

Homework 5a

Question # 1

Material # 1: $PI = LL - PL = 35 - 20 = 15$

Then from Fig. 7.5 chart 2: $\Rightarrow GI = GI_1 + GI_2 = 8 + 2 = 10$

Material # 2: $PI = LL - PL = 29 - 25 = 4$

Then from Fig. 7.5 chart 2: $\Rightarrow GI = GI_1 + GI_2 = 8 + 0 = 8$

Material # 3: since there is no LL or PL, therefore, GI depends only on the percentage passing sieve # 200.

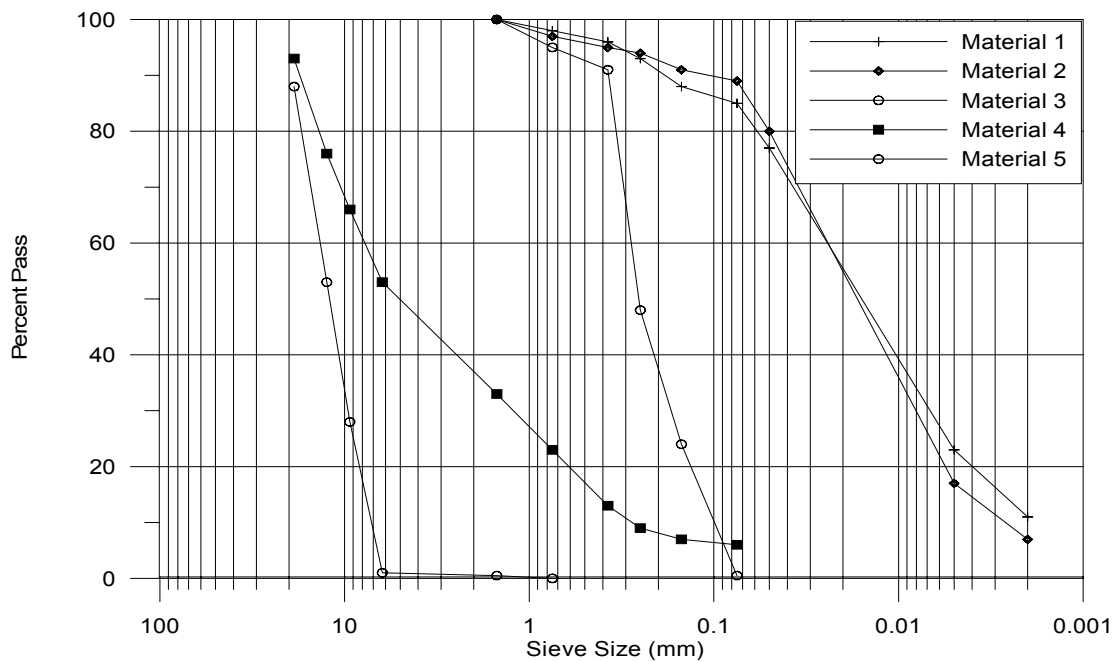
Therefore, $GI = 0.2 * a = 0.2 * 35 = 7$

Material # 4: since there is no PL, therefore, GI depends only on the percentage passing sieve # 200 and LL.

Therefore, $GI = 8$ (from fig. 7.5)

Material # 5: since there is no LL or PL, therefore, GI depends only on the percentage passing sieve # 200.

Therefore, $GI = 0.2 * a = 0.2 * 35 = 7$

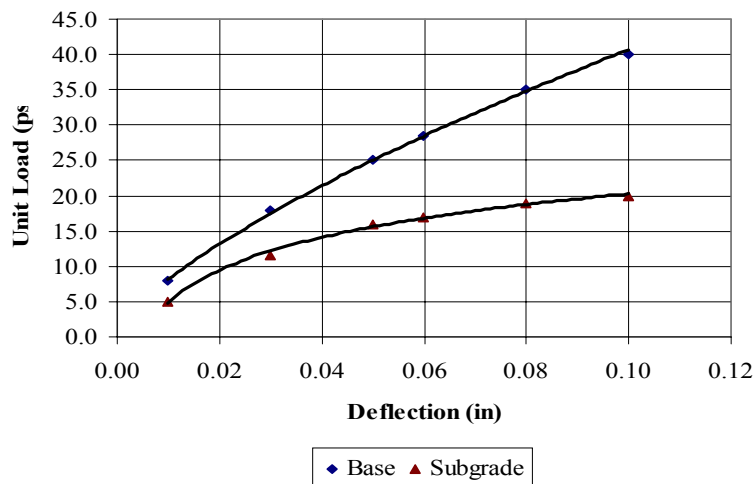


	Material 1	Material 2	Material 3	Material 4	Material 5
GI	10	8	0	8	7
AASHTO	A-6	A-4	A-3	A-3	A-1a
FAA	E-7	E-6	E-3	E-2	E-3
UNIFIED SYSTEM	CL	ML	SP	GW	GP
Description	Not suitable for base	Not suitable for base	Not suitable for base	Excellent for base	Good for subgrade

Question # 2

$$\text{Area of the plate} = \frac{\pi * 30^2}{4} = 760.5 \text{ in}^2$$

Unit Load	Deflection (Base)	Unit Load	Deflection (Subgrade)
8.0	0.01	5.0	0.01
18.0	0.03	11.5	0.03
25.0	0.05	16.0	0.05
28.5	0.06	17.0	0.06
35.0	0.08	19.0	0.08
40.0	0.10	20.0	0.10

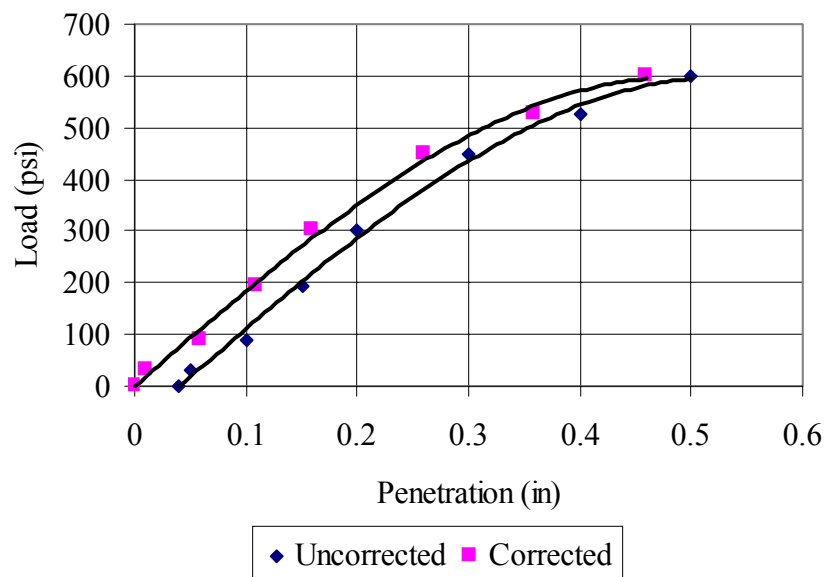


$$K_{base} = \frac{10}{0.013} = 769.2 \text{ pci}$$

$$K_{subgrade} = \frac{10}{0.021} = 476.2 \text{ pci}$$

Question # 3

First correct the test data as shown in the following figure:



$$CBR = \max. \text{ of } \left[\frac{\text{Unit load at 0.1}}{\text{Standard load at 0.1}} * 100 \text{ or } \frac{\text{Unit load at 0.2}}{\text{Standard load at 0.2}} * 100 \right]$$

$$CBR = \left[\frac{190}{1000} * 100 \text{ or } \frac{350}{1500} * 100 \right] \Rightarrow CBR = 23$$

Question # 4

$$\text{The unit weight of the pavement per in}^2 = \frac{140}{12^3} * 18 = 1.458 \text{ psi}$$

Surcharge weight = weight per unit area * surcharge area

$$\text{Surcharge weight} = 1.458 * \left(\frac{\pi * 6^2}{4} - 3 \right) = 36.85 \text{ lb}$$

Question # 5

$$\sigma = \frac{P}{A} = \frac{1500}{4 * 2.5} = 150 \text{ psi}$$

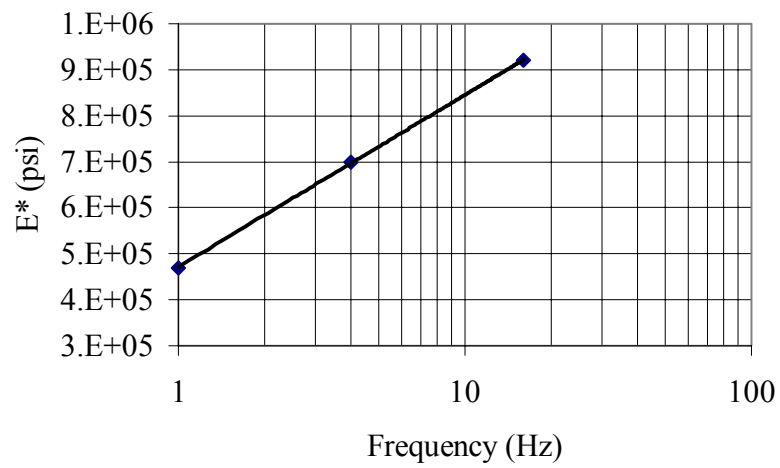
Question # 6

$$|E^*| = \frac{\sigma_o}{\varepsilon_o}$$

At Frequency 1 Hz $\Rightarrow |E^*| = \frac{17.5}{37 * 10^{-6}} = 4.7 * 10^5 \text{ psi}$

At Frequency 4 Hz $\Rightarrow |E^*| = \frac{17.5}{25 * 10^{-6}} = 7.0 * 10^5 \text{ psi}$

At Frequency 16 Hz $\Rightarrow |E^*| = \frac{17.5}{19 * 10^{-6}} = 9.2 * 10^5 \text{ psi}$



Question # 7

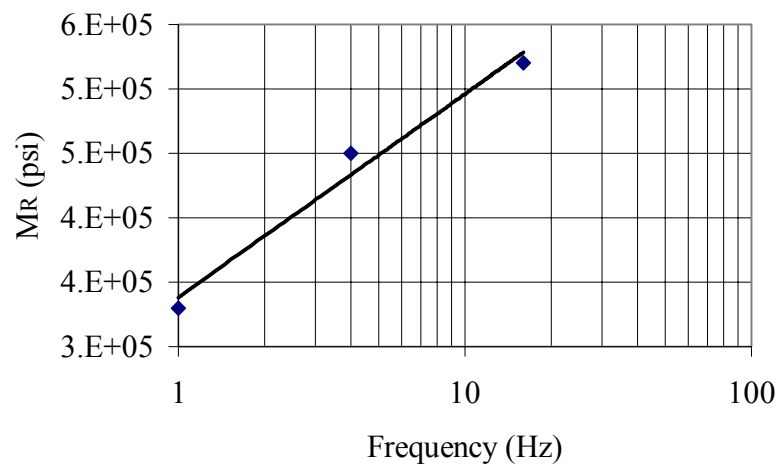
$$MR = \frac{P(\mu + 0.2734)}{t * \delta_h} \quad (\text{for } AC, \mu = 0.35)$$

Given $P = 400 \text{ lb}$, $t = 2.5 \text{ in}$

$$\text{At } 1 \text{ Hz} \Rightarrow MR = \frac{400(0.35 + 0.2734)}{2.5 * 3 * 10^{-4}} = 3.3 * 10^5 \text{ psi}$$

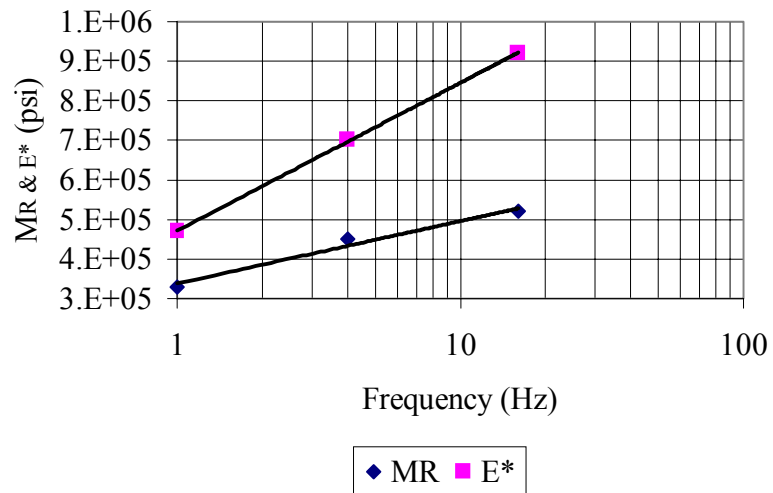
$$\text{At } 4 \text{ Hz} \Rightarrow MR = \frac{400(0.35 + 0.2734)}{2.5 * 2.2 * 10^{-4}} = 4.5 * 10^5 \text{ psi}$$

$$\text{At } 16 \text{ Hz} \Rightarrow MR = \frac{400(0.35 + 0.2734)}{2.5 * 1.9 * 10^{-4}} = 5.2 * 10^5 \text{ psi}$$



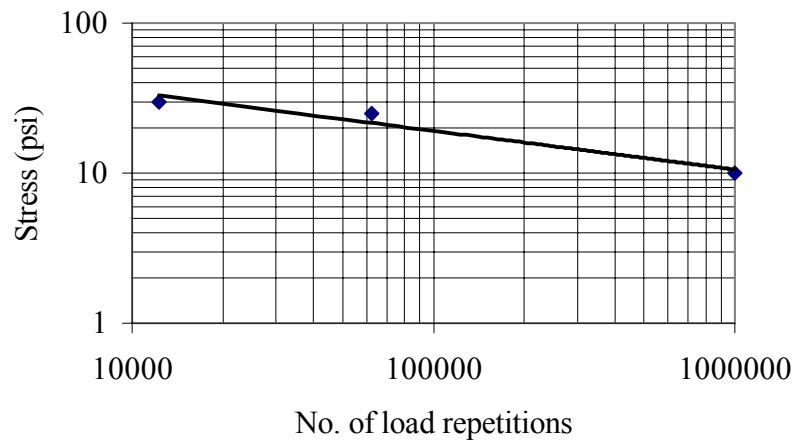
Question # 8

Hz	MR	E*
1	330000	470000
4	450000	700000
16	520000	920000



E* is greater than MR because it includes both the elastic and visco-elastic behavior.

Question # 9

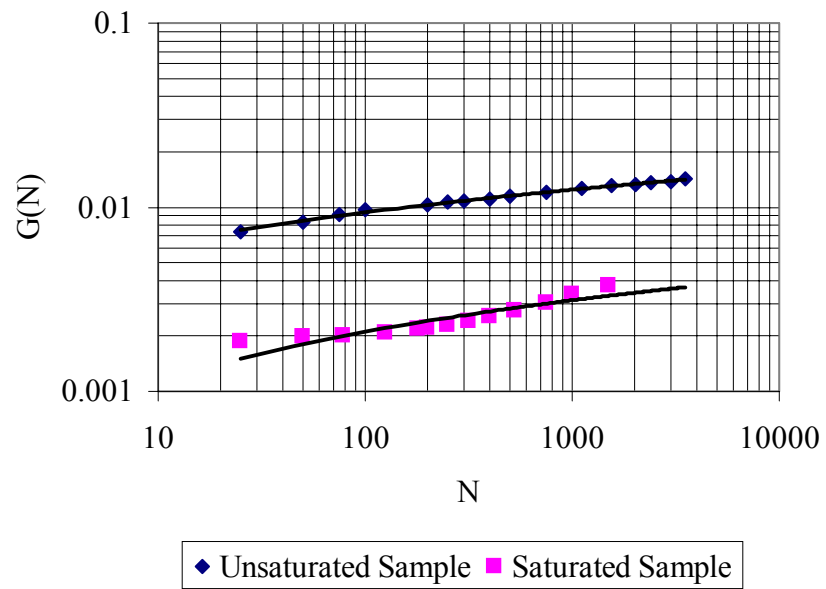


From the Graph:

at $S = 15 \Rightarrow N_f = 257000$

at $S = 25 \Rightarrow N_f = 42000$

Question # 10



For the Saturated Sample: $\varepsilon_p = 0.001 * N^{0.1718}$

For the Unsaturated Sample: $\varepsilon_p = 0.0052 * N^{0.1242}$

The saturated sample is more elastic than the unsaturated sample; this obviously appears from the permanent deformation of each sample.

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