ACI Egg Protection Device Competition

OBJECTIVES

Design and build the highest-impact-load resistant plain or reinforced concrete Egg Protection Device (EPD). Learn and report on concrete's impact resistance and other real-life aspects which an EPD simulates.

PRIZES

The winning team will be granted a trip to attend the ACI 2014 fall convention in Washington, DC. Second and Third place entries will be recognized and will receive awards to be announced later.

RULES

I. ELIGIBILITY

a. Each team must have a supervising faculty advisor who will see that the student team complies with the rules of the competition. The faculty member is permitted to advise more than one team.
b. Each team must consist of 4th or 5th year undergraduate students or graduate students of a college or university at the time of casting the EPD. All members of a given team must be from the same school.
c. A team should consist of a maximum of two students.
d. A student may not be a member of more than one team.
e. Each school will be permitted to enter no more than three teams.

II. MATERIAL

a. The binder shall be cementitious material consisting of any combination of the following: portland cement meeting ASTM C 150; blended cement meeting ASTM C 595 or C 1157; slag cement meeting ASTM C 989; and silica fume meeting ASTM C 1240. Chemical admixtures, meeting ASTM C 494 or 1017, are allowed. Epoxies and other polymers, glue, and similar binders shall not be used. The concrete must be cured to the stage that it is a solid (i.e., no fresh concrete).
b. All reinforcement, longitudinal and stirrups (transverse reinforcing), shall not be greater than 1.6 mm diameter. No more than 15 stirrups may be used in the EPD. Bundling of reinforcement for stirrup construction is not permitted. Longitudinal reinforcement shall be limited to 8 bars/wires in a cross section. No wire meshes, soldering, or welding of cages is
permitted. (For fabrication of cages, small gauge tie wire or glue is permitted). Fibers are not permitted.

c. No flat plate type embedments or coverings are allowed (i.e., metal or plastic sheets, etc.)
d. Any type of aggregate may be used, except metal, and must pass through a 9.5 mm sieve.

III. CURING AND AGE OF SPECIMEN

a. Curing shall be at atmospheric pressure. The curing temperatures shall not exceed the boiling point of water. Use of a standard moist curing room is permitted.
b. EPDs shall not be older than 8 weeks during the day of competition.

IV. SPECIMEN AND TESTING CONFIGURATION

a. EPDs must fit into the slot in a base plate 400 mm ± 5 mm long by 200 mm ± 5 mm wide (as shown in the diagram).
b. EPD must provide clear passage of a rectangular template measuring 210 mm high by 275 mm wide; the top surface of the EPD may not be higher at any point than 250 mm above bottom of the base (to fit into loading frame).
c. EPD footings are allowed only at the ends of the base plate slot. The maximum size of the footing is 50 mm long by 200 mm wide. The footings shall be made of concrete only, but reinforcement in compliance with Section II (b) may be used. Between the footings, the EPD must remain clear of the base plate of the loading frame during testing.
d. There must be at least a 50 mm diameter flat area on top of the EPD, centered 25 mm to either side of the centerline (where the load will impact), which must be made out of solid concrete (Reinforcement in compliance with Section II (b) may be used in this area if unexposed). This will result in a 100 mm long area at the center of the EPD where the load will impact as shown in the diagram).
e. Loading of the device will not take place along the center line, but 25 mm to either direction of the centerline. This direction will be determined on the day of competition, randomly, by the judges.
f. The maximum mass of the EPD shall be 3000 grams.
g. Modification of entries shall not be permitted once they are submitted for competition.

V. QUALIFICATION AND TESTING PROCEDURES
a. Qualification Test
The competition procedures consist of three steps, all handled by a group of judges. First, the report (as described in Section VII) will be evaluated. Second, every EPD entry is individually weighed and checked for size and clearances and compliance with the requirements of Sections I to IV (above) will be checked. Only after the first two qualification steps have been completed will each qualifying EPD be taken to the final step of the destructive test. Refer to Section I for final qualification and prize eligibility.
b. Impact Test
During this phase, each EPD will be subjected to an impact load of 8 kg falling, one time, from each of the following increasing heights of 0.5 m, 1.0 m, 1.5 m, 2.0 m, 2.5 m, and up to five times from the maximum height of 3.0 m. The winning EPD is determined based on the maximum energy (load x height) prior to failure (as defined below) and larger number of impact repetitions at 3.0 m height (for EPDs reaching this load stage). In the event of a tie, the winning EPDs will be determined based on the minimum mass determined at the beginning of the competition.
c. Failure Criteria
Cracking of the egg constitutes failure of the EPD. Cracking of the egg can be due to structural damage of the EPD or spalling of concrete. Note: If due to vibration, the egg is not damaged by the EPD, but instead jumps out of the eggcup, a new egg will be used and the loading will continue. The EPD must be stable and must not fall under its own weight during the test. Stability checks will be performed after every impact load. Unstable EPDs will be disqualified.
VI. JUDGING
   a. The judges will be appointed by the Lebanese Concrete Society (ACI, Lebanon Chapter) & ACTS.
   b. The judges will determine whether or not the rules have been followed.
   c. The decision of the judges will be final, and appeals will not be considered.
   d. Advance registration is required.

VII. SUBMITTING THE EPD AND SUPPORTING MATERIALS
   The labeled EPD, along with its mix design, shall be submitted in person on the day of the competition. Each team shall provide a hard copy of an EPD report (maximum 15 pages) as described below on standard letter sized paper two weeks after the day of competition. The grading criteria will be announced at a later stage. Failure to provide the following documentation will disqualify a team from participating.
   a. Each EPD report shall contain photographs of the following:
      i. Batching and placing procedures
      ii. Reinforcing cage construction and layout (including photo of completed cage)
      iii. Casting of the specimen
      iv. Curing procedures
   b. Describe the mixture design in detail, the manufacturing process of the EPD, selection of the reinforcing and its layout, and the curing processes.

VIII. COMPLIANCE WITH ACI-EPD COMPETITION RULES:
   ACI reserves the right to perform detailed examination and check entries for compliance with the competition rules. Due to the complexity of this task, the examination may be done after the competition. If the examination shows that a team did not follow the rules, the team, their advisor and all his/her teams will be disqualified.

IX. CONTACT INFORMATION
   Gina Korek
   Materials Engineer, ACTS
   Student Chapter Coordinator, ACI Lebanon Chapter
   Email: gkorek@acts-int.com
   Tel: +961 1 753100 ext: 114
   Mob: +961 3 960598