King Fahd University of Petroleum & Minerals
CIVIL ENGINEERING DEPARTMENT

CE 441

DESIGN OF PAVEMENT

Fall 2002-2003

HOMEWORK # 5a.

MATERIAL CHARACTERIZATION

1) Solve problem 7.1, textbook.

2) A 30" plane bearing test was performed on subgrade and granular base. Determine the modulus of subgrade reaction of the subgrade soil and the soil base coarse.

Load (lb)	Deflection 12" Base (in.)	Load (lb)	Deflection of subgrade (in.)
5652	0.01	3,532	0.01
12,717	0.03	8,100	0.03
17,662	0.05	11,304	0.05
20,135	0.06	12,010	0.06
24,727	0.08	13,423	0.08
28,260	0.10	14,130	0.10

3) Do problem 8.4, textbook page 293.

4) Determine the surcharge weights which are required for a CBR test on a soil wherein the estimated pavement thickness will be 18 inches. The pavement will have a unit weight of 140 pcf.

5) An indirect tensile strength test was performed on an asphaltic material sample 4" diam. and 2.5" thickness, the maximum load was 1500 lbs. Calculate the maximum indirect tensile strength?

6) A dynamic modulus test is conducted on asphalt mix. For a temperature of 70°F, a maximum sinusoidal stress of 17.5 psi results in maximum axial strains of 37, 25, and 19 microinches/inch for frequencies of 1, 4, and 16 Hz, respectively. Calculate the $|E^*|$ for this mix at these frequencies. Plot the relationship between E* and frequency.

7) A diametral Modulus of resilience test was made on a disc sample 4" diam. and 2.5" thickness by applying a repeated sinusoidal load of an amplitude of 400 lbs at 3 different frequencies 1 Hz, 4 Hz and 16 Hz. The results of horizontal deformation are

$$3 \times 10^{-4}, \quad 2.2 \times 10^{-4}, \quad 1.9 \times 10^{-4} \text{ inches}$$

Calculate the diametral Modulus of resilience at these three frequencies and plot M_r versus frequency.

8) Discuss and comment on your results obtained in problems (6) and (7) showing the difference between E* and M_r.

9) The fatigue test was performed on 4 samples at different stress levels and 4 corresponding lives were obtained as follows:

Stress S (psi)	5	10	25	30
Life N_f (cycles)	did not fail	1×10^6	6.25×10^4	1.23×10^4

Plot S-N curve on log-log graph paper and from the plot determine:

a) Fatigue life at S = 15, 25 psi

b) The maximum stress (strength) of this material

c) Can you determine the endurance limit from the given data? Give reason to your answer.

10) Rutting Test was performed on two 4" soil samples. Readings of permanent deformation G(N) at various N cycles are given. Plot the permanent strain ε_p versus N on log-log graph paper, from the plot determine the rutting parameters A and b in the equation $\varepsilon_p = A(N)^b$.

Compare between the two values before and after saturation.

(I) Unsaturated Sample

N	G(N)
25	0.007358
50	0.008327
75	0.009101
100	0.009682
200	0.010259
250	0.010649
300	0.010796
400	0.011138
500	0.011431
750	0.012066
1110	0.012701
1550	0.013120
2020	0.013324
2400	0.013529
3000	0.013815
3500	0.014224

(II) Saturated Sample

N	G(N)
25	0.001860
50	0.001980
78	0.002010
125	0.002090
180	0.002180
200	0.002220
250	0.002290
315	0.002407
400	0.002540
525	0.002730
750	0.003040
1000	0.003350
1500	0.003740