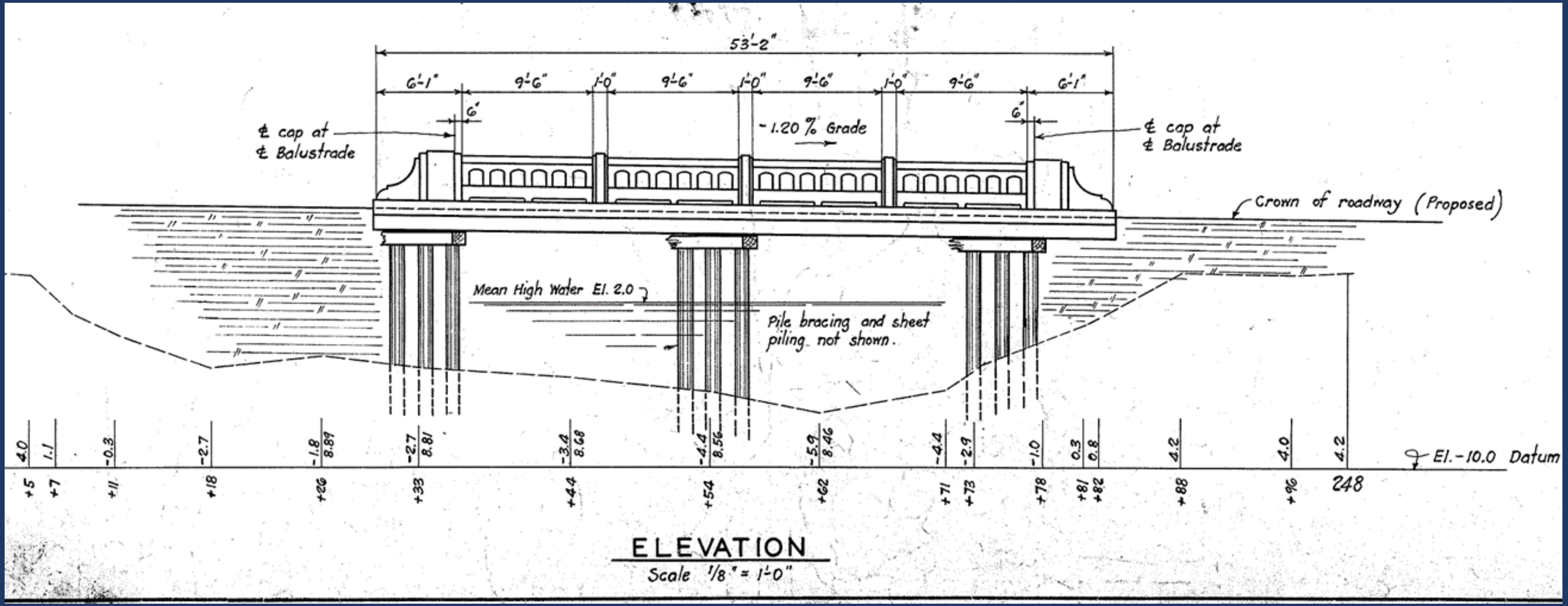
Bridging Maryland Becoming Engineers



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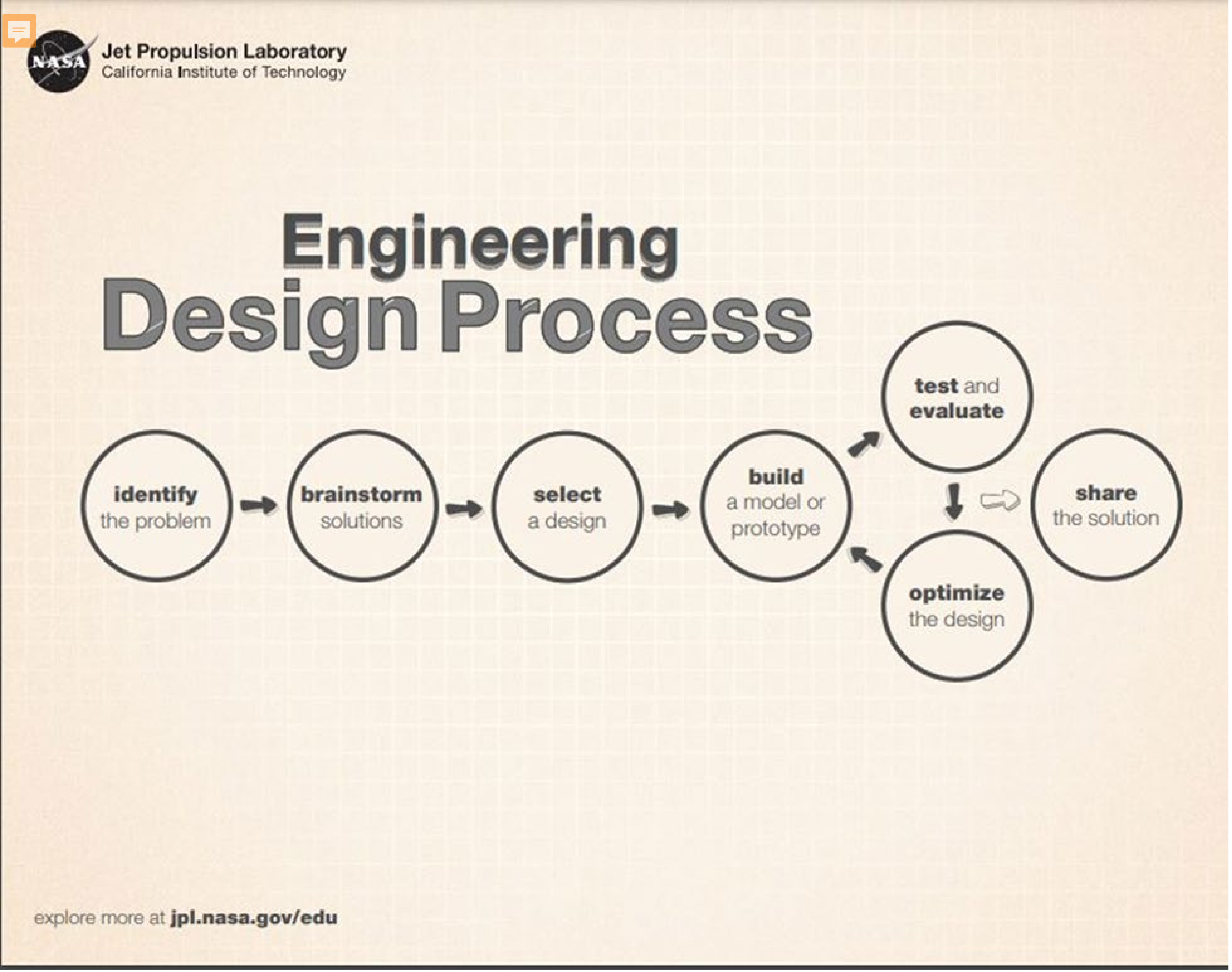
A Lesson in the Engineering Design Process linked to a Historic Maryland Bridge

Part 2



As introduced in Part 1, the steps of the Engineering Design Process include:

- Identifying the problem
- Brainstorming
- Selecting a design
- Building a model
- Testing
- Optimizing
- Sharing the solution

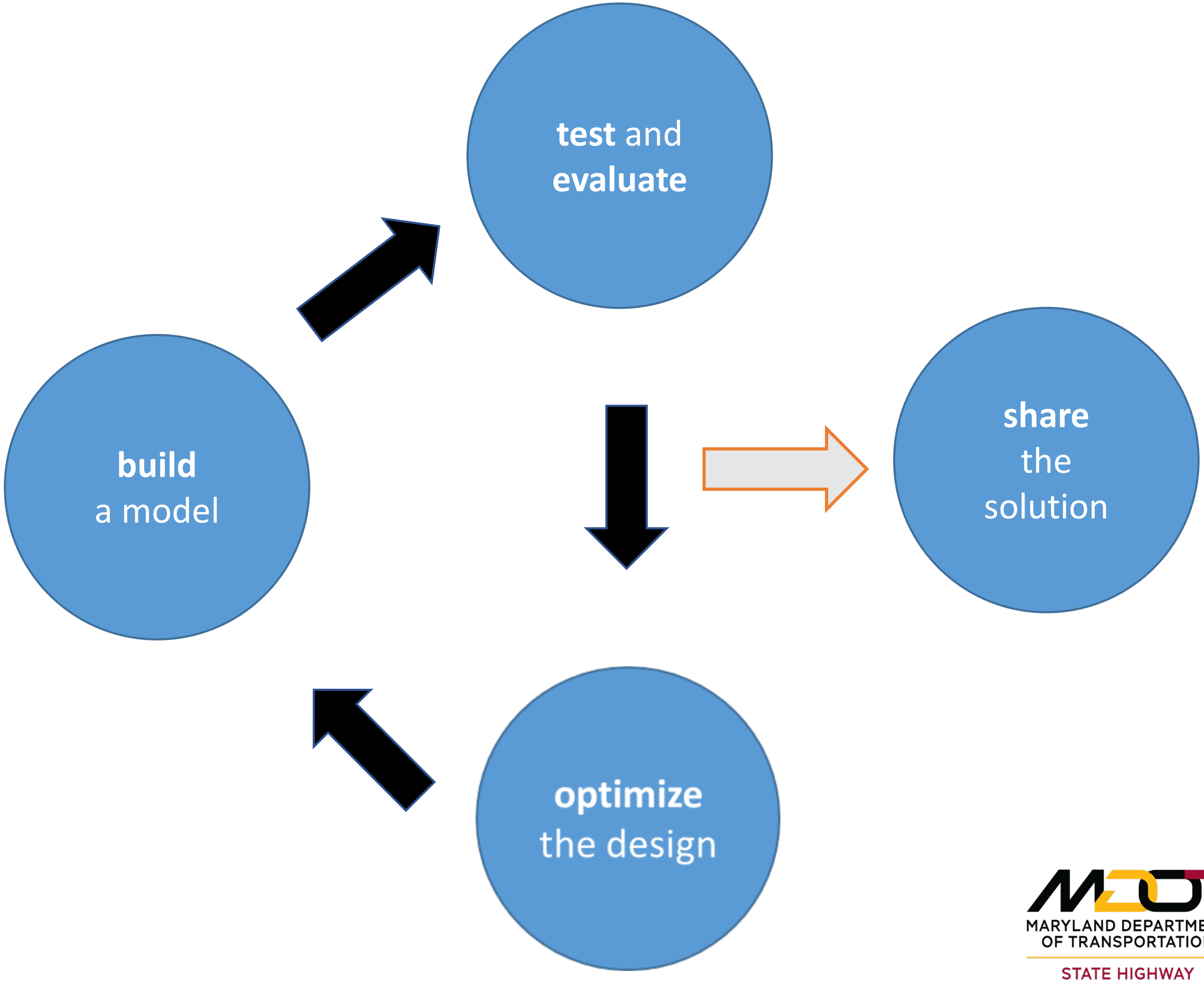
The Engineering Design Process is *iterative.*

Iterative means that a process involves repeating parts to improve the outcome. In an iterative Engineering Design Process, the steps are not simply a straight ladder. The process requires improvement on the experiment.

In Part 1, we learned about how engineers identify the problem, brainstorm solutions, and select a design.

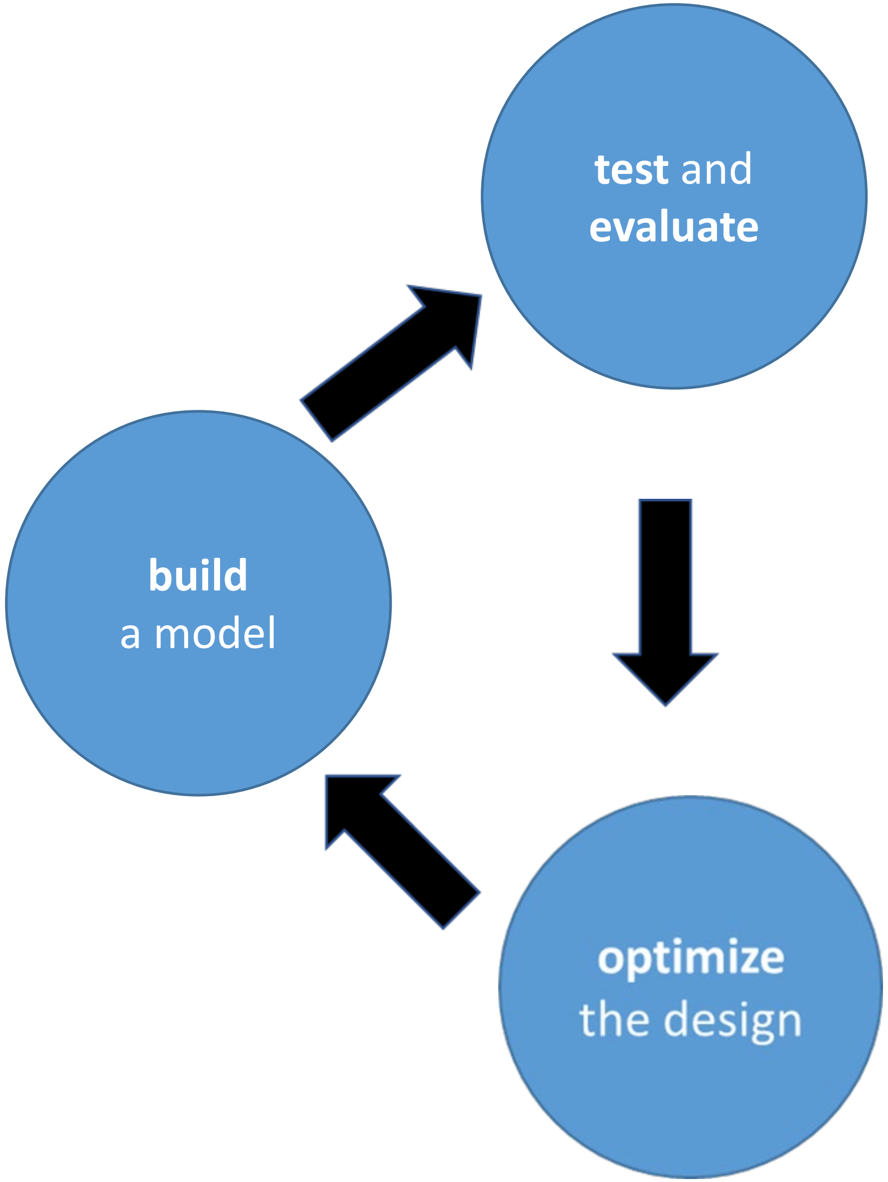
In Part 2, we will build a model of a timber-concrete composite bridge. We will also learn more about the real-life engineers that helped develop and test timber-concrete composite bridge technology and how their work fits into the engineering design process.

In Part 3, we will test and evaluate it, optimize the design, and share the solution.



As mentioned in Part 1, an engineer named James Seiler developed a design for a slab deck form of a timber-concrete composite bridge in the early 1930s.

He joined together wood boards with nails and concrete creating a continuous solid deck that could be expanded to any width and length desired.



In a laboratory, Seiler the tested his designs to determine the weight the timber-concrete beams could hold.

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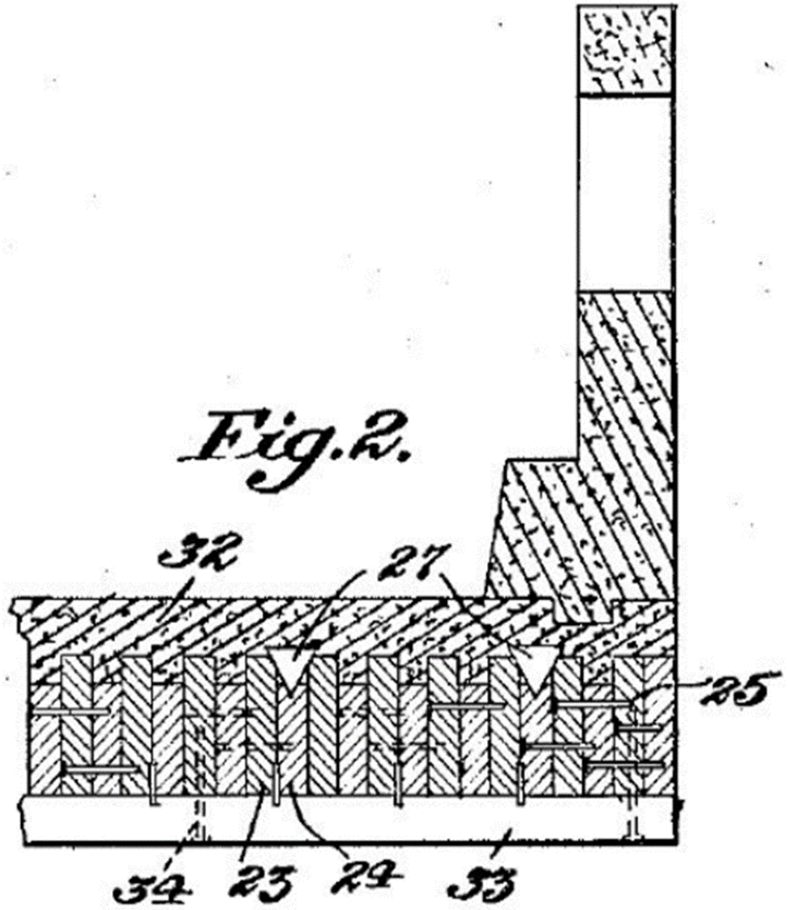
share
the
solution

Seiler shared his test results, applied for a patent, and published plans for a timber-concrete composite bridge in 1933.

Fig.2.



This cross-section detail, from Seiler's patent, shows the two sizes of wood placed in an alternating pattern and covered by concrete. The cross-section also shows a concrete parapet or railing.

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CHALLENGE (Part 1)

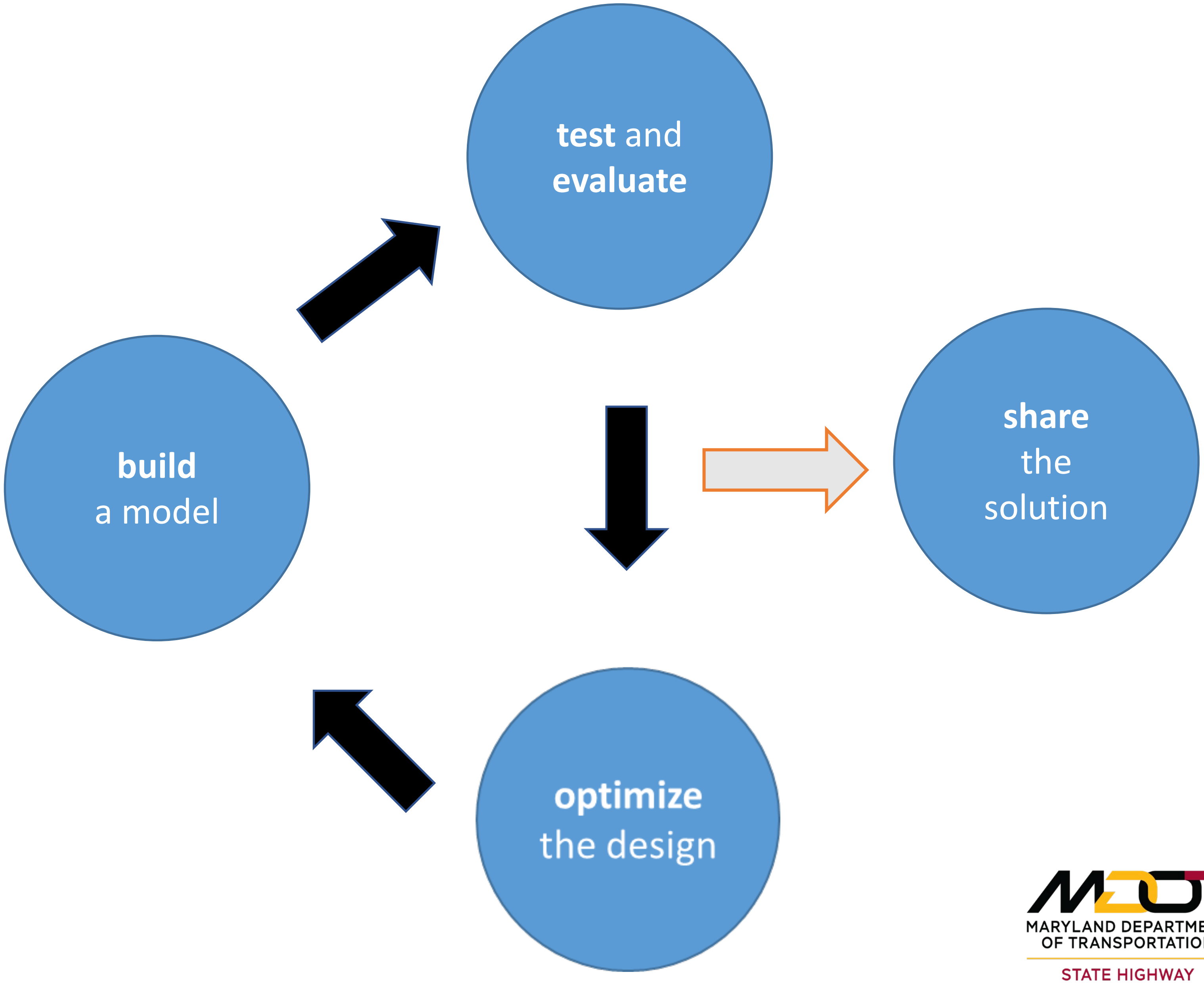
Imagine you are a bridge engineer, working for Walter C. Hopkins at the Maryland State Roads Commission. Your team has selected a timber-concrete composite bridge as the type of bridge for Salisbury Boulevard. **The channelized river already has a timber bulkhead that you can use for your bridge abutments.**

What details do you need to decide about the design?

How wide and how long does it need to be?

What kind of **piers** would you design to support your bridge?

How strong do you need to make your bridge?



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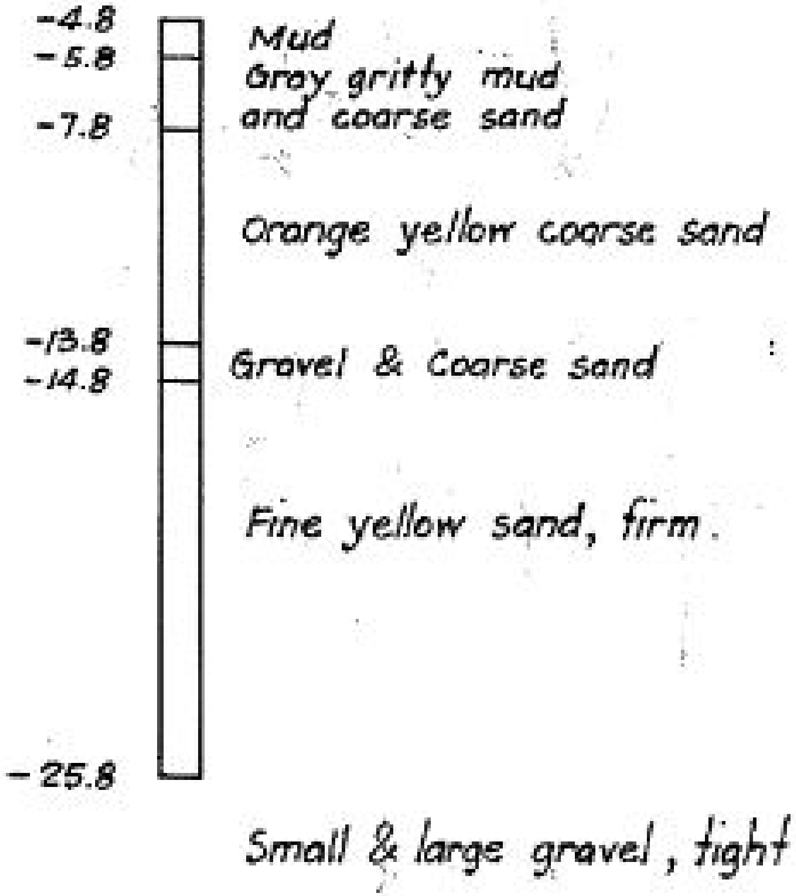
Additional information

Soil borings help engineers determine what the ground is like at a specific location.

To the right is the soil boring from the middle of the bottom of the East Branch of the Wicomico River crossed by Salisbury Boulevard.

Below a foot of mud, there is mud mixed with sand for two more feet. Layers of sand are below the mud. Gravel is below the sand.

How might this information affect the design of the bridge piers? How deep do the piers need to extend to reach a firm layer?



optimize
the design

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The following instructions will provide information about how to build a basic unit of a timber-concrete composite bridge, prototype model, but you will need to think about how you might alter this prototype.

Materials:

- Regular craft sticks (4.5” x 3/8” x 1/16")
- Jumbo craft sticks (6" x 3/4" x 1/16")
- Glue
- Paintbrush
- Cardboard to protect working surface

build a model

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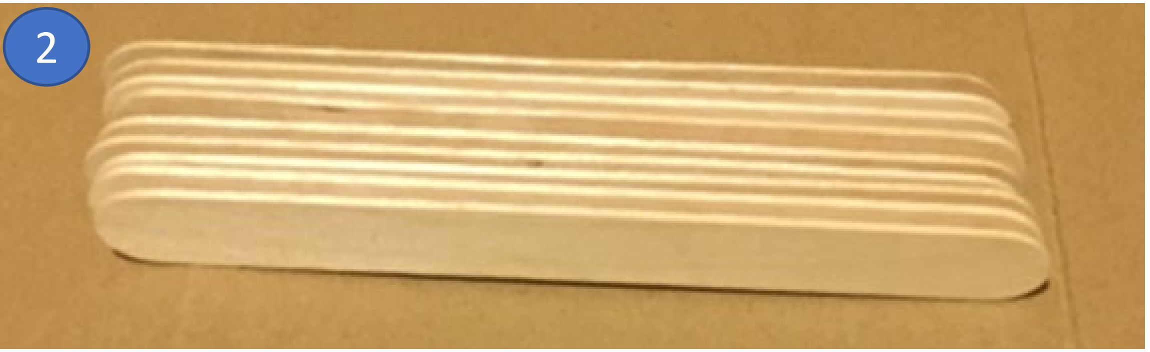
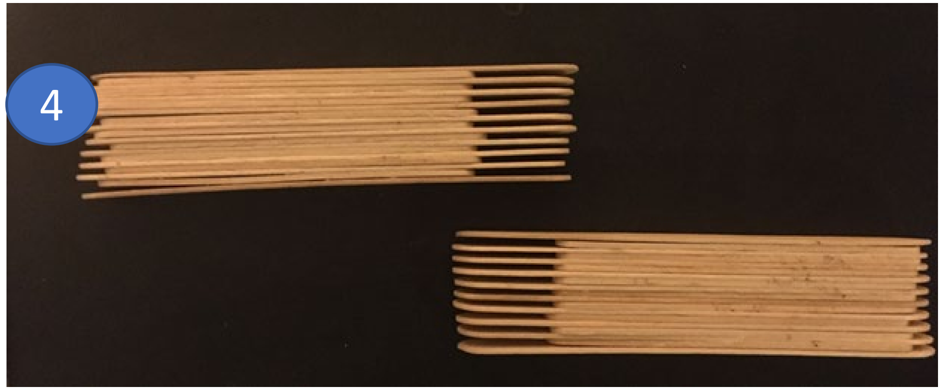
1. Use the paintbrush to spread glue to layer 1 regular craft stick on top of 1 jumbo sized craft stick. Keep the regular sized craft stick off-center and aligned at one edge of the jumbo stick.

2. Repeat until you have a stack of 10 jumbo sized craft sticks and 9 regular craft sticks. Keep the regular-sized craft sticks aligned to the same side.

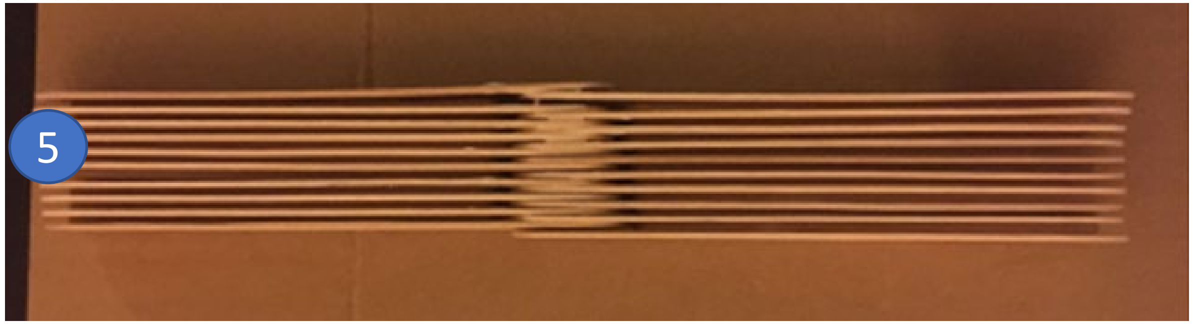


3. Repeat and make another stack.

4. One side of the stack will be flat.



5. Turn the flat sides to the bottom and interlock the two stacks.



6. Cover the top of your bridge deck with glue.

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Use your creativity to develop design details for your bridge.

build
a model

In what ways might you expand your bridge from the basic unit?

What kind of piers and are needed to help support your bridge deck? How many piers does the bridge need between the abutments? What if the bridge was longer or wider?

How do you connect the piers to the bridge deck?

The Jumbo-sized craft sticks are more expensive than the regular sized craft sticks. How might this impact your design choice? Could you design piers that only use the regular sized craft sticks or fewer Jumbo-sized craft sticks?

Bridge engineers need to consider public safety.
How could you build railings to make the bridge safe for traffic?

This bridge model example uses the basic bridge deck unit with cross-braced piers constructed with jumbo craft sticks. To simulate the layers of mud found in the soil boring, whipped cream is layered above a denser layer of brownie. You might be able to use sand, gravel, or dirt to simulate the river bottom.

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Slide Image Sources

Bridging Maryland-Becoming Engineers: A Lesson in the Engineering Design Process linked to a Historic Maryland Bridge, Part 2

Slide 1: MDOT SHA Bridge Archives, Bridge No. 2200400 carrying US 13 Business (BU) over East Branch of the Wicomico River.

Slide 2: NASA STEM Engagement. Engineering Design Process. https://www.nasa.gov/audience/foreducators/best/edp.html

Slide 3, 4, and 5: No images.

Slide 6: Partial Cross Section of Timber-Concrete composite deck, as designed by James F. Seiler; included in U.S. Patent No. 2,022,693.

Slide 7: No image.

Slide 8: State of Maryland State Roads Commission, Composite Timber-Concrete Bridge, Relocation Through Salisbury over E. Br. of Wicomico River, Plan and Elevation, Plan Sheet 9 of 10, June 1937.

Slide 9, 19, 11: MDOT SHA.