

**MINISTÉRIO DA DEFESA
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DEPARTAMENTO DE CIÊNCIA E TECNOLOGIA
INSTITUTO MILITAR DE ENGENHARIA
(Real Academia de Artilharia, Fortificação e Desenho, 1792)**



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1. Objective

The activity includes developing a project to build a popsicle-stick bridge. The bridge should be constructed with wooden popsicle sticks, attached with glue.

The groups should follow the rules presented in this document and prepare all the necessary documentation for project delivery.

The evaluation of this activity will be done considering the project documentation generated and the result of bridge construction.

The bridge should withstand a growing load to assess its structural performance.

2. General Items

The class should be divided into XX groups of at most XX students and can participate with only one bridge.

The bridges presented will be brought to rupture, by a destructive test.

3. Bridge Construction Rules

a. The bridge shall be indivisible in such a way that movable or engageable parts will not be permitted.

b. Construction should be performed using only popsicle sticks and wood glue. The dimensions of popsicle sticks are approximately:

- 115.0 mm in length;
- 2.0 mm depth;
- 8.4 mm wide.

c. The joints for the bars should be made with sticks overlapping following the scheme on Figure 1

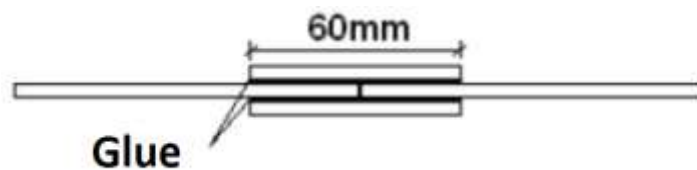


Figure 1 –Sticks Joints

d. The bridges shall be constructed with bars having cross sections of at most 3 popsicle sticks, as shown in Figure 2 below.

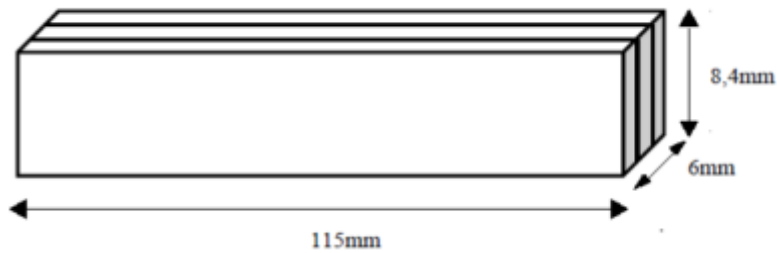


Figure 2–Bridge cross section

e. The weight of the bridges (considering the mass of the sticks and glues used) will be taken into account, being part of the evaluation criteria described in item 4 d. However, the weight of the support mechanism attached to the ends of the bridge shall not be considered.

f. The bridge can only be coated or painted with the glue allowed, considering that the popsicle sticks should become apparent.

g. As shown in Figure 3 below, the bridge should be capable of overcoming a clearance of 0.8m (80cm), being freely supported at its ends, so that the attachment of the ends will not be allowed. Each end of the bridge shall have a support of 0.1 m (10 cm), totaling the total length of 1.0 m (100 cm).

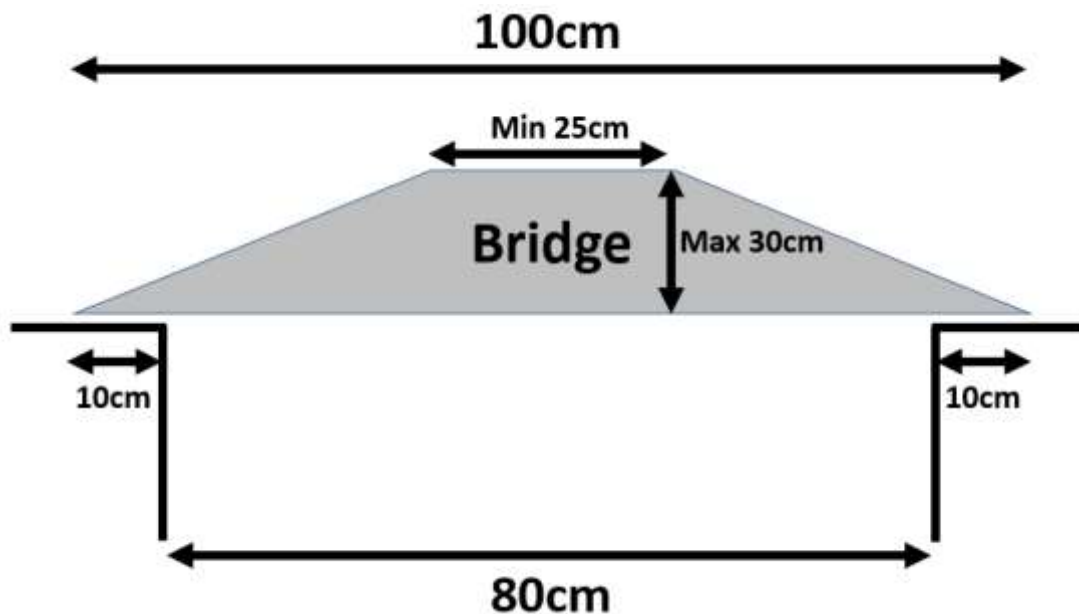


Figure 3 – Bridge Scheme

h. The bridge should have the width according to the length of the popsicle stick (115.0 mm), along its entire length.

i. The maximum height of the bridge, measured vertically from its lowest point to its highest point, shall not exceed 30cm.

j. The bridge shall have a horizontal upper plane at least 25 cm in width (width defined by the length of the stick) in such a way that the weights may be supported at the time of testing. The lack of this plan does not disqualify the prototype, but can generate eccentricity in the cargo, damaging the final result.

4. Bridge Presentation Rules

- a. Each group should deliver their already constructed bridge, a brief exposition of the project and then the load test.
- b. On the day XXXXX, committee members will weigh and measure the bridge and verify compliance with the requirements of this regulation (materials used and dimensions of prototypes).

5. Evaluation Rules

- a. The sequence order of load tests will be defined according to group numbers.
- b. The result will be released after the test of the prototypes and the grade attributed to the activity will be presented after the correction of the written part of the project.
- c. As general criteria for judging the works presented, the following will be considered:

- WRITTEN PART
- MEET THE MINIMUM LOAD
- BREAKING POINT
- PROTOTYPE WEIGHT
- AESTHETICS

- d. The Final Score of each group will be as follows:

Score = 5 points (project written part) + 1 point (minimum load) + 3 points (breaking point and bridge weight ratio) + 1 point (bridge aesthetics).

- The written part of the project will be evaluated according to the concepts of best project management practices presented during the semester and will receive a grade from 0 to 5.
- Each bridge shall withstand a minimum load of 1 kg.
- A ratio of the breaking point and bridge weight (BBR) of all bridges will be calculated. The highest ratio obtained Max (BBR) will be the weight applied to all projects, according to formula:

$$BBR = \frac{\text{Rupture Load}}{\frac{\text{Bridge Weigth}}{\text{Max}(BBR)}}$$

- A maximum of one point will be placed for the aesthetics of the bridge.

- e. Each group will indicate one of its members to perform the load test of its bridge. During the load test, students should wear protective gloves to avoid accidents at the time of bridge collapse.

- f. The initial load to be applied will be 1kg in the center of the bridge. If after 10 seconds of applying the load, the bridge does not present structural damage, the bridge will be

considered to have passed the minimum load test, being enabled to participate in the collapse load test.

g. If the bridge has passed the minimum load test, subsequent loads will be applied in commission-defined increments. A minimum of 10 seconds will be required between each load increase application.

h. The bridge will be considered to have collapsed if it presents severe structural damage less than 10 seconds after the application of the load increase. The official collapse load of the bridge will be the last load the bridge was able to withstand for a period of 10 seconds without severe structural damage.

i. If, upon application of a load increase, the point of application of the load became damaged, the bridge shall be deemed to have collapsed, due to the impossibility of applying further load increments (although the rest of the bridge remains without major structural damage).

j. After the collapse of each prototype, the remains of sticks and glue may be examined by members of the competition supervisory committee to verify that only permitted materials have been used in its construction. If the use of non-permitted materials is verified, the bridge will be disqualified.

k. In case of tie in the final note of two or more bridges, will be used as final tie-breaking criterion of the prototypes state after the collapse. If the tie still exists, the delivery order of the bridges will be considered.

l. Any problem, doubt or occurrence not contemplated in this regulation, should be analyzed by the supervisory committee, and the final decision on the matter in question will be the responsibility of the teacher (s) of the participant's group (s) evaluation. The commission will decide which point will be applied, considering the weight and burst load factors.

References

<https://www.mlab-ymf.org/psbc>

Projeto baseado no Concurso de Pontes de Palitos de Picolé da Semana Nacional de Ciência e Tecnologia de 2013 do Instituto Federal São Paulo Campus Presidente Epitácio.