

# Final Term Exam

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Section B

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Subject Highway and Traffic  
Engineering

Submitted To,

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Q.NO (01)

(a)

The Difference between flexible and Rigid pavement are;

Flexible PavementRigid Pavement

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>For binder of flexible pavement we used Bitumen.</li> </ul>            | <ul style="list-style-type: none"> <li>For binder of Rigid pavement we used Cement.</li> </ul>                      |
| <ul style="list-style-type: none"> <li>Load is transfer by grain to grain Contact</li> </ul>                  | <ul style="list-style-type: none"> <li>No Such phenomenon of grain to grain load transfer exists</li> </ul>         |
| <ul style="list-style-type: none"> <li>Have low life span usually 10-15 years</li> </ul>                      | <ul style="list-style-type: none"> <li>Life span is more as compare to flexible usually 30+ years.</li> </ul>       |
| <ul style="list-style-type: none"> <li>Deformation in the Sub grade is transferred to upper layers</li> </ul> | <ul style="list-style-type: none"> <li>Deformation in the Sub grad is not transfer to Subsequent layers.</li> </ul> |

⊙ Flexible pavement have low initial construction cost

⊙ Rigid pavement have High initial construction cost.

⊙ High Maintenance Cost

⊙ Low Maintenance Cost.

⊙ Strength of flexible in road Highly depended on Sub-grade

⊙ Strength of road less depend on strength of Sub-grade in Rigid pavement.

⊙ Road can be used For traffic within 24 hours

⊙ Road can not be used until 14 days of curing.

⊙ Quick Process of construction b/c its ready For traffic within in 24 hours

⊙ Slow process of construction b/c its take 14 days of curing.

Part (b)

Advantages of water bound over wet mix macadam are;

① The main advantage 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.

② Addition of water while mixing facilitates the handling of the mixture. The operation of laying is much simpler than that of water-bound macadam, where the screenings and binding 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 the moisture added which lubricates the individual particles.

⊙ The wet-mix macadam is that it is slightly costlier than water-bound.

⊙ Water bound macadam has been traditionally a labour-oriented Specification.

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

part (c) Difference b/w asphalt and Bitumen.

Asphalt

Bitumen

⊙ Asphalt is generally used as a term to refer to the combination of bitumen and gravel. Specification for road construction.

⊙ In some literature bitumen is actually the liquid binder that holds asphalt together.

Q. NO(02) :-

Solution :-

For a design speed of 75 mi/h

$$K = 312 \quad \text{From table 15.5}$$

$$\text{Minimum length} = ([312 * [3 - (-4)]])$$

$$\text{Minimum length} = [312 * 3 - (-4)]$$

$$\text{Minimum length} = \boxed{2184 \text{ ft}}$$

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

$$\text{Station of BVC} = \boxed{334+68}$$

$$\text{Station of EVC} = (334+68) + (21+84)$$

$$\text{Station of EVC} = \boxed{356+52}$$

$$\text{Elevation of BVC} = 250 - \left(\frac{0.03 * 2184}{2}\right)$$

$$\text{Elevation of BVC} = \boxed{217.24 \text{ ft}}$$

Thus the Required results,,

QNO(03) :-

Solution :-

- ⊙ Reliability level (R) = 99%
- ⊙ Standard deviation ( $S_o$ ) = 0.49
- ⊙ Initial Serviceability index  $p_i = 4.5$
- ⊙ Terminal Serviceability index  $p_t = 2.5$
- ⊙  $\Delta PSI = 4.5 - 2.5 = 2$

For Finding  $SN_1$  and  $D_1$   
(Surface Course)

Step(1) :-

Draw the line joining the reliability level of 99% and the over all standard deviation  $S_o$  of 0.49

Step(2) :-

Draw a line join point A to the ESAL of  $2 \times 10^6$

Step(3) :- Draw a line join B point and resilient modulus ( $M_r$ ) of Base Course and extent this line.



Step (4) :-

Draw a horizontal line from point C to intersect the design serviceability.

① loss (PSE) curve at point D

$$\Delta PSE = 4.5 - 2.5 = 2$$

②  $D_1$  of Surface Course is 2.6

Step (5) :-

Residual value of Asphalt  
= 450,000 lb/in<sup>2</sup>

Therefore  $a_1 = 0.44$

The thickness of the Surface Course ( $D_1$ )

$$D_1 = S_{N1} / a_1$$

$$= 2.6 / 0.44$$

$$= 5.9''$$

The thickness should be taken to the nearest 0.5''

So the thickness of the Surface Course is 6''

$$S_{N1} = D_1'' \times a_1$$

$$S_{N1} = 6 \times 0.44$$

$$S_{N1} = 2.64$$

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Finding  $SN_2$  and  $D_2$   
(Base Coarse)

$$D_2 = \frac{(SN_2 - SN_1)}{a_1 m_2}$$

$$= \frac{3.8 - 2.64}{0.14 \times 0.80}$$

$$D_2 = 10.36''$$

use 12''

So the thickness of base  
Coarse 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  $D_3$   
(Sub-base Coarse)

$$D_3 = \frac{(SN_3 - SN_2)}{a_3 m_3}$$

$$D_3 = \frac{(4.4 - 3.98)}{0.10 \times 0.80}$$

$$D_3 = 5.25''$$

we will use 6'' as a

$$\text{Sub-base } SN_3 = 2.64 + 1.34 + 6'' \times 0.10 \times 0.80$$

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

Final Design:-

⊙ Asphalt Concrete Surface = 6"

⊙ Granular base Course = 12"

⊙ ~~Sub grad~~

⊙ Sub-base = 6"

Total pavement thickness = 24"

Thus the Required result ✓✓

QNO. (04) :-

Different Pavement Distresses are;

Alligator 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 ( $< \frac{1}{2}$  inch wide)
- ⊙ Crack Seal to prevent entry of moisture.
- ⊙ High Severity Cracks ( $> \frac{1}{2}$  inch wide and crack with raveled edges)
- ⊙ Remove and replace the cracked pavement layer with an overlay.

## Patholes :-

- ⊙ Small bowl-~~Spa~~ Shaped depressions in the pavement surface that penetrate all the way through the HMA layer down to the base course.
- ⊙ patholes are most likely to Occure on road with HMA Surface (1 to 2 inches)

and Seldom Occure on  
road with 4 inch or  
deeper HMA Surface.

### Problem :-

⊙ Roughness (Serious vehicular damages can result from driving across potholes at higher speed) moisture infiltration.

### Possible Causes :-

⊙ Generally, potholes are the end result of fatigue cracking. As fatigue cracking becomes severe, the inter-connected cracks create small chunks of pavement which can be dislodged as vehicles drive over them.

### Repair :-

⊙ Patching techniques.

## Rutting :-

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

⊙ Surface depression in the wheel path, are particularly evident.

## Possible Causes :-

⊙ Insufficient Compaction of HMA layer during construction.

⊙ Sub grade rutting.

e.g. ⊙ excessively high asphalt content

⊙ excessive mineral filler.

⊙ Insufficient amount of angular aggregate particles.

are example of Improper mix design.

- ⊙ Sub grade rutting (e.g. as a result inadequate pavement structure)

### Repair :-

- ⊙ Slight ruts ( $< \frac{1}{3}$  inch deep) can generally be left untreated, pavement with deeper ruts should be leveled and overlaid.

### Bleeding :-

#### Problem :-

- ⊙ Loss of skid resistance when wet.

#### Possible Causes :-

- ⊙ Excessive asphalt binder in the HMA
- ⊙ Excessive application of asphalt binder during BST application.
- ⊙ 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-resistance Slurry 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.

⊙ Inadequate Compaction during Construction

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