Concrete Bowling Ball Competition Rules (V1.0)

Student Host Champion: Cody Bourbon (ecodyb@ksu.edu)
Faculty Host Champion: Dr. Christopher Jones (jonesca@ksu.edu)

Mid-American Enginuity

Background

As a part of the 2023 ASCE Mid-America Student Symposium, the Kansas State ASCE Student Chapter intends to host a *Concrete Bowling Ball Competition* for interested student teams. The competition will closely mimic the ACI FRC Bowling Ball Competition and teams may be able to synergistically utilize mixtures or fabrication approaches from the ACI hosted competition. Innovation is fundamentally the spirit of the proposed competition; however, several restrictions are imposed to ensure fairness and are similar to those rules proposed by ACI.

Overview

Student teams will design and prepare two identical bowling balls to compete. One bowling ball will be used for bowling portion of the competition. The second bowling ball will be destructively tested to determine the material toughness. Competition outcomes will be determined by scoring on both the bowling and toughness evaluations as well as adherence to dimensional guidelines and the beauty of the set of bowling balls.

Design Requirements

The bowling balls shall be designed to achieve a final mass at the time of bowling of 5500 grams +/- 500 grams. The diameter of each ball shall be 200 mm +/- 15 mm. The balls shall be designed to survive a bowling environment which will involve accelerating down a ramp, rolling straight down a bowling lane, and impacting several bowling pins. Balls will also be loaded until failure in uniaxial, unconfined compression with the goal of achieving the greatest material toughness (defined as the integration of the load-deflection curve up to failure). Bowling balls must be marked to identify to which student chapter designed the bowling balls.

Material Restrictions

The primary material for use in the construction of the bowling ball shall be concrete composed of hydraulic cement and aggregates. Fibers and other filler materials / particles may be used but may not constitute a majority of the volume of the resulting concrete. Any type of fiber is acceptable, but individual fibers must be of the same length and may not be longer than 60 mm.

Aesthetic Restrictions

Creativity in the surface treatment of the bowling balls is encouraged, but any coating or labeling shall be aesthetic in nature only. Paints or coatings shall not contribute significantly to the

strength nor the smoothness of the ball. For example, the ball may not be painted with a layer of fiber reinforced epoxy resin.

Participation Restrictions

Each student chapter participating in the ASCE Mid-America Student Symposium has one entry into the Concrete Bowling Ball Competition. Student chapters may have an alternate team in the event the primary team is unable to compete for any reason (damage to bowling balls in transit, illness, etc.). However only one entry per student chapter will be permitted to compete and once the competition starts an alternate team cannot participate. A concrete bowling ball team shall consist of two to four students who shall be on-site for the competition. Faculty advice and input is encouraged, though a named faculty advisor is not required to participate. As is common for any bowling team, a team bowling shirt is essential.

Scoring

The competition will be based on the performance of the team in four categories and each category will be assessed a fraction of the total score as:

- Dimensional Accuracy (both bowling balls) 15 points
- Mass Accuracy (both bowling balls) 15 points
- Bowling Performance 30 points
- Material Toughness 30 points
- Aesthetics and Bowling Shirt 10 points

Dimensional Accuracy Scoring

The diameter of each bowling ball will be measured by judges three times for a total of six measurements per team. The absolute value of the difference of each diameter measurement and the target diameter of 200 mm will be summed to obtain the total “dimensional error”. The teams will be ranked in from least dimensional error to greatest dimensional error. If the total dimensional error exceeds 1000 mm, all points for Dimensional Accuracy will be forfeited for that team.

Mass Accuracy Scoring

The mass of each bowling ball will be measured by judges. The absolute value of the difference of each mass measurement and the target mass of 5500 grams will be summed to obtain the total “mass error”. the teams will be ranked from least mass error to greatest mass error. If the total mass error exceeds 1000 grams, all points for Mass Accuracy will be forfeited for that team.

Bowling Performance Scoring

At the time of competition, judges will decide how many frames will be bowled based on the number of entered teams and the perceived availability of time. The goal will be to knock down as many pins as possible, and the teams ranked according to the number of pins knocked down. No multipliers for strikes or spares will be considered. If a bowling ball is damaged during the bowling portion of the competition, but the bowling ball will still roll down the alley, the team can continue to bowl and earn points.

Material Toughness Scoring

The material toughness shall be approximated as product of maximum compressive load and the test-frame crosshead displacement at failure, where failure is defined as total specimen rupture or the maximum cross head displacement (approximately two inches), whichever is smaller. The teams shall be ranked in descending order of toughness.

Aesthetics of the Bowling Balls and Shirts Scoring

The judges will evaluate the aesthetics of the bowling balls and shirts. A significant component will be consideration of the Mid-America Student Symposium theme (Mid-American Enginuity) and the mascot of team's institution.