

Pervious Concrete Cylinder Competition

1. Objective

Teams are challenged to apply sustainability concepts and to use their knowledge of concrete mixture design by producing pervious concrete that balances permeability and splitting tensile strength. Additionally, teams are challenged to develop a mixture design that demonstrates cementitious efficiency by maintaining the overall performance of the mixture with the lowest amount of cementitious material. A report that documents the team's cylinder production process and ability to generate an accurate mixture design will also be scored.

2. Prizes

Performance Index will be calculated as explained in Point 7. Based on performance index, First, Second and Third Prizes will be awarded. First, Second and Third prizes will be Rs. 10,000/-, Rs. 7,000/-, Rs. 5,000/- respectively.

3. Eligibility

- a) Team members should be from undergraduate college or diploma or university student(s) at the time of cylinder casting. All members of a team shall be from the same college/institute/university.
- b) A team is limited to maximum five individuals. One student cannot not be a member of more than one team. Each team shall submit a single entry into the competition. Each entry is comprised of *two pervious concrete cylinders, one Report*, and one *Official Mixture Design spreadsheet*.
- c) Each team will have a supervising faculty advisor. The advisor will be professionally responsible for assuring compliance with the rules of the competition and shall sign the entry forms. One faculty advisors may supervise more than one team.

4. Materials

Only those materials should be used which are listed in the Official Mixture Design spreadsheet and described below. Mixtures shall be proportioned to result in a pervious concrete material meeting the definition of pervious concrete according to ACI 522.1-13.

- a) All aggregates shall be non-metallic and not exceeding 20 mm in nominal size. A gradation shall be performed of the individual aggregates or final combination of aggregates.
- b) Mixes shall use cementitious materials as a binder. Cementitious materials used in the mixtures shall be portland cement meeting IS 269:1989; blended cement meeting IS 1489(Part 1&2):1991. The following supplementary cementitious materials may also be used: fly ash or natural pozzolans meeting IS 3812, silica fume meeting IS 15388. Epoxies, glues, and similar binders shall not be used.

- c) Chemical admixtures meeting IS 9103: 1999 may be used. It is important to note that some special packaged “pervious admixtures” are available in market, which however are not yet accepted as they do not meet any of the above standards.
- d) Fibers with a maximum length of 64 mm made of glass, synthetic, or natural materials may be used. Steel fibers shall not be used. Any other type of reinforcement is not to be used.
- e) Cylinders shall be cured at an atmospheric pressure and curing temperatures shall not exceed the boiling point of water. Steam curing shall not be used. Please note that cylinders must be in a dry condition prior to submission at the competition.

5. Cylinder Configuration

- a) Each entry for the competition shall submit two cylinders. One cylinder will be tested during the competition. However, both cylinders will be kept for verification of compliance with the competition rules, if needed.
- b) Cylinders shall be submitted to the competition site in a dry condition (that is, as close to oven dry as reasonable). Teams are cautioned that submitting wet cylinders is disadvantageous. Cylinders will be submerged in water for minimum 30 minutes. Prior to testing their dry weight is obtained. The dry weight may be used as a tool for mixture design verification.
- c) Cylinders shall be 100 mm in diameter and 150 mm in length with a tolerance of plus or minus 5 mm in all dimensions.
- d) The cylinders shall have flat and parallel surfaces at right angles with perpendicular sides and no indentations, cupped edges, fins or other features to bias water flow over the specimen.
- e) Each cylinder shall mark on the top surface (with permanent marker) team’s name and a five-character entry identification marking. Same marking is to be used for both cylinders in each entry. The marked surface will be considered as top of the cylinder and placed upwards during permeability testing. Painting or otherwise coating the cylinders is not permitted.
- f) Modifications to cylinders are not permitted once submitted for the competition.

6. Cylinder Performance

- a) The judges will inspect both pervious concrete cylinders prior to testing to verify compliance with the rules including dimensional and material requirements. Both cylinders shall comply with the rules and be made from the same batch of concrete.
- b) The judges will randomly select one of the cylinders for testing. All tests shall be performed on same cylinder.
- c) Permeability Test:
 - After obtaining dry weight, all cylinders will be submerged in water for a minimum 30 minutes. The cylinder selected for testing shall be removed from water when prepared for testing.

- The cylinder shall be prepared for testing by the judges. Cylinders will be wrapped with a polyvinyl chloride (PVC) shrink wrap for testing as well as possible foam to prevent short-cutting of water along the edges. Specimens awaiting testing will be returned to the water bath until being placed in the testing apparatus.
 - Each entry will be tested for permeability using a falling-head permeameter test setup (see Fig. 1). With the valve closed, water shall be poured into the graduated cylinder above the cylinder until the water level remains steady at 230 mm above the cylinder and air pockets are minimized.
 - Time begins when the valve is opened. The test is complete when the water level in the graduated cylinder reaches 25 mm. Time is recorded when test is complete. Maximum time limit for the test shall be 120 seconds, after which the water level above the cylinder is recorded. Teams failing to meet the maximum time limit shall be placed in descending order based on the lowest water level and ranked below the entries completing the test within the time limit.
- d) Splitting Tensile Strength Test: Each entry shall be tested for splitting tensile strength using IS 5816:1999, “Method of test for splitting tensile strength of concrete.”

7. Scoring

Entries in the Cylinder Performance prize category shall be ranked on the performance in permeability test, splitting tensile test and report section which are indicated previously. The entry with the lowest Performance Score, calculated as follows shall be declared the winner of the Cylinder Performance prize category. In the case of a tie, the winner shall be the team with the better report ranking; if still tied, the team with the better permeability ranking shall be the winner.

$$\text{Performance Score} = (0.40)(P) + (0.40)(S) + (0.20)(R)$$

where: P = Overall ranking of entry in the permeability test

S = Overall ranking of entry in the splitting tensile test

R = Overall ranking of entry in the report

8. Judging

- a) The judges will make the final determination on compliance with the rules and penalties for rule violations up to and including the disqualification of entries if required. Disqualified entries shall not be included in the scoring or considered for awards. However, they may be tested if time permits.
- b) The decision of the judges shall be final, and appeals will not be considered.
- c) Advance registration is required. Teams shall submit an online advance registration form for their entry. The pervious concrete cylinders will be submitted on the day of the competition.
- d) Both pervious concrete cylinders with the identifying markings clearly displayed on the cylinders, accompanied by a hard copy of the Registration Form shall be submitted at

the competition site in person on or before 10:00 a.m. local time on the day of the competition.

- e) Cylinders arriving past 10:00 a.m. will not be accepted for entry into the competition and will be tested after the competition, if time permits. The individual bringing the cylinders and registration form to the competition does not have to be a member of the team and does not need to remain in the testing area.

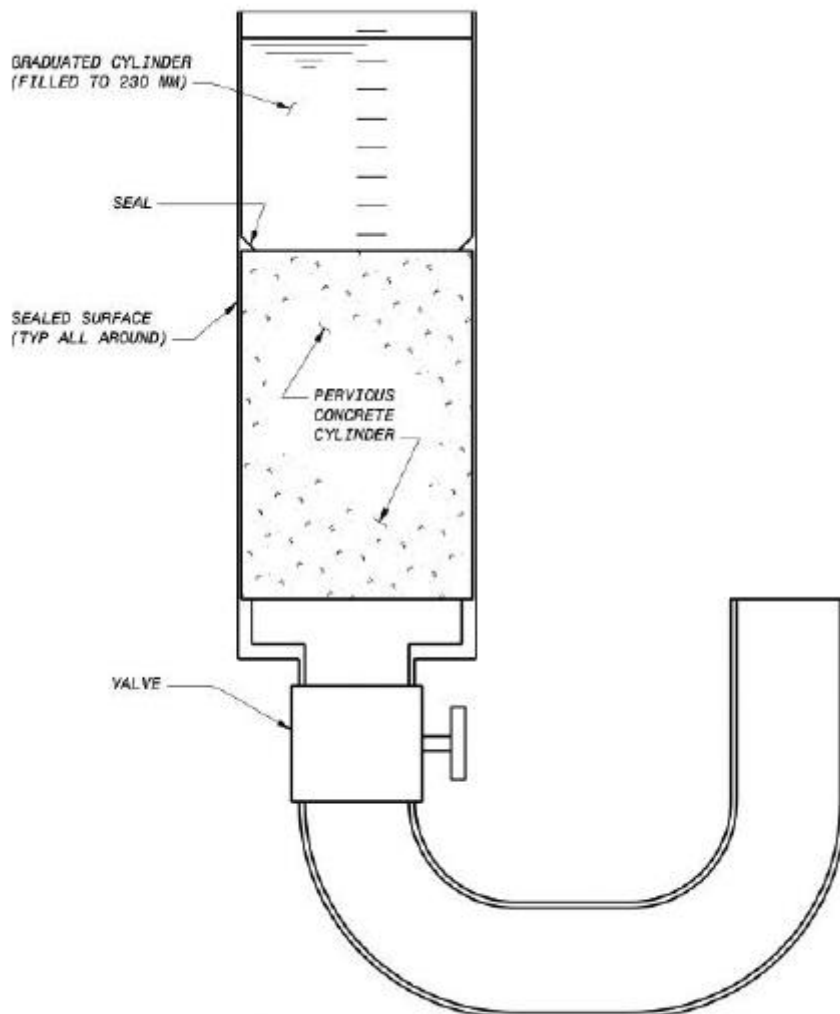


FIGURE 1 - PERMEABILITY TEST SETUP