Tournament Questions and Rules of the Third International Youth Innovation Design Competition

Challenge B: Structure——Ultimate Challenge

【Competition Theme】
Autonomously、Collaboration、Exploration、Practice、Innovation

【Educational Goals】
Humanities: Stage Performance、Team collaboration、Creativity、Communication
Skills、Art
Mathematics: Function、Equation、Geometry、Calculus
Science: Mechanics of Materials、Physics、Chemistry、Environmental Science
Technology: Critical Thinking、Structural Design、Technical Test、Craft、System、Control
Engineering: Ergonomics、Process Management、Problem Solving

【Competition Overview】
Contestants are required to design a structure model in collaboration and test the stability and strength on the “Roof Structure”. Besides, design a story around the theme of “Building Security” and give a live performance.

【Key Point】
1. Conceive and design a structure.
2. Conceive a creative story with the theme of “Building security”.
3. Make the structure and accept the stability and strength test
5. Design and make promotional posters.

【Participate form and number】
In the unit of team, 7 participants and 1-2 tutors for each team.

一、Competition contents

<table>
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<tr>
<th>Modules</th>
<th>Grades</th>
<th>Contents</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
<td>Technical Design</td>
<td>A points</td>
<td>1. Structure basement detection 2. Field test Bearing ratio A=Structure bearing (kg)/Structure weight (g)</td>
<td></td>
</tr>
</tbody>
</table>

二、Competition rules

1. Time requirement

<table>
<thead>
<tr>
<th>Project name</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field test of Technical Design Module (Only once)</td>
<td>3 minutes</td>
</tr>
</tbody>
</table>
Display of Humanistic Design Module (Including stadium layout time) 5 minutes

2A. Material list (Only materials listed below can be used to make the structure):
- Softwood——Natural Paulownia;
- Corrugated cardboard——Thickness of 0.015ft or less;
- Tape——Color unlimited, width of 0.165ft;
- Viscose——Any kind of binders available in the market;
- Fishing line——Diameter of 0.005ft or finer;
- Beverage straw——Diameter of 0.20ft or finer;
- Toothpick——Length of not more than 0.17ft;
- Pokers, Newspapers, Disposable plastic bags, Food wrap, Facial tissues.

3. Specific rules:

【Technical Design】

1. Design and make structures:
   a. Making materials must be chosen from those species listed in part 2A. We encourage participating teams to make several structures and do the technical test before the competition.
   b. Designed structure must be able to place in the structural tester. Firstly, play a bearing plate on the structure, and then place a barbell on the bearing plate to test how much the structure can withstand the weight.
   c. Team members must participate every marking process, including tools using and materials processing, the participating structure must be made by all members in collaboration.

2. Structure Specifications:
   a. Making materials must be chosen from part 2A: using at least 5 kinds of materials.
   b. The judges will inspect the materials before the structure testing, and verify its eligibility.
   c. Structure weight: The total weight of the structure can not be more than 17 grams.
   d. Structure height: The top-down structure height should be controlled within 0.561ft——0.693ft.
   e. The structure must be a single party.
   f. The structure must be able to place in the structural tester, and it must have a top-down opening, also can run through a cylinder with periphery diameter of 0.165ft.
   g. The structure is not allowed to touch safety post.

3. Testing process:
   a. After the start of the competition, every participating team should place the structure on the tester base and run through the security cylinder, making the structure completely located in the base of the tester.
   b. Adjust the structure position, place the bearing plate.
c. Place the barbell.

d. Each placing of barbell need 1 second delay.

e. Bearing ratio (A) = Ultimate bearing weight (kg) ÷ Total structure weight (g)

【Special Instructions】
1. Competition venue:
   a. Competition venue is generally 8m * 3m. Under conditions permitting, Organizing Committee will provide bigger venues and participating teams could use any space, but they should also be prepared to give performance in the specified minimum venue.
   
   b. Participating teams can not move the location of the structure tester.
   c. A projector, a computer; a patch panel and a microphone will be provided near of competition venues.

2. Testing process of structure basis:
   Before the competition, participating teams should take the structure to the judges to be detected at the specified time appointed by the Organizing Committee.
   a. The judge indicates participating teams to place the structure on the electronic balance. When the pointer of balance is not swing, the judge reads out the weight in grams, precision 0.01.
   
   b. Diameter measurement: make the cylinder with diameter of 0.165ft can pass through the structure.
   
   c. Measure the height of the structure, make sure the height is within 0.561 —0.693ft.
   
   d. The judge will detect the eligibility of the materials of the structure.
   
   e. After the basic testing, the judge lable the structure and give it to the field staff.Retrieve it at the strat of competition.

Table 1: The size of the structure tester

<table>
<thead>
<tr>
<th>Tester Components</th>
<th>ft</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tester Base</td>
<td>1.155 * 1.155</td>
<td>Thickness of 0.0099ft</td>
</tr>
<tr>
<td>Bearing plate</td>
<td>1.155 * 1.155</td>
<td>Thickness of 0.0099ft</td>
</tr>
<tr>
<td>Holes of bearing plate</td>
<td>Diameter of 0.0099</td>
<td></td>
</tr>
<tr>
<td>Security support height</td>
<td>0.561</td>
<td>From the uppermost surface of tester baseto the top of the support</td>
</tr>
<tr>
<td>Security support diameter</td>
<td>0.165</td>
<td></td>
</tr>
</tbody>
</table>
Security cylinder height: 2.31
From the ground to the top of the cylinder
Security cylinder diameter: 0.066

Size of bearing plate
Size of Inner core

Renderings of Structure Tester
Real picture of structure tester

All barbells are Olympic-sized weightlifting barbells, each has a 5.1cm round hole in the center. The total weight of barbells is 40kg, namely 8 barbells, each 5kg. Ignore the weight of bearing plate. Once the bearing plate is placed on the structure, participants can not touch the structure or the tester, unless remove the bearing plate firstly.
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Test C: Controlling——Carbonless car

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【Educational Goals】
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【Competition overview】
Design and make a carbonless car, test the car’s driving distance and trajectory under a given gravitational potential energy.

【Key point】
1. Conceive and design a carbonless car.
2. Conceive a creative story with the theme of “Environmental friendly”.
3. Design and make promotional posters. (Humanistic communication)
4. Make a carbonless car and accept field test.
5. Give a live performance of your creative story.

【Participate form and number】
In the unit of team, 5-8 participants and 1-2 tutors for each team.

一、Competition contents

<table>
<thead>
<tr>
<th>Modules</th>
<th>Grades</th>
<th>Contents</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical design</td>
<td>L points</td>
<td>1. The car’s routine test 2. Field test L=Car’s farthest valid driving distance (ft) *100</td>
<td></td>
</tr>
</tbody>
</table>

二、Competition rules

1. Time requirement
2. Specific rules

【Technical design】
1. The car’s design and making

    Design a king of car, whose driving energy is converted from a given gravitational potential energy, according to the Energy Conversion Principle. The given gravitational potential energy is 4 Joule (g=10m/s²), getting from a 1 Kg hammer ( styl 0.165 * 0.214ft, plain carbon steel) vertical dropping in the competition, with fall head 1.32±0.0066ft, the car need to carry the hammer to drive together when it drops from a height, and the hammer is not allowed to drop from the car.

    a. It requires that the car need to complete all the actions in the driving process with energy only converted from the given gravitational potential energy, any other kind of energy is not allowed.
    b. It requires that the car is with three wheels, and the specific design, materials used and making should be finished autonomously by the participants.
    c. The participating teams need to be involved in every making process of the car, including tools using and materials processing.
    d. The spring is not allowed to be used as the car’s making material.

2. Car’s specification:

    The car’s volume should not exceed ——length * width * height (35cm*35cm*70cm)

3. Test process:

    a. After the start of the competition, the participating teams need to place the car on the “waiting area” of the test orbit, and the front end of the car coincides with the starting line. The surface of the test orbit is smooth (like
the surface of common posters), and it consists of waiting area, orbit and security area. See below:

b. Relief the hammer, and the car will run freely driven by the gravitational potential energy.

c. Each team can test it twice, the better grade will be used.

d. Driving distance (L) = The farthest distance the car drives along the prescribed orbit (ft)

Schematic view of the car’s test orbit (Very important)

The car orbit’s surface is made by smooth and uncoated poster, and the orbit consists of three planks of wood, 2.97ft * 1.65ft * 0.099ft (length, width, height), please notice the interfere to the car caused by the chink of orbit joint.

<table>
<thead>
<tr>
<th>Name</th>
<th>Size (length * width * height)/ft</th>
<th>Name</th>
<th>Size (length * width * height)/ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waiting area</td>
<td>1.32<em>1.65</em>0.099</td>
<td>Linear orbit</td>
<td>5.94<em>1.65</em>0.099</td>
</tr>
<tr>
<td>Inlined orbit</td>
<td>2.97<em>1.65</em>0.099</td>
<td>Slope of inclined orbit</td>
<td>25 degrees</td>
</tr>
<tr>
<td>Width of security</td>
<td>0.165</td>
<td></td>
<td></td>
</tr>
<tr>
<td>area</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>