Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

ME Semester –II Examination Dec. - 2011

Subject code: 1721302 **Date: 12/12/2011**

Subject Name: Pavement Design & Evaluation

Time: 02.30 pm – 05.00 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) Fill in the blanks... 07

(i) The width of single lane road as per IRC recommendation is _____

(ii)The Standard axle load _____ and wheel load is _____ taken for the design purpose as per IRC

(iii) As per IRC cumulative fatigue life consumed is _____ for safe design.

(iv) Tongue and groove joint is a type of _____

(v) Joint spacing in case of expansion joint is _____ than the case of contraction joint.

(vi) The ratio of contact pressure to tyre pressure is defined as _____

(vii) Frost heaving is a type of failure in _____

(b) What are the IRC guidelines for the joint spacing? 07

Q.2 (a) Explain the test carried out for road unevenness measurement with neat sketch. 07

(b) What is the difference between highways and runways stress analysis for pavements? 07

OR

(b)Explain in details the maintenance of cement concrete pavements. 07

Q.3 (a)Explain the graphical method for determination of ESWL. 07

(b)Explain the failures in flexible pavement with neat sketches. 07

OR

Q.3 (a) What is vehicular damage factor? Explain its significance in design of pavement. 07

(b)Differentiate between reinforced and prestress concrete pavements. 07

Q.4 (a)Calculate the design repetitions for 20 years period for various wheel loads equivalent to 2268 kg using the following traffic survey data on a four lane road. Assume average daily traffic from both direction considering traffic growth is 215 total volume. 07

Wheel loads in Kg	Percentage of total volume
2268	13.17
2722	15.30
3175	11.76
3629	14.11
4082	06.21
4536	05.84

(b)Calculate the deflection using Boussineq's theory at the surface of a pavement due to a wheel load of 40 KN and a tyre pressure of 0.5 MN/m^2. The value of E of the pavement and subgrade may be assumed to be uniformly equal to 20 MN/m^2. 04

(c)Compute the radius of relative stiffness of 15cm thick amount concrete slab from the 03

following data. Modulus of elasticity of cement concrete 210000 Kg/cm^2,
Poisson's ratio for concrete is 0.13,
Modulus of subgrade reaction is 7.5 Kg/cm^2.

OR

Q.4 (a)Using Westerguard's stress equation calculate the stresses at the interior, edge and corner region of cement concrete pavement. 07

Wheel load = 5100 Kg
Modulus of elasticity of concrete = 300000 Kg/cm^2
Pavement thickness = 18 cm
Poisson's ratio of concrete = 0.15
Modulus of subgrade reaction k = 6.0 Kg/cm^2 per cm
Radius of contact area = 15cm

(b)Existing black top pavement was tested using Benkleman Beam with attest vehicle of 8170 Kg rear axle load, observations are recorded at a pavement temperature of 43˚C are given below.Length of test stretch = 300 m. 07

Sr No.	Rebound deflection	Sr No.	Rebound deflection
1	1.46	7	1.68
2	1.52	8	1.74
3	1.56	9	1.96
4	1.76	10	1.42
5	1.96	11	1.56
6	1.74	12	1.62

Compute the thickness of overlay of bituminous concrete taking allowable deflection as 1.25 mm , if the factor of subgrade moisture correction is 2.0

Q.5 (a) From the following axle load survey data compute the expected repetitions of axle loads of different magnitudes during design period according to IRC:58-2002 07

Present traffic = 3000 cvpd
Design life = 20 years
Rate of traffic increase = 7.50 %

Single Axle Load		Tandem Axle Load	
Axle Load class	% of axle load	Axle Load class	% of axle load
19 – 21 tonns	0.6	34 – 38 tonns	0.3
17 – 19 tonns	1.5	30 – 34 tonns	0.3

(b) In the context of the above problem calculate the stresses due to single axle load (19-21 tonns) only and the ratio of Fatigue Life cosumed. 07

Assume trial thickness = 32 cms
Subgrade modulus = 8 Kg/cm2 per cm
Modulus of rupture = 45 Kg/cm2
LSF = 1.2

OR

Q.5 (a) Soil sub grade sample was obtained from the project site and the CBR test was conducted at field density. The following were the results.Find CBR value? 07

Penetration mm	Load kg	Penetration mm	Load kg
0.0	0.0	3.0	60.0
0.5	03.5	4.0	72.0
1.0	14.5	5.0	78.0
1.5	32.0	7.5	94.6
2.0	43.0	10.0	104.5
2.5	54.0	12.5	112.4

(b)In the context of the above problem it is define to use the following for different pavement layers, 07

Sandy soil with CBR value 12 %
Soil kankar mixed with CBR value 28 %
Broken stone and gravel with CBR value 94 %
Bitumen concrete for sandy surface 5cm thick.

Design pavement structure for commercial vehical of 2500/day with 8 % growth rate and 2 year for completion of project.

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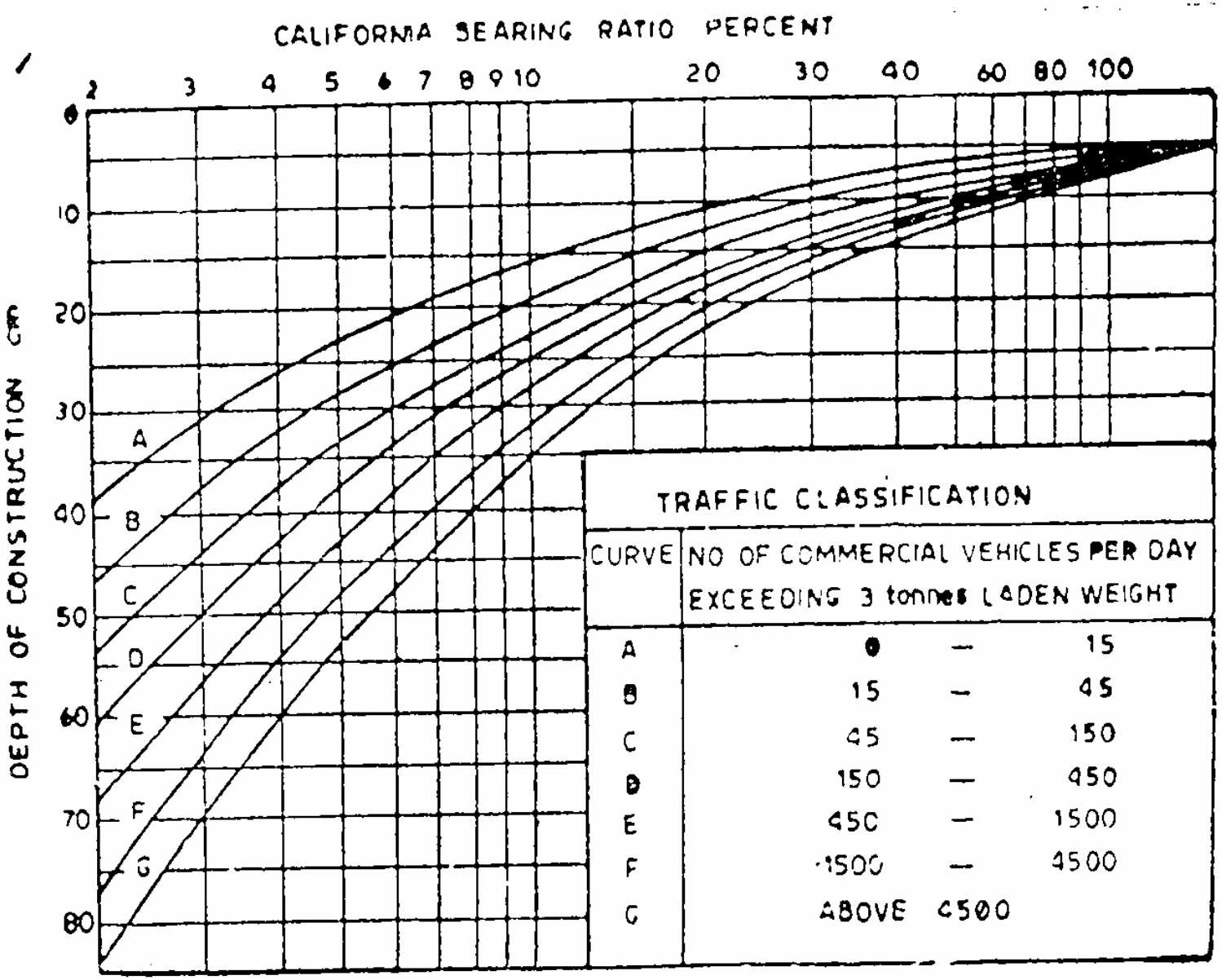


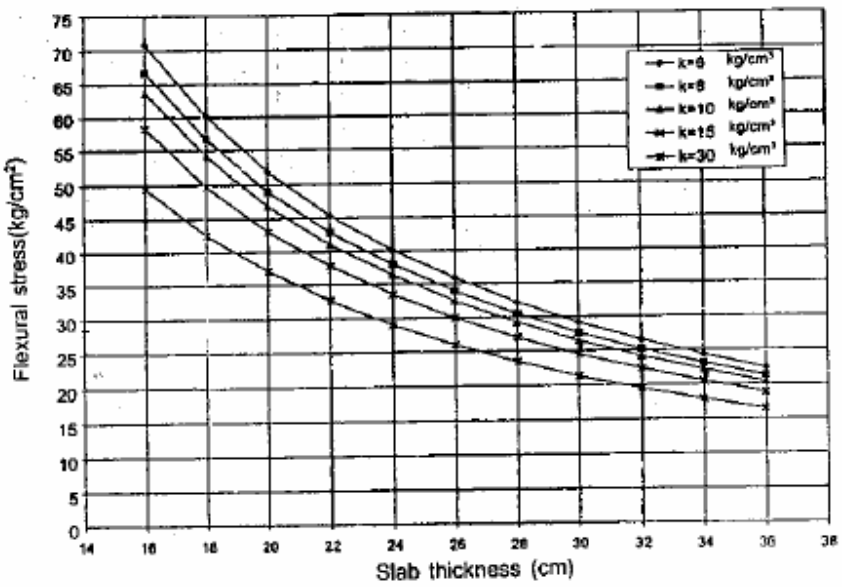
C.B.R. Design Chart (Recommended by IRC)

TABLE STRESS RATIO AND ALLOWABLE REPETITIONS IN CEMENT CONCRETE

Stress Ratio	Allowable Repetitions	Stress Ratio	Allowable Repetitions
0.45	6.279×10^7	0.66	5.83×10^3
0.46	1.4335×10^7	0.67	4.41×10^3
0.47	5.2×10^6	0.68	3.34×10^3
0.48	2.4×10^6	0.69	2531
0.49	1.287×10^6	0.70	1970
0.50	7.62×10^5	0.71	1451
0.51	4.85×10^5	0.72	1099
0.52	3.26×10^5	0.73	832
0.53	2.29×10^5	0.74	630
0.54	1.66×10^5	0.75	477
0.55	1.24×10^5	0.76	361
0.56	9.41×10^4	0.77	274
0.57	7.12×10^4	0.78	207
0.58	5.4×10^4	0.79	157

Appendix-1 (Contd.)

Stresses in Rigid Pavement (Single Axle Load = 24 tons)



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