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Section : A

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Paper : Highway & Traffic Engineering

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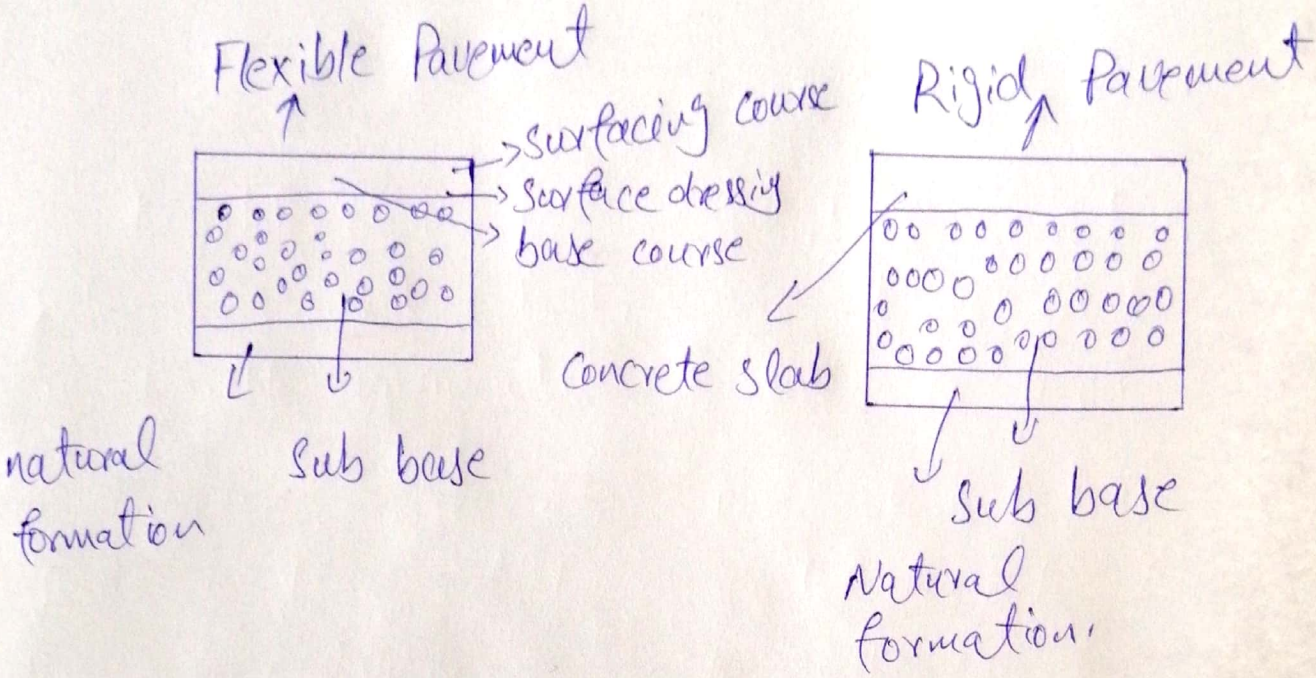
Q NO 1 :-

Part (a) Difference b/w flexible and rigid Pavement?

Flexible Pavement	Rigid Pavement
→ Bitumen is used a binder in Flexible Pavement.	→ Cement is used as a binder in rigid Pavements.
→ Deformation in the sub grade is transfered to the upper layers.	→ Deformation in the sub grade is not transferred to subsequent layers.
→ Load is transfered by grain to grain contact.	→ No such phenomenon of grain to grain load transfer exists.
→ Have low life span usually 10-15 years.	→ Life span in more as compare to flexible usually 30+ years.
→ Surfacing cannot be laid directly on the sub grade but a sub base is needed.	→ Surfacing can be directly laid on the sub grade.
→ Roads can be used for traffic with in 24 hours.	→ Road cannot be used until 14 days of curing.



X ——— X ——— X ——— X

Part B :-

Ans:- Advantages of water Bound Macadam Road over wet Mix Macadam:-

→ The construction cost of WBM road is comparatively low.

→ water bound macadam is superior in quality because the materials are carefully graded and the

resulting mass is almost void less compacted mass.

→ The interlocking of aggregate particles imparts adequate strength of the materials selected for filling the voids. Thereby ensure non-entry of the plastic materials of sub-grade into the voids.

→ In the construction of WBM road no skilled labours are required.

→ They are constructed from locally available materials.

→ If the WBM roads are maintained properly and from time to time, it can resist load of traffic of about 900 tonnes per lane per day.

Part C:-

Difference b/w asphalt and bitumen?

Ans:- Asphalt:-

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

→ Asphalt is produced in a plant that heats dries and 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 the end use.

Asphalt is commonly used as a surface for roads, car parks and driveways. In American terminology both asphalt and Bitumen are same and are asphalt.

Bitumen :-

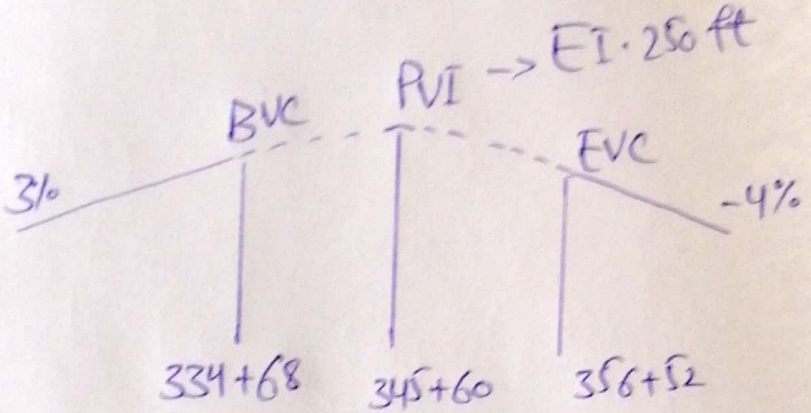
→ A class of black or dark-colored cementitious substances, natural or manufactured, composed principally of high molecular weight hydrocarbons found in Asphalts, Tars, Pitches, and Asphaltities are typical.

Bitumen is a binding agent Produced from Petroleum. Bitumen is known for being strongly adhesive and resistant to damage from water and oil spills. Bitumen is actually The liquid binder that holds asphalt together.

A bitumen-sealed road has a layer of bitumen sprayed and Then covered with an aggregate. This is Then repeated to give a two-coat seal.

x ——— x ——— x ———

Q No 2:-



Sol:- For a design speed of 75 mi/h.

$K = 312$ From Table 15.5

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	Tangent Elevation	Offset $\left[r=\frac{Ax^2}{200L}\right](ft)$	Curve Elevation
BVC 334+68	0	217.24	0.01	217.24
" 335+00	32	217.24+3/100x=218.20	0.02	220.92
" 336+00	132	221.20	0.086	225.43
" 337+00	232	224.20	1.77	227.21
" 338+00	332	227.20	2.99	228.66
" 339+00	432	230.20	4.54	229.80
" 340+00	532	233.20	6.40	230.61
" 341+00	632	236.20	8.59	231.11
" 342+00	732	239.20	11.09	231.29
" 343+00	832	242.20	13.92	231.13
" 344+00	932	245.20	17.07	230.66
" 345+60	1032	248.20	20.54	229.88
" 346+00	1132	251.20	24.32	228.77
" 347+00	1232	254.20	28.43	227.34
" 348+00	1332	257.20	32.86	225.59
" 349+00	1432	260.20	37.61	223.52
" 350+00	1532	263.20	42.68	221.15
" 351+00	1632	266.20	48.07	218.44
" 352+00	1732	269.20	53.79	215.38
" 353+00	1832	272.20	59.82	212.03
" 354+00	1932	275.20	66.17	208.36
EVC 355+52	2032	278.20	72.84	204.37
			76.44	206.32

Q3 :-

Given Data:-

Resilient Modules at 68°F

$4500000\ lb/in^2$ CBR value of base

coarse material 100 M_r $3000\ lb/in^2$

CBR value of subbase course

material 22 M_r $13500\ lb/in^2$

CBR value of sub grade

material 6

M_r of subgrade $6 \times 1500\ lb/in^2$

$= 9000\ lb/in^2$

Moisture content = 30%

Sol:- Reliability level (R) = 99 %

standard deviation = (S) = 0.49%

Initial serviceability index $P_i = 4.5$

Terminal serviceability index $P_t = 2.5$

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

Step 1:- Finding SN, & D_1.

Draw the line joining the reliability level of 99% & over all standard deviation So of 0.49.

Step 2:- Draw a line joining Point A to the ESAL of 2×10^6.

Step 3:- Draw a line joining Point B & resiliant modulus (M_r) of base coarse & extend this line.

Step 4:-

Draw a horizontal line from Point to interest design.

→ Loss (PSI) curve at Point D.

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

→ D_1 of surface coarse is

2.6.

Step 5:-

Finding SN_1 & D_1

So The structure number required to protect The base coarse & to find The Thickness D_1 of The surface coarse is 2.6

Step 6:-

As The Percentage of time pavement structure exposed to moisture level approaching saturatio is 30% (ie greater Than 2.5%)

So Drainage co-efficient $m_2 = 0.8$

from chart

Layer Co-efficient $a_2 = 0.14$

Thickness of surface coarse D_1.

$D_1 = SN_1 / a_1$

$2.6 / 0.44$

$= 5.9''$

Thickness should be taken to The nearest $0.5''$.

So Thickness of surface coarse is $\hat{6}$.

$SN_1^* = D_1 \times a_1$

$SN_1^* = 6 \times 0.44 = 2.64$

Finding SN_2 & D_2 (Base coarse)

$D_2 = (SN_2 - SN_1)\, a_2 m_2$

$= 38 - 264 / 014 \times 80$

$D_2 = 10.3\hat{6}$

Use $12\hat{}$

So Thickness of base coarse is $12\hat{}$.

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

$= 1.34 + 2.64$

$= 3.98$

Finding SN_3 & D_3 (Sub base coarse)

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

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

$$D_3 = 5.25''$$

we will use 6" as a Sub base.

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

$SN_3 = 4.46 \rightarrow 4.4$ okay.

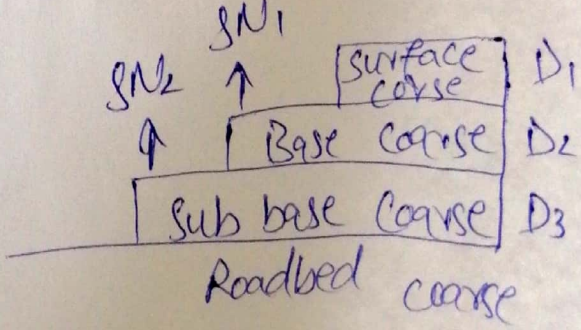
Final Design

Surface coarse = 6"

Base coarse = 12"

Sub base = 6"

Total Pavement Thickness = 24"



Q No 4:-

Ans:-

① Alligator Cracking:-

→ It is also known as map cracking as fatigue failure.

→ it is also similar as alligator skin so That why it is called alligator cracking.

Reasons of Alligator Cracking:-

The main reasons are:

(1) over loading.

(2) Poor construction.

(3) inadequate structural Design.

Method of Repairing:-

→ crack sealing is effective.

→ Dry out & replace area of Poor subgrade.

② Block cracking:-

→ Block cracking looks like large interconnected rectangular.

Causes of Block cracking:

→ HMA shrinkage.

→ Asphalt binder Aging.

→ Poor choice of Asphalt binder in mix design.

Method of Repairing:-

→ Low severity crakes to Prevent entry of moisture.

→ High severity crakes > half inch wide.

Remove & Replace the cracked Pavement layer with an overlay.

(3) Rutting:-

Surface depression in the wheel path are Partically evident after a rain when they are filled with water.

Reasons of Rutting:-

-> Insufficient compaction of HMA layer during construction.

-> Sub grade Rutting.

-> Improper Mix design.

Method of Repairing:-

slights ruts (½" deep) can generally be left untreated Pavement with deeper ruts should be leveled & over layed.

Bleeding:-

Bleeding or flushing is a shiny black surface film of asphalt on the road surface caused by upward movement of Asphalt in Pavement surface.

causes of Bleeding:-

→ Excessive asphalt binder in the HMA.

→ Low HMA air void content.

Method of Repairing:-

Apply a skin resistance slurry seal BSt or non structural overlay.

Potholes:

Small bowl shaped depression in the pavement surface that penetrate all the way through the HMA layer down to the base coase.

Cause: Generally potholes are the end result of fatigue cracking.

Method of Repairing:

→ Patching techniques.

Longitudinal cracking:

It occur parallel to the centre line of the pavement.

Cause :-

→ Poor constructed Joints.

→ Shrinkage of Asphalt layer.

→ cracks reflecting from underlying layer.

Transverse cracking :-

It is an unconnected cracks that run across a road Pavement perpendicular to direction of road.

Cause :- → Shrinkage of Asphalt layer

→ reflection from an existing crack.

→ This is not load related.