RELATING DESIGN TO STRESS *(page 1 of 2)*

Stress applied to only one point on an object causes stress throughout the object. The way a force travels through an object depends in part on the shape of the object. Before engineers can design a structure that will provide safe, reliable performance of its intended purpose, they must know how various materials formed or cut into different shapes will react in various conditions. Do you think small holes or notches made in a material make a difference in the overall way the material handles stress?

Questions & Predictions *Predict and record answers to these questions. Observe and measure for Evidence & Proof below.*

1. Is a slat notched near one end able to resist the same amount of stress to its opposite end as an unnotched slat?
2. Is a slat with a hole drilled near one end able to resist the same amount of stress to its opposite end as an undrilled slat?
3. Is a drilled slat more able, less able, or equally able to resist stress as a notched slat?

EVIDENCE & PROOF

Materials:

6 balsa wood slats, each about 1/8 in. thick and about 1 in. wide and 12 in. long;
manual drill with a 3/8 in. bit; craft knife;
1 empty half-gallon drink carton, washed out, with the top cut off;
48 in. of heavy nylon cord;
masking tape;
balance scale;
about 1 cup of sand or salt;
safety glasses

Process: *Follow these steps. Compare your results with your predicted answers to the questions.*

Caution: *Craft knives are very sharp. Always cut away from the hand holding the wood. Use drill with caution. Wear safety glasses*

1. Draw lines 1 1/2 in. from both ends of all slats. Label A and B.
2. Draw two more lines on each slat, 1 1/2 in. inward from the first lines. Label these lines C and D.
3. On one slat, cut a V-shaped notch 3/8 in. wide and about 3/8 in. deep at line C. (See Fig. 1)

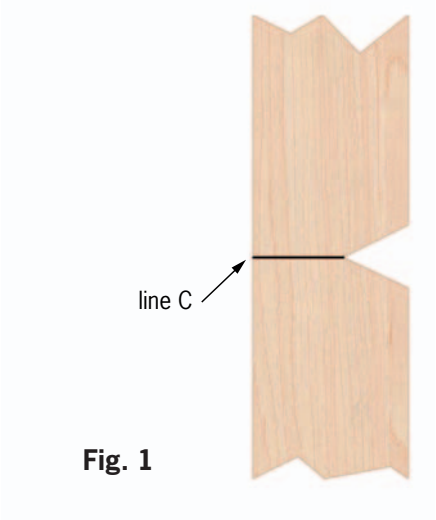

Fig. 1

4. On one slat, drill a hold at the center of line C. (See Fig.2)
5. Make a hanging bucket from the milk carton and cord: Poke holes in two opposite sides of the carton near the top. Thread the string through the holes and tie one end of the string securely to the other. Reinforce holes with masking tape.

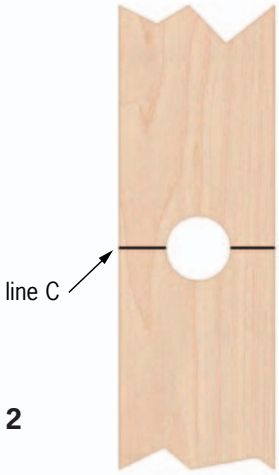

Fig. 2

6. Set up an unnotched, undrilled slat as shown in Fig. 3. Align slats so lines A and B are right at the edges of the desks. Tape in place. Hang the carton bucket from the slat. Place the string on line D. Tape lightly in place to avoid slipping. Be sure the bucket hangs free about 4 in. above the floor.

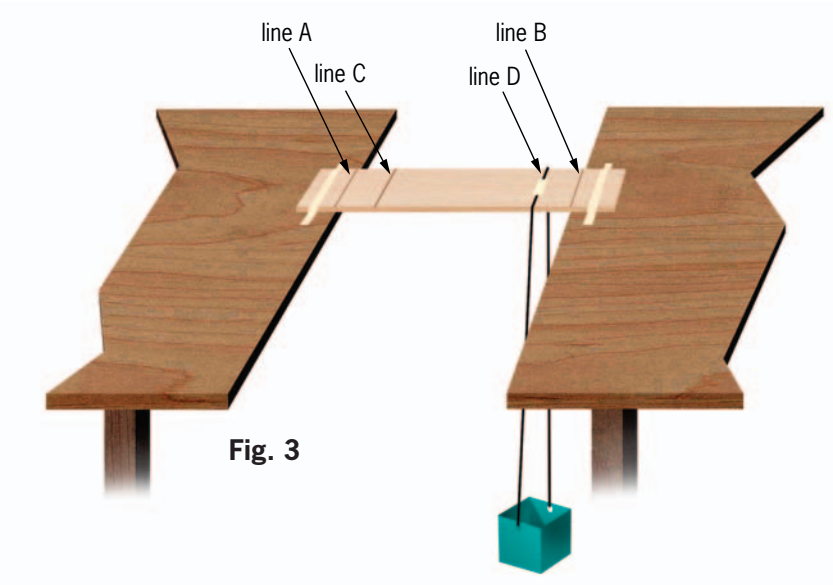

Fig. 3

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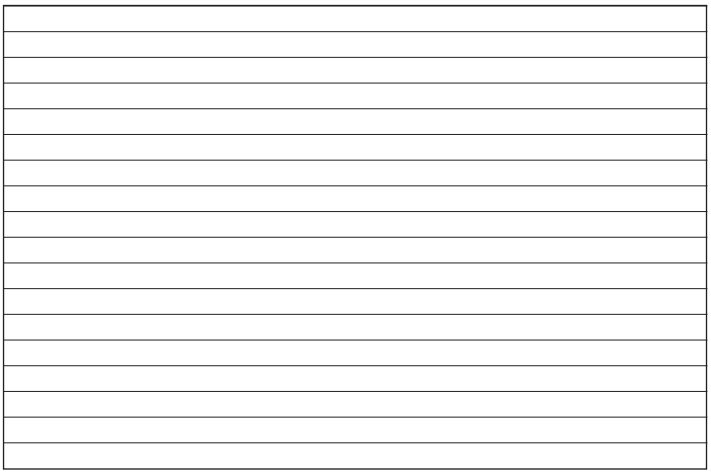
7. Without touching the milk carton, slowly pour sand or salt into the bucket until the slat breaks. Measure the mass of the bucket and sand. Record the mass in the Trial 1 row for an unchanged slat in the Data Table. Return the sand or salt from the milk carton to its container. Examine the broken stick. Measure and note in the Data Table where the break occurred.
8. Repeat Steps 6 and 7 with other undrilled, unnotched slat. Record the mass in the Data Table. Then find the average breaking mass by adding Trials 1 and 2 and dividing the sum by 2. Record your answer in the Average Mass column.
9. Repeat Steps 6-8 for the remaining slats.
10. Determine the best scale to graph your results. Use your scale and the information on your Data Table to complete the bar graph.

Bar Graph: Average Breaking Mass of Slats



Data Table: Testing Shape for Resistance to Stress

TRIAL	SHAPE	MASS	LOCATION OF BREAK POINT	AVERAGE MASS
1	unchanged			
2	unchanged			
1	notched			
2	notched			
1	drilled			
2	drilled			

CONCLUSIONS & INFERENCES

Assume that notching and drilling have the same effects on steel as on wood. Rosa is an engineer. She is designing steel beams for an aviation museum. Life-size replicas of aircraft will hang from these beams. Should she consider notching the beams to hold the support wires? What about drilling holes? Why or why not?