Name: _____ Date:_____

FLAT ROOFS

In Design-Technology, you have to considee strength and stability in your designs. The roof design of a building, is one area in which one must consider strength and stability of the roof. In many of the countries around the world, quick housing is formed with a flat roof.

Discussion Question

Determining the strength of the roof is an important consideration in buildings: offices and factories often have flat roofs. Why are flat roofs popular (including what kind of shelters include flat roofs) and why they might cause problems?

Group Investigation

In 1998, a severe ice storm hit Eastern Ontario and Quebec damaging roofs that could not support the weight of the heavy snow and ice. In this problem, you will experiment with the weight-bearing capability of a flat roof. You will work as a group, then do the analysis on your own.

1. Send the materials handler in your group to pick up the following items:
   - A small light-weight container and a collection of identical weights to test the load that your "roof" will bear
   - Six 28 cm by 10 cm strips of paper to simulate roofs of various thicknesses
   - Two supports of the same height to simulate the walls (texts)

2. Stack the strips of paper neatly, and then fold the stack carefully, with a narrow lip on each side of 2.5 cm in height. Each strip simulates a layer of the roof. Suspend a single-layer roof between the two supports.

3. The roof should overlap each support by the same amount on both sides (5 cm). Place the container in the centre of the roof model.

4. Add pennies to the container, one at a time and gently, until the roof collapses.

5. Record your results in a table that shows the number of layers in the roof and the number of weights needed before the roof collapses.

6. Create a roof with an extra layer and repeat the data collection until you collapse a roof of 6 layers.

Individual Analysis

Share the data in your group and **create a table of values** showing the layers of paper and the number of weights. The rest of your work will be done **on your own**.

1. **A2, C2** Create a graphical display for your data, with appropriate labels and indicate the independent and dependent variables.

2. **K2** Is your data linear? Justify your response in at least two ways.

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3. Suppose the data does have a linear relationship (*regardless of your answer in question 2).*

   a. **K1** Determine the equation of the line for this data.

   b. **K1, A1** What is the slope of this line? Comment on what this value means realistically.

   c. **A2** What is the y-intercept of this line? Comment on what this value means realistically.

   d. **K2, A1** Using your linear model, how many weights could you add for 10 layers of paper (yummy!)? Confirm your response using the equation and the graph.

   e. **K2, A1** Using your linear model, how many layers of paper would 50 weights hold? Confirm your response using the equation and the graph.

4. **T2, C1** If your group had decided to fold the paper in half before stacking them, describe how you think the linear model would change.

5. Alexa's group modelled the collapsing weight for various thicknesses of roofs, using a paper cup and pennies. Alexa's group drew this graph from their investigation.

   a. **T2, C2** How would this graph differ if your group had used a heavy reusable cup instead of a paper cup? Sketch the graph that would result from your experiment. Alexa's original graph using a paper cup is drawn as a dotted line in the reference graph. Explain your reasoning.

   b. **T2, C2** How would the graph differ if her group had still used a paper cup, but toonies ($2 coins) instead of pennies? Sketch the graph that would result. Again, Alexa's original graph using a paper cup is draw in as a dotted line as a reference graph. Explain your reasoning.