Composite Bridge Design Worksheet

Composite Bridge Design Challenge:

A civil engineer has called upon you and your team of materials science engineers to develop a composite bridge that is both strong and lightweight. In addition the bridge should not fail catastrophically (total collapse). Bridges that show signs of deformation prior to catastrophic failure have a greater chance of reducing injury and loss of life. You will be building a composite bridge using additives to make the bridge stronger than plain Plaster of Paris. Your bridge will consist of a beam that has a 1" x 1" cross-section and must span a distance of 1 ft. You will determine the best ratio of plaster to water for your bridge matrix and then decide which additives to use and how they will be placed within the beam. The materials available to you for your bridge design and their associated costs are:

Material	Cost	Amount Used	Total
Plaster of Paris	$0.64/lb (assume 0.9 lb/cup)		
Water	Free	1.5 cups	
2" x 12" sheets of foil	$0.02/sheet		
Steel tie wire	$0.02/ft		
Carbon fiber sleeving	$0.09/in		
Upholstery thread	$0.005/ft		
2" wide gauze bandage	$0.03/in		
Fiberglass sleeving	$0.05/in		
Newspaper sheet	$0.01/sheet		
Sand	$0.02/pound		
Pea Gravel	$0.02/pound		
Other Materials			
Total Material Cost			

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Date_____ Team _____

Your bridge must cost less than **$4.00**.

Recognition will be given to the team with the highest **strength-to-weight ratio** and the team with the highest **strength-to-cost ratio**.

Design (10 points - Individual)

Brainstorm possible solutions for your bridge construction. Narrow your solutions based on what you know or have researched and decide on your prototype design. Before building,

- **Draw a schematic** of your design including all **dimensions**
- **Label each item** in your schematic with the material that will be used.
- List the **amount of material used** in the table above
- Calculate the **total bridge cost** including plaster.

Build your Bridge (10 points - Group)

Important safety precautions: When mixing, wear **safety glasses**, dust mask, and **gloves**. Do not allow **bare skin** to have prolonged exposure to plaster.
Never pour any plaster down the drain

1. Coat your mold with a **thin** layer of petroleum jelly.
2. Prepare all of your additives and know your plan for their placement within the plaster matrix **before** you start mixing.
3. Measure your volume of water and pour it into your mixing container (for the pucks, use disposable drinking cups).
4. Measure your volume of plaster. Before adding it to the water break up any lumps using a mixing spoon.
5. Gently sprinkle the plaster, slowly and evenly, onto the surface of the water until the entire volume of plaster has been added to the water.
6. Tap the side of you mixing container to release any air bubbles. Let your plaster soak for 2 – 4 minutes, without further agitation.
7. Gently mix the slurry, using a side-to-side motion, until you have a smooth, even consistency. Do not stir vigorously to avoid introducing any air bubbles.
8. Pour plaster into your mold and place your additives into the matrix. The procedure for additive placement will vary based on your bridge design.
9. Tap mold on the table to release any air bubbles.

Allow the plaster to set for 20 – 30 minutes. Remove the plaster from its mold.
Allow plaster to cure for 24 – 48 hours.