Course No: **CIVL 4330**
Course Title: Transportation Engineering II
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Time: 2 hr
Using Calculator (Yes)

University of Palestine

Final Exam
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Total Grade: 50

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College Name: Engineering
Dep. / Specialist: Civil Engineering
Using Dictionary (Yes)

Answer All Questions

First Question

A. Indicate which of the following statements is true or false : 10

1. The emulsified asphalts generally are used in highway maintenance and construction.
2. The ductility of good asphalt it more than 50mm.
3. Functional performance is related to the physical condition of the pavement.
4. Traffic loads are transferred by the wearing surface to the underlying supporting materials through the cohesion of fine materials only.
5. The subbase is usually the natural material serves as the foundation of the pavement structure.
6. When the quality of the subgrade material meets the requirements of the subbase material, the subbase component may be omitted.
7. The specifications for subbase materials usually include more strict requirements than those for base course materials.
8. Bituminous binders can be classified into five types asphalt cement, asphalt cutbacks, emulsified asphalt, blown asphalt and road tars.
9. Medium-curing cutback asphalts (MC0) use between base coarse and asphalt layers.
10. The penetration is the distance in 0.01 mm that a standard needle will penetrate a given sample under specific conditions.

B. Explain procedure of **Marshall test** 5

Second Question	**20**

The aggregate mix used for the design of an asphalt mixture consists of

52% coarse aggregates with bulk specific gravities 2.63,

39% fine aggregates with bulk specific gravities 2.59

9% mineral filler with bulk specific gravities 2.68

If the effective specific gravity of the aggregates is 2.82 and the specific gravity of the asphalt is 1.24, **determine the optimum asphalt content as a percentage of the total mix if results obtained using the Marshall method are shown in the following Table**.

Percent Asphalt	*Weight of Specimen (g)*		*Stability (lb)*	*Flow (0.01 in.)*
	in Air	*in Water*		
5.0	1330.1	793.3	1836	14
5.5	1336.2	800.8	1861	16
6.0	1342.0	804.5	1818	20

Third Question **15**

Design a suitable flexible pavement to carry a design ESAL of $3\times\ 10^6$.The reliability level is 99%, and the standard deviation is 0.45 and p_i = 4.5 and p_t = 2.5. The pavement structure will be exposed to moisture levels approaching saturation 15% of the time, and it will take about one week for drainage of water. Effective CBR of the subgrade material is 10. CBR of the base and subbase are 90 and 28, respectively, and M_r for the asphalt mixture is 420,000 lb/in^2.

End of Questions
Good luck

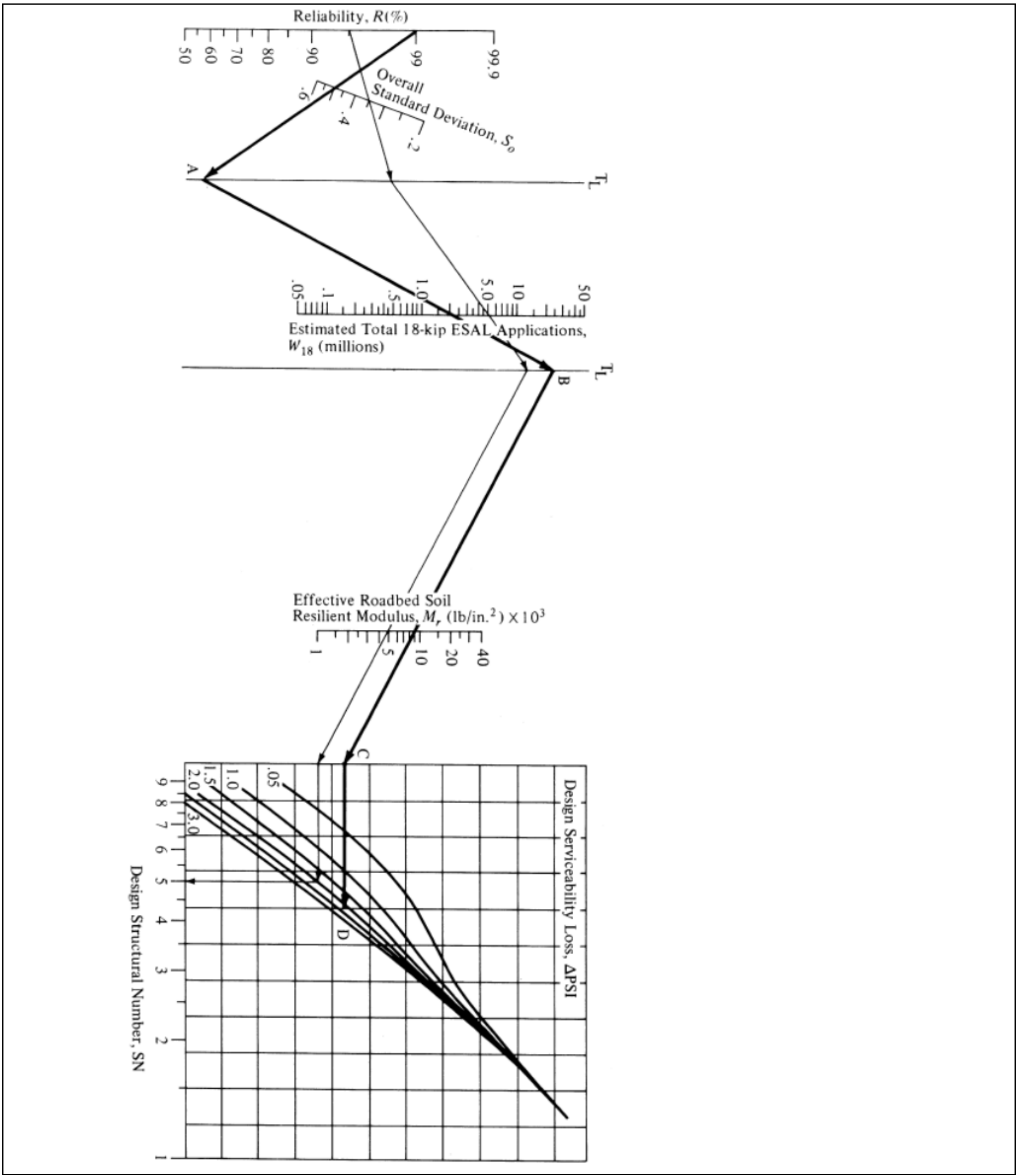
Reliability, R(%)
50
60
70
80
90
99
99.9
Overall Standard Deviation, S_o
.6
.4
.2
A
T_L
.05
.1
.5
1.0
5.0
10
50
Estimated Total 18-kip ESAL Applications, W_{18} (millions)
T_L
B
Effective Roadbed Soil Resilient Modulus, M_r (lb/in.^{2}) $\times 10^3$
1
5
10
20
40
C
D
Design Serviceability Loss, ΔPSI
.05
1.0
1.5
2.0
3.0
Design Structural Number, SN

Table 19.5 Definition of Drainage Quality

Quality of Drainage	*Water Removed Within**
Excellent	2 hours
Good	1 day
Fair	1 week
Poor	1 month
Very poor	(water will not drain)

Table 19.6 Recommended m_i Values

	Percent of Time Pavement Structure Is Exposed to Moisture Levels Approaching Saturation			
Quality of Drainage	*Less Than 1%*	*1 to 5%*	*5 to 25%*	*Greater Than 25%*
Excellent	1.40–1.35	1.35–1.30	1.30–1.20	1.20
Good	1.35–1.25	1.25–1.15	1.15–1.00	1.00
Fair	1.25–1.15	1.15–1.05	1.00–0.80	0.80
Poor	1.15–1.05	1.05–0.80	0.80–0.60	0.60
Very poor	1.05–0.95	0.95–0.75	0.75–0.40	0.40

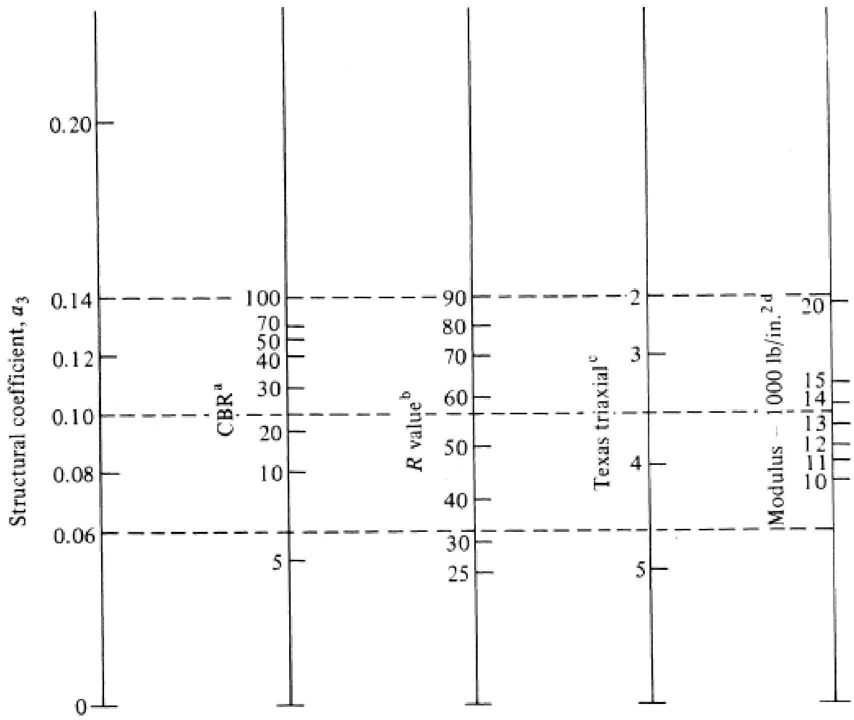

Figure 19.3 Variation in Granular Subbase Layer Coefficient, a_3, with Various Subbase Strength Parameters

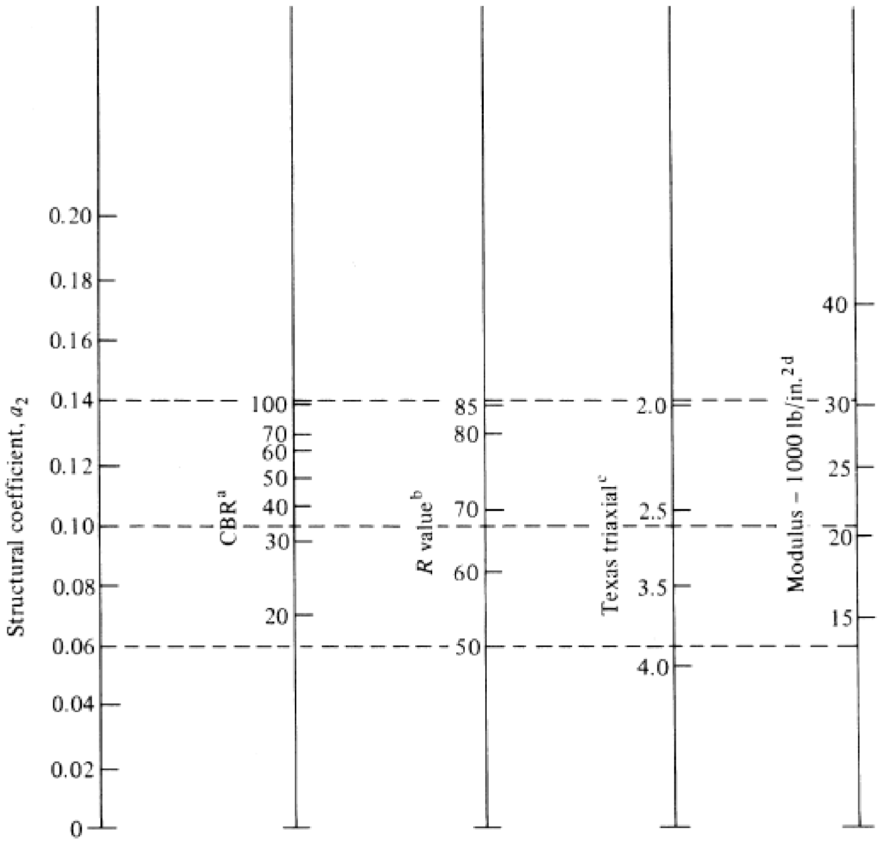

Figure 19.4 Variation in Granular Base Layer Coefficient, a_2, with Various Subbase Strength Parameters

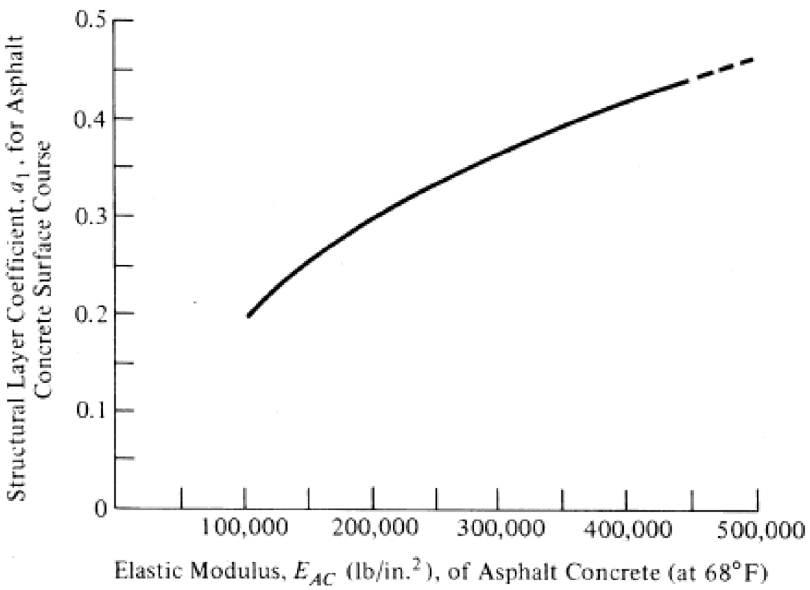

Figure 19.5 Chart for Estimating Structural Layer Coefficient of Dense-Graded/Asphalt Concrete Based on the Elastic (Resilient) Modulus

$$G_{mb} = \frac{W_a}{W_a - W_w} \quad (18.4)$$

where

W_a = weight of sample in air (g)
W_w = weight of sample in water (g)

$$G_{sb} = \frac{P_{ca} + P_{fa} + P_{mf}}{\frac{P_{ca}}{G_{bca}} + \frac{P_{fa}}{G_{bfa}} + \frac{P_{mf}}{G_{bmf}}} \quad (18$$

where

G_{sb} = bulk specific gravity of aggregates in the paving mixture
P_{ca}, P_{fa}, P_{mf} = percent by weight of coarse aggregate, fine aggregate, a mineral filler, respectively, in the paving mixture. (Note tl P_{ca}, P_{fa}, and P_{mf} could be found either as a percentage of t paving mixture or as a percentage of only the total aggı gates. The same results will be obtained for G_{sb})
$G_{bca}, G_{bfa}, G_{bmf}$ = bulk specific gravities of coarse aggregate, fine aggregate, a mineral filler, respectively

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

where

G_{mm} = maximum specific gravity of paving mixture (no air voids)
P_s = percent by weight of aggregates in paving mixture
P_b = percent by weight of asphalt in paving mixture
G_{se} = effective specific gravity of the aggregates (assumed to be constan different asphalt cement contents)
G_b = specific gravity of asphalt

$$P_{be} = P_b - \frac{P_{ba}}{100} P_s \quad (18.10)$$

where

P_{be} = effective asphalt content in paving mixture (percent by weight)
P_b = percent by weight of asphalt in paving mixture
P_s = aggregate percent by weight of paving mixture
P_{ba} = amount of asphalt absorbed as a percentage of the total weight of aggregates

$$VMA = 100 - \frac{G_{mb} P_s}{G_{sb}} \quad (18.11)$$

where

VMA = percent voids in compacted mineral aggregates (percent of bulk volume)
G_{mb} = bulk specific gravity of compacted mixture
G_{sb} = bulk specific gravity of aggregate
P_s = aggregate percent by weight of total paving mixture

$$P_a = 100 \frac{G_{mm} - G_{mb}}{G_{mm}} \quad (18.12$$

where

P_a = percent air voids in compacted paving mixture
G_{mm} = maximum specific gravity of the compacted paving mixture
G_{mb} = bulk specific gravity of the compacted paving mixture