Name :- Hamza Ejaz

ID :- 7835

SEMESTER :- 6th

SECTION :- B

SUBJECT Highway & Traffic Engineering

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Q1 (a) Difference between flexible and rigid Pavement?

Flexible Pavement	Rigid Pavement
Bitumen is used a Binder in flexible pavement.	Cement is used as Binder in rigid pavement
Deformation in the sub grade is transfer-ed to the upper layer	Deformation in the sub grade is not transfered to subsequent layers.

• Load is transfered by grain to grain contact.	• NO concept of grain to grain load transfer
• It have low initial construction costs but have high maintainance costs.	• It has low maintance cost but have high initial construction costs.
• The life span is usually 10-15yrs.	• life span is more then 30 yrs
• surface cannot be laid directly on the subgrade but sub base is needed	• Surface can be directly laid on the subgrade
• Road can be used for traffic with 24 hrs	• Roads cannot be used until 14 days of curing.

(b) ADVANTAGES OF WATER BOUND OVER WET MIX MACADAM:-

Following are the advantages of water bound over wet mix macadam.

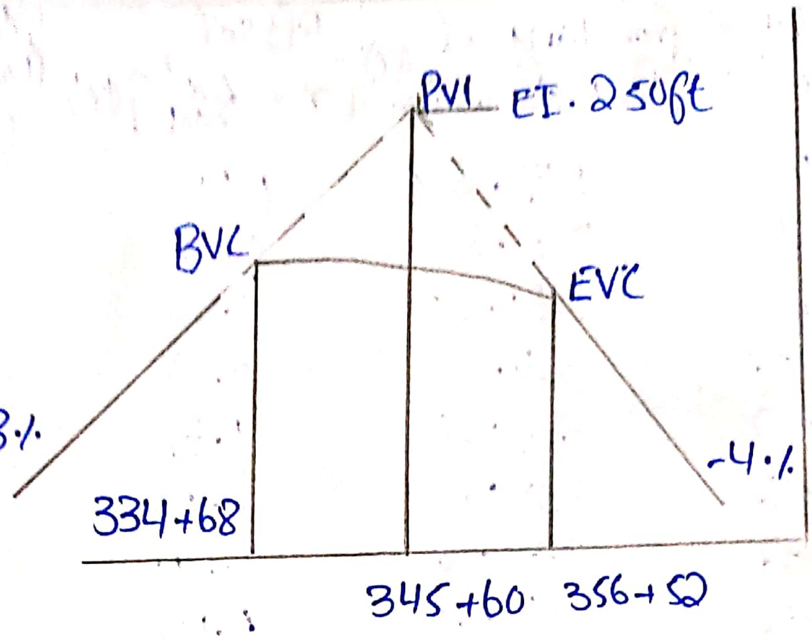
- WBM is slightly cheaper than the wet-mix macadam. The reason is WBM requires general labour while wet macadam requires mixer plant and paver.
- Aggregates of WBM are or can be broken by hands while the WMM needs a crusher for the disintegration of aggregates.
- The interlocking of aggregate particles imparts adequate strength of the materials for filling the viods. These ensure non-entry of the plastic materials of the sub-grade into voids.

C. DIFFERENCE BETWEEN ASPHALT AND BITUMEN:-

- Bitumen is actually the liquid binder that holds asphalt together.
- Asphalt is generally used as a term to refer to the combination of bitumen and gravel for road construction.

Bitumen is known for being strongly adhesive and resistant to damage from water and oil spills. This makes bitumen the ideal binder for asphalt because asphalt is commonly used as a surface for roads, car, parks etc.

Given:-



Sol:-

For a design speed of 75mil/h, k = 312

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

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 = $250 - \left(0.03 \times \frac{2184}{2}\right) = 217.24$

The remainder of the computation is efficiently done using the format shown below in the table.

P.T.O

Station	Distance from BVC (x) (ft)	Tangent Elevation (ft)	Offset $\left[y = \frac{\Delta x^2}{200}\right]$ (ft)	Curve Elevation (tangent − 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	2.98	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
BVC 356+52	2184	281.76	76.44	206.32

QNo3

STEP NO 1:-

Draw a line joining the reliability level of 99% and the overall standard deviation so 0.49, and extend this line to intersect the first TL line at point A

STEP # 2:-

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 (PSI) curve at point D, so here

DPSI = 4.5 - 2.5 = 2

STEP # 5:-

The structure number required to protect the base course and to find the thickness D_1 of the surface course is 2.6

STEP # 6:-

Determine the appropriate structure layer co-efficient for each construction material

Resilient value of asphalt = 450000 lb/in²

Therefore

$a_1 = 0.44$

$D_1 = SN_1 / a_1$

$= 2.6 / 0.44 = 5.9''$

Thickness should be taken to the nearest 0.5 inches 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 and D_2 (Base course)

Find the value of a_2 from layer coefficient table and m_2 from drainage co-efficient table.

⇒ Thickness of Base course (D_2)

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

$D_2 = (3.8 - 2.64) / (0.44 \times 0.80) \Rightarrow D_2 = 10.36''$

Use 12"

So The Thickness of Base Course is 12"

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

$SN_2 = 1.34 + 2.64$

$SN_2 = 3.98$

SN_3 and D_3 (subbase course) and also layer coefficient a_3 and drainage coefficient m_3 from Their respective table

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

$$= (4.4 - 3.98) / .10 \times 0.80$$

$$D_3 = 5.24''$$

we will use 6" as a subbase

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

$SN_3 = 4.46 > 4.4$

⇒ FINAL DESIGN :-

⇒ Surface Course = 6"

⇒ Base Course = 12"

⇒ Sub Base = 6"

⇒ Total pavement thickness = 24".

Q NO 4

Ans:- Following are the different pavement distress.

① ALLIGATOR CRACKING:-

Possible Causes	Repair
• over loading • Inadequate structure design • poor construction	• Cracking sealing is ineffective • Dig out and replace area of poor subgrade.

② BLOCK CRACKING:-

Problem:- Allows moisture infiltration

Possible Causes	Repair
• HMA shrinkage • Asphalt binder aging • poor choice of asphalt binder in the mix design	• Low severity cracks: (< 1/2" wide) crack seal to prevent entry of moisture • High severity cracks (> 1/2" wide) cracks with revealed edges remove and replace the cracked pavement layer with an overly.

⇒ potholes are most likely to occur on roads with thin HMA surface (1"- 2") and seldom occurs on road with 4" or deeper HMA surfaces.

Problem:-

Roughness (serious vehicular drainage) can result from driving across potholes at higher speed. moisture infiltration

Possible Causes

⇒ Generally, potholes are the end result of fatigue cracking becomes sever, the interconnected cracks create small chunks of pavement, which can be dislogged as vehicles drive over them

Repair

⇒ patching techniques.

4:- Rutting:-

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

Possible causes:-	Repair
⇒ Cosufficient compaction of HMA layer during construction ⇒ Subgrade rutting (eg as a result) of inadequate pavement structure. ⇒ Improper mix design [eg example excessive high asphalt content, excessive mineral filler, insufficient amount of angular aggregate particle	2) slight ruts (< 1/3" deep) can generally be left untreated. pavement with deeper ruts should be levelled and over layed.

5:- BLEEDING:-

Problem:-

Loss of skid resistance when wet

Possible Causes:-

2) Excessive asphalt binder in the HMA

⇒ Low HMA air void content

⇒ Excessive application of asphalt binder during B&T application.

(6) Pollished Aggregate:-

Possible causes	Repair
⇒ Repeated traffic application This can cause quicker if the aggreagate is susceptible to abrasion.	⇒ Apply a skid-ressistance slurry seal, BST or non-structural overly.

(7) RAVELING:-

Lose debris on the pavement which increases pavement roughness and loss of skid resistance.

Possible Cause	Repair
⇒ Asphalt binder aging ⇒ Aggregate segregation matrix ⇒ Inadequate compaction during construction	Fog seal / slurry seal or Remove the damage pavement and overly.