Q no 1:-

Ans a) Difference b/w flexible & rigid pavement:-

Flexible pavement:-	Rigid pavement:-
1) Bitumen is used a binder in flexible pavement	Cement is used as a binder in rigid pavements.
2) Deformation in the sub grade is transfered to the upper layer.	Deformation in the subgrade is not transfered to subsequent layer.
3) Load is transfered by grain to grain contact.	No such phenomenon of grain to grain load exists.
4) Flexible pavements have low initial construction costs but have high maintanance cost	Rigid pavements have low maintanance cost but have high initial construction costs.
5) Have low life span usually 10-15 years.	Life span is more as compare to flexible usually 30+ year.

Ans b) ADVANTAGES OF WATER BOUND OVER WET MIX MACADAM:-

→ The water bound macadam construction of base course is less costly than the wet mix macadam as its specifications do not involve the use of mixing plant & power.

→ water bound macadam requires more time for construction

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

Qno1)

Ans c) Difference b/w Asphalt & Bitumen:-

Asphalt:-	Bitumen:-
(1) Asphalt is a composate mix of Agregate, sand, stone dust, ~~Air~~ Bitumen	→ The liquid binder that holds Asphalt togather.
→ It has 95% Agregate 5% = Binder (Bitumen)	→ It is highly viscous & sticky black.
	→ composed of partially hydrogeneled, polycyclic arromatic compound.
→ Density = 2330 kg/m³	→ Density of bitumen = 1040 kg/m³
→ Boiling point > 300 °C	→ Boiling point = 525 °C.

Qno2)

Ans 2) solution:-

For a design speed of 75 mi/h, K = 312

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

The remainder of the computation is efficently done using the format shown in the table on next page.

Station	Distance from BVC (x) (ft)	Tangent elevation (ft)	offset $[Y - \frac{Ax^2}{200L}]$ (ft)	Curve elevation (Tangent Elevation − offset) (ft)
BVC 334 +68	0	217.24	0.01	217.24
BVC 335 +00	32	$217.24 + \frac{32}{100} \times 3 = 218.24$	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
BVC 356+52	2184	282.76	76.44	206.32.

Qno3)

Ans 3) Draw a line joing the reliability level of 99% & the overall standard deviation so of 0.49 & extend line of intersect the first TL line at point A.

Step 2:-

Draw a line joining point A to the ESAL of 2×10^6 & extend this line to intersect the first TL line at point B.

Step 3:-

Draw a line joing point B & resilient modulus (MR) of base course & extend this line to intersect the design serviceability loss chart at point C.

Step 4:-

Draw a horizental 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 5:-

The structure number required to project the base course & to find the thickness D1 of the surface course is 2.6.

step 6:-

Determine the appropriate structure layer coellicent for each construction material

Reselient value of asphalt = 450,000 lb/in^2,

Therefore a1 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"

$SN_1 = D_1 \times a_1$

$= 6 \times 0.44 = 2.64$

Now find SN_2 & D_2 (Base course)

Find the values of a_2 from layer coefficent table & m_2 from drainage coefficent table.

→ Thickness of base course (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 course 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 & D_3 (sub base course) & also layer coefficent a_3 & drainage coefficent 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 subbase

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

$SN_3 = 4.46 > 4.4$ okay

Final design:-

surface course = 6"

Base course 12"

Sub base = 6"

Total pavement thickness = 24"

Qno4)

Ans4) Pavement distresses:-

Distress is the condition of 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

Different kind of pavement Distresses

1) Alligator cracking:-

Possible cause:- → over loading
→ inadequate structural design
→ Poor construction

Repair:- → crack sealing is in effective
→ Dig out & replace area of poor subgrade.

2) Block cracking:- Allows moisture infiltration.

Possible cause:-

HMA shrinkage
Asphalt binder aging
Poor choise of asphalt binder in the mix design.

Repair:-

Low severity cracks (<1/2 inch wide) crack seal to prevent entry of moisture.

High severity crack (> 1/2 inch & crack with raveled edges). Remove & Replace the cracked pavement layer with an overlay

3) Rutting:-

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

Possible cause:-

→ Insufficient compaction of HMA layers during construction

→ subgrade rutting

→ Improper mix design.

Repair:-

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

→ Pavement with deeper rut should be leveled & overlayed

4) Bleeding:-

Loss of skid resistance when wet.

Possible cause:-

→ Excessive asphalt binder in the HMA

→ Excessive application of asphalt binder during BST application.

5) Pollished Aggregate:-

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

Repair:-

Apply a skid-resistante slurry seal, BST or non structural overlay.

6) Raveling:-

Loose debris on the pavement which increases pavement roughness & loss of skid resistance.

Possible cause;-

Asphalt binder aging
Aggregate segregation
inadequate compaction during construction

Repair:-

Fog seal / slurry seal or Remove the damaged pavement & overlay.