Name M. Mustafa

ID # 7866

Section # B

Semester # 6th

Paper # Highway AND TRAFFIC ENGINEERING

Submitted To ENGR ABDUL-FARHAN.

FINAL TERM EXAM.

IQRA NATIONAL UNIVERSITY

DATED, 22/6/2020

QNO(1) ANSWERS:

Part:a: Difference:

Following are the difference b/w Flexible and Rigid pavement.

Flexible Pavement	Rigid Pavement.
(i) Bitumen is used a binder in Flexible pavement.	(i) Cement is used as a binder in rigid pavements.
(ii) Deformation in the sub grade is transferred to the upper layers	(ii) Deformation in the sub-grade is not transferred to subsequent layers.
(iii) Load is Transferred	(iii) Non-such phenomenon of grain to grain load transferred exists.
(iv) Flexible pavements have low initial construction costs but have high maintenance cost.	(iv) Rigid pavements have low maintenance cost.
(v) Have low life span usually 10-15 years	(v) Life span is more as compare to flexible usually 30+ years.

(vi) Surfacing cannot be laid directly on the sub grade but a sub base is needed.	(vi) Surfacing can be directly laid on the sub grade
(vii) In flexible pavement strength of road highly dependent on strength of sub-grade.	(vii) Strength of road less dependent on strength of sub-grade in rigid pavement.
(viii) Road can be used for traffic within 24 hrs	(viii) Road cannot be used untill 14 days of curing.

QN.O 1: Part :b:

ADVANTAGES:

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

(i) Water bound macadam is slightly cheaper then the wet-mix macadam. The season is general labours while wet-mix macadam requires mixer plant and power

(ii) Aggregate of WBM can be broken

broken by hands while the WMM need a crusher for the dis integration of aggregates.

(iii) The interlocking of aggregates particles imparts adequate strength of a material for filling the voids. These ensure non-entry of the plastic materials of the grade into voids.

QNO(1) Part: c:

Difference:

Following are the difference between asphalt and bitumen.

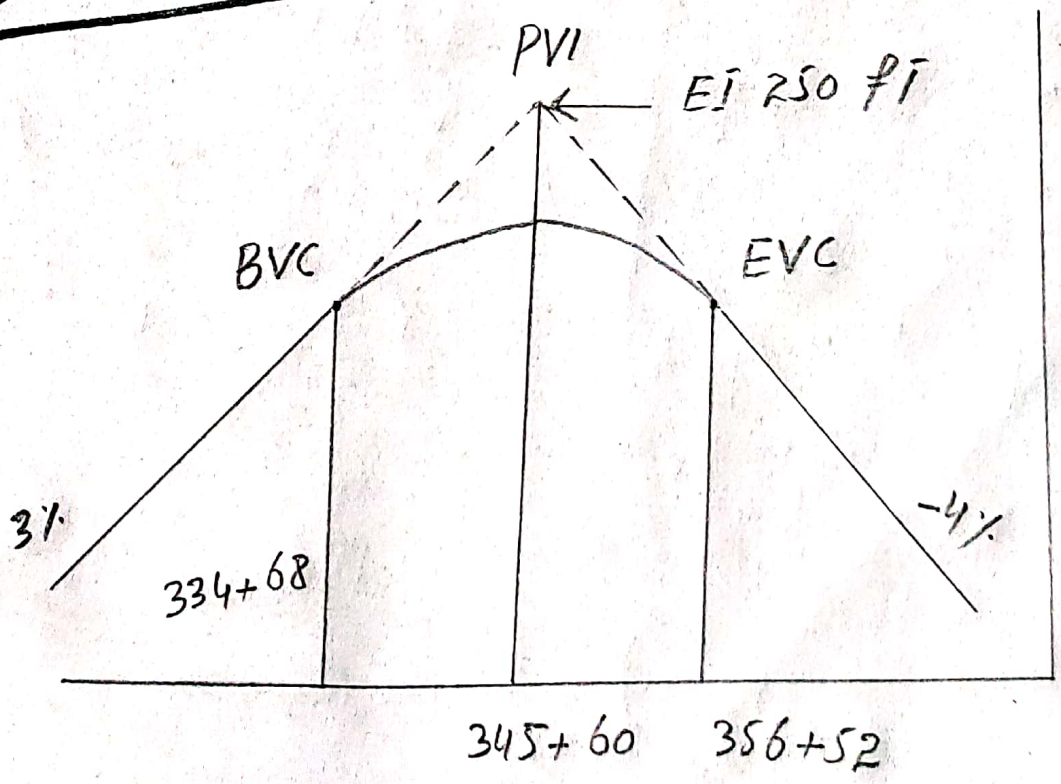
- Bitumen is actually the liquid binder that holds asphalt together
- Asphalt is generally used as a term to refer to the combination of bitumen and gravel for road construction.

P.T.O

⊙ 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.

QN.O#(2): [redacted]

Solution:-



For a design speed of 75 mil/hr

$K = 312$ (From Table)

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

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

Station	Distance from BVC (x) (ft)	Tangent Elevation (ft)	Offset $\left[r = \frac{Ax^2}{200L}\right]$ ft	Curve Elevation (Tangent Elevation) 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
BCV 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
BVC 356+52	2184	282.76	76.44	206.32

QNO :03: SOLUTION:

Step #01:

Draw a line joining the reliability level of 99% and the overall standard deviation so of 0.49, and extend this 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 second TL line at point B.

step 03: Draw a line joining point B and resilient modulus (Mr) of base course and extend this line to intersect the design serviceability loss chart at point C.

P.T.O

Step 04: Draw a horizental 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 required to protect the base course and to find the thickness D_1 of the surface course is 2.6.

Step 06: Determine the appropriate structure layer coefficent for each construction material.

Resident value of asphalt = 450,000 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

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 co-efficient table and m_2 from drainage coefficient table.

→ Thickness of Base course (D_2)

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

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

$$\boxed{D_2 = 10.36"}$$

Use 12"

So the thickness of base course is 12"

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

$$SN_2 = 1.34 + 2.64$$

$$SN_2 = 3.98$$

→ Finding SN_3 and D_3 (Subbase Course) and also layer co-efficient m_3 from their respective Table

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

$$D_3 = (4.4 - 3.98) / 0.10 \times 0.20$$

$$D_3 = 5.24''$$

We will use 6" as a Sub-base

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

$$SN_3 = 4.46 > 4.4 \quad \text{Okay!}$$

FINAL DESIGN:

→ Surface Course = 6"

→ Base Course = 12"

→ Sub-base = 6"

→ TOTAL Pavement Thickness = 24"

P.T.O

Q N.O :4:

Following are the different pavement distresses.

1: ALLIGATOR; CRACKING:—

Possible Causes	Repair.
• Overloading • Inadequate structural design • poor construction	• Crack Sealing is in effective • Dig out and replace area of poor subgrade

2. Block Cracking:

problems: 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) Cracks seal To prevent entry of moisture. • High severity cracks ($> \frac{1}{2}$ wide) and cracks with ravelled edges. Remove and replace the cracked pavement layer with an overlay.

3. POTHOLES:

These are small, bowl shaped depressions in pavement surface that penetrate all the way through the HMA layer down to the base course.

- Potholes are most likely to occur on road 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 speeds), moisture infiltration.

Possible Causes	Repair
Generally potholes are the end result of fatigue cracking. As fatigue cracking becomes severe, the interconnected cracks create small chunks	• Patching techniques.

Chunks of pavement which can be dislodged as vehicles drives over them.	

4- Rutting:

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

Possible Cause	Repair
. Insufficient compaction of HMA layer during construction . Subgrade rutting (e.g as a result of inadequate pavement structure. . Improper mix design (e.g excessive high asphalt content, excessive, mineral filler, insufficient amount of aggregate particle).	Slight ruts ($< \frac{1}{3}$" deep can generally be left untreated. Pavement with deeper ruts should be levelled and overlayed.

5. Bleeding:

Problem: Loss of skid resistance when wet.

Possible Causes:

- Excessive Asphalt binder in the HMA.
- Excessive application of asphalt binder during BST application.
- Low HMA air void content.

6. Polished aggregate:

Possible Causes	Repair:
• Repeated Traffic applications. This can occur quicker if the aggregate is susceptible to abrasion.	Apply a skid-resistant slurry seal, BST or non-structural overlay.

7. Raveling: Loose debris on the pavement which increases pavement roughness and loss of skid resistance.

Possible Causes	Repair.
• Asphalt binder aging. • Aggregate segregation. If fine particles are missing from the aggregate matrix. • Inadequate compaction during Construction	• Fog seal / Slurry seal or Remove the damaged pavement and overlay.