Birla Institute of Technology & Science, Pilani- Pilani Campus

First Semester 2022-2023

Comprehensive Exam

Course No: CE G547 Course Title: Pav. Fai. Eva. & Reh.
Nature of Exam: Closed Book Max. Marks: 60 (Weightage: 35%)
Duration: 180 Min Date of Exam: 26/12/2022

Note:

1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Assume the data if necessary.

Q.1 Estimate the safe thickness of concrete overlay by using the following data: [20]

Design Life = 20 years
Traffic Growth Rate = 7.5%
Commercial traffic = 2300 cvpd
k of subgrade = 55 MPa/m
Thickness of granular base = 200 mm
Thickness of bituminous layer = 130 mm
Modulus of rupture = 46 kg/cm^2
Elastic modulus of concrete = 30000 MPa
Length of square slab = 1.5 m
Poisson ratio of concrete = 0.15
Temperature differential = -0.15°C/ cm
Coefficient of thermal expansion = $10*10^{-6}$ per °C
% of different axle loads

Single Axle		Tandem Axle	
Axle load class (Tons)	% Axle loads	Axle load class (Tons)	% Axle loads
21-23	15	30-34	2
19-21	10	26-30	4
17-19	10	22-26	5
15-17	5	18-22	6
13-15	5	14-18	2
11-13	6		
9-11	7		
7-9	8		
Less than 7	15		

Q.2 Design the bituminous overlay using the following data: [30]

- Existing pavement has two bituminous layers with a total thickness of 170 mm & granular layer of 575 mm
- Design traffic = 150 msa
- Single wheel load = 40000 N
- Contact Pressure = 0.56 MPa
- Condition of pavement: Good
- No. of deflection measuring sensors = 7
- Radial distances (mm) where deflections measured = 0, 300, 600, 900, 1200 ,1500, 1800
- Poisson ratio values of layers from top: 0.5, 0.4, 0.4
- Month of Testing: August
- Location of Existing Pavement: Tamilnadu

- Multiplication factors for lower and upper moduli of subgrade = 0.8 & 1.2; 0.95 & 1.2, 1.1& 1.2
- Deflections measured at different locations of the homogeneous sections are normalized for 40 kN standard load

Sr. No.	Normalized deflection at a radial distance (mm) of							Pavement Temperature (°C)
	0	300	600	900	1200	1500	1800	34
1	0.471	0.284	0.206	0.153	0.124	0.101	0.0700	34
2	0.468	0.307	0.221	0.176	0.146	0.120	0.0906	36
3	0.471	0.330	0.232	0.191	0.160	0.120	0.0905	36
4	0.490	0.312	0.222	0.188	0.141	0.129	0.0830	37
5	0.467	0.314	0.230	0.180	0.149	0.118	0.0909	38
6	0.475	0.309	0.220	0.184	0.142	0.131	0.0901	38
7	0.463	0.305	0.219	0.181	0.139	0.121	0.0870	39
8	0.450	0.291	0.203	0.178	0.141	0.120	0.0830	37
9	0.470	0.355	0.201	0.180	0.150	0.132	0.0908	37
10	0.477	0.317	0.225	0.177	0.151	0.128	0.0902	40

Q.3 Estimate the safe thickness of concrete overlay by using the following data: [10]

Design Life = 20 years
Traffic Growth Rate = 7.5%
Commercial traffic = 2100 cvpd
k of subgrade = 20 MPa/m
Thickness of cement treated base = 200 mm
Thickness of bituminous layer = 100 mm
Modulus of rupture = 46 kg/cm^2
Elastic modulus of concrete = 30000 MPa
Length of square slab = 1.2 m
Poisson ratio of concrete = 0.15
Temperature differential = -0.15°C/ cm
Coefficient of thermal expansion = $10*10^{-6}$ per °C
% of different axle loads

Single Axle		Tandem Axle	
Axle load class (Tons)	% Axle loads	Axle load class (Tons)	% Axle loads
21-23	5	30-34	3
19-21	10	26-30	3
17-19	10	22-26	7
15-17	5	18-22	9
13-15	5	14-18	7
11-13	6		
9-11	7		
7-9	8		
Less than 7	15		