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Section # A

Semster = 6th

Program = B.Sc civil Engineering

Subject: Highway and traffic Engineering

(1) Ans (a) Comparison of flexible vs Rigid Pavement

Flexible Pavement	Rigid Pavement
(i) Bitumen is used a binder in flexible pavement	(i) cement is used as a binder in rigid pavement
(ii) Deformation in the sub grade is transfered to the upper layer	(ii) Deformation in the sub grade is not transferred to subsequent layers
(iii) load is transferred by grain to grain contact	(iii) no such phenomenon of grain to grain load tranfer exists
(iv) flexible pavement have low intial construction costs but have high maintenance cost	(iv) Rigid pavement have low maintenance cost but have high intial construction costs.
(v) Have low life span usually 10-15	(v) life span is more as compare to flexible usually 30+ year
(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 load highly dependent on strength	(viii) Strength of road less dependent on strength of subgrade in rigid Pavement.

Flexible Pavement	Rigid Pavement
(vii) of Sub grade.	
(viii) Road can be used for traffic within 24 hour	(viii) Road cannot be used until 14 days of curing

(b) Advantages of water bound over mix macadam

(i) water bound Macadam :-
if the stone material are held together by the addition of water and filler.

(ii) wet mix macadam :-
if graded stones are used mixed with water and compacted.

Advantages of water bound over mix macadam

(x) The main advantages 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 that of water-bound macadam where the screenings and binding material is used there is have to be added in stages and forced into voids if a crusher-run 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.

(1) Ans (c) Differences between Asphalt and Bitumen.

Asphalt	Bitumen.
(i) Asphalt pavement are durable with a layer depth of 25 - 40mm and life span of 20+ year	(i) Bitumen pavement are less durable with a layer depth of 10-20 mm and lifespan of 5-10 years.

Asphalt	Bitumen
(ii) Surface made of asphalt is smother and more skidresistant ensuring the driver safety and minimal noise.	(ii) The loose fragements on bitumen pavements make the driving experience noister and can wear down tires consequently causing safety issues.
(iii) ~~Surface made of asphalt is smoother and more~~ Reduced friction between tire and car meaning better fuel economy and minimization of carbon dioxide emission	(iii) Higher frictional resistance of a bitumen Pavement mean less efficiency in energy utilization
(iv) installation is comparatively costlier	(iv) cheap to install compared to asphalt
(v) less sensitive to temperature compare to bitumen pavement negative impact are seen only in extremely high or low temperature.	(v) Pavement are susceptible to high temperature which can make it slick and soft.

(2) Ans

Solution:-

for a design speed of 75 min/h K = 312

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	offset $y = \frac{Ax^2}{200L}$ ft	curve Elevation = tangent elevation − offset.
BVC 334+68	0	217.24	0.01	217.24
BVC 335+00	32	$217.24 \times \frac{32}{100} \times 3 = 48.0$	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	227.13
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

Bvc347+00	1232	254.20	24.32	229.88
Bvc348+00	1332	257.20	28.32	228.77
Bvc349+00	1432	260.20	32.86	227.34
Bvc350+00	1532	263.20	37.61	225.59
Bvc351+00	1632	266.20	42.68	223.52
Bvc352+00	1732	269.20	48.07	221.13
Bvc353+00	1832	272.20	53.79	218.41
Bvc354+00	1932	275.20	59.82	215.38
Bvc355+00	2032	278.20	66.17	212.03
Bvc356+00	2132	281.20	72.84	208.36
Bvc356+52	2184	282.76	76.44	206.32

(3) Ans

Step #1

Draw a line joining the reliability level of 99% and the overall standard divation so of 0.49 and extend line to interset the first TL line at point A

Step #02

Draw a line joing point A to the BAL 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 resident modulus (MR) of base course and extand this line to intersect the design Serviceability loss chart at point C

Step # 4

Draw a horizantal line from point C to intersect the design Serviceability loss (PSI) cure at point D So here

$$\Delta PSI = 4.5 - 2.5 = 2$$

Step # 5

The structure number require to product the base course and to find the thickness DI of the surface coarse is 2.6.

Step # 6

Determine the appropriate structure layer co-efficient for each construction material Resilient value of Asphalt = 450,000 lb/in²

$$DI = SN1 / a1$$

$$2.6 / 0.44 = 5.9''$$

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.

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

$$D_2 = (3.8 - 2.64) / 1.4 \times 0.80$$

$$D_2 = 10.36"$$

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 coefficient a_3 and drainage coefficient m_2 from their moisture 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 a 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"

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(4) Ans Pavament distresses:-

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

(*) Distresses could occur in a pavement due to

(*) unstable mixes

(*) Higher wheel load than those considered in design.

Alligator (fatigue) cracking

* Possible cases
* overloading
* inadequate structure 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
  * Poor choice of asphalt binder in the mix design

*Repair

* low severity cracks (> 1/2 inch wide and cracks with revaled edges Remove and replace the cracked pavement layer with an ~~old~~ overlay.

potholes:-

* Small bowl shapped depression 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 road with thin HMA surfaces (1 to 2 inch) and seldom occur on roads with 4 inch ~~Pot~~ deeper HMA surface.

(*) Problem Roughness (serious vehicular damage can result of fatigue for driving across potholes at higher speeds moisture infiltration.

Rutting:-

Surface depression in the wheel Path, are particular evident after a rain when they are filled with water

Possible causes.

(A) insufficient compaction of HMA layer during construction

(B) Subgrade rutting (e.g) as a result of inadequate pavement structure)

Repair.

(A) slight ruts (> 1/3 inch deep) can generally be left untreated pavement with deeper ruts should be leveld and overlayed.

Bleeding.

* Problem of skid resistance when wet
* Possible cause.
* Excessive asphalt binder in the HMA
* Excessive application of asphalt binder during BST application.

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.

Raveling:-

* loose debris on the pavement roughness and loss of skid resistance
* Possible causes.
* Asphalt binder aging
* Aggregate segregation if fine particles are missing from the aggregate-matrix.