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Q3, Part (a)

What is the difference b/w flexible and rigid Pavement?

Flexible Pavement	Rigid Pavement
1) Bitmun is used as binder in Pavement	. Cement is used as a binder
2) Have low life span usually 10-15 years	. Life span is more as compare to flexible usually 30+ years.
3) Deformation in the subgrade is transfered to the upper layers	. Deformation in subgrade is not transfered to subsequent layers.
4) Road can be used for traffic with in 24 hours.	. Roads cannot be used untill 14 days of curing
5) Flexible Pavements have low Initial construction costs but have high maintance cost.	. Rigid Pavements have low maintenance cost but have high initial construction costs.

Q1, Part (b)

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

1) The main advantage of wet-mix macadam over water-bound macadam is that it is composed of a well-graded mixture.

2) Addition of water while mixing facilitates the handling of the mixture. The operation of laying is much simpler than that of water bound. where the screenings and binding material have to be added in stages and forced into voids.

3) The compaction is greatly facilitated by the moisture added which lubricates individual particles.

4) One disadvantage of a wet-mix macadam is that it is slightly costlier than water-bound macadam. This is because the specification involves the use mixing plant and paver.

5) The aggregates for wet mix macadam will have to be crusher-run whereas the aggregates for water-bound macadam are generally hand-broken.

Q1 Part (c)

What is the difference between Bitumen and asphalt.

	Bitumen	Asphalt.
1)	A class of black or dark colored (solid, semi solid or viscous) cementitious substance natural or manufactured, composed of high molecular weight.	A dark Brown to black cementitious material in which Predominating consitituent are bitumen which occurs in nature or obtained by frictional distillation.
	In American Terminology Bitumen are same	both asphalt and
2)	In same literature Bitumen is actually the liquid binder that hold asphalt together.	Asphalt is generally used as term refer to the combination and gravel specifically for road construction.

Qno 2:-

Solution:-

For design speed of 75 mil/h

value of k from table

$K = 312$

Minimum Length-

$K \times (3 - (-4))$ $\quad \therefore k = 312$

$= 312 \times (3 - (-4))$

$= 2184 ft$

Station of BVC = Tangent intersection station. $-\left(\frac{21+84}{2}\right)$

∴ tangent intersection

station = (345+60)

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 = $250 - \left(0.03 + \frac{2184}{2}\right)$

$= 217.24 ft$

Qno 3)

Ansi-

Flexible Pavement Design:-

Reliability level CR = 99%.

Standard deviation So = 0.49

Initial Serviceability Index $P_i = 4.5$

Terminal Serviceability Index, $Px = 2.5$

Step 1.

Draw a line joining the reliability of 99% and the overall standard deviation so of 049, and extend this line to intersect the first T_2 at Point A.

Find value of SN, and D:-

Step 2:-

Draw a line joining Point A to the ESAL 2×10^6 and this line to intersect the second T_2 line at point B.

Step 3:-

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

Step:-4

Draw a horizontal line from Point C intersect the design serviceal.

loss (PSI) Curve at point D

$$\Delta PS_1 = P_i - P_t = 4.5 - 2.5 = 2.0$$

Step:-5

So the structure number required Protect the base course and to find the thickness DI of surface cause is 2.6

Step:-6

Determine the appropriate structure layer co-efficient for each construction moderial

Resilient value of asphalt = 450,000 lb/in²

therfore $a_1 = 0.44$

Thickness of surface coarse $D_1 = SN_1 / a_1$

$= \frac{2.6}{0.4} = 5.9''$

$\therefore SN_1 = 2.6$

$a_1 = 0.44$

Thickness should be taken to the nearest 0.5 inch

So, Thickness of surface coarse is 6"

$$SN_1 = D_1'' \times 2a_1$$

$$= 6 \times 0.44$$

$$SN_1 = 2.64$$

Q4 What are different Pavement distresses?

Pavement Distress:-

Distress is a condition of the Pavement structure that reduces serviceability or lead to reduction in services life.

Distress in Pave occure due to

- unstable mixes
- Higher wheel loads than those considered in design.

Aligator cracking:-

- Cause
- over loading
- Inadequate structure.

Repair

- Crack sealing is in effective.
- Dig out and replace Poor area.

Black cracking:-

Problem:-

Allow moisture, infiltration

Possible cause:-

- HMA Cause
- Asphalt Binder aging

Repair:-

Low severity crack (<½ inch wide). crack seal to Prevent entry of moisture high severity crack (>½ inch wide) and crack with revealed edges. Remove and replace the cracked Pavement layer with on overlay.

Potholes:-

Small bowlshaped depresion in the Pavement surface the Pentrates all the way through HMA layer down to the base course.

- Potholes are most likely to occure on road with the HMA surface (1 to 2 inch and seldom occure on road with 4inch or deeper HMA surface.

Repair:-

Patching Techniques.

Rutting:-

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

Possible cause:-

- In sufficient compaction of HMA layer during construction.
- Improper mix design (e.g as a result inadequate Pavement structure.
- Subgrade ruthig

Repair:-

Slight ruts (< 1/3 inch deep) can generally be left untreated.

Bleeding:-

Problem:-

→ less of skid resistance when wet.

Possible cause:-

- Excessive asphalt blinder in the HMA
- low HMA air void.

Rave Ling:-

loose debris on the Pavement which increase Pavement roughness and loss of Skid Resistance.

Possible cause:-

Asphalt binder aging.

In adequate compaction during construction.

Repair:-

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