

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 sustainable benefits related to durability, impact Resistance and other real-life aspects which an EPD simulates. Two prize categories will be Awarded – one for overall performance and one for efficiency of design.

Prizes

First, Second, and Third place entries in each prize category will be awarded a certificate of Recognition, will be recognized in Concrete International magazine if space allows, and will be Recognized on ACI's website. In addition, the First, second and third place teams will receive special awards. Awards and Overall results are not announced until the end of the competition.

Rules

1. 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.** A team may consist of up to five students.
- c.** A student may not be a member of more than one team.
- d.** Up to 3 teams from the same university can participate.
- e.** At least one individual (faculty advisor or student team member) must be designated to represent each team and be present during the testing of the specimen at the time and location specified for this competition.

2. Materials

- 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; fly ash meeting ASTM C 618; and silica fume meeting ASTM C 1240.
 - b. 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).
 - c. All reinforcement, longitudinal and stirrups (transverse reinforcing), shall not be greater than $(2.0 + 0.2)$ mm (0.079 in) diameter, and must be metal. No more than 11 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 of any type are not permitted to be used. Reinforcing shall not be visible at the surface of the EPD (specially the bottom surface) as this would indicate insufficient concrete cover and ultimately a structure that is not durable. **Visible reinforcing may result in disqualification.** The winner specimen detail will be checked after the competition and may if the rules are seen violated.
1. for the determination of longitudinal versus shear (stirrups) reinforcement, an imaginary plane will be used and may pass anywhere long the structure, cutting parallel or perpendicular to the horizontal.
 2. In the supports of the structure, any reinforcing that passes through a vertical plane at an angle greater than 30 degrees will be considered shear reinforcing and count against the total number of stirrups.

3. In the main horizontal member, any reinforcing that passes through a horizontal plane at an angle greater than 30 degrees will be considered shear reinforcing and count against the total number of stirrups.

d. No flat plate type embedment's or coverings are allowed (i.e., metal or plastic sheets, etc.)

e. Any type of aggregate may be used, except metal

3. Curing and Age of Specimens

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 and Cylindrical Specimens shall not be older than 8 weeks during the day of competition.

c. Each EPD shall be marked in marker with a 5 digit identification that matches the 5 digit code provided in the team registration and the EPD report.

4. Specimen and Testing Configuration

a. EPDs must fit into the slot in a base plate 400 mm (15.75 in) \pm 5 mm (0.2 in) long by 200 mm (7.87 in) \pm 5 mm (0.2 in) wide (as shown in the diagram).

b. EPD must provide clear passage of a rectangular template measuring 210 mm (8.27 in) high by 275 mm (10.83 in) wide; the top surface of the EPD may not be higher at any point than 250 mm (9.84 in) above bottom of the base (to fit into loading frame).

c. The maximum mass of the EPD shall be 3.000 kg (6.61 lbs.).

d. Modification of sample entries shall not be permitted once they are submitted for competition.

5. Qualification and Testing Procedures

a. Qualification Test

The competition procedures consist of three steps, all handled by a group of judges appointed by the Chair of ACI S 801 and/or the lead judge of the competition. First, the report (as described in Section 8) will be evaluated.

Second, every EPD entry is individually weighed and checked for size and clearances and compliance with the requirements of Sections 1 to 4 (above) will be checked. Only after the qualification test has been completed will each qualifying EPD be taken to the final step of the destructive test.

b. Impact Test

During this phase, each EPD will be subjected to an impact load of 8.39 kg (18.5 lbs.) falling, one time, from each of the following increasing heights of 0.5 m (1.64 ft.), 1.0 m (3.28 Ft.), 1.5 m (4.92 Ft.), 2.0 m (6.56 Ft.), 2.5 m (8.20 Ft.), and up to five times from the maximum height of 3.0 m (9.84 Ft.). 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 (9.84 Ft.) height (for EPDs reaching this load stage). In the event of a tie (for the EPDs that survive the 5 impact load repetitions at 3.0 m (9.84 Ft.) height and do not fail), 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.

6. Report

Every participating team should submit a report with the EPD sample. This report should include:

- a. The mix design.
- b. Photos of the EPD sample before casting, illustrating the number of the stirrups and longitudinal bars.

** Punishment

- 1- Max. weight is $(3 + 0.5)$ kg, more than that will result in disqualification.
- 2- For weights 3 to 3.5 kg the punishment will be by reducing one blow (last one).
- 3- For extra stirrups (2 and above) one blow will reduced.
- 4- Any extra longitudinal reinforced bar (9 and above) will be disqualified.



Figure (1)