Birla Institute of Technology & Science, Pilani- Pilani Campus

First Semester 2023-2024

Comprehensive Exam

Course No: CE G522   Course Title: Pav. Des. Main. Mang.
Nature of Exam: Closed Book   Max. Marks: 75 (Weightage: 35%)
Duration: 180 Min   Date of Exam: 26/12/2023

Note:

1. All questions are compulsory.

2. Assume the date from relevant code if required.

3. Figures to the right indicate full marks.

Q. 1	A cement concrete pavement is to be designed for a four-lane divided national highway with two lanes in each direction in the state of Karnataka. Design the pavement for a period of 30 years. Lane width = 3.5 m; transverse joint spacing = 4.5 m. It is expected that the road will carry, in the year of completion of construction, about 5000 commercial vehicles per day in each direction. The proportion of traffic in predominant direction is 50%. Axle load survey of commercial vehicles indicated that the percentages of front single (steering) axle, rear single axle, rear tandem axle and rear tridem axle are 40%, 25%, 15% and 20% respectively. The percentage of commercial vehicles with spacing between the front axle and the first rear axle less than 4.5 m is 60%. Traffic count indicates that 65% of the commercial vehicles travel during night hours (6 PM to 6 AM). Details of axle load spectrum of rear single, tandem and tridem axles are given in Table 1. The average number of axles per commercial vehicle is 2.30. Subgrade CBR is 8%. Estimate the safe thickness of PQC layer using IRC 58:2015 method for debonded concrete pavement with tied concrete shoulder with doweled transverse joints. The thickness of granular sub-base and DLC layer are 225 mm and 150 mm, respectively. [45]

Table 1: Axle load spectrum data

Single Axle		Tandem Axle		Tridem Axle	
Axle load class (kN)	Frequency (% of single axles)	Axle load class (kN)	Frequency (% of tandem axles)	Axle load class (kN)	Frequency (% of tridem axles)
185-195	26	380-400	40	530-560	25
175-185	29	360-380	40	500-530	20
165-175	25	340-360	10	470-500	25
155-165	20	320-340	10	440-470	30
	100		100		100

Q. 2	A 4 lane interstate pavement with doweled joints and no concrete shoulders, has 6 inch thick untreated subbase on subgrade with k = 100 pci, MR of concrete = 650 pci and expected load repetitions are given in Table 2. Assume trial thickness of 10 inch. Take LSF = 1.2. Estimate whether the 10 inch thickness of PQC layer is adequate by using PCA method. [30] **See page 2 for the expected load repetitions**

Table 2: Expected load repetitions			
Single axle load (kip)	Frequency (no. of repetitions)	Tandem axle load (kip)	Frequency (no. of repetitions)
30	6000	52	20000
28	12000	48	45000
26	30000	44	125000
24	60000	40	400000
22	120000	36	900000
20	240000	32	950000
18	300000	28	2000000
16	450000	24	900000
14	600000	20	1200000
12	2000000	16	1500000