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Section A

Semister 6th

Final paper Highway & Traffic Engr

QNo.1):

(a):

Ans:

Flexible pavement	Rigid pavement
1-Bitumen is used as a binder in flexible pavement.	1-Cement is used as a binder in rigid pavement.
2-Deformation in the sub grade is transfered to the upper layers.	2-Deformation in the sub grade is not transferred to subsequent layers.
3-Load is transferred by given grain to grain contact.	3-No such Phenomenon of grain to grain Load transfer exists.
4-Flexible pavement have low initial construction costs but have high maintenance cost.	4-Rigid pavement have Low maintenance cast but have high initial Construction costs.
5-Have low life span usually 10-15 years.	5-Life span is more as compair to flexible pavement usually 30 years.
6-Surfacing cannot be laid directly on the sub grade but sub base is needed.	6-Surface can be directly laid on the sub grade.
7-In flexible pavement strength of road highly dependent on strength of sub grade.	7-Strength of road less dependent on strength of subgrade in rigid pavement.
8-Road can be used for traffic with in 24 hours.	8-Road cannot be used until 14 days of curing.

Q.No.1):

(b):

Ans: Advantage of Water Bound vs 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 thay of water bound macadam, where the screenings and binding material is used, there is no possibility of plastic fines entering into the mixture.
- The compaction is greatly facilitated by the moisture added which lubricated the individual particles.

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QNO.1):

(C):

Ans:

Asphalt	Bitumen
① Asphalt pavement are durable; with a layer depth of 25-40 mm and life span of 20+ years.	① Bitumen pavements are less durable; with a layer depth of 10-20 mm and lifespan of 5-10 years.
② Surface made of asphalt is smoother and more skid-resistant, ensuring the driver's safety and minimal noise.	② The loose fragments on bitumen pavements make the driving experience noisier and can wear down tires, consevuently causing safety issues.
③ Reduced friction between tire and car; meaning better fuel economy and minimization of carbon dioxide emission.	③ Higher frictional resistance of a bitumen pavement means less efficiency in energy utilization.
④ Less sensitive to temperature compared to bitumen pavement	④ pavements are susceptible to high temperature.
⑤ Installation is comparatively costlier.	⑤ Cheap to install compared to asphalt

QNO.2):

Given:

For a design speed of 75mi/h,

$K = 312$

Solution:

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 (ft)	Offset $\left[y = \frac{A x^2}{200L}\right]$ (ft)	Curve Elev (Tangent Ele − Offset) ft
BVC 334+68	0	217.24	0.01	217.24
BVC 335+00	32	$217.24 + \frac{32}{100} \times 3 = 218.20$	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
BVC 350+00	1532	263.20	37.61	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	2132	281.20	72.84	208.36
EVC 356+52	2184	282.76	76.44	206.32

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QNO.3):

Ans:

Step#01: Draw a line joining the reliability level of 99% and the overall standard deviation S_o of 0.49 and extend the 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, and extend this line to intersect the first 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 (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 and to find the thickness D_1 of the surface coarse is 2.6.

Step #06: Determine the appropriate structure layer co-efficient for each construction material. Resilient value of asphalt = 450,000 lb/in3,
therefore a_1 0.44

$D_1 = SN_1 / a_1$

$= 2.6 / 0.44 = 5.9''$

Thickness should be taken to represent 0.5 inches so the thickness of the surface couose is 6".

$SN_1 = D_1 \times a_1$

$= 6 \times 0.44 = 2.64$

→ Now find SN_2 and D_2 (Base course) find the value of a_2 from layers coefficient table and m_2 from drainage coefficient table.

→ Thickness of base course (D_2)

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

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

$D_2 = 10.36''$

use 12" thickness of base course so the is 12".

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

$SN_2 = 1.34 + 2.64$

$SN_2 = 3.98$

→ Finding SN_3 and D_3 (sub base course) and also layer coefficient a_3 and drainage coefficient m_2 from their respective table.

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

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

$D_3 = 5.24''$

We will use 6" as sub base.

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

$SN_3 = 4.46 > 4.4$ okey.

Final design:

surface course = 6"

Base course = 12"

Sub Base = 6"

Total pavement thickness = 24"

QNO.4):

Ans:

Pavement Distress:

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

Block cracking:

Problem: Allows moisture infiltration.

possible causes:

→ HMA shrinkage

→ Asphalt binder aging.

→ poor choice of asphalt binder in the mix design.

Repair:

→ Low severity crack (< 1/2 inch wide). crack Seal to pavent entry of moisture.

→ High severity cracks (> 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 surface that penetrate all the way through the HMA layer down to the base course.

→ potholes are most likely to occur on roads with thin HMA surfaces (1 to 2 inches) and seldom occurs 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 becomes severe, the interconnected cracks create small chunks of pavement, which can be dislodged as vehicles drive over them.

- Repair: Patching techniques

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Rutting:→surface depression in the Wheel path are particularly evident after a rain when they are filled With Water.

→surface depression in the wheel path are particularly evident after a rain when they are filled with water.

Possible causes:

→Insufficient compaction of HMA Layers during construction.

→subgrade rutting (e.g as a result of inadequate pavement structure).

→ Improper mix design(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 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 HMA air void content.

Polished Aggregate:
Possible causes: 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.

Ravelling:
→ Loose debris on the pavement which increases pavement roughness and loss of skid resistance.
Possible causes:
→ Asphalt binder aging.
→ Aggregate segregation. If fine particles are missing from the aggregate matrix
→ Inadequate compaction during construction
Repair: Fog seal/Slurry seal or Remove the damaged pavement and overlay.