University of Palestine
Faculty of Applied Engineering and Urban Planning

Course Name	Roads and Transportation Engineering II			Course No.	CIVL 4330
Academic Year	2018/2019	Semester	2nd	Exam Type	Final
Exam Date	21/05/2019			Exam Time	12pm – 2pm

اسم الطالب(بالعربي):	الرقم الجامعي:		
اسم المدرس: د. ساري أبو شرار	رقم الشعبة: □ 101 □ 102	وقت المحاضرة: □9:30 am– 8:00 am □11:00 am– 9:30 am	الرقم المتسلسل:

Important Instructions

- ***This is a closed-book exam; all related material must be placed away from your desk.***
- ***Cell phone use is prohibited for any purpose: Your cell phone must be turned off and placed off of the desk. Cell phones may not be accessed during the exam. Failure to comply may be treated as a violation of the Honor Code.***
- ***Headphones of any kind are not permitted.***
- ***This exam is 120 minutes long.***
- ***Make sure that you have 12 pages including this page.***
- ***This exam has 4 questions. Read each question carefully before answering.***
- ***Calculators can be used but cannot be shared.***
- ***When you finish, you must:***
  - ***Check that you have written your information in the spaces provided.***
  - ***Give the exam package (all papers) to the proctor before you leave.***

For Teacher's Use OnlyFor Proctor's Remarks

QN	KPI/ILO	SO	DL	Mark	Weight
1	b1, b3	a, b	3		15
2	b1	k	2		10
3	b2	a	6		10
4	b3	c	5		15
Total					**50**

KPI: Key Performance Indicator, ILO: Intended Learning Outcomes, SO: ABET Student Objectives, DL: Difficulty Level (1. Very easy, 2. Easy, 3. Moderate, 4. Somewhat hard, 5. Hard, 6. Very Hard)

Answer All Questions

Q1. Choose the correct answer (15/50)

1. The highest CBR number is required for
   a) Pavement
   b) Sub grade
   c) Sub base
   d) Base

2. Bitumen is a by-product of
   a) Wood
   b) Petroleum
   c) Kerosene
   d) Coal

3. Bleeding may be avoided by
   a) Water voids
   b) Air voids
   c) Porosity
   d) Water content

4. The specified method for bitumen mix in Palestine is
   a) Hveem
   b) Marshalls method
   c) Hubbard method
   d) Super paver mix method

5. The temperature in Marshall's method is
   a) 25
   b) 30
   c) 35
   d) 60

6. The surface of the pavement should be
   a) Smooth
   b) Rough
   c) Sufficient enough to resist skid
   d) Very rough

7. The design of horizontal and vertical alignments, super elevation, gradient is worst affected by
   a) Length of vehicle
   b) Width of vehicle
   c) Speed of vehicle
   d) Height of vehicle

8. The most raised portion of the pavement is called
   a) Super elevation
   b) Camber
   c) Crown
   d) Kerb

9. A part of pavement raised with respect to one side keeping the other side constant is called
   a) Footpath
   b) Kerb
   c) Super elevation
   d) Camber

10. The reaction time considered in SSD is
   a) 1.5 sec
   b) 2 sec
   c) 2.5 sec
   d) 3 sec

11. The basic principle of bituminous stabilization is
   a) Water proofing
   b) Cohesion
   c) Water proofing with cohesion
   d) Adhesion

12. A road running parallel to highway for some selected areas with grade separator are called
   a) Footage road
   b) Urban road
   c) Frontage road
   d) Parallel highway

13. The width of formation is calculated by adding
   a) Sum of width of pavements
   b) Width of pavement+ separators
   c) Width of pavement + separators +shoulders
   d) Width of pavement + separator+ shoulders + side drains

14. Which of the following is a controlled type of pedestrian crossing?
   a) Pavement marking
   b) Studs
   c) Warning signs
   d) Pedestrian signals

15. The mix design should take into consideration.
   a) Stability
   b) Durability
   c) Stability and durability
   d) Age

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer															

Q2. It is required to join two straights having a total deflection angle 25°35' right by a circular curve, having cubic spiral transition curves at each end. The design velocity is 60 km/h and the rate of change of radial acceleration along the transition curve is not to exceed 0.3 m/s^3. Chainage of I (point of intersection) is 1225.50 m. Use a chord length of 20 m for both the transition and simple curves, coefficient of side friction of 0.10 and rate of superelevation of 0.02 to determine: (10/50)

a. The length and stations of the first transition curve. (3 points)

b. The length and stations of the simple curve. (2points)

c. The length and stations of the secondtransition curve. (2 points)

d. The deflection angles and the corresponding chord lengths for setting out the first transition curve only. (3 points)

Q3. The following table lists data used in obtaining a mix design for an asphalt paving mixture. If the maximum specific gravity of the mixture is 2.41 and the bulk specific gravity is 2.35, determine: (10/50)

Material	*Specific Gravity*	*Mix Composition by Weight of Total Mix*
Asphalt cement	1.02	6.40
Coarse aggregate	2.51	52.35
Fine aggregate	2.74	33.45
Mineral filler	2.69	7.80

a. The bulk specific gravity of aggregates in the paving mixture. (2 points)

b. The asphalt absorbed of aggregates in the paving mixture. (4 points)

c. the effective asphalt content of the paving mixture. (2 points)

d. The percent voids in the mineral aggregate VMA. (2 points)

Q4. The traffic on the design lane of a proposed four-lane rural interstate highway consists of 40% trucks. Classification studies have shown that the truck factor can be taken as 0.45, AADT on the design lane during the first year of operation is 1000, pi= 4.2 and pt= 2.5. The growth rate is 4%, the design life is 20 years, the reliability level is 95%, and the standard deviation is 0.45.The pavement structure will be exposed to moisture levels approaching saturation 20% of the time (use $m_i = 0.9$), and it will take about one week for drainage of water. Effective CBR of the subgrade material is 7. CBR of the base and subbase are 70 and 22, respectively, and M_r for the asphalt mixture is 450,000 lb/in^2. (Note: use minimum thickness of asphalt concrete equals 3.5 in, aggregate base and subbase equals 6 in) (15/50)

a. Determine the design ESAL. (5 points)

b. Design a suitable flexible pavement using the 1993 AASHTO guide procedure to carry a design ESAL of $2\times\ 10^6$. (10 points)

End of Questions

Useful Formulae

$$G_{mb} = \frac{W_a}{W_a - W_w}$$

$$G_{sb} = \frac{P_{ca} + P_{fa} + P_{mf}}{\frac{P_{ca}}{G_{bca}} + \frac{P_{fa}}{G_{bfa}} + \frac{P_{mf}}{G_{bmf}}}$$

$$G_{se} = \frac{100 - P_b}{(100/G_{mm}) - (P_b/G_b)}$$

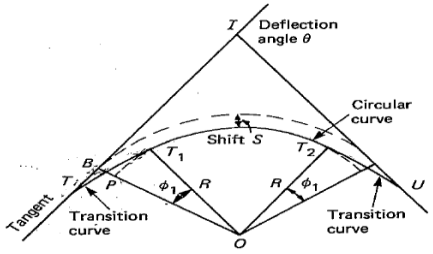
$$G_{mm} = \frac{100}{(P_s/G_{se}) + (P_b/G_b)}$$

$$P_{ba} = 100\,\frac{G_{se} - G_{sb}}{G_{sb}G_{se}}\,G_b$$

$$P_{be} = P_b - \frac{P_{ba}}{100}\,P_s$$

$$VMA = 100 - \frac{G_{mb}P_s}{G_{sb}}$$

$$P_a = 100\,\frac{G_{mm} - G_{mb}}{G_{mm}}$$



$$\alpha L = \frac{V^3}{R}$$

$$S = \frac{L^2}{24R}$$

$$IT = (R+S)\tan\frac{\theta}{2} + \frac{L}{2}$$

$$\delta = \frac{l^2}{6RL} \text{ radians}$$

$$\phi_1 = 3\delta_1$$

$$R = \frac{u^2}{g(e + f_s)}$$

$$\text{length of arc } T_1T_2 = R(\theta - 2\phi_1)\,\frac{\pi}{180}$$

$$\delta_{\text{circular arc}} = 1718.9 \times \frac{c}{R} \text{ min}$$

$$\text{ESAL}_i = f_d \times G_{rn} \times \text{AADT}_i \times 365 \times N_i \times F_{Ei}$$

$$G_{rn} = [(1+r)^n - 1]/r$$

$$\text{SN} = a_1D_1 + a_2D_2m_2 + a_3D_3m_3$$

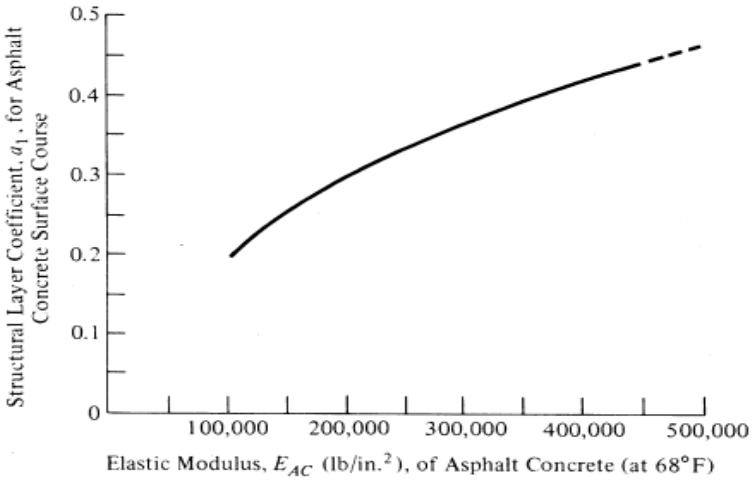


Figure 19.5 Chart for Estimating Structural Layer Coefficient of Dense-Graded/Asphalt Concrete Based on the Elastic (Resilient) Modulus

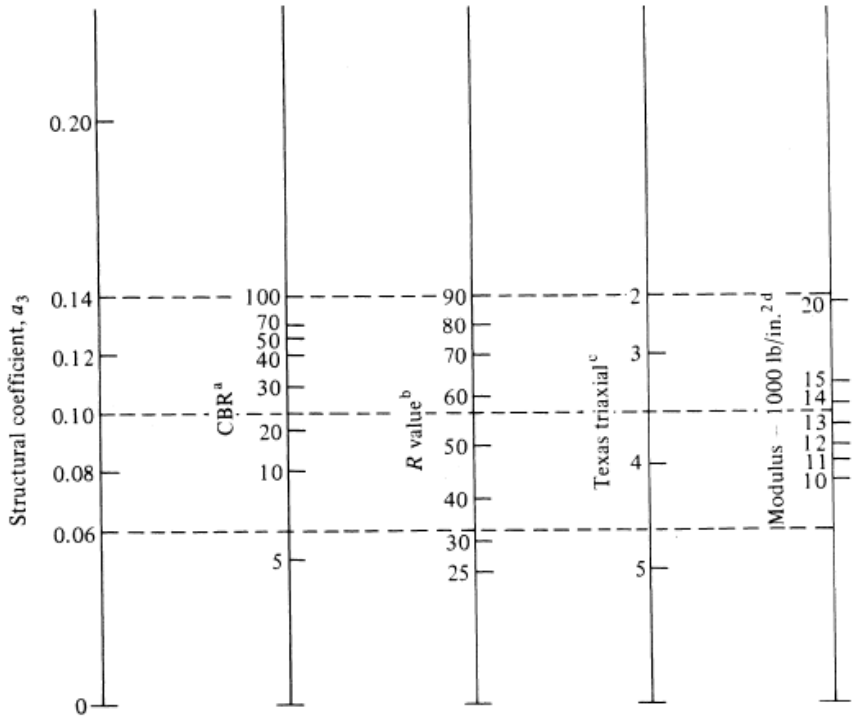


Figure 19.3 Variation in Granular Subbase Layer Coefficient, a_3, with Various Subbase Strength Parameters

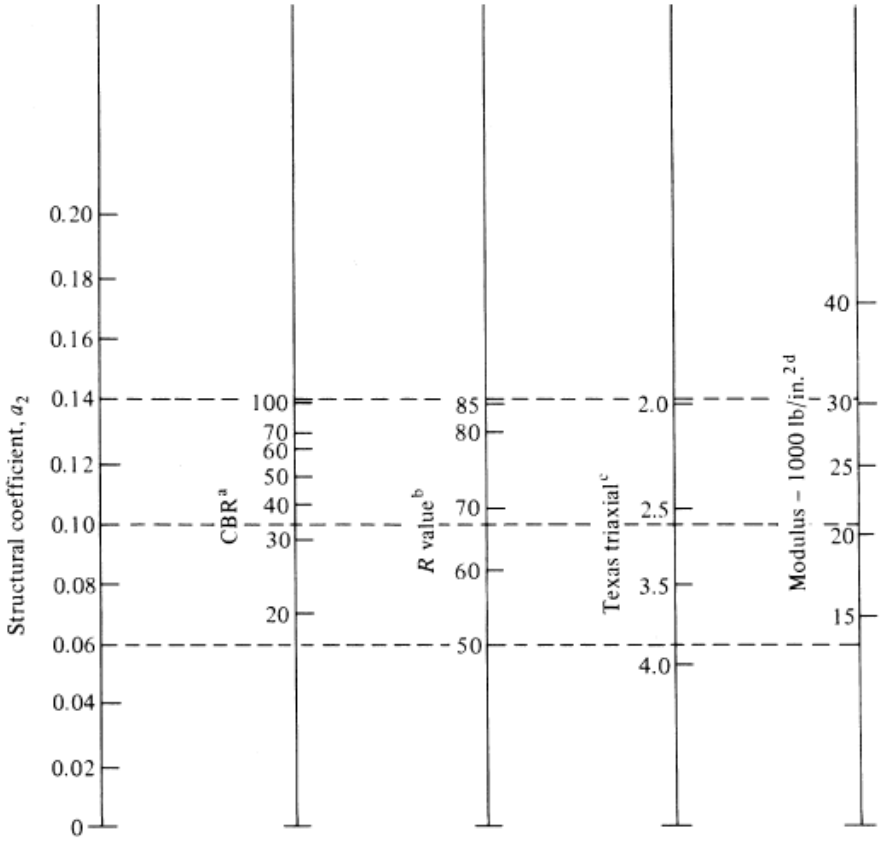


Figure 19.4 Variation in Granular Base Layer Coefficient, a_2, with Various Subbase Strength Parameters

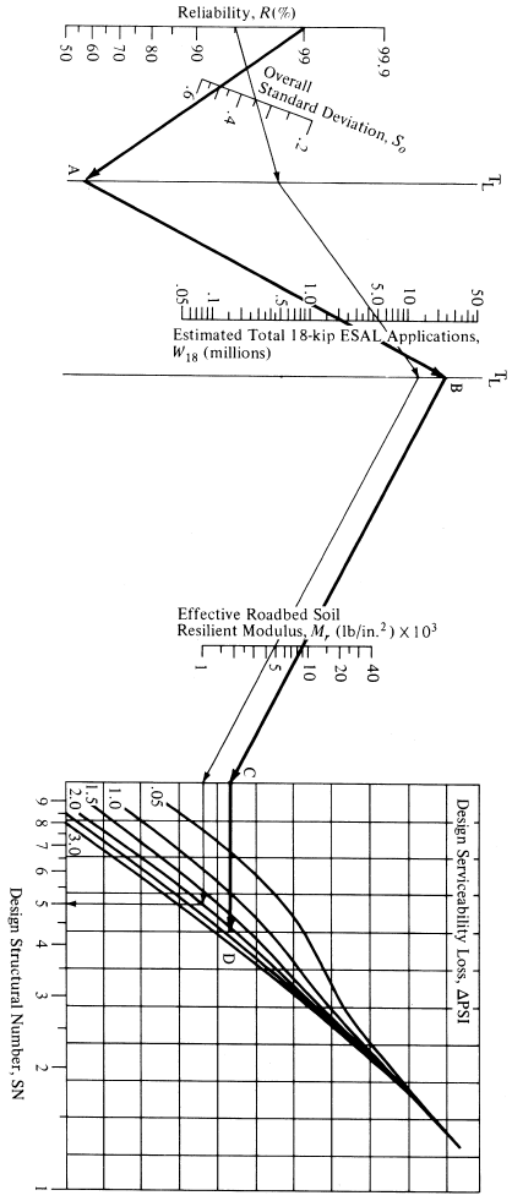


Figure 19.8 Design Chart for Flexible Pavements Based on Using Mean Values for each Input