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Subject : highway & traffic.

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Section : "B"

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Q1 What is the difference b/w flexible and rigid pavement

	Flexible pavement	Rigid Pavement
1	Bitumen is used as a binder in flexible pavement	Cement is used as a binder in rigid Pave
(2)	Diformation in the subgrade is transfered to the upper layers.	Deformation in the subgrade is not transfered to subsequent layers.
3)	Load is transfered by grain to grain contact	No such phenomenon of grain to grain load transfer exists.
(4)	Have low life span usually 10-15 years.	Life is more as Compare to flexible usually 30+ years.
(5)	Road can be used for traffic with in 24 hours.	Road cannot be used until 14 days of curing.

(b) What are the advantages of water bound over wet mix macadam.?

→ The main advatages 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 facilities the handling of the mixture The operation layer laying is much simpler than that of water bound macadam. Where the screening and bindings material 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 moisture added which lubricates the individual particles.

→ The aggregates for which wet mix macadam will have to be Crusher run. whereas the aggregates for water - bound macadam are generally hand broken.

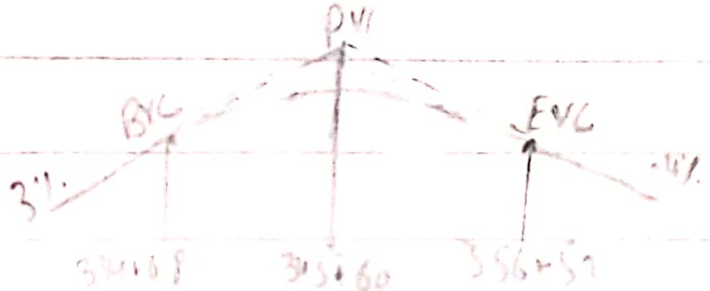
Q What is the differences b/w asphalt and bitumen ?

Bitumen	Asphalt.
→ A class of black or dark-coloured Cementation substance natural or manufactured Composed principally of high molecular weight ~~hydration~~ hydrocarbon found in Asphalts Tars, pitches are typical	A dark brown to black Cementitious mat in which the predominating Constituents are bitumen which occur in nature or are obtained in fractional distillation along with certian mineral ~~fad~~ matter.

→ In some literature 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 spacifically for road construction.

Q no 02. A crest virtical vertical curve joining a +3 Percent and +4 Percent grade is to designed for 75 mi/h. if the tangents intersect at station (345+60.00) at an elevation of 250' determine the station and elevation of BVC and EVC, Also calculate the elevations of inter mediate points on the curve at the whole stations.



Solution :-

For a design speed of 75 mi/h,

K = 312 from table 15.5.

minimum length = $312 \times [3-(-4)] =$

2184'

Station of BVC = $\left(345+60 - \left(\frac{21+84}{2}\right)\right.$

= 334 + 68

station of EVC = (334+68) + (21+84)

= 356 + 52

Elevation of BVC = $250 - (0.03 \times \frac{2184}{2}) = 217.24$ ft.

Q No.3 A flexible pavement for an urban interstate highway is to designed using 1993 .....

Ans Resilient modulus of Asphalt Concrete at 68°F 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 6×15,00 lb/in²

= 9000 lb/in²

Flexible Pavement Design :->

→ Reliability level (R) = 99%

standard deviation S_o = 0.49.

Initial Serviceability index, P_i = 4.5

Terminal Serviceability index P_t = 2.5

$\Delta PSi = Pi - Pt =$

$= 4.5 - 2.5 = 2.0$

Step - 1

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 at point A.

Finding the value of SNi & Di:-

Step : 02

Draw a line joining point A to the ESAL 2×10^6 and this line to intersect the second TL line at point B.

Step : 3

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

Step : 04

- Draw a horizental line from point C to intersect the design serviceal
- loss (PSI) Curve at Point Di

$$\Delta Psi = Pi - Pt = 4.5 - 2.5$$
$$= 2.0$$

So the structure number required to protect the base course and to find the Thickness DI of surface course is 2.6

Step : 05

Determine the appropriate structure layer co-e-fficient for each construction material , - Risilient value of asphalt = 450,000 lb/in², Therefore ai = 0.44

Thickness of surface - Coarse Di :

$$Di = \frac{SNi}{ai} \quad \because SNI = 2.6, \; ai = 0.44$$

$$= \frac{2.6}{0.44} = 5.9''$$

Thickness should be taken to the nearest 0.5".

So Thickness of surface course is 6"

$$SN_1 = D_1'' \times a_1$$

$$= 6 \times 0.44$$

$$SN_1 = 2.64$$

Finding SN_2 and D_2 (Base course).

$\because SN_2$ from table $= 3.8$

$\because a_2 = 0.14$

$\because m_2 = 0.80$

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

$$= (3.8 - 2.64)\, 0.14 \times 0.80$$

$$D_2 = 10.36''$$

Use 12"

So Thickness of base course 12"

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

$$SN_2 = 1.34 + 2.64$$

$$= 3.98$$

Finding SN3 and D3.

$\therefore SN3 = 4.4$

$\therefore a3 = 0.10$

$\therefore m3 = 0.80$

$D3 = (SN3 - SN2) / a3m3$

$= 6(4.4 - 3.98) / 0.10 \times 0.80$

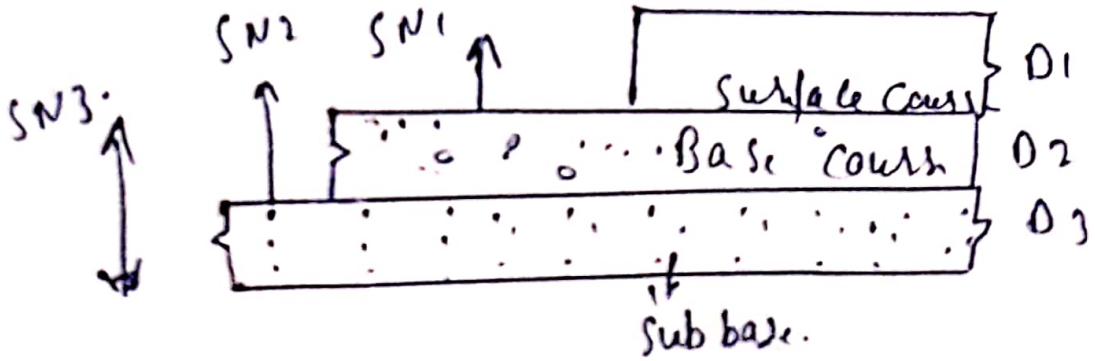
$D3 = 5.25''$

We will use 6" as sub base

$SN3 = 2.64 + 1.34 + 6'' \times 0.10 \times 0.80$

$SN3 = 4.46 > 4.4$ okay.

Final Design :=>



Ashto Design equation For SN.

$$\log_{10} W_{18} = ZR S_o + 9.36 \log_{10}[SN+1] - 0.20$$

$$\frac{\log_{10}\left[\Delta PSI / 4.1 - 1.5\right]}{0.40 + \left[1094 / (SN+1)^{5.19}\right]}$$

$$+ 2.32 \log_{10} M_r - 8.07$$

Q4 What are the different pavement distresses ? Explain in details?

⇒ Pavement Distresses :->

Distress 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 loads than those considered in design.

→ Alligator (Fatigue) Cracking :->

→ Possible Causes :->

- overloading
- inadequate structural 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 the mix design.

→ Repair :

- Low severity cracks (< 1/2 inch wide) crack seal prevent entry of moisture.
- High severity (> 1/2 inch wide and cracks with reveled edges) Remove and Replace the cracked pavement layer with an overlay.

Potholes :->

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

→ Problem :→

Roughness (serious vehicular damage can result from driving across potholes at higher speeds) moisture infiltration.

→ Possible causes :→

Generally potholes are the end result of fatigue cracking.

→ Repair :→

patching techniques.

→ Rutting :→

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

→ Possible causes :→

insufficient Compaction of HMA layers during construction

Subgrade rutting (e.g excessively high asphalt content

- Subgrade rutting :(eg as a result of inadequate pavement structure)

Repair :->

- Slight ruts (< 1/3" deep) can generally be left untreated, pavement with deeper ruts should be leveled and overlayed.

-> Bleeding :->

-> problem : loss of skid resistance when wet.

-> Possible cause :->

Excessive asphalt binder in the HMA

-> Low HMA air void content.

Polished Aggregate :

-> Possible causes :->

Repeated traffic application

This can occur quicker if the aggregate is susceptible to abrasion.

-> Repair : Apply a skid-resistant seal BST, or non structural overlay.

⇒ Raveling :

⇒ loose debris on the Pavement which increases Pavement roughness and loss of skid resistance.

→ Possible causes :->

- Asphalt binder aging.
- Aggregate segregation.

if fine particles are missing from the aggregate matrix.

Repair :->

Fog seal / slurry seal or Remove the damaged Pavement and overlay