TOWERS

1. **DESCRIPTION:** Team members design and build the most efficient tower.

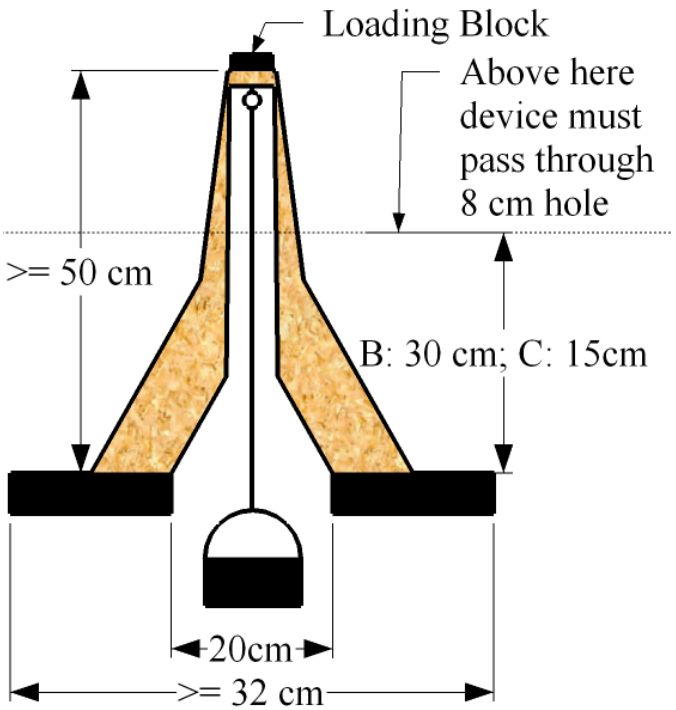
   A TEAM OF UP TO: 2 **IMPOUND**: NO **EYE PROTECTION**: #2 **MAXIMUM TIME:** 10 minutes

2. **EVENT PARAMETERS:**

   a. Each team may enter only one tower, built prior to the competition.
   b. Team members must wear eye protection during the set-up and testing of the tower.
   c. The Event Supervisor provides the assessment devices, testing apparatus, hardware, and clean, dry sand or similar dry, free-flowing material (referred to subsequently as "sand").

3. **CONSTRUCTION PARAMETERS:**

   a. The tower must support a standard loading block (see 4.a.) a minimum of 50.0 cm above the test base in both Division B and Division C. There is no maximum tower height.
   b. The tower must span a 20.0 cm x 20.0 cm opening on a test base (see 4.b.).
   c. The tower must not be braced against any edge of the test base for lateral support at any time. No portion of the tower is allowed to extend below the top surface of the test base prior to testing.
   d. **The portion of the tower more than 30.0 cm above the test base for Division B, or more than 15.0 cm above the test base for Division C, must pass through an 8.0 cm diameter circular opening or hole (see 4.c.).**
   e. The loading point on the tower must permit placement of a loading block supporting a chain (see 4.d.).
   f. The chain must pass through the tower and be within 2.5 cm of the center of the test base opening when the bucket is attached.
   g. The tower must be a single structure with no separate or detachable pieces.
   h. The tower must be constructed of wood and bonded by glue. Other materials must not be used (e.g. no particleboard, wood composites, bamboo, paper, or commercially laminated wood).
   i. There are no limits on the cross section sizes of individual pieces of wood. Wood may be laminated without restriction by the team.
   j. Any type of commercially available bonding material (glue) may be used.



4. **TESTING APPARATUS:**

   a. The loading block must be a square block measuring 5.0 cm x 5.0 cm x ≈ 2.0 cm high with a hole in the center of the square faces for a ¼" threaded rod or eyebolt.
   b. The test base shall be a solid, level surface as follows:
      i. The test base must be at least 32.0 cm long x 32.0 cm wide.
      ii. The test base must have a 20.0 cm x 20.0 cm square opening at its center.
      iii. The test base must have a smooth, hard, low-friction surface. The test base must be stiff enough that it does not bend noticeably when loaded.

c. A ¼" threaded eyebolt must be suspended from the loading block. The head of the eyebolt must be at least 5.0 cm from the loading block.
d. The head of the eyebolt and the chain must fit through a 3.0 cm diameter hole. A five-gallon plastic bucket must be suspended from the chain by means of one or more hooks with enough clearance above the floor to allow for tower deflection.
e. Team members must add sand to the bucket during testing. The Event Supervisor must verify that the combined mass of the loading block, chain, bucket, sand, and attaching hardware is between **15.000 kg and 15.200 kg prior** to testing.

5. **THE COMPETITION:**

a. Team members must not make alterations, repairs, or substitutions to the tower after check-in for competition. Once teams enter the event area to compete, they must not leave or receive outside assistance, materials, or communication until they are finished competing.
b. All towers must be assessed prior to testing for compliance with Construction Parameters.
c. Team members must place their tower on the scale for the Event Supervisor to determine the mass, in grams to the nearest 0.01 g.
d. Team members must place the tower on the test base, assemble the loading block, eyebolt and chain, and hang the bucket from the chain as required to test the tower. Team members may adjust the tower until they start loading sand. Once loading of sand has begun, the tower must not be adjusted.
e. Team members have a maximum of ten minutes to set up and test their towers either to the maximum load or failure.
f. Failure is defined as the inability of the tower to support an additional load.
g. Loading must stop immediately when failure occurs. The Event Supervisor may remove any sand which, in his or her judgment, was added after failure.
h. The load held must be measured in kilograms to the nearest gram.
i. Pending no arbitration teams may take their towers with them after testing.

6. **SCORING:**

a. Towers must be scored and ranked as defined by the following equation:
   i. **Score = (Load Supported)^2/(Mass of Tower).**
   ii. **Load supported is in kilograms to the nearest 0.001 kg; mass of the tower is in grams to the nearest 0.01 g.**
b. Load scored shall not exceed 15.000 kg, and includes the mass of all testing apparatus supported by the tower. **The least amount of load to be scored shall be the mass of the loading block.**
c. Tiers:
   i. Tier 1: Towers meeting all the Construction Parameters are to be ranked by highest score.
   ii. Tier 2: Towers not meeting Construction Parameters are to be ranked by highest Score.
   iii. Tier 3: Towers unable to be loaded for any reason (e.g., cannot accommodate loading block, chain, failure to wear eye protection, etc.) are ranked by lowest mass.
d. Ties are broken by the lightest tower mass.

Recommended Resources: All reference and training resources including the **Towers DVD** are available on the Official Science Olympiad Store or Website at http://www.soinc.org