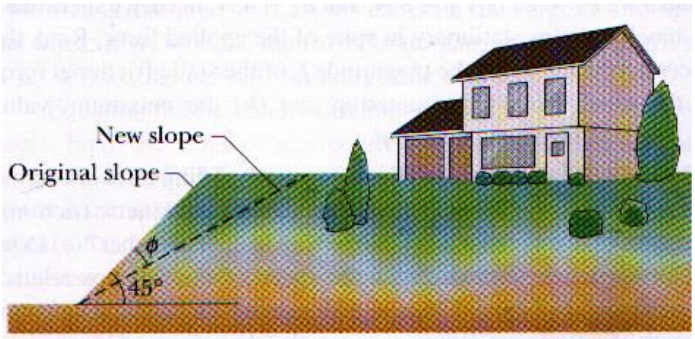
Answer on Question #61858-Physics-Mechanics

A house is built on the top of a hill with a nearby 45 degrees slope as shown in the figure. An engineering study indicates that the slope angle should be reduced because the top layers of soil along the slope might slip past the lower layers. If the static coefficient of friction between two such layers is 0.5, what is the least angle φ through which the present slope should be reduced to prevent slipping?



Solution

$$F_{fr} = \mu N$$

$$N = mg\cos\theta$$

The equilibrium condition:

$$F_{fr} = mg\sin\theta$$

$$\mu mg\cos\theta = mg\sin\theta$$

$$\mu = \frac{mg\sin\theta}{mg\cos\theta} = \tan\theta$$

$$\theta = \tan^{-1}\mu = \tan^{-1}0.5 = 26.6°$$

$$\phi = 45° - \theta = 45° - 26.6° = 18.4°$$

Answer: $18.4°$.