Birla Institute of Technology & Science, Pilani- Pilani Campus

Second Semester 2022-2023

Mid Semester Exam

Course No: CE G518 Course Title: Pav. Ana. Des.
Nature of Exam: Closed Book Max. Marks: 50 (Weightage: 30%)
Duration: 90 Min Date of Exam: 17/03/2023

Note:

1. Assume suitable data from relevant code if required.

2. Figures to the right indicate full marks.

3. All the questions are compulsory.

Q. 1. Estimate the safe thickness of dense bituminous macadam layer by using the following data.

Layer	Resilient Modulus (MPa)	Thickness (mm)	Poisson ratio
Bituminous concrete	3000	50	0.35
Dense bituminous macadam	3000	?	0.35
Granular layer	130.23	300	0.35
Subgrade	50	Infinite	0.35

The limiting tensile strain at the bottom of dense bituminous macadam is $1.085*10^{-4}$. The limiting vertical compressive strain on top of subgrade is $2.36*10^{-4}$. The contact radius and contact pressure are 12.2 cm and 828 kPa respectively. The pavement was loaded with single axle with single tire. Use the KENPAVE software for estimation of safe and economical thickness of bituminous layer. [6]

Q. 2. Estimate the optimum thickness of bituminous layer for design of flexible pavement as per IRC37:2018 with following data. Take combined thickness of surface and binder course layer. Change the thickness of bituminous layer only while doing the trials for safe design of pavement. (32 marks)

Traffic count: 200 msa

Subgrade CBR: 5%

Place of Road Construction: Maharashtra

Bitumen: Unmodified Bitumen

Va = 4%, Vbe= 11.2%

Base layer: Cement treated base

Sub-base layer: Cement treated sub-base

Aggregate interlayer at the interface of cement treated base and bituminous layer

Modulus of elasticity of CTB base layer: 4500 MPa

Modulus of Rupture of CTB base layer: 2.3 MPa

Modulus of Elasticity of Cement Treated Sub-base: 450 MPa

Modulus of Elasticity of Aggregate interlayer: 450 MPa

Poisson ration of aggregate interlayer: 0.35

% of Single, Tandem and Tridem Axles: 35%, 40%, 25%

The axle load spectrum data is given in the following Table.

Single Axle Loads		Tandem Axle Loads		Tridem Axle Loads	
Axle Load Class (kN)	% of Axles	Axle Load Class (kN)	% of Axles	Axle Load Class (kN)	% of Axles
185-195	0.6	380-400	1.9	585-615	1.5
175-185	1.9	360-380	2.5	555-585	1.7
165-175	8.5	340-360	4.5	525-555	3.0
155-165	15.6	320-340	2.8	495-525	10.9
145-155	15.6	300-320	23.5	465-495	16.9
135-145	12.3	280-300	30.5	435-465	25.0
125-135	13.0	260-280	21.5	405-435	25.0
115-125	32.5	240-260	12.8	375-405	16.0

Q. 3. For a one-layer pavement system shown in Figure 1, estimate the following stresses and strain using the Ahlvin and Ulery equations.

i) Vertical stress (ii) Radial horizontal stress (iii) Tangential horizontal stress (iv) vertical radial shear stress (v) vertical strain (vi) radial horizontal strain (vii) tangential horizontal strain (viii) vertical deflection. [12]

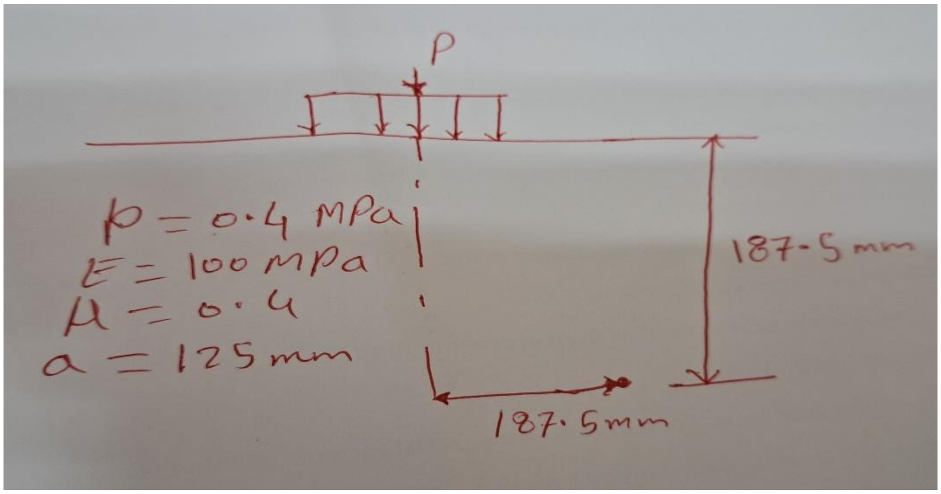

Figure 1: One-layer pavement system