

# MS STRUCTURAL ENGINEERING

## 2017 PROBLEM STATEMENT

### BACKGROUND

Your parents have decided to buy a lakeside lot on which to build a home. The front of the lot is bordered by an access road that follows the perimeter of the lake. The elevation of the lot varies from one side to another: the left side maintains a gradual slope from the front of the property down to the lake, while the right side has a steep drop off adjacent to the access road. For aesthetic and access purposes, your parents wish to have a bridge built that connects the front entrance of the home to a point just off of the access road. Because of the length required, they also wish to include a simple gable roof in the design of the structure.

### CHALLENGE

Research truss and structural framing designs; use the research to develop and engineer a design for a bridge structure that will provide access to the home.

Be sure to consider the following in developing a design:

1. Aesthetics
2. Size constraints
  - a. Length
  - b. Width (inside and out)
  - c. Height
3. Railing requirements
4. Dead load of the structure
5. Live load of the structure
6. Materials durability and availability
7. Maintenance

### DIMENSIONS, MATERIALS, SPECIFICATIONS

#### Actual dimensions

Length of bridge:	48'
Inside width of bridge:	12'
Overall height of bridge:	14 ½'

#### Scale dimensions

Structure scale:	¼" = 1'
<b>Structure length:</b>	12"
Inside structure width:	3"
Outside structure height:	3 5/8"

#### Materials

Balsa wood sheet - 1/32" (for the bridge platform/walking surface only)

Balsa wood strips

1/8" x 1/8" (for structural framing components)

1/8" x ¼" (for horizontal structural framing components)

Card stock (65#) must be used to cover the inside vertical surfaces and the roof surfaces of the structure.

There are no limits placed on the amounts of the designated materials, other than the card stock and the 1/32" sheet balsa specified for the platform surface.

Keep in mind that the weight of the structure is factored into the formula to determine the efficiency of the structure.

Excess weight will have a negative impact on the efficiency rating because of the unnecessary use of excessive materials.

### **Specifications**

1. Bridge sides: 3/8" thick
2. Bridge inside vertical surfaces and the roof surfaces must be covered with one layer of 65# card stock (outside vertical surfaces remain uncovered).
3. Bridge platform framing: 3/8" thick
4. Bridge platform: 1/32" sheet (only one thickness allowed)
5. The bottom of the structure framing (1/2" at each end) will be placed on the horizontal surface of the abutment blocks of the testing device.
6. Substructures are not allowed.
7. A 1" hole must be left in the center of the structure so that a testing rod can be passed through it.
8. The test block will be 2 1/2" wide x 3/4" thick x 6" long.
9. For this event, *lamination* refers to the combining of two or more pieces of material with the grain running in the same direction; ***laminating pieces of same size materials is not allowed for this event.***
10. Laminating of card stock is not allowed.
11. Laminating pieces of the card stock or the 1/32" sheet material between or to the sides of structural members is strictly forbidden.
12. The card stock may be used as gusset material (3/8" diameter or square) to connect/reinforce butt and end joints of materials
13. Lap joints are allowed and involve the gluing of two pieces of balsa material with the grain pattern normally at right angles; however, any lap joint less than 10° or greater than 170° would circumvent the lamination guidelines and be ruled unacceptable.
14. Any type of glue, other than hot glue, may be used for construction; the use of glue for coating structural components is not allowed.
15. A tolerance of 1/16" will be applied for all measurements.

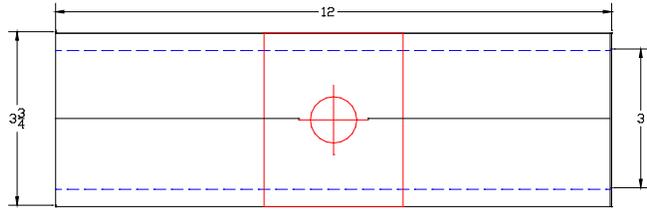
### **REQUIREMENTS FOR CHECK-IN**

1. Completed model structure
2. Three-view drawing (full size standard orthographic layout)
3. Verification form
4. Assessment form

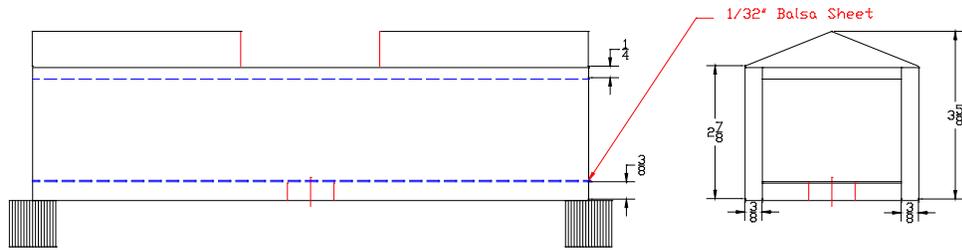
### **ILLUSTRATION**

The illustration that follows provides information about size constraints, configurations, laminations, and types of joints that are and are not allowed for the structure.

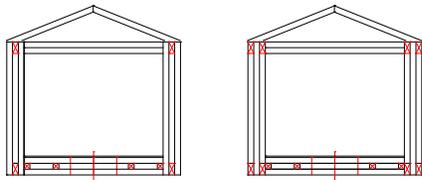
# 2017 MIDDLE SCHOOL STRUCTURAL ENGINEERING DESIGN LAYOUT



The rectangle centered on the top view must be left open to allow access for placement of the testing rod and nut.



SAMPLE END VIEWS



EXAMPLES OF MATERIAL CONFIGURATIONS

SAME SIZE STRIPS



Non-allowable laminations

DIFFERENT SIZE STRIPS



Allowable laminations