Mathematics 172 Homework

To simplify the arugment I was trying to make in class to day, let assume that we have a material that has a is crushed by a pressure of 9,000 lbs/ft^2. If we have a cube to this material with side length s ft then the weight will be of the form

$$w = cs^3 \text{lbs}$$

for some constanct c. If a cube with a side of length 2 ft weights 500 lbs then we can find c by solving for it in the following

$$500 = c(2)^3$$

which give

$$c = \frac{500}{2^3} = 62.5$$

and thus

$$w = 62.5s^3$$

The base of this cube will be a square with side length s and therefore its area will be

$$A = s^2.$$

The preasue on the base will be the weight, $w = 62.5s^3$ lb, spread over an area of $A = s^2$ ft^2. Thus the pressure will be

$$\text{Presusure on base} = \frac{w}{A} = \frac{62.5s^3}{s^2} = 62.5s$$

So how big can a cube of this material be? If the pressure on the base is larger than the crushing pressure of the material then it will break. In the case here the curshing pressure is 9,000 lbs/ft^2. So the largest cube we can have is when

$$62.5s = \text{Presusure on base} = \text{curshing pressure} = 9{,}000.$$

We can solve for s to get

$$s = \frac{9{,}000}{62.5} = 144\text{ft}.$$

Thus the largest cube that can be made of this material without it collapsing is 144 ft.

1. The crushing presure of eastern elm is 707,040 lb/ft^2. If a cube of eastern elm with side of size 3 ft weights 945 lbs then how big can a cube made of eastern elm be before it crishes itself under its own weight?

2. The crushing presure of oak is 1,064,183 lb/ft^2. If a cube of oak with side of size 1.5 ft weights 152 lb then how big can a cube made of oak be before it crishes itself under its own weight?