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Section :: "B"

Subject :: Highway and traffic Engineering

Smester :: 6th

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Q No-1

What is different B/w flexible and rigid pavments ?.

FLEXIBLE PAVEMENT	RIGID PAVEMENT.
→ Bitumen is used a binder in flexible pavements	→ Cement is used as a binder in rigid pavements.
→ Deformation in the subgrade is transferred to the upper layer.	→ Deformation in to subgrade is not transferred to subsequent layers.
→ Load is transferred by grain to grain contact.	→ No concept of grains to grains transffer
→ It have low initial construction costs but have high maintance cost	→ It has low maintance cost but have high initial construction costs.
→ The life span is usually 10-15 yrs.	→ Life span is more than 30 yrs.
→ Surfacing cannot be laid directly on the subgrade but sub base is needed	→ Surfacing can be directly laid on the subgrade
→ Road can be used for traffic with 24 hrs.	→ Road cannot be used until 14 days of curing.

Q No. 1 (B)

What are the advantages of water bound over wet mix macadam?

Ans/ 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-mix macadam requires mixer plant and power.

→ Aggregates of WBM are or can be broken by hands while the WMM needs a crusher for the disintigration of aggragates.

→ The inter locking of aggregate are or can be broken by hands while particles imparts adequite strength of the materials for filling the voids - these ensure non entry of the plastic materials of the subgrade into voids.

Q.No. 2

PART: C

⇒ What is the difference between asphalt and bitumen.

Ans → 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 resistance to damage from water and soil spills. This make bitumen the ideal binder for asphalt because asphalt is commonly used as a surface for roads, car, parks etc.

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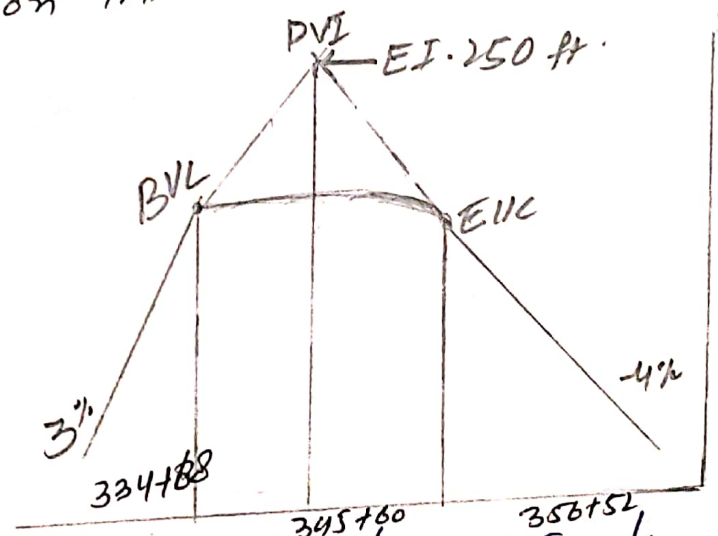
Q No. 2

A crest vertical curve joining a +3 percent and a -4 percent grade is to be design for 75 mi/h. If the tangents interfect at station and elevations of 250 fts, determine the station and elevation of the BVC and EVC. Also calculate the elevation of intermediate points on the curve at the whole stations.



Solutions: For a design speed of 75 mi/h, K = 312 (From table)

Mini. Length = 312 × [3 - (-4)] = 2184 ft

Station of BVC = (345+60) - $\frac{(21+84)}{2}$ = 334 + 68

Station of EVC = (334+68) + (21+84) = 356+52

Elevation of BVC = 250 - (0.03 × $\frac{2184}{2}$) = 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 $\left[y = \frac{A x^2}{800L}\right]$ (ft)	Curve elevation (tangent elevation) offset ft.
BVC 335+68	0	217.24	0.01	217.24
BVC 336+00	32	218.20	0.02	218.18
BVC 337+00	132	221.20	0.28	220.92
BVC 338+00	232	224.20	0.86	223.34
BVC 339+00	332	227.20	1.77	225.43
BVC 340+00	432	230.20	2.99	227.21
BVC 341+00	532	233.20	4.54	228.66
BVC 342+00	632	236.20	6.40	229.80
BVC 343+00	732	239.20	8.59	230.61
BVC 344+00	832	242.20	11.09	231.11
BVC 345+00	932	245.20	13.92	231.28
BVC 346+00	1032	248.20	17.07	231.13
BVC 347+00	1132	251.20	20.54	230.66
BVC 348+00	1232	254.20	24.32	229.88
BVC 349+00	1332	257.20	28.43	228.77
BVC 350+00	1432	260.20	32.86	227.34
BVC 351+00	1532	263.20	37.61	225.59
BVC 352+00	1632	266.20	42.68	223.52
BVC 353+00	1732	269.20	48.07	221.13
BVC 354+00	1832	272.20	53.79	218.41
BVC 355+00	1932	275.20	59.82	215.38
BVC 356+00	2032	278.20	66.17	212.03
~~BVC~~ 356+00	2132	281.20	72.84	208.36
EVC 357+52	2184	282.76	76.44	206.32

Q No. 3

A Flexible highway is to be design to carry a design ESAL of 2×10^6. It is estimated that it takes about a week for water to be drained from within the pavement and the pavement structure will be exposed to moisture levels approaching saturation for 30% of the time. The following additional information is avaicable;

- → Resilient modulus of asphalt concrete at 68F 450,000 lb/in².
- → CBR value of Base course material 100, Mr 31,000 lb/in²
- → CBR value of Sub Base course material 22, Mr 13,500 lb/in²
- → CBR value of Subgrade material 6
- → Mr of Subgrade 6×1500 lb/in² = 9000 lb/in²

Solution

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 (Mr) 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
→ Lose (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 thicknes D_1 of the surface course is 2.6.

Step #06 :-

Determine the appropriate structure layer Co-efficent for each construction material. Resilient value of asphalt = 450,000 lb/in², therefore

$a_1 = 0.44$ $\quad D_1 = SN_1/a_1$

$2.6/0.44 = 5.9"$

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 cofficient table and m_2 from drainaged co-efficient table.

→ Thickness of Base Course (D_2)

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

$D_2 \quad (3.8 - 2.64/14 \times 0.80)$

$D_2 \quad 10.36"$

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_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 sub base

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

$SN_3 = 4.46 > 4.4$ OKAY !.

⇒ FINAL DESIGN :-

→ Surface course = 6"

→ Base course = 12"

→ SUB Base = 6"

→ Total pavement thickness = 24".

Qno.4

What are the different pavement distresses? Explain in details?

Ans/ Following are the different pavement distresses.

① ALLIGATOR CRACKING:-

Possible causes	Repair
Over loading	→ Crack Sealing is no effective
Inadequate Structural design	→ Dig out and replace area of poor subgrade.
poor construction	

② BLOCK CRACKING:-

problems:- Allows moisture Infiltration

Possible causes	Repair
→ HMA Shrinkage	→ Low severity cracks (< ½" wide) crack seal to prevent entry of moisture
→ Asphalt binder aging	→ High severity cracks (> ½" wide) and cracks with the raveled edges remove and replace the cracked pavement layer with an overly -
→ poor choice of asphalt binder in the mix design.	

③ POTHOLES:-

These are small, bowl shape 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 Surface (1"–2") and seldom occurs on road with 4" or deeper HMA surfaces.

Problem :- Roughness (Serious vehicular drainge can result from driving accross potholes at higher speeds), moisture infiltration.

Possible causes	Repair
→ Generally, potholes are the end result of fatigue cracking. As fatigue cracking becomes sever, the interconnected cracks create small chunks of pavement, which can be dislodged as vehicles drive over them.	→ 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
→ 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 angular aggregate particle	→ Slight ruts (< 1/3" deep) can generaly be left Untreted. 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.
- Low HMA air void content.
- Excessive application of asphalt binder during during BST application.

6. POLISHED AGGREGATE:

Possible cause	Repair
→ Repeated traffic application This can accel quicker if the aggregate is susceptible to abrasion.	Apply a skid-resistance slurry seal, BST or non-structural overlay.

7. RAVELING:

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

Possible Cause	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 damage pavement and overlay.