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Section A

Q1:-a) What is difference between flexible...?

	Flexible Pavement	Rigid Pavement
i)	Have low flexural Strength and consist of series of layers.	Have more flexural Strength and consist of one layer portland concrete Slab
ii)	Surfacing cannot be laid directly on subgrade	Surfacing can be laid directly on the subgrade.
iii)	No thermal stresses are induced	Thermal stresses are induced
iv)	Life span 10-15 years	Life span 20-30 years.
v)	Low initial cost and high maintenance cost	High initial cose, No or low maintenence cost.
vi)	Damaged by oils and certain chemicals flexible pavement are workible after 24 hours of construction	No damage by Oils and other chemicals It cannot be used untill 14 days of curring.

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4) What are the advantage - - - ?

Water boud maccadam:- Dense and comp- course of pavement composed of stone aggregates bound together by a thin film of cementing medium consisting of fine mineral filler.

Wet Mix Maccadam:-

Wet-mix Maccadam is a specification in which a well graddied agregate is mixed with water in mechanical mixer and the resultant mixer is laid by pavers and compacted.

Advantage of WBM over WMM.

* Water bound maccadam is cheaped than wet mix maccadam. This is because the "WMM" specification involves the use of mixing plant and paver. on the other hand water bound maccadam has been tradionally a labour oriented specification
* The aggregates for wet mix macaddam will have to be crusher-run, where as the aggregate for water bound macaddam are generally hand broken.

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Section A

4) **Difference between Ashphalt and Bitumen?**

* **Bitumen:-** Bitumen is a binding agent produced from petroleum. Bitumen is known for being strongley adhesive and resistant to damage from water and oil spills.
* Bitumen is actually the liquid binder that holds asphalt together.
* Bitumen is only used by commercial suppliers as a binder or sealant for other products.

* **Asphalt:-** Asphalt is produced in a plant that heats, dries and mixes aggregates, bitumen and sand into a composite mix.
* It is a composite mixture that provides a durable and flexible surface for cars and heavy vehicles.
* Asphalt is generally used as a term to refer to the combination of bitumen and gravel specifically for road construction.

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Section A

QNO2:- SOLUTION:-

For a design speed of 75 mi/h

$k = 312$

Minimum length $= 312 \times [3-(-4)] = 2184$ ft

Station of BVC $= (345 + 60) - \frac{21+84}{2} = 334+64$

Station of EVC $= (334 + 68) + (21 + 84)$

$= 356 + 52$

Elevation of BVC $= 250 - (0.03 \times \frac{2184}{2})$

$= 217.24$ ft.

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STATION	Distance from Bvc (ft)	Tangent elevation	offset	Tangent elevation - offset
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

offset $\Rightarrow Y = \left(\frac{A \times 8^2}{2002}\right)$ ft

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Station	Distance from BVC (ft)	Tangent Elevation	offset	Elevation tangent - Elevation offset.
BVC 348 +00	1332	257.20	28.43	228.77
BVC 349 +00	1432	260.20	32.86	227.34
BVC 350+00	1532	263.20	37.51	225.59
BVC 351 +00	1632	266.20	42.68	223.52
BVC 352+00	1732	269.20	48.07	221.13
BVC 353 +00	1832	272.20	53.79	218.41
BVC 354 +00	1932	275.20	59.82	215.38
BVC 355 + 00	2032	278.20	66.17	212.03
BVC 356 +00	2122	281.20	72.84	208.36
BVC 357 +00	2184	282.76	76.44	206.32.

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Q NO 3:- Standard deviation (S_o) = 0.49
Terminal Servicebility index, P_t = 2.5
Initial Servicibility Index, P_i = 4.5
Reliability level, (R) = 99%
$\Delta PSI = 4.5 - 2.5 = 2.0$
SN_1 & D_1 = ?

SOLUTION:-

Step 1:- Draw the line joining the reliability level of 99% and the over all standard deviation S_o 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 and residind modulus of Base course and extent this line

Step 4:- Draw a horizental line from the point C to intersect the design servicability.
loss PSI curve at point D
$\Delta PSI = 4.5 - 2.5 = 2$
D_1 of surface coarse is 26.

Step 5:- Residind value of Asphalt = 450,000 Db/in²
Therefore $a_1 = 0.44$
Thickness of surface coarse A
$D_1 = SN_1 / a_1$
$D_1 = 2.6 / 0.44$
$D_1 = 5.99''$
Thickness of the surface is 6".

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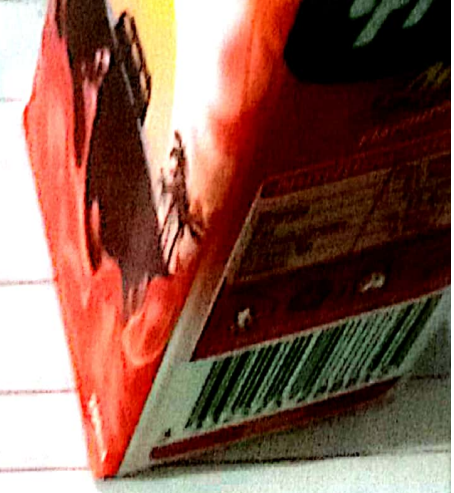

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$SN_1 = D_1 \times a_1$

$SN_1 = 6 \times 0.44 = 2.64$

SN_2 & D_2 = ?

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

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

$D_2 = 10.36''$

Use 12"

So thickness of base coarse is 12"

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

$SN_2 = 1.24 + 2.64$

$SN_2 = 3.88$

SN_3 & D_3 = ?

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

$D_3 = (4.4 - 3.98)/0.10 \times 0.80 \Rightarrow D_3 = 5.25''$

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

$SN_3 = 4.467 > 4.4$ (which is ok)

Final Design:-

Surface Coarse = 6"

Base Coarse = 12"

Sub base = 6"

Total Pavement thickness = 24"

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Section A

Q4 **Explain different pavement distresses?**

Pavement Distresses:- Distress is a condition of the pavement structure that reduces servicibility, distress occur due to

=> unstable mixes

=> Highes wheel loads than those considered in design

Different Pavement distresses:-

Alligator cracking:-

* Known as map cracking or fatigue failure since it appears similar as alligator skin so it is called as alligator cracking.
* The failure due to weaknese in surface base or subgrade, a surface that is too thin, poor drainage or combination of all three.

Block cracking:-

* Block cracking look like large inter connected rectangles (roughly)
* Generally it is caused by shrinkage of the asphalt pavement due to an inability of asphalt binder to expand and contrad with temperature cycles.
* This can be because the mix was mixed and placed too dry.

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Section A

Longitudnal cracking:-

* [redacted] Longitudnal cracks are individual and run parallel to the centerline
* This can be considered as either a structural or environmental distress
* These can be a result of both pavement fatigue reflective cracking or poor joint construction

Rotting:-

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

Possible cause:-

* Insufficient compaction of HMA layers during construction.
* Subgrade rotting

Repair :- Slight rot are left untreated and deeper ruts should be level. and overlayed.

Bleeding:- It is shiny, black surface film of asphalt on the road surface caused by upward movement of asphalt in the surface

Causes:- Excessive asphalt binder in the HMA
Low HMA air void content.
Excessive application of asphalt binder during BSI applications.

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Section A.

Polished Aggregate:-

Causes:-

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

Repair:- Apply a skid-resistant slurry seal

Raveling:- loose debris on the pavement which increase pavement roughness and loss of skid resistance.

Possible Causes:-

Asphalt binder aging

Inadiquate compaction during construction