Name: _____

Engineered Composite Building Investigations

Lesson 1: Design of Composite Floor Tiles (Laminate Flooring)

Part 1: Design your Laminate Tile

Directions: Make a visual model of your laminate floor tile. Label each layer in your drawing. After you are finished with your model, get it approved by your instructor before making the tile.

Part 2: Build your Laminate Tile

Directions: Layer your materials using glue in between each tile. Brush on a thin but even layer of quick setting glue with a brush. Make sure to brush the glue on the top, all sides, and bottom of your tile. Be sure to make two identical tiles of your approved design. When you are finished give to your teacher to cure for at least 30 minutes.

Follow-Up Questions:

1. Predict what materials will be more durable against a falling object?

2. Predict what materials will be less durable against a falling object?

Lesson 2: Test the Design of your Laminate Tile

Procedure:

1. Place one of your identical designed tiles on the floor. Use two to four small pieces of tape to secure one of the identical tiles on the floor.
2. Take a 200 g weight and drop it on to the first tile from 1 meter high. Make sure to try to hit the middle of the tile.
3. Measure the deflection in millimeters and record the measurement in Data Table 1.
4. Calculate the force applied onto the first tile and record the measurement in Data Table 1.
5. Place the second of your identical designed tiles on the floor. Use two to four small pieces of tape to secure the second tile on the floor.
6. Take a 600 g weight and drop it onto the second tile from 1 meter high. Make sure to try to hit the middle of the tile.
7. Repeat steps 3 and 4 for the second tile.

Data Table 1. Difference amounts of force applied to designed tiles.

	Load (mass in grams)	Deflection (mm)	Force (Newtons) F = m x a
Test 1 of Tile 1	200 g		
Test 2 of Tile 2	400 g		

Follow-Up Questions:

1. Analyze the force data found in Data Table 1 above. What type of relationship (direct or inverse) does mass and force have? Support your answer using evidence from Data Table 1.

2. By using your answer above, write a CER (claim, evidence, reasoning) to support the claim that Newton's second law of motion describes the mathematical relationship among the force, mass, and acceleration of an object.

Claim: The greater the mass of the object, the more force that object will have.

Evidence:

Reasoning:

3. Looking at Data Table 1, did the greater force affect the amount of deflection in your tile? Support your answer with evidence from Data Table 1.

4. Reflect on the design of your tile. Did materials you picked for your tile influence the impact strength of your tile? Did the different forces applied to your tile create damage or did your tile withstand against the forces applied to your tile? Use evidence from Data Table 1 to support your answer.

5. If you were to do this investigation again, what would you change from your original design to make the impact strength greater for your tile? Explain how you would redesign it and what other materials you would use.

Optional Extension for Lesson 2:

Directions: Graph force vs. deflection data from data table one. Use graph paper or Google Sheets to make your graph. After you have created your graph, answer the following questions.

Follow-Up Questions:

1. What is impact strength?

2. How does force effect impact strength?

3. Why is it important for your tiles to have impact strength?

4. How is impact strength measured?

5. Compare the impact test results of one or two other groups. Decided which group designed the strongest floor tile. Use evidence from all the groups data table to help support your answer.

Lesson 3. Evaluate Moisture Properties of Materials

Important Note: Steps 1 – 6 of procedure may have been completed by instructor. If instructor did the initial measurements, obtain data from instructor and fill it in on Data Table 2.

Procedure:

1. Obtain caliper (or ruler) and weighing scale.
2. Label samples (1 – 5) with sharpie marker.
3. Weigh samples in grams and record this as WT1 in Data Table 2.
4. Measure the dimensions with caliper or ruler in millimeter for length, width, and height of each sample. Record these measurements as L1 for length, W1 for width, and H1 for height in data table 2.
5. Calculate initial volume (V1) for all samples using equation V = L x W x H.
6. Completely soak samples in water for at least 2 hours.
7. After at least 2 hours of samples soaking in water, take samples out of the water and completely dry them quickly with paper towels.
8. Weight samples in grams and record this as WT2 in Data Table 2.
9. Measure the dimensions with caliper or ruler in millimeters for length, width, and height of each sample. Record these measurements as L2 for length, W2 for width, and H2 for height in data table 2.
10. Calculate final volume (V2) for all samples using equation V = L x W x H.
11. In data table 3, calculate the percent of water absorption and percent of volumetric change for each sample.
12. Clean up materials and answer the follow-up equations.

Equation for Data Table 2.

Volume: V = L x W x H

Equations for Data Table 3.

% of Water Absorption: $\%WA = \frac{(W2-W1)}{W1}$

% of Water Absorption: $\%VC = \frac{(V2-V1)}{V1}$

Data Table 2. Initial and final measurements of composite material samples in millimeters.

Sample #	WT1	WT2	L1	L2	W1	W2	H1	H2	V1	V2
Sample 1										
Sample 2										
Sample 3										
Sample 4										
Sample 5										
Sample 6										

Data Table 3. Calculations for percent of water absorption and volumetric change.

Sample #	% Water Absorption	% Volumetric Change
Sample 1		
Sample 2		
Sample 3		
Sample 4		
Sample 5		

Follow-Up Questions:

1. How do the engineered material samples react to water? Where some samples better than others? Explain describing which samples performed better and which samples performed worst.

2. Which samples will you recommend for exterior/interior applications of a house or building? Explain your answer with evidence from data table 3.