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Term	Final
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Q No (01)

Part (a)

What is the difference between flexible and rigid pavement?

Ans :→

Difference b/w Flexible & Rigid Pavement:

Flexible Pavement	Rigid Pavement
1→ In Flexible Pavement Bitumen is used as a binder	1→ While in Rigid Pavement Cement is used as a binder.
2→ In Flexible pavement Deformation in the Sub grade is Transfered to the upper layers.	2→ While in Rigid the Deformation in the Sub grad is not Transfred to the Subsequent layers.
3→ Load is Transfered by grain to grain Contact in Flexible pavement	3→ No Such Phenomina of grain to grain Trasf exist in Rigid pavement.
4→ Flexible Pavements have low initial Construction Cost but have high maintainace cost	4→ Rigid pavement have low maintenace cost but have high initial Construction Costs.
5→ Flexible Pavement have low life Span usually 10-15 years	5→ Life Span of Rigid is more as compare to flexible usually 30+ years.

6→ Surfacing cannot be laid directly on the Sub grade but a Sub base is needed in flexible pavement.	6→ But in Rigid pavements Surfacing can be directly laid on the Surface of Sub grade.
7→ In flexible pavement Strength of the Road highly dependent on the Strength of Sub grade.	7→ Strength of Road less dependent on Strength of Sub grade in Rigid pavement
8→ In flexible pavement Road can be used for Traffic within 24 hours.	8→ Road can not be used until 14 days of Curing.
9→ Easy to locate the underground work like pipe location. etc	9→ Difficult to do the underground work.
10→ Thickness is more	10→ Thickness is ~~more~~ less.

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Q No 01

Part B :→

Ans :→

↳ Advantages of W.B.M over W.M.M :→

→ The water bound macadam (W.B.M) is less costly in term of construction of base course then the wet mix macadam as its specification do not involve the use of mixing plant and paver.

→ water bound macadam requirs more time for construction

→ wet mix macadam roads are superior the water bound macadam in all aspects but WBM is the old method of construction having low construction cost because it has been Traditianally a labour oriented specification.

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Q No (01)

Part C :→

What is the difference between Asfalt and bituman?

Ans :→

↳ Bitumen :→

A class black or dark-colored cementation substances, natural or manufactured, composed principlly of high molecular weight hydrocarbons found in Asphalts, pitches, and Asphaltites are typical.

→ In some literature Bitumen is actually the liquid binder that holds asphalt together.

→ Composition of Bitumen is partially hydrogeneted poly cyclic aromatic compound. $C_{10}H_8$

→ Density of Bitumen → 1040 kg/m^3

→ Boiling point of bituman → 525 °C

↳ Asphalt :-

While on the other hand Asphalt is a dark brown to black cementitious material in which the predominating constituents are bitumen which occurs in nature or obtained in fractional distillation of petroleum (Crude oil) along with certain mineral matter.

→ Asphalt is generally used as a term to refer to the combinations of bitumen and gravel Specification for Road Construction.

→ Asphalt is Composite Mix of aggregate, Sand dust & Bitumen.

→ 95% Stone, Sand & 5% as a binder bitumens.

→ Temprature 150°c to 190°c
Density → 2330 kg/m³
Less flexible pavement → 10-14 mm
More flexible pavement → 5-10 mm.

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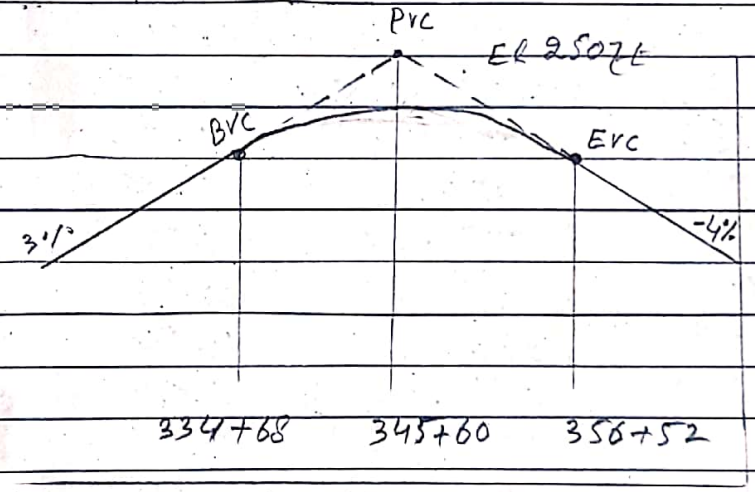
Q no (02)

A crest vertical curve joining a +3 percent and a -4 percent grade is to be designed for 75 mi/h. If the tangent intersect at station (345+60.6) at an elevation of 2507ft, Determine the station and elevation of BVC & EVC. Also Calculate the elevation of intermediate points on the curve at the whole station.



Sol :→

For a design Speed of 75 mil/h,

$K = 312$

So

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

Now calculation of elevation of Intermediat point of whole Station :-

Station	Distance from BVC (x) ft	Tangent Elevation (ft)	Offset $\left[y = \frac{ex^2}{200L}\right]$ (ft)	Curve Elevation (ft)
BVC 334+68	0	217.24	0.01	217.24
BVC 335+00	32	$217.2 + \frac{32}{100} \times 3 = 218.2$	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	227.20	1.77	225.43
BVC 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
EVC 356+52	2184	282.76	76.44	206.32

Q no. (03)

Ans :→

Step 01 :→ Draw a line joining the realiability level of 99% & the overall standared deviation So of 0.49 and extend 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 first TL line at a point B.

Step 03 :→ Draw a line joining point B and Relient modulas (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 → loss (PSI) curve at point D, So here

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

Step 05 :→ The structure number requir to protect the base course and to find the thickness D1 of the surface coarse is 2.6

Step 06:- Determine the appropriate structure layer co-efficient for each construction material - Resilient 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 thickness of the Surface course is 6"

$SN_1 = D_1 \times a_1$

$= 6 \times 0.44 = 2.44$

Now find SN_2 and D_2 (Base coarse) Find the value of a_2 from layers co-efficient table and m_2 from drainage co-efficient table.

→ Thickness of base coarse (D_2)

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

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

$$D_2 = 10.36''$$

use 12"

So The Thickness of base Coarse is 12"

Then

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

$$SN_2 = 1.34 + 2.64$$

$$SN_2 = 3.98$$

Finding SN_3 & D_3 (Sub base Course) and also layer Co-efficient a_3 and drainag coefficient m_2 from their respective 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

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

$$SN_3 = 4.46 > 4.4 \text{ okay}$$

Final Design:-

→ Surface Course = 6"
→ Base Course = 12"
→ Sub base = 6"
→ Total Pavement Thickness = 24"

Q no 04

What are the different pavement distress? Explain in detail.

Ans :→

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

↳ Distress could occur in a pavement due to:
- → Unstable mix
- → Higher wheel load than those considered in design.

⇒ Alligator (Fatigue) Cracking.

Possible Causes:-
- ↳ Overloading
- ↳ Inadequate structure design
- ↳ Poor construction.

Repair:-
- ↳ Crack Sealing is in effective
- ↳ Dig out and replace area of poor subgrade.

⇒ Block Cracking

problem:-
Allow moisture infiltration

possible causes:-
- ↳ HMA Shrinkage
  Asphalt binder aging
- ↳ Poor choice of asphalt binder in mix design

Repair :-

↳ Seal to prevent entry of moisture.

↳ Also replace & remove the cracked pavement layer with an overlay in high severiety.

⇒ Potholes :-

Small bowl-shaped depression in the pavement surface that penetrate all the way through the HMA layer down to the base coarse

Problem :-

Roughness

possible causes :-

Creat small chunks. of pavements.

Repair :-

patching techniques.

⇒ Rutting :-

possible causes :-

↳ Insufficient compaction of HMA layer during construction.

↳ Improper mix Design.

Repair:-
Slight ruts can generally be left untreated. pavement with deeper ruts should be leveled and overload.

=> Bleeding

problem
loss of skid resistance when wet

possible Causes:-
↳ Excessive asphalt binder
↳ Excessive application of asphalt binder during BST application.
↳ low HMA air void Content

=> Ravelling:-

possible causes:-
↳ Asphalt binder aging
↳ Aggregate segregation.
↳ Inadequate compaction during construction.

Repair:-
Fog/seal/Slurry Seal.
or Remove the damaged pavement and overlay.