15CV833

Eighth Semester B.E. Degree Examination, June/July 2019
Pavement Design

Time: 3 hrs.   Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing
ONE full question from each module.
2. Missing data, if any may be assumed.
3. Use of relevant charts is permitted.

Module-1

1 a. Draw neat sketch of cross section of a flexible pavement and describe the functions of each layer. **(08 Marks)**

   b. Determine the deflection values under a wheel load of 60kN and contact pressure 0.7 N/mm^2 in a homogeneous mass of soil at a depth of $Z = 2.5a$ upto a radial distance of $r = 5a$. Take modulus of elasticity of subgrade as 8 N/mm^2. Sketch the deflection curve. Use Fig.Q.1(b). **(08 Marks)**
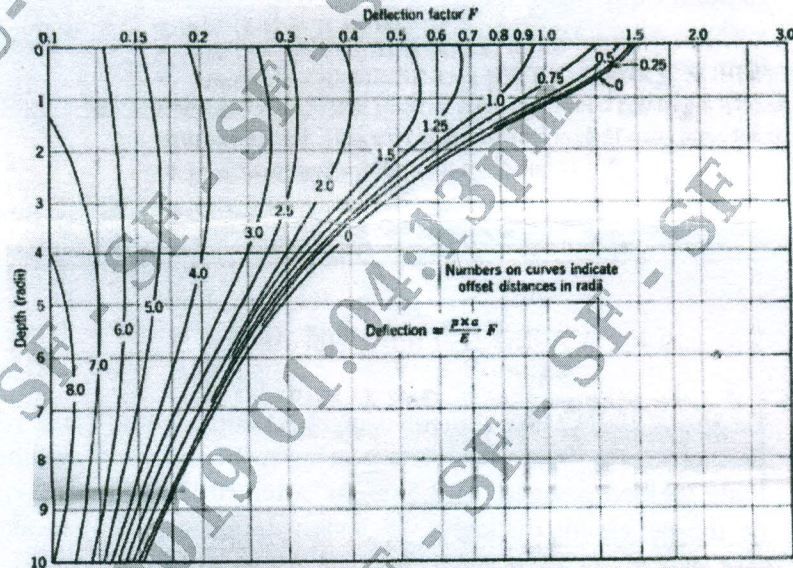

Figure 1.6: Vertical Deflection w due to Circular Loading (Foster and Ahlvin, 1954)

Fig.Q.1(b)

OR

2 a. Compare the salient features of flexible and rigid pavements. **(08 Marks)**

   b. A plate load test was carried out on subgrade using 300mm diameter plate and corresponding to a deflection of 5mm, the load sustained on the plate per unit area was 0.08 N/mm^2. The test was repeated on base course of thickness 300mm and unit load sustained was 0.45 N/mm^2 at the same deflection. Find:

   i)   Elastic modulus of subgrade and the ratio EP/ES.

   ii) What should be the thickness of base course as to sustain wheel load of 50kN and contact pressure 0.6 N/mm^2 so that maximum deflection does not exceed 5mm. Use Fig.Q.2(b). **(08 Marks)**
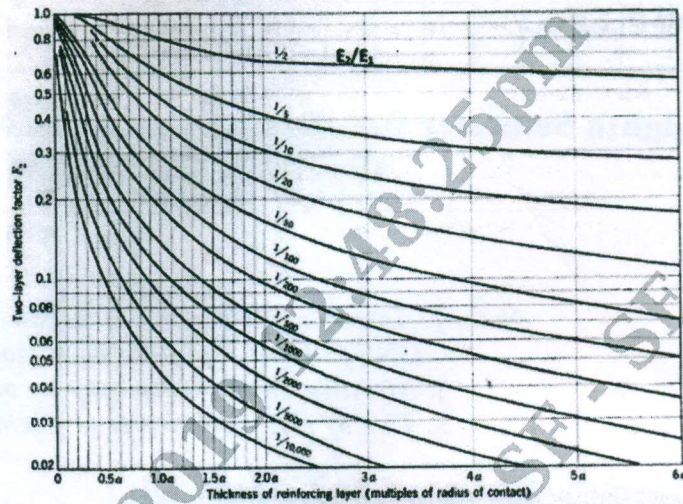
Fig.Q.2(b)

Module-2

3 a. Explain what is trust action. What are the factors affecting frost action and what are the remedial measures? **(08 Marks)**

b. Explain Equivalent Wheel factor (EWL). Calculate design repetitions for 20 years period for various wheel loads equivalent to 22.68kN wheel load using the following survey data on a four lane road. **(08 Marks)**

Wheel load, kN	AOT, both directions	% of traffic volume
22.68	Total volume of	13.17
27.22	traffic consisting of	15.30
31.75	traffic growth = 215	11.36
36.29		14.11
40.82		6.21
45.36		5.84

OR

4 a. Design a highway pavement using McLeod method for a wheel load of 5100 kg with tyre pressure 6.5 kg/km^2. The plate bearing test conducted on subgrade soil using 30cm diameter. Plate yielded pressure of 2.5kg/cm^2 after 10 load repetitions at 0.5cm deflection. What will be the pavement thickness, if design deflection is taken as 0.35cm? Use Fig.Q.4a(i) and Fig.Q.4a(ii).
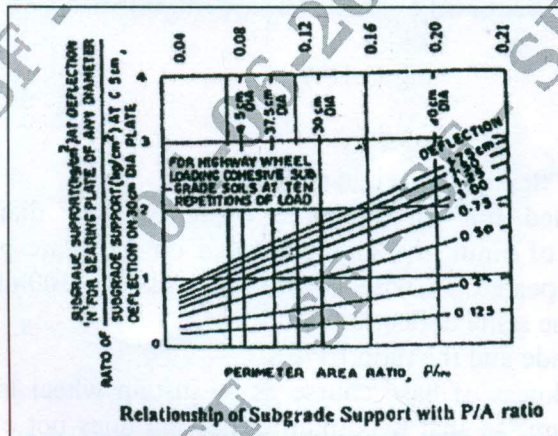

Relationship of Subgrade Support with P/A ratio

Fig.Q.4a(ii)

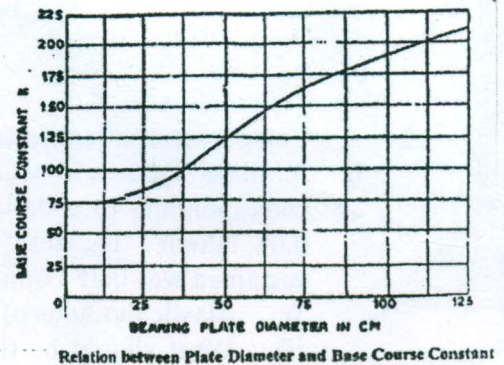

Relation between Plate Diameter and Base Course Constant

Fig.Q.4a(i)

b. Design the pavement by triaxial method using the following data:
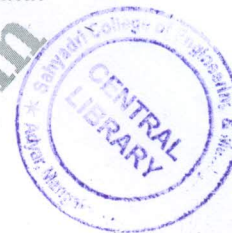Wheel load = 51 kN, radius of contact area = 150 mm
Traffic coefficient = 1.5,
Rainfall coefficient = 0.9
Design deflection = 2.5mm
E of subgrade = 10 N/mm^2
E of base course = 40 N/mm^2
E of 75mm thick bituminous concrete surface = 100 N/mm^2. **(08 Marks)**

Module-3

5 a. List the general causes of flexible pavement failures and describe the failures in sub base and base courses. **(08 Marks)**
   b. Explain the step by step procedure of conducting Benkleman Beam deflection studies for evaluation of flexible pavement surface condition. **(08 Marks)**

OR

6 a. Briefly explain the typical types of flexible pavement failures. **(08 Marks)**
   b. Existing black top pavement was tested using Benkleman beam. The observations recorded at a pavement temperature of 43°C are given below. Compute the thickness of bituminous concrete overlay taking allowable deflection as 1.25mm, factor of subgrade moisture as content as 2 and accuracy 84%.
   1.46, 1.52, 1.56, 1.76, 1.96, 1.74, 1.68, 1.74, 1.96, 1.42, 1.56, 1.62mm. **(08 Marks)**

Module-4

7 a. As per IRC 58-2002, explain the procedure of design of rigid pavements. **(08 Marks)**
   b. Calculate the wheel load stresses at edge and corner regions of a CC pavement using modified equations and the following data: wheel load = 51 kN E = 3 × 10^4 N/mm^2 μ = 0.15 pavement thickness = 180mm, radius of contact area = 150mm and modulus of subgrade reaction = 0.06 N/mm^3. **(08 Marks)**

OR

8 a. Explain, how warping stresses are formed in cc pavements. Describe the Bradbury's equations to calculate warping stresses at critical locations. **(08 Marks)**
   b. The design thickness of a CC pavement is 26cm, considering a design axel load (98th percentile load) of 12000 kg on single axel and M40 concrete with characteristic compressive strength of 400 kg/cm^2, radius of relative stiffness 62.2 cm, elastic modulus of dowel / steel 2×10^6 kg/cm^2, modulus of dowel concrete interaction 41500 kg/cm^3 and joint width 1.8cm, design the dowel bars for 40% load transfer considering edge loading. Take diameter of dowel bar = 3cm, spacing = 25cm. **(08 Marks)**

Module-5

9 a. What are the factors considered in design of rigid pavements? Explain any three factors. **(08 Marks)**
   b. List the typical failures in rigid pavements and explain any three of them. **(08 Marks)**

OR

10 a. With sketches, describe the various types of joints and their requirements, in rigid pavements. **(08 Marks)**
    b. Determine spacing between contraction joints for a 3.5m slab width having thickness of 200mm, friction 1.5, for the following two conditions:
    i)   Planche cement concrete, allowable Sc = 0.08 N/mm^2
    ii) Reinforced cement concrete, 10mm diameter bars at 0.3m spacing. **(08 Marks)**

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