Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. Sem. – II[nd] - Examination – June/July- 2011

Subject code: 1721302

Subject Name: Pavement Design and Evaluation

Date:24/06/2011 **Time: 10:30 am – 01:00 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Explain different typical failures of flexible pavement. **07**

(b) Differentiate between rigid pavement and flexible pavement. **07**

Q.2 **(a)** Explain ESWL and the concept in the determination of the equivalent wheel load. **07**

(b) Define the VDF. Axle load spectrum from a survey data is presented in the following table, find the value of VDF (Assume The standard single axle load as 8.2 Tones.) **07**

Axle load (t)	% Frequency
17-15	03
15-13	19
13-11	23
11-09	39
09-07	12
07-05	04

OR

(b) Calculate ten year **EWL** and **TI** values using the following AADT data. Assume 50% increase in traffic in 10 years period. **07**

No. of axle	AADT	EWL constant
2	3500	330
3	325	1100
4	295	2460
5	70	5000

Q.3 **(a)** Explain the CBR method of pavement design. How is this method useful to determine thickness of component layers? **07**

(b) Calculate the equivalent C-value of a three layered pavement section having individual C-values as given below: **07**

Materials	Thickness (cm)	C- values
Bituminous concrete	10	55
Cement treated base	20	220
Gravel sub base	10	15

OR

Q.3 **(a)** What are the factors to be considered for the design of pavement? Explain contact pressure and Repetition of load in detail. **07**

(b) Design the flexible pavement (Two lane single carriageway) for construction of a new bypass with the following data (refer fig 1 and 2): **07**

(1) Initial traffic in the completion year of construction = 400CV/day (sun of both direction)

(2) Traffic growth rate per annum = 7.5 %
(3) Design life = 15 y
(4) Vehicle damage factor = 2.5 (Standard axle per CV)
Design CBR of sub grade soil = 4%

Q.4 **(a)** Write a short note on stresses in cement concrete pavement. **07**

(b) Calculate load stress induced at the edge in the cement concrete pavement of thickness 33 cm. if temperature stress at the edge is 17 kg/cm^2, check the pavement safety at the edge. National highway in Gujarat (Temp. difference = 15.8 C). Total two way traffic is 3000 cv/day. **07**

Flexural strength in CC = 45 kg/cm^2
Effective Modulus of sub grade reaction of the DLC sub base = 8 kg/cm^2
E of CC = 3 X 10^5 kg/cm^2
Poisson's ratio = 0.15
Coefficient of thermal expansion (CC) = 10X 10^{-6} C
Rate of traffic increase = 0.075
Spacing of contraction joints = 4.5 m
Width of Slab = 3.5 m

The axle load spectrum obtained from axle load survey is as following.

Single axle load		Tandem Axle load	
Axle load (t)	%ge of axle load	Axle load (t)	%ge of axle load
19-21	.6	34-38	0.3
17-19	1.5	30-34	0.3
15-17	4.8	26-30	0.6
13-15	10.8	22-26	1.8
11-13	22.0	18-22	1.5
9-11	23.3	14-18	0.5
<9	30.0	<14	2.0

The stresses produce d due to various axle load is follow for given condition.

Axle load X 1.2	Stress(kg/cm^2)
Single axle	
20 X 1.2	24.10
18 X 1.2	21.98
16 X 1.2	19.98
Tandem Axle	
36 X 1.2	19.38

OR

Q.4 **(a)** Explain types of joints in C.C. pavement. **07**

(b) Considering following data, design the tie bar (plain tie bar) for the cement concrete pavement as per IRC 58 2002. **07**

Slab thickness = 33 cm
Lane width = 3.5 m
Coefficient of friction =1.5
Allowable tensile stress in plain tie bar (kg/cm^2) =1250
Allowable bond stress in tie bar (kg/cm^2) = 17.5
Diameter of tie bar = 12 mm
Density of concrete (kg/m^3) = 2400

Q.5 **(a)** Explain the step by step procedure of Dowel bar design as per IRC 58 -2002. **07**

(b) Describe road construction in desert. **07**

OR

Q.5 **(a)** Explain Benkelman beam test with sketch. **07**

(b) Benkelman beam deflection studies were carried out on 15 selected points on a stretch of flexible pavement during summer season using a dual wheel load of 4085 kg, 5.6 kg/cm^2 pressure. The deflection values obtained in mm after making the necessary leg corrections are given below. If the present traffic consists of 750 CV per day, determine the thickness of bituminous overlay required, If the pavement temperature during the test was 30 C and correction factor for subsequent increase in subgrade moisture content is 1.3 Assume traffic growth rate increase as 7.5 % and duration between last count and construction of overlay as 2 year. **07**

1.40, 1.32, 1.25, 1.35, 1.48, 1.60, 1.65, 1.55, 1.45, 1.40, 1.36, 1.46, 1.50, 1.52, and 1.45 mm.

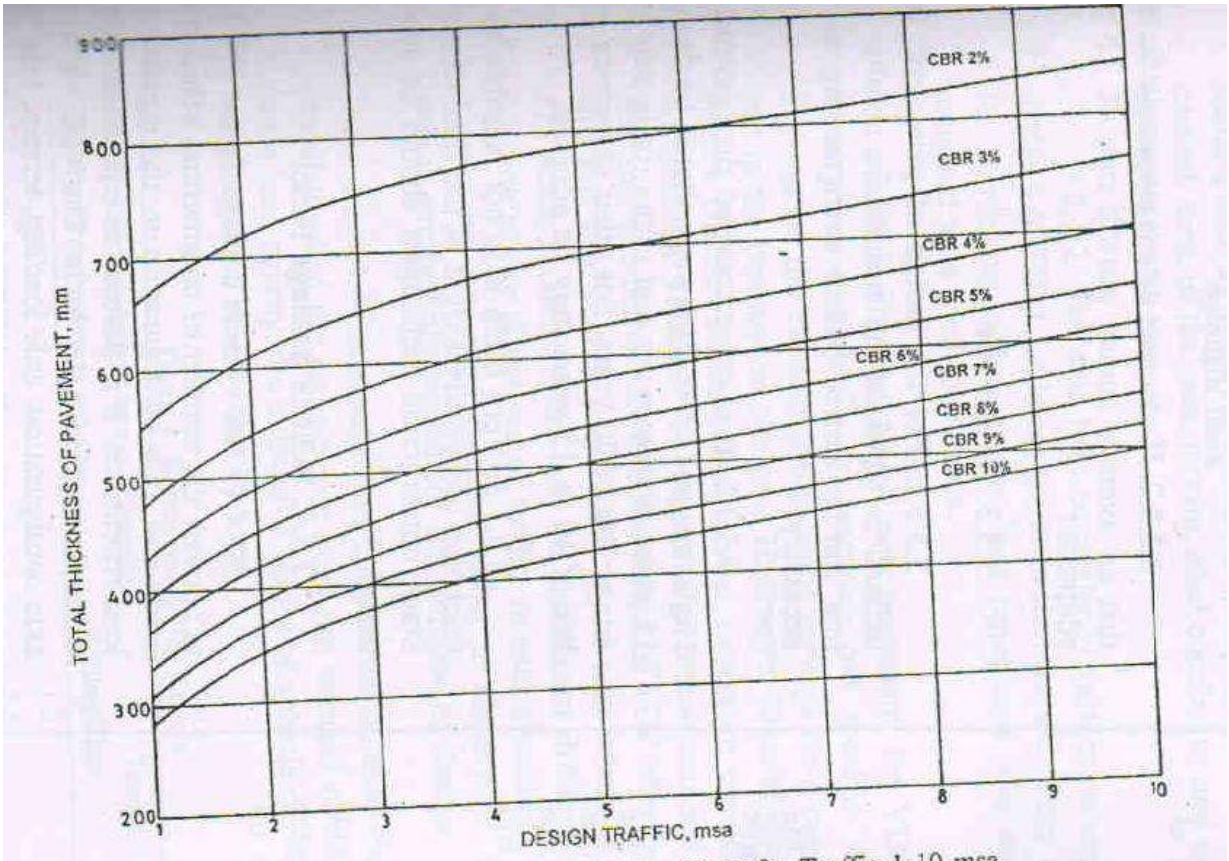

Fig. 1. Pavement Thickness Design Chart for Traffic 1-10 msa

PAVEMENT DESIGN CATALOGUE

PLATE 1 – RECOMMENDED DESIGNS FOR TRAFFIC RANGE 1-10 msa

CBR 4%					
Cumulative Traffic (msa)	Total Pavement Thickness (mm)	PAVEMENT COMPOSITION			
		Bituminous Surfacing		Granular Base (mm)	Granular Sub-base (mm)
		Wearing Course (mm)	Binder Course (mm)		
1	480	20 PC		225	255
2	540	20 PC	50 BM	225	265
3	580	20 PC	50 BM	250	280
5	620	25 SDBC	60 DBM	250	285
10	700	40 BC	80 DBM	250	330

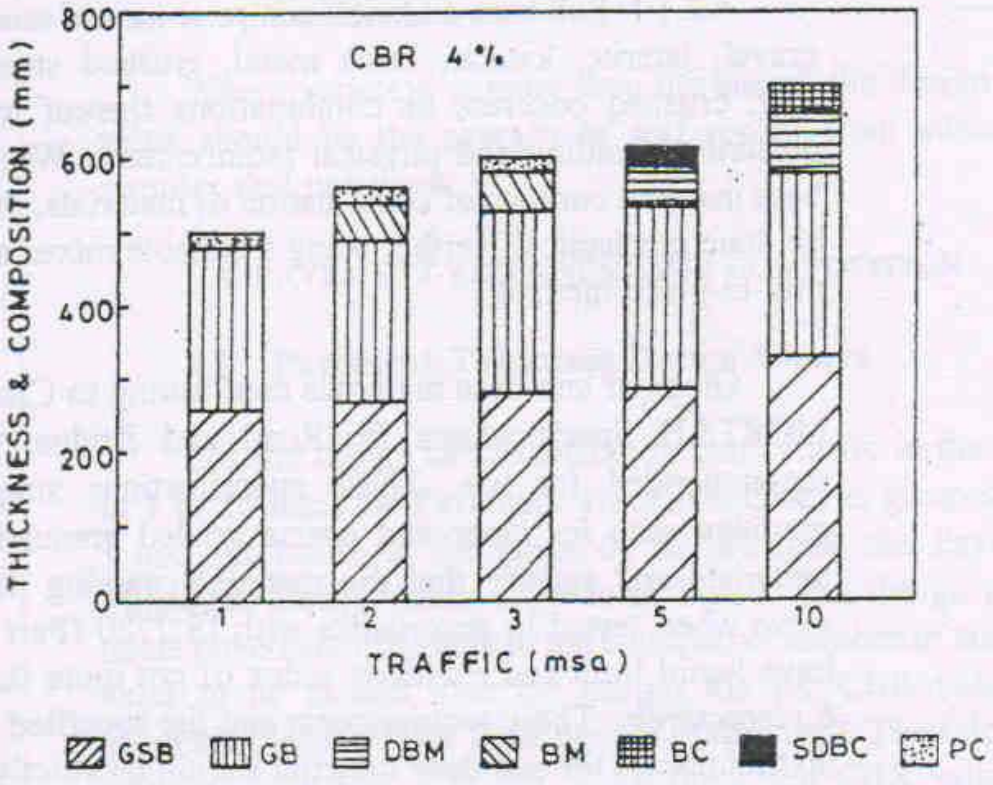

Fig 2

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