Final term exam

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Section : B

Semester # 6th

Subject : Highway & Traffic engineering

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Q# 01
Part (A) Comparison of flexible Vs Rigid Pavement

* Flexible pavement :-
- Bitumen is used a binder in flexible pavement.
- Deformation in the sub grade is transferred to the upper layer
- Load is transferred by grain to grain contact.
- Flexible pavements have low initial construction costs but have but have low maintenance cost.
- How low life span usually 10-15 years
- Surfacing cannot be laid directly on the sub grade but a sub base is needed.
- Road can be used for trafic within 24 hours.

Rigid pavements:-

- Cement is used as a binder in rigid pavements.
- Deformation in the sub grade is not transferred to subsequent layers.
- No phenomenon of grain to grain load transfer exists.
- Rigid pavements have low maintenance cost but have high initial construction costs.
- life span is more as compare to flexible usually 30+ years.
- Surfacing can be directly laid on the sub grade.
- Road cannot be used until 14 days of curing.

Q#02
Part (B) Advantages of Water bond over over Mix Macadem:-

- The main advantage of Wet-Mix Macadem is that it is compated of a well-graded Mixture. This ensure good interlook and high stability.
- Addition of Water While mixing facilities the handling of the mixture. The operation of laying is much simpler than that of Water-bound macadem. Where the screenings and binding material have to be added in stages and forced into voids. if a crusher-run material is used, there ~~in~~ is no possibility of plastic fines entering into the mixture.
- The compaction is greatly facilitated by the moisture added which lubricates the individual particals.
- One advantage of the Wet-Mix Macadem is that It is slightly costlier than Water-bound macadem.

This is because the specification involves the use of mixing plant and paver. On the other hand Water-bound macadem has been traditionally a labour-oriented specification.

- The aggregates for Wet-mix macadem ~~has been traditionally~~ will have to be crusher-run. Whereas the aggregates for Water-bound macadam are generally hand-broken.

Q # 01
Part(c)

Asphalt	bitumen
. Asphalt is generally used as a term to refer to the combination of bitumen and gravel specification for road construction.	. In some literature bitumen is actually the liquid binder that holds asphalt together.
. Asphalt is produced in a plant that heat, dries and mix aggregate bitween and send into a composite.	. Bitumen sprayed and then covered with an aggregate. This is then repeated to give a two coat seal.

Q#02 Solution:-

For a design speed of 75 m/h

K = 312 from table 15.5

Minimum length = 312 [3 - (-4)]

= 2184 ft

Station of BVC = (34+60) - $\left[\frac{21+84}{2}\right]$

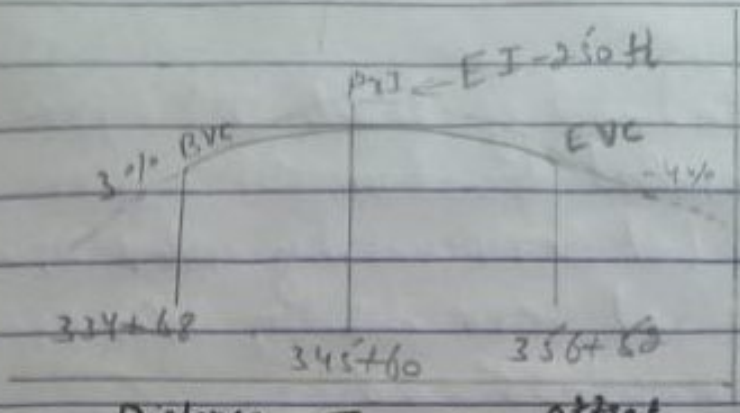
= 334 + 68

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	Tangent elevation	offset $r = Ax^2/200$	Curve elevation (Tangent-elevation offset) ft
BVC 334+68	0	217.24	0.01	217.24
BVC 335+00	32	217.24+3.2 = 218.2	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	230.20	1.77	225.43
BVc 339+00	432	233.20	4.54	228.66
BVc 340+00	532	236.20	6.40	229.80
BVc 341+00	632	239.20	8.59	230.61
BVc 342+00	732	242.20	11.09	231.11
BVc 343+00	832	245.20	13.92	231.28
BVc 344+00	932	248.20	17.07	231.13
BVc 345+00	1032	251.20	20.54	230.66
BVc 346+00	1132	254.20	24.32	229.88
BVc 347+00	1232	257.20	28.403	228.77
BVc 348+00	1332	260.20	32.86	227.34
BVc 349+00	1432	263.20	37.61	225.59
BVc 350+00	1432	266.20	42.68	223.52
BVc 351+00	1432	269.20	48.07	221.13
BVc 352+00	1432	272.20	53.79	218.41
BVc 353+00	1532	275.20	59.82	215.38
BVc 354+00	1632	278.20	66.17	212.03
BVc 355+00	1732	281.20	72.84	208.36
BVc 356+00	1832	284.20	76.44	206.20
	1932			
	2032			
	2124			

Q#03

Solution:-

Reliability level (R) = 99%
Standard deviation (So) = 0.49
Initial serviceability index Pi = 4.5
Terminal serviceability index Pt = 2.5
$\Delta PSI = 4.5 - 2.5 = 2.0$

Finding SN1 and D1 (Surface course).

Step#01:- Draw the line finding the reliability level of 99% and the over all standard deviation So of 0.49

Step#02:- Draw a line joining point A to the ESAL of 2×10^6

Step#03:- Draw a line Joining Point ~~A to the ESAL~~ B and resilnd modules and extent this line

Step#04:- Draw a horizontal line from the point C to intersect the design serviceability.

-> loss (PSI) Curve at point D

$\Delta PSI = 4.5 - 2.5 = 2$

-> D1 of Surface Coarse is 2.6

Step#05:- Resilind value of Asphalt
= 450,000 lb/in²

Therefore a1 = 0.44

Thickness of Surface Course D1

$D_1 = SN_1/a_1$

$2.6/0.44$

$= 5.9''$

Thickness should be taken to the nearst 0.5".

So thickness of Surface Course is 6"

$SN_1 = D_1 \times a_1$

$SN_1 = 6 \times 0.44 = 2.64$

Finding SN_2 and D_2 (Base Course).

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

$= (38.264)/0.14 \times 0.80$

$D_2 = 10.36''$

Use 12"

So thickness of base Coarse is 12"

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

$SN_2^* = 398$

Finding SN_2 and D_3 (Sub base Course)

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

$$D_2 = (4.4 - 3.98)/0.10 * 0.80$$

$$D_2 = 5.25''$$

We will use 6" as a sub base

$$SN_3 = 2.64 + 1.24 + 6'' \times 0.10 \times 0.80$$

$$SN_3 = 4.48 > 4.4 \text{ okey}$$

Final design:-

Surface Course = 6"

Base Course = 10"

Subbase = 6"

Total pavement thickness = 24"

Q#04

* **Pavement Distress:-**

=> Distress is a condition of pavement structure that reduce serviceability or loads to reduction in service life.

=> Distress could occure in Pavement due to.

- Unstable mixes.
- Higher Wheel loads than these considered in design.

* **Alligator Cracking:-**

=> Possible Causes

- over loading
- Inadequate structural design
- Poor construction

Repair:- Crack sealing is effective.

* **Block Cracking:-**

=> Possible Causes:-

- HMA shrinkage
- Asphalt binder aging
- Poor choice of asphalt binder in the mix design

Repair:- ~~Crack sealing is effective~~

- Low serverity - High serverity cracks

Q#04

* Pavement Distress:-

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- Higher wheel loads than these considered in design.

* Alligator Cracking:-

=> Possible Cause:

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- Poor construction.

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* Block Cracking:-

=> Possible Causes:-

- HMA shrinkage
- Asphalt binder aging
- Poor choice of asphalt binder in the mix design

Repair:- ~~Crack sealing is effective~~

- Low serverity • High serverity cracks

* Potholes:-
Small bowl shape depression in the pavement Surface that penetrate all the way through the HMA layer down to base course.

* Rutting:-
Surface depression in the wheel path are parbically evident after a rain when they are filled with water

Possible causes:-
Insufficient Compaction of HMA layer during Construction
- Sub grade rutting
- Improper Mix design.

Repair:- => Slight rute.

* Bleeding:-

Possible causes:-
- Excessive asphalt binder in the HMA

- Excessive application of asphalt binder during BST application
- Low HMA air void content

* Polished aggregate:-

Possible Cause:- Repeated traffic application this can occure quicker if the aggregate is susceptable to abrasion.

Repair:- Apply a skid-resistance slurry seal BST or non structur overlay.