Rules for

The 2020 International Concrete Dragon Boat Competition

(ICDBC-2020)

1. Background

Concrete is one of the most important modern materials. To reflect the cutting-edge progress of concrete research and technology, encourage students for innovation, cross-disciplinary and creative thinking, the 2020 International Concrete Dragon Boat Remote Competition (ICDBC-2020) will be organized on the October 17th, 2020, in Haining, Zhejiang, China. The competition promotes professionalism, technology, sportsmanship, entertainment, and synergy. The event is of great significance to combine cultural heritage inheritance with the study of modern science and technology, as well as cross-culture communication and collaboration. The competition is organized by Zhejiang University, Zhejiang University-University of Illinois Institute and cosponsored by American Concrete Institute (ACI) and other organizations.

Due to the pandemic of Corvid19, the 2020 Concrete Dragon Boat Competition will be held remotely.

This document provides the rules and regulations of the competition. The guiding principle is to encourage innovation and implementation of state-of-the-art new technologies.

2. Overview of Competition

2.0 General rules

The team should be formed primarily by undergraduate students. The team of players should independently design and build a concrete dragon boat model ship that meets the specified size and shape requirements and has the corresponding remote navigation capability. Each contestant team needs to submit a concrete dragon boat model ship and a report to the designated location before the competition.

The competition consists of three parts: 1. design (technical paper and presentation); 2. experimental validation (hull parameter measurement, material tests); and 3. racing competition (straight-line racing, obstacle maneuver). Each part of the game has a corresponding score, and the final score of each team is weighted and summed as the final score, and the ranking of the game is determined.

2.1 Design Essential Elements

1) The influence of the geometric scale of the concrete dragon boat hull;
2) Buoyancy and gravity calculation of concrete dragon boat hull;
3) Aggregate selection, concrete proportioning design and reinforcement design;
4) Stability of the hull in fluid, anti-overturning design, sealing and waterproofing;
5) Hull strength, internal force analysis and reinforcement calculation;
6) Dragon boat CFD simulation analysis (bonus points are not more than 6%).

Optimized Design

1) Optimized hull shape to reduce fluid resistance;
2) Engine layout and control system performance for improved stability and maneuverability;
3) Artistic presentation (dragon boat decoration);
4) Maximized load-to-weight ratio for a stable structure.

2.2 Key date and venue

Date (2020)	Arrangement	Location
June 25 – July 17	Promotion and registration	On-line
July 17	Registration deadline	On-line
July to October 10	Design, manufacture, pre-racing	Respective universities
Before October 10	Send to Zhejiang University International Campus	/
October 17, 2020	Official competition	Zhejiang Univ. Int. Campus, Haining, and On-line

3. Competition Contents

3.1 Entry requirements and registration method

① Due to the organizational capacity and time limit of the event, the event is an invitational tournament. The participation is free, but the teams are responsible for their own cost for all other need. In principle, participants are required to be students currently enrolled in the full-time undergraduate programs and participate in teams. Each team is normally formed with two to five students. Each university is in principle, limited to up to two teams to participate in ICDBC-2020. Participants must submit registration information online, at URL:https://www.concretedragon.org , or send email to concretedragon@intl.zju.edu.cn

② Each team can only submit one model and should name the boat preferably in Chinese characters.

③ Each student is only allowed to participate in one team, and each team should independently complete the project design and model construction.

④ The team must register on-line by the deadline. Each team shall participate according to the competition rules and send the boat model to the organizer. Failure of sending the boats and participating on line in time will be disqualified.

3.2 Competition Rules

3.2.0 Hull production

As shown in Figure-1, the concrete hull structure (decorative faucet tail is not included) shall have a length (the front end to the hull end) of 80cm to100cm. The height and width are not regulated but are recommended as 9.0cm-15.0cm for the height and 5.0cm-30.0cm for the width. The shape of the hull is freely designed by the competitors, however, in principle, it is required to conform to the shape of the dragon boat in the traditional sense.

Suggested materials: concrete made with cement-based binder, foam templates, water reducing agents, lightweight sands, steel wire or steel bars, FRP, multi-channel remote control equipment, motors, batteries, tapes, screwdrivers, utility knives, hot melt adhesives, etc. The participants are allowed to add materials or adjust the ratio of materials when preparing the concrete. The volume ratio of concrete material in the hull shall not be less than 50% and should be clearly stated in the technical paper.

The hull of the model boat should be decorated by the player to preferably achieve the image of the dragon boat. Several examples are shown in Figure-2, for reference only.

Figure-1 Model dragon boat hull size

Figure-2 Example of a dragon boat model

Figure-3 Recommended motor and remote control

The power engine system is recommended to use the remotely controlled double electric motors (the example motor model is RK-380PH-4733) and double propellers as shown in Figure-3. Each remote control and receiving device correspond to a specific radio frequency number. Before the competition, the team shall be sure to provide the organizer the specific operating frequency and shall be confirmed by the organizer. Unconfirmed remote controls may not be able to enter the competition due to possible interference with the event. The ratios of motor power and boat weight, as well as speed will be counted as indexes for final score.

3.2.1 Technical Report

Each team should submit a technical paper of 4 to 6 pages of A4 size to document the design, analysis, construction of the concrete dragon boat. The template will be designed and can be downloaded from the registration website.

3.2.2 Time Schedule

October 10, 2020

The teams need send the concrete dragon boats to (Engineering Building, International Campus, Zhejiang University, 718 East Haizhou Road, Haining, Zhejiang, China, 304400

Shengwei Qi, 19857367599)

October 17, 2020

The opening ceremony will start at 9:00 am online, 5 minutes to the opening ceremony of the introduction and the introduction of the jury. The workers will be display dragon boat, every dragon boat will have only 5 minutes on the show, the judges will go to online evaluate dragon boat design, (and on-site measuring hull size is in accordance with the requirements and dragon boat weight), and get the number, sortilege groups. All dragon boats will be managed by the organizer.

After all the competitions are completed, the referee will calculate the total score for all the teams on the spot and award the winners of the competition, including Super First, First, Second, Third prizes and MCD (Most Creative Dragon).

Award and closing ceremony. Certificates of award will be sent to the team after the event.

3.2.3 Tests

Hull parameter measurement:

At first, the full weight of the boat model is measured and recorded as W1, including all the contents such as the engine and power units, decorations, etc. Then the boat is placed on the water in a tank by a team member for additional loading. Weight blocks are to be placed on the boat model by the team member to the maximum limit before becoming unstable or sinking. The judgement to define the limit is the boat needs to maintain floating for at least 20 seconds after placing the maximum additional weight. This weight is recorded as W2.

The ratio of load to weight of the boat r=W2/W1 is calculated by the referee and recorded in the team's score (5%).

Strength Tests

Each team shall prepare 5 pieces of samples (10mm thick, 20mm wide and 100mm long) using the same materials as that used for constructing the hull of the concrete dragon boat. Three samples shall be randomly chosen for static loading tests, at the local site of the team, and the other two sent to the organizer for impact loading test and a possible substitute confirmation static test,. As shown in Figure 4, the loading conditions of the two tests are in the form of simply supported beam with a clear span of 80 mm and a mid-span loading in the thickness direction of the sample. The static test is step-by-step loading using weight blocks, with the increment of 50g-500g chosen by the team members. After each step of loading, wait for 30 seconds before the next level of loading until the failure (the total displacement exceeds 2% of the span, i.e. 16mm). For each loading step, if the pause period is less than 30 seconds, the loading is judged as unsuccessful. The average value of the maximum load for the three tests is the value of the static load test capacity. The static load test accounted for 5% of the total score.

As shown in Fig.4, the initial impact is a 50g weight block dropped from the initial drop height of 50mm. If successful, the player can choose (through on-line communication) the next step impact height (multiple of 50mm, but less than 200mm) for the second and further impact testing. If the final drop height exceeds 800mm, no additional tests will be performed. After each impact, the load is held for 30 seconds, if the total residual deformation does not exceed 2% of the span (that is 16 mm) the loading is deemed successful. The drop weight test accounted for 5% of the total score.

Figure-4 Schematic diagram of loading test device (left: static load; right: impact)

3.2.4 Obstacle maneuvering competition (15% of the total score):

The obstacle competition will be conducted at the team's own venue (e.g. swimming pool, etc.) and send the video to the organizer for judging.

As shown in Figure 5, the race will circle obstacles continuously according to the marked route. The first lap is a large lap, and the second lap is an "8" shape circles to return to the starting point.

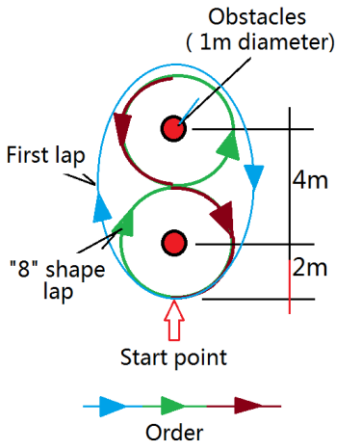

Figure-5 Obstacle course

3.2.5 Straight Track Racing (35% of the total):

The race is the second part of the game and will be held near the southwest corner of the International Campus Lake, as shown in Figure 5. Two to three dragon boats with their motors operated by remote controllers with different frequencies will contest for speed and time to

reach the finish line. At beginning of the competition, staff member will hold the boat at front of the starting point and place the dragon boat in the designated water area. After the referee signal gun is fired, the dragon boat will be operated by the remote control via internet and video webcasting towards finish line. The staff will record the time for each dragon boat at the finish line. In case of technical difficulties due to web and internet connection, the staffs will operate the remote control for the team, along with webcasting.

Figure-5 Straight track racing venue

Note**:**

1. Launching the boat before the referee's fire signal is a foul, and two fouls may result in the boat to be disqualified for the racing.
2. The racing track is 60m long with a width of 2m for each track. Each track is separated by buoys.
3. During the racing competition, intentionally entering the other competitor's track may result in disqualification of a dragon boat.
4. Any wrecked or sunken boat model shall be salvaged by the staff members, and dropped out.

3.3 Scoring

(1) The aesthetics, artistical appearance and rationality of the work are to be judged for a maximum of 10 points

(2) Technical paper (17 points) and poster presentation (8 points). The paper shall contain abstracts, technical background, dragon boat design, calculation, material ratio and design, etc. The paper and the exhibition poster templates will be provided and can be downloaded from the organizing committee website.

(3) The obstacle course maneuvering racing counts for 15 points;

(4) The score of the straight track racing is 35 points (time, power/boat weight ratio, power/speed ratio);

(5) The testing and measurement score are 15 points (5 points for load ratio; 5 points for static loading test; and 5 points for impact test).

(6) Dragon boat CFD simulation analysis (bonus points are not more than 6%).

4. Contact information

For questions related to the competition, please write to the Secretariat of the Technical Committee of the ICDBC-2020, Mr. Shengwei Qi, at concretedragon@intl.zju.edu.cn

Website: https://www.concretedragon.org

Address: Engineering Building, International Campus, Zhejiang University, 718 East Haizhou Road, Haining, Zhejiang, China, 304400

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Note: The technical committee of the ICDBC-2020 holds the right of final interpretation of the rules and regulations for this event.

Announced on Dragon Boat Festival, 2020.6.25