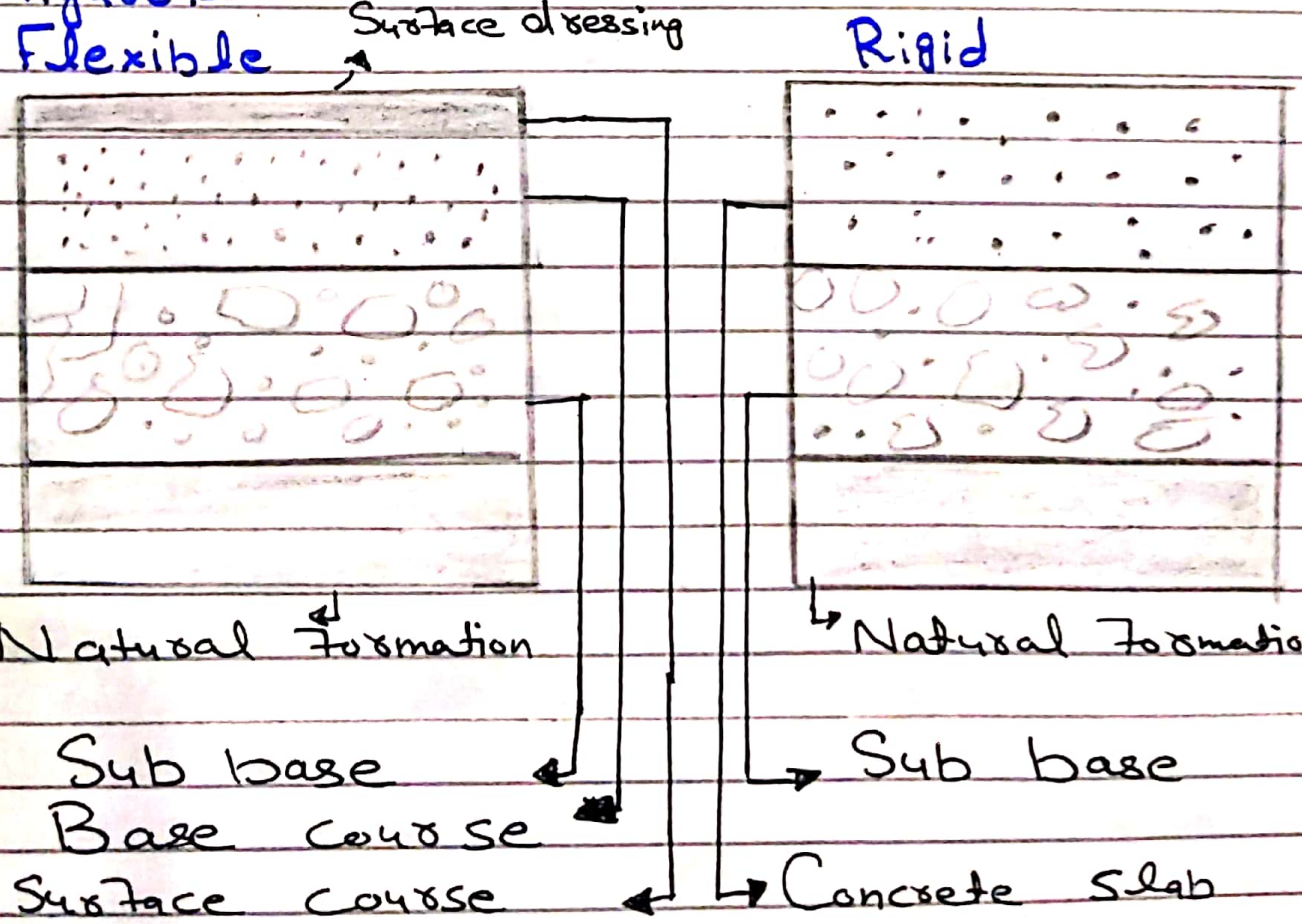
Rigid Pavement:- It typically distribute Wheel loads over a wide area of the Subgrade and consist generally of Cement Concrete and may be reinforced with Steel.

Comparison:-

Flexible Pavement	Rigid Pavement
(1) Bitumen is used a binder in Flexible Pavem	(1) Cement is used a binder in Rigid Pavement.
(2) Deformation is the Sub grade is transferred to the upper layer.	(2) Deformation in the Sub grade is not transferred to Subsequent layer.

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 initial Construction Costs but have high maintance Cost	(4) Rigid Pavement have low maintenance cost but have high initial Construction Costs.
(5) Have low life span usually 10 — 15 Years	(5) Life span is more as compare to flexible usually 30 + Years.

figure:-



(b) What are advantages of water bound over Wet mix macadam:-

Ans:- Water Bound macadam:- It the Stone materials are held togather by the addition of water & filler.

Wet mix macadam:- It the graded Stones are mixed with water & Compacted.

Advantages:-

(WBM):- (i) Water bound macdam is superior in quality because the materials are carefully graded and the resulting mass is almost void less Compacted mass

(ii) The interlocking of aggregate particles imparts adequate Strength of the materials Selected for filling the voids. These ensure non entry of the plastic materials of the Sub grade into the voids.

(iii) WBM is less Costly as Compared to bituminous base Course.

(WMM):- (i) Production rate is high.

(ii) It is very easy to operate.

(iii) It is efficent and easily maintained

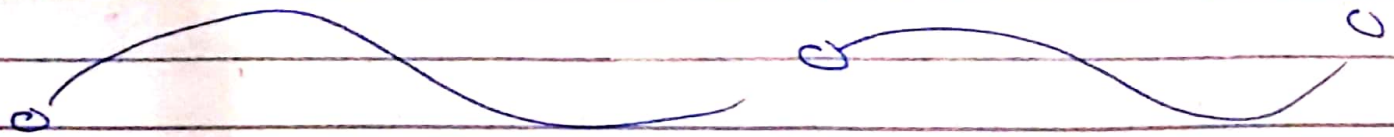
(iv) The most recent Ep worldwide procedure embedded into the hardware parts.

(v) Highly Accurate Aggregate and additive feeder. Portable Ey Stationary variations.

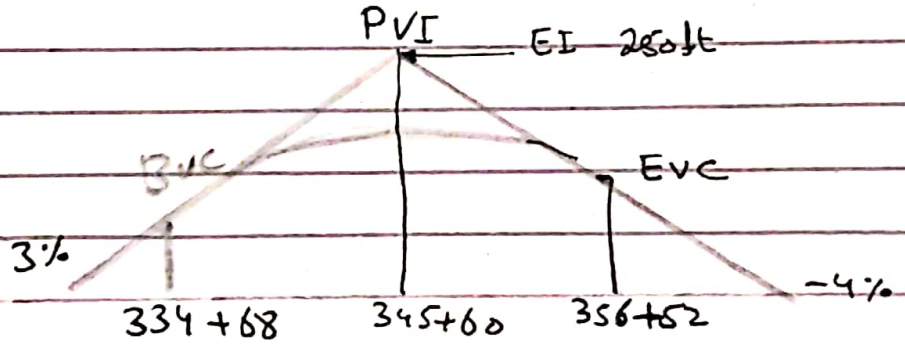
(C) What is difference b/w Asphalt and bitumen :-

Ans:- Asphalt :- A dark brown to black Cementitious material in which the predominating Constituents are bitumen which naturally occur or are obtained in fractional distillation of petroleum along with certain minerals matter.

Bitumen :- A Class of black or dark-colored (Solid, Semisolid, viscous) Cementious substances, natural or manufactured, composed principally of high molecular weight hydrocarbon found in Asphalt. Tars, Pitches and Asphatics are typical.



Q2 A Crest vertical Curve Joining a+3 percent and a-4 percent grade is to be designed for 75mi/h. if the tangent intersect at Station (345+60.00) at an elevation of 2507t, determine the Station & elevation of BVC & EVC. Also Calculate the elevation of intermediate points on the Curve at the whole Stations.



Solution:-

for a design Speed of 75mi/h k = 312

Minimum 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

Station	Distance from BVC (x) (ft)	Tayget Elevation (ft)	offset $\left[y = \frac{Ax^2}{200L}\right]$ (ft)	Curve Elevation tayget Elevation offset (ft)
BVC 334+68	0	217.24	0.01	217.24
BVC 335+00	32	218.20	0.02	218.18
BVC 336+00	132	221.20	0.28	220.92
BVC 337+00	232	224.20	0.86	223.34
BVC 338+00	332	227.20	1.77	225.43
BVC 339+00	432	230.20	2.99	227.21
BVC 340+00	532	233.20	4.54	228.66
BVC 341+00	632	236.20	6.40	229.80
BVC 342+00	732	239.20	8.59	230.61
BVC 343+00	832	242.20	11.09	231.11
BVC 344+00	932	245.20	13.92	231.28
BVC 345+00	1032	248.20	17.07	231.13
BVC 346+00	1132	251.20	20.54	230.66
BVC 347+00	1232	254.20	24.32	229.88
BVC 348+00	1332	257.20	28.43	228.77
BVC 349+00	1432	260.20	32.86	227.34

BVC350+00	1532	263.20	37.61	225.59
BVC351+00	1632	266.20	42.68	223.52
BVC352+00	1732	269.20	48.07	221.13
BVC353+00	1832	272.20	53.79	218.41
BVC354+00	1932	275.20	59.82	215.38
BVC355+00	2032	278.20	66.17	212.03
BVC356+00	2132	281.20	72.84	208.36
BVC356+52	2184	282.76	76.44	206.32

Q3 A Flexible highway is to be designed to carry a design ESAL of 2×10^6. It is estimated that it make take about a week for water to be drained from within the pavement & the pavement structure will be exposed to moisture level approaching Saturation for 30 % of the time. the following additional information is available

⇒ Resilent 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 Course material 22, Mr 13,500 lb/in^2

⇒ CBR Value of Subgrade material 6

⇒ Mr of Subgrade $6 \times 1500\ lb/in^2$
$= 9000\ lb/in^2$

Solution.

Ans: Draw a line Joining the reliability level of 99% & the overall Standard deviation So

of 0.49 & extend line to intersect the first TL line at point A.

Step # 02

Draw a line joining point A to the ESAL of 2×10^6, & extend this line to intersect the first "TL" line to point "B"

Step # 03

Draw a line joining point "B" & resilient modulus (MR) 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 (PSI) Curve at point "D" So here

$$\Delta PSI = 4.5 - 2.5 = 2$$

Step # 05

The Structure number require to protect the base course & to find the thickness "D2"

of the Surface course is "2.6".

Step # 06

Determine the appropriate structure layer Co-efficent for each Construction material resilient value of asphalt = 450,000 lb/in² there fore a1 0.44

$$D_1 = SN_1 / a_1$$

$$2.6 / 0.44 = 5.9''$$

Thickness Should be taken to the nearest 0.5 inch So the thickness of the Surface Course is 6"

$$SN_1 = D_1 \times a_1$$

$$= 6 \times 0.44 = 2.64$$

Now find SN_2 & D_2 (Base Course) find the value of a_2 from layers Co-efficent table and m_2 from drainage Co-efficent table.

Thickness of base Course (D_2)

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

$$D_2 = (3.8 - 2.64) / .14 \times 0.80$$

$$D_2 = 10.36''$$

use 12"

So the thickness of base course is 12"

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

$SN_2 = 1.34 + 2.64$

$SN_2 = 3.98$

finding SN_3 & D_3 (Sub base course) & also layer Co-efficent a_3 & drainage Co-efficent m_2 from their respective table.

$D_3 = (SN_3 - SN_2) / a_3 m_2$

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

$D_3 = 5.24"$

We will use 6" as a Sub base

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

$SN_3 = 4.64 > 4.4$ OK ... !

Final design Step:-

- Surface Course = 6"
- Base Course = 12"
- Sub base = 6"
- Total pavement thickness = 24"

Q4 What are the different Pavement distresses, Explain in detail.?

Ans:- Pavement Distresses:-

Distresses is a Condition of the pavement Structure that reduce Serviceability or leads to a reduction in Service life.

⇒ Distresses could occur in pavement due to.

* Unstable mixes
* Higher wheel loads than those in design.

Types:-

(1) Alligator (Fatigue) Cracking:-

⇒ Possible Causes.

(1) overloading
(2) Inadequate Structural design.
(3) Poor Construction

⇒ Repair

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

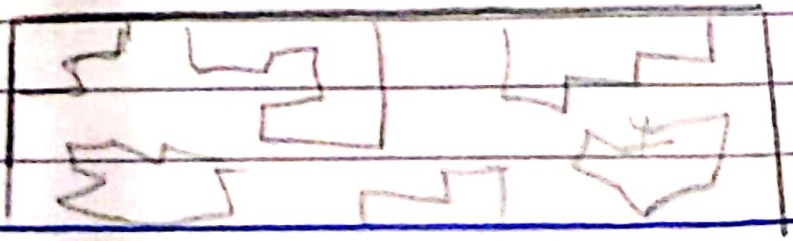


Figure (a)

(2) Block Cracking:-

⇒ Problem:-

(1) Allows moisture infiltration.

⇒ Possible Causes:-

(1) HMA Shrinkage.

(2) Asphalt binder aging.

(3) Poor Choice of asphalt binder in the mix design.

⇒ Repair:-

(1) Low severity crack (< 1/2 inch wide). Crack seal to prevent entry of moisture.

(2) High Severity Cracks (> 1/2 inch wide) Remove and replaced the cracked pavement layer with an overlay.

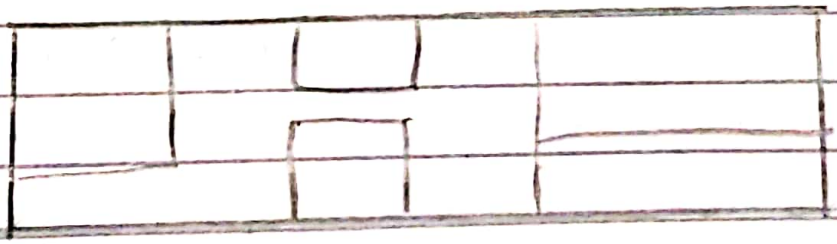


Figure (b)

(3) Potholes:- Small, bowl-shaped depressions in the pavement surface that penetrate all the way through the HMA layer down to the base course.

⇒ Potholes are most likely to occure

on roads with this HMA surface (1 to 2) inches and seldom occure on roads with 4 inch or deeper HMA surfaces.

⇒ **Problem:-** Roughness (Serious vehicular damage can result from driving across potholes at higher speeds), moisture infiltration.

⇒ **Possible causes:-** Generally, potholes are the end result of fatigue cracking. As fatigue cracking became severe, the interconnected cracks create small chunks of pavement which can be dislodged as vehicles derive over them.

⇒ **Repair:-** Patching technique.

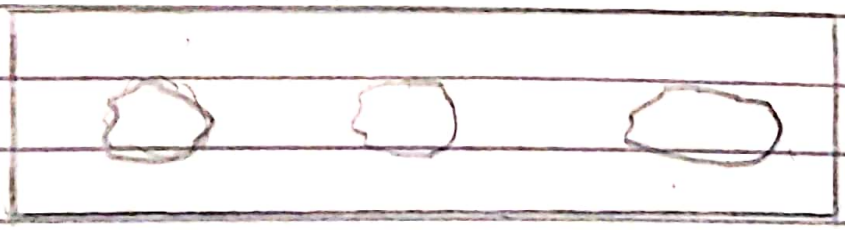


Figure (c)

(4) **Rutting:-** Surface depression in the wheel path, are particularly evident after a rain when they are filled with water.

⇒ **Possible Causes:-** (1) Insufficient Compaction of HMA layers during Construction.
(2) Subgrade rutting (e.g excessively high Asphalt Content, excessive mineral filler, insufficient amount of angular aggregate particles).

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

Figure (d)

(5) Bleeding:-

Problem:- Loss of skid resistence when wet.

⇒ **Possible Cause:-** (1) Excessive Asphalt
(2) Excessive application of asphalt binder during BST application
(3) Low HMA air void Content.

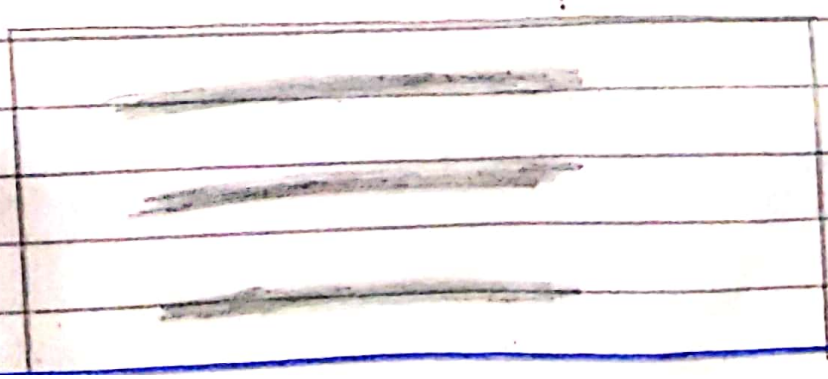


Figure (e)

(6) Polished Aggregate:-

⇒ **Possible Cause:-** Repeated traffic application. this can occure quicker if the aggregate is susceptable to abrasion.

⇒ **Repair:-** Apply a Skid resistant Slurry Seal BST or non structural overlay.

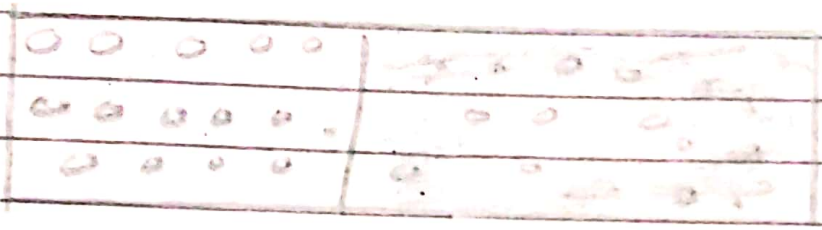


Figure (F)

(7) Raveling:- Loose debris on the pavement which increases pavement roughness and loss of Skid resistance.

Possible Cause:- (1) Asphalt binder aging
(2) Aggregate segregation. if the particles are missing from the aggregate matrix.
(3) Inadequate Compaction during Construction.

⇒ **Repair** Fog Seal / Slurry Seal or Remove the damage pavement & over lay.

Figure (G)