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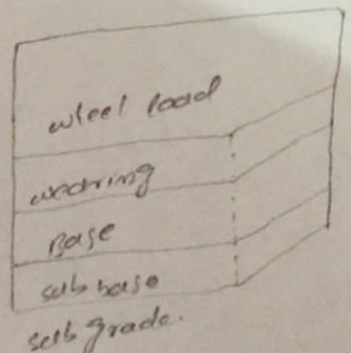
Q#01

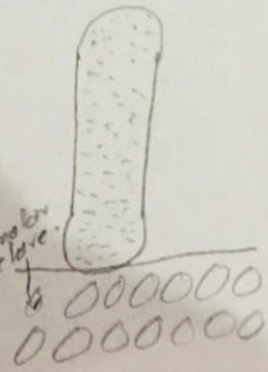


part #A

Answer: Comparison of flexible vs rigid pavement.

| Flexible pavement | rigid pavement. |
| --- | --- |
| ① Bitumen is used binder in flexible pavement. | 1" cement is used as a binder in rigid pavement |
| (2) Deformation of in the sub-Grade is transfered to the upper layer. | 2" Deformation in the sub grade is not transfered to subsequent layers |
| 3) load is transfered by Grain to grain contact. | 3" No such phenomena of grain to grain load transfer exists. |
| 4) Flexible pavement have low initial construction cost but have high maintenance cost | 4" Rigid pavement have low maintenance cost but have high initial construction costs. |
| 5) Road can be used for traffic with in 24 hours. | 5" Road can't be used until 14 days of curing |



Ans:- Advantage of water Bond over wet mix mecadam

* main advantages:-

(1) The main advantage of wet mix mecadam over water bound mecadam is that it is composed of well graded mixture. this ensure good interlocle and high stability

2) Addition of water while mixing facilities the handling of the ~~water bond mecadam~~ mixture of the operation of laying is much simpler then that of water bond mecadam. where the screening and the binding material have to be added in stage and forced into voids if a crusher ran material is used there is no possibility of plastic fines entering into the mixture

(3) The compaction is greatly facilated by the moisture added which lubricates the individual particales.

4) The aggregates for wet mix macadam will have to be crusher, ran whereas the aggregates for water bound mecadam are generally hand broken

* main Advantage:- The main advantages is its composed of well graded mixture.

Q#1 part # C

Ans:- Difference btw Asphalt and Bitumen:-

**Bitumen:-**

Bitumen is a liquid binder
- It hold asphalt together.
- A bitumen sealed surface is a layer of bitumen sprayed and then covered with an aggregate

**Asphalt:-**

- Asphalt is produced in plant
- It ~~previded~~ produced in plant that heats. dries and mixes aggregate, bitumen and sand into a composite.

**Benifits of Asphalt:-**

(1) minimal noise (2) Reduced wear and tear on vehicles and tires.

(3) safe than most pavement option.

**Benifits of Bitumen:-**

(1) cheap to Install compared to Asphalt

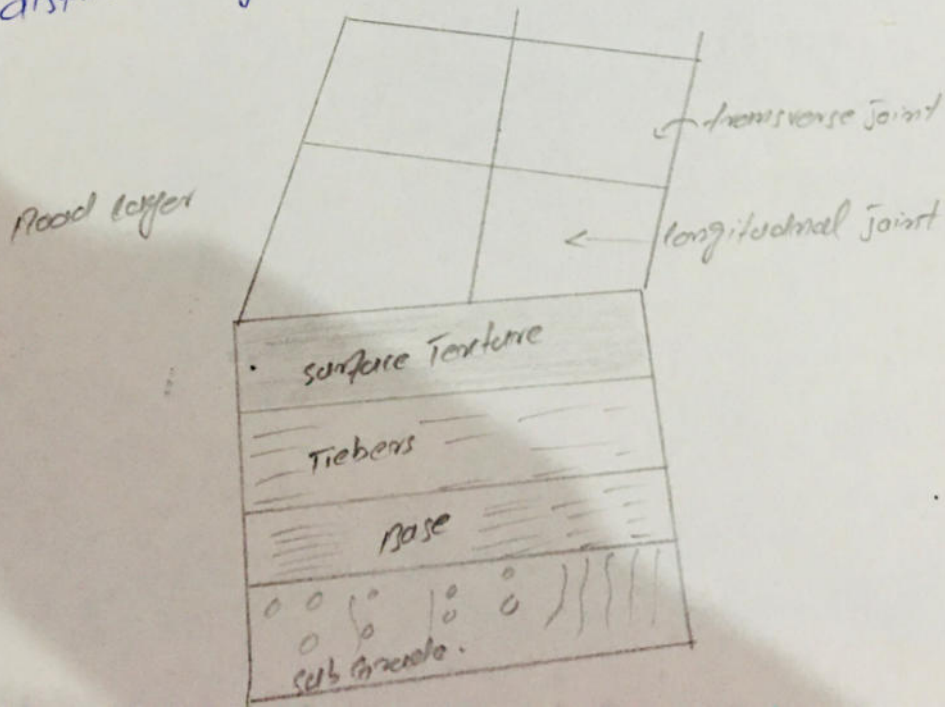
(2) Can be recycled Instead of Going to land fill.

Q #04 page #04

Ans Different pavement distresses:-

**Introduction:-** A highway pavement a structure consisting super imposed layers of processed materials. The pavement structure should be able to provide a surface of acceptable riding quality. Adequate skid resistance favourable light reflecting characteristic and low noise pollution.

**Rigid pavements:-** Rigid pavement have sufficient flexural strength to transmit the wheel load stresses to a wider area below. In rigid pavement load is distributed by slab Action.



## factored Affecting pavements performance:-

- Traffic. Contact pressure, wheel loading. Axle configuration moving load.

=> structural model Layer elastic model

=> material characterization.

=> Environmental factor. Temperature, moisture.

## Common Rigid pavement Distresses :-

(1) spalling (2) Faulting

3" Cracking (4) longitudinal cracle.

(5) slab cracking (6) Durability cracle.

(7) polished aggregate (8) pumping and water. Bleeding.

(9) shrinkage cracking.

Details

1: Spalling at the joint:- Cracking, breaking or chipping of joints (crack edges, usually occurs with in about 0.6m (2ft) of joint/crack edge.

=> It caused by infiltration of incompressible material and subsequent expension (can also caused blowsups)

2) Faulting: A difference elevation accross a joint or crack usually associated with undowled JPCP. usually the approch slab is higher then the leave slab due to pumping.

3) longitudnal Cracking: longitudnal cracks not associated with corner breaks or blowups that extend accross the entire slab into two or four pieces.

4) Corner Cracking: A slab that interest the PCC slab joint near the corner with in about 3m (10ft) or so. A corner extends through the entire slab and caused by high corner stresses.

(5) Rutting: Surface depression in a wheel path are particularly evident after a rain when they are filled with water.

Causes:
(1) Insufficient Compaction.
(2) Subgrade roating
(3) Improper mix design.

Repair:
① ~~loss of Stick~~ slight rust < 1/4 inch deep

(6) Bleeding:
• Loss of skid resistance when wet.

Causes:
• Excessive asphalt binder in the HMA
• Excessive application of Asphalt binder during BST application.

7) polished Aggregate:

Cause:
Repeated traffic application. (This can be occur quicker if the aggregate is susceptible to abrassion.

(8) Alligator:
Causes: over loading poor construction.
Repair:
① Cracle sealing in an effective
(2) rig out and replace area of subgrade.

(9) Block cracking: Allow moisture infiltration
Causes:
HMA Shrinkage
Asphalt binder aging

Q #02

Ans:-

Required data:-

Calculate the elevation of intermediate points on the curve at the whole stations ?-

Sol:-

As we know.

For designed speed of 75 min/h, Ic = 312 from table.

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 = $250 - (0.03 \times 2184/2) = 217.24 ft$

4. The remainder of the computation is efficiently done using the format show in table graph.

| Station | Distance from BVC (x) (ft) | Tangent Elevation (ft) | Offset $\left[Y = \frac{Ax^2}{200L}\right]$ (ft) | Curve Elevation (Tangent Elevation − offset) (ft) |
|---|---|---|---|---|
| BVC 334+68 | 0 | 217.24 | 0.01 | 217.24 |
| BVC 335+00 | 32 | $217.24 + \frac{32}{100} \times 3 = 218.20$ | 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 | 42.86 | 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 |
| BVC 356+52 | 2184 | 282.76 | 76.44 | 206.32 |

Q #03:-

Ans:-

Sol:-

- Reliability level (R) = 99%
- Standard deviation ($S_o$) = 0.49
- Initial serviceability index ($P_i$) = 4.5
- Terminal serviceability index ($P_t$) = 2.5
- $\Delta PSI = 4.5 - 2.5 = 2.0$

**step #1:-** Draw a line joining the reliability level 99% and the overall standard deviation ($S_o$) of 0.49 and extend this line to intersect the first TL line at point A.

**step #02:-** Draw a line joining point A to the ESAL of $2 \times 10^6$ and extend this line to intersect the second TL line at point "B"

**step #03:-** Draw a line joining point B and resilient modulus ($M_R$) of base coarse 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. In this problem

$\Delta PSI = 4.5 - 2.5 = 2.0$

∴ so the structure No required to protect the base coarse and to find the thickness ($D_1$) of the surface coarse 2.6.

**Step # 5 :-**

Determine the appropriate structure layer coefficient for each construction material

Resilient value of asphalt = 450000 lb/in²

Therefore $a_1 = 0.44$

**Thickness of surface course ($D_1$) =>**

By formula $D_1 = SN_1 / a_1$

$= 2.6 / 0.44 = 5.9'' \approx 6''$

As thickness should be taken to nearest 0.5", so the thickness of the surface course is 6"

Now

$SN_1^* = D_1 \times a_1 \Rightarrow 6 \times 0.44$

$SN_1^* = 2.64$

**Thickness of Base course = $D_2$ =-**

Also By formula

$$D_2 = \frac{(SN_2 - SN_1^*)}{a_2 m_2}$$

$$\Rightarrow \frac{3.8 - 2.64}{0.14 \times 0.80} \Rightarrow \boxed{D_2 = 10.36''}$$

Rounding $D_2$ to nearest whole Number i.e. 12"

so the thickness of Base course is 12"

$\Rightarrow SN_2^* = 0.14 \times 0.80 \times 12 + SN_1^*$

$= 1.34 + 2.64$

$\boxed{SN_2^* = 3.98}$

## Thickness of sub-Base course ($D_3$):-

$$\Rightarrow D_3 = \frac{(SN_3 - SN_2^*)}{a_3 m_3} = \frac{(4.4 - 3.98)}{0.10 \times 0.80}$$

$$\boxed{D_3 = 5.25}$$

we take 6" instead of 5.25" $\Rightarrow \boxed{D_3 = 6"}$

$$\Rightarrow SN_3^* = 2.64 + 1.34 + 6" \Rightarrow$$

$$\times 0.10 \times 0.80$$

$$SN_3^* = 4.46$$

As $4.46 > 4.4 \rightarrow$ O.K.

## Final design:-

=> Surface course = 6"
=> Base course = 12"
=> Sub Base = 6"
=> Total pavement thickness = 24"