Karate Board & Hooke's Law

Introduction:

In this experiment we will examine a force applied to a seemingly un-spring-like object, a pine board, and measure its deformation to see if it obeys Hooke's criteria. In other words does the deformation of the pine board vary linearly with the applied force? If Hooke's criteria can be reasonably applied to the pine board then we will estimate the speed with which we need to strike the board with our hand in order to break it. We will base these estimates on energy considerations: $U = \frac{1}{2} k x^2$ and $KE = \frac{1}{2} m v^2$.

Apparatus:

The experimental arrangement that we use in this lab is made of a cradle that hangs from a piece of board supported by an upside-down V-shape platform. Loading the platform with bricks, one at a time, increases the weight of the cradle. For each addition of a brick we determine the distance that the board bends using a position indicator dial-gauge. This gauge measures small changes in increments of 0.001 inches. (We load the cradle with enough bricks to ultimately break it.)

Procedure:

- First measure the mass of six to seven bricks, one at a time, to obtain an average mass for one brick. Record these and from this data determine the uncertainty in the value of the mass of a single brick. Also, record the mass of the cradle.
- Place a board horizontally on the two metal rods of the platform. Attach the nylon strings to the sides of the board by screwing the eye-hooks into the board. The purpose of these strings is to keep the board pieces from flying away and causing any injuries or damage, once the board breaks.
- Mark the location of the tip of the dial touching the board using your pen and zero the dial.
- Next hang the cradle from the board and record the dial.
- Now add one brick at a time to the cradle and record the dial for each step. Continue until the board breaks! **Please make sure to keep your toes and fingers away from the bottom of the cradle at all times!**

Analysis:

Plot the weight (F) versus distance (x). If the data approximates a straight line, fit the data and determine the effective spring constant of the board. What is the uncertainty in this value? Estimate the weight of your fist (fully explain how you arrive at this value). From these values determine the speed with which you need to strike the board with your fist in order to break it. In addition calculate the work done using your plot and using the definition of work.