

12nd CONTEST REGULATION

CONCREBOL 2015

1 OBJECTIVE

1.1 This contest intends to test the competitors' ability in developing construction methods and the production of lightweight homogeneous concrete with optimized strength parameters.

1.2 The proposed challenge is to build a sphere (BALL) of lightweight concrete able to roll in a rectilinear trajectory, within the materials and dimensions established in this Regulation.

1.3 This Regulation sets the requirements to be attended in order to participate in this Contest, provides the guidelines to prepare the specimen and defines the classification criteria. It also provides information about the offered prizes by IBRACON to the winner teams in this challenge.

2 PARTICIPATION

2.1 To participate in this Contest, the teams must be composed by technology or architecture and civil engineering or students from any states of Brazil or from other countries, since the students are enrolled in academic year in a program authorized by *Ministério da Educação* (MEC) or respective higher education agency from foreign countries.

2.2 Each team must be composed by students from a single educational institution and it is mandatory that at least one component of the team must be registered in the 57th Brazilian Concrete Congress 2015.

2.3 There is no restriction regarding the number of participants in each team.

2.4 The team must elect one of its students as the team's leader. This student must be an IBRACON membership.

2.5 It is allowed the inscription of at the most two BALLS per educational institution. In other words, if the institution is represented by only one team, they can participate at the most with two BALLS.

2.6 It is not allowed the participation of any member in more than one team.

2.7 Each team must be guided by a professor from the respective educational institution. This professor must be an IBRACON membership and ensure the team

conformity with the rules established in this Regulation, signing the Technical Report (Annex 2) and the Responsibility Term (Annex 3) for the team participation in this competition.

3 TEAMS APPLICATION

3.1 To perform the application, each team must submit the **Application Form (Annex 1)** properly filled until **July 30, 2015**.

3.2 The **Technical Report (Annex 2)** properly filled and the **Term of Responsibility (Annex 3)**, both signed by the team's professor mentor, must be submitted until **September 30, 2015**.

3.3 The documents above described must be submitted by e-mail to **concrebol@ibracon.org.br** until the deadlines.

4 HANDLING THE BALL

4.1 The BALL must be handled at the Contests Arena in the Convention Center of Bonito/MS, where the 57th Brazilian Concrete Congress takes place.

4.2 **The handling shall be realized on October 27th, 2015, from 5pm to 8:30pm.**

4.3 As soon as the Organizer Committee receives the BALL, they must verify if it meets the dimensional, form and mass requirements, according to 5.2.1. The performance of these procedures must be accompanied by a member of each team. The noncompliance of these requirements disqualifies the team.

4.4 If the BALL is accepted because of meeting the 4.3 requirements, the team will receive identification from the Organizing Committee that confirms its participation in the Contest and the BALL will be retained by the Commission until the moment of the tests.

4.5 It will not be accepted any BALL handled by thirds or after the deadline.

4.6 It will not be allowed any changes in the BALL after it has been delivered.

4.7 The tests will take place at **2pm on October 30, 2015**.

5 MOUNTING THE BALL

5.1 Materials

5.1.1 Portland Cement and active mineral cementitious materials

For concrete mixture, any type of Portland cement currently commercialized or normalized by Brazilian Association of Technical Standards (ABNT NBR 5732, ABNT NBR 5733, ABNT NBR 5735, ABNT NBR 5736, ABNT NBR 5737, ABNT NBR 11578, ABNT NBR 12989 or ABNT NBR 13116) or by ASTM C 150, must be used.

It is allowed the use of active mineral cementitious materials normalized by ABNT, as silica fume (ABNT NBR 13956), metakaolin (ABNT NBR 15894) and other pozzolanic materials (ABNT NBR 12653). In the case of teams from foreign countries, the use of cementitious material shall be restricted to the similar standards in Brazil, and its characterization and Technical Standard must be informed.

It is not allowed the use of other types of binders such as adhesives and polymers with organic origin.

NOTE: The concrete samples of the winner teams may be analyzed through specific tests to check the use of materials that is not provided in this regulation.

5.1.2 Aggregates

The used aggregates shall have stony nature, according to ABNT NBR 7211. It is forbidden the use of aggregates with other origins (metal, glass beads, etc.), with the exception of lightweight aggregates provided in ABNT NBR 7213 and pearls of expanded polystyrene.

5.1.3 Fibers

It is not allowed the use of any kind of fibers.

The verification of the presence of any kind of fibers in the concrete (minerals, vegetables, metals, propylene, polyethylene or other) will disqualify the team.

5.1.4 Chemical Admixtures

It is allowed the use of admixtures according to ABNT NBR 11768.

In the case of teams from foreign countries, the use of chemical admixtures must be restricted to equivalents products in Brazil. The characterization and the Technical Standard of this product shall be informed.

5.2 Executive Procedure

5.2.1 BALL Characteristics

The BALL shall have a spherical shape, diameter ranging from 210 mm to 240 mm

and mass smaller or equal to 10 000 g (see 6.2 and 6.3).

5.2.2 Curing

The curing process can be chosen by the teams. It is allowed moist-cure at ambient temperature, thermo-controlled cure and other procedures, since described in the Technical Report.

5.2.3 Laboratory Procedures

The laboratorial procedures must follow the Brazilian Technical Standard (ABNT) requirements, when relevant.

5.2.4 Markings

It is allowed to identify the BALL with the logo or name of the team's institution. If this identification is made by adhesive, it must be easy to remove. The Organizing Committee may request the removal or repositioning of this adhesive on the ball.

5.2.5 Homogeneity and finishing

The BALL shall be homogeneous, with the same composition throughout its mass.

The BALL cannot contain special cores and flat surfaces; it cannot be painted as well, under penalty of disqualification of the team.

6 TESTING

6.1 Steps

The test consists of four steps, as described from 6.2 to 6.5:

- **Step 1:** diameter and volume of the BALL;
- **Step 2:** BALL mass and density of concrete;
- **Step 3:** BALL uniformity;
- **Step 4:** concrete strength.

6.2 Step 1: diameter and volume of the BALL

For each BALL, three determinations of diameter must be realized. These dimensions will be realized by the Organizer Committee through different orthogonal planes.

The average diameter of the BALL must be between 210 mm and 240 mm and corresponds to the average of the three dimensions, realized with 1 mm accuracy. This value is used to calculate the volume and the final score to classify the teams.

6.3 Step 2: BALL mass and density of concrete

The mass of the BALL shall be determined in balance with a resolution of 1g, and must be smaller than 10 000 g. This value is used to calculate the final score to classify the teams.

Calculate the density of the concrete used to prepare the BALL, considering the mass and the volume of the BALL (the volume is the one calculated in Step 1). The value of the density will be used in the event of a tie.

6.4 Step 3: BALL uniformity

At this step, the uniformity of the BALL will be evaluated according to its capacity to roll, going on a straight route (through a lane) and converting this movement to a "Goal", considering the BALL starts the movement because of an initial force.

In order to provide an equal impulse to the BALLS, it will be used an equipment showed in Figure 1, that consists of a 20 kg mass pendulum, with an 80 cm lever arm, released at an angle of 37° (thirty-seven degrees).

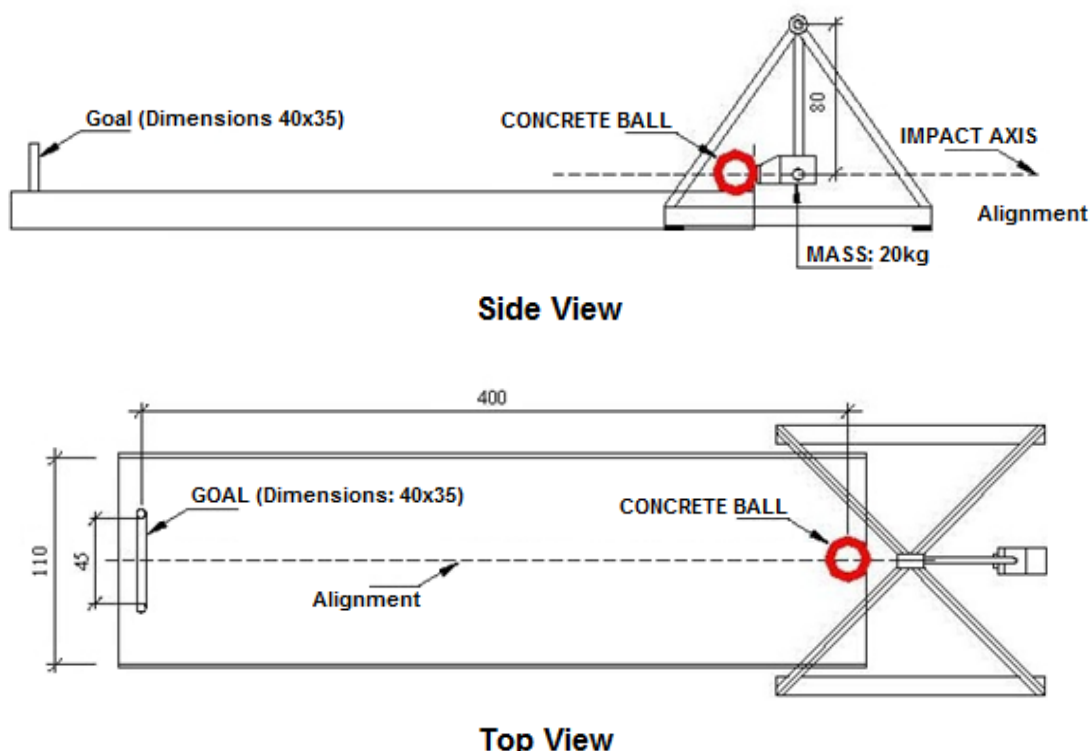
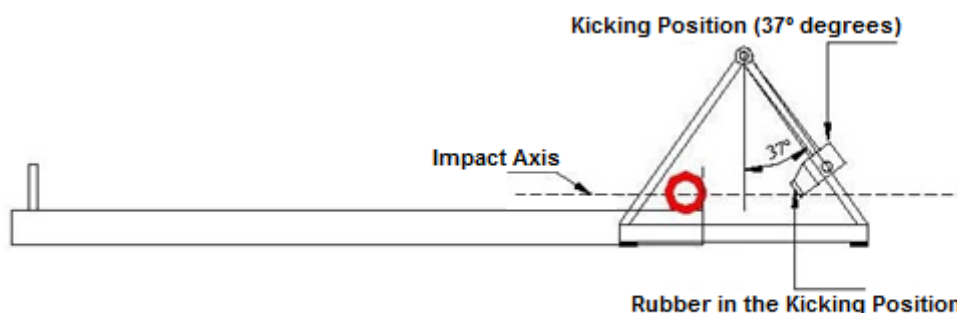


FIGURE 1: Drive equipment, Track and Goal

The concrete BALL shall be placed over the penalty mark (marked on the track) and, at the time of the test, be driven as shown in Figure 2.

To obtain the highest score, the BALL must run through the 4m length track and enter the Goal (Figures 1 and 2).


Side View
FIGURA 2: Equipment in the position to kick the BALL

The Figures 1 and 2 show the dimensions of the track and the goal, as well as its alignment considering the axis of an impact point on the BALL.

To each BALL, the team will have only one chance to try to score the Goal.

Independently of the success of the kick, it will be attributed a C_1 coefficient, according to Table 1, and it will be part of the final score, to elect the winner team of the Contest.

Table 1 – Valores do coeficiente C_1 em função do Gol

Evento	C_1
O chute é convertido em gol	1,00
O chute não é convertido em gol	0,60

It will be considered a Goal when more than a half of the ball crosses the line that limits the track from the Goal area.

Each team must choose one of its members to be the Captain, who will be responsible for the position of the ball on the penalty mark. It is not allowed to lean on the track during the positioning.

6.5 Step 4: concrete strength

After the realization of Steps 1 to 3, the BALL will be submitted by a compressive load in an upper swash plate under a (0.90 ± 0.15) MPa/s loading velocity. The maximum breaking load (F) obtained shall be registered with three decimal places, in kiloNewtons (kN).

This value is used to calculate the final score to classify the teams.

6.6 Final score

The final score (PF) of each BALL shall be calculated by the following equation.

$$PF = \frac{4 \cdot \pi \cdot r^3 F}{3 \cdot M} \cdot C_1$$

Where:

PF is the value of the final score;

F is the maximum load registered in the compressive strength test, in kiloNewtons (kN)

r is the radius of the BALL, calculated as a half of the average diameter obtained in Step 1 (see 6.2), in meters (m);

M is the mass of the BALL, in kilograms (kg);

C_1 is the uniformity coefficient, determined by the capacity to convert the BALL movement to a Goal over the equipment provided in this Regulation (Table 1).

The value of the final score will be presented with a four decimal places accuracy.

7 RANKING OF THE TEAMS

7.1 Ascending sort by results

The ranking of the teams will be based on the final score for the tested BALLS, in a descending order.

It will be considered the winner the team which the BALL obtains the highest final score. The second and third places will be from the teams with BALLS rated on this sequence.

Teams who registered more than a BALL will be rated by the BALL with the best performance. In this case, the BALL with the lowest score of each team will be disregarded.

The noncompliance of this Regulation disqualifies the team, even after the ending of the Congress. The BALLS of the five best-rated teams may be collected for verification as to its compliance.

Disqualified teams will have its procedures evaluated by the Judging Commission and may be prevented from participate for one or two editions of this contest.

7.2 Tiebreaker

In the event of a tie for the final score, the winner team will be the one which the BALL has the lowest density. During the realization of the event, the mass of each BALL will be known only by the team that prepared it and the Organizer Committee.



IBRACON

8 ORGANIZER COMMITTEE

The Organizer Committee is formed by IBRACON members that represent the region of the event and the National Coordination. The members of the Organizer Committee will be revealed during the 57th Brazilian Concrete Congress 2015.

The Organizer Committee is responsible for receiving and verifying the BALLS, realizing the tests and evaluating the compliance of this Regulation.

The divulgation of results will be made by IBRACON's Direction on the awards event of the 57th Brazilian Concrete Congress.

More information can be reported to the Organizer Commission by the e-mail concrebol@ibracon.org.br.

9 PRIZES

The team winning first place will be awarded a cash prize (the value of which will be released from 30/04 on the contest website). The three teams with highest scores will receive, during the awards ceremony of the 57th Brazilian Concrete Congress, the plates allusive to the reached result in this contest.

**ANNEX 1
APPLICATION FORM**
**12nd CONCREBOL CONTEST
BONITO/MS - 2015**

Educational Institution				
Team members	Name	E-mail	Registration number	IBRACON's membership number
Professor mentor			--	
Team's Captain				

PS: At the time of registration, attach the logo of the educational institution and the team photo to this Application Form.

**ANNEX 2
TECHNICAL REPORT
12nd CONCREBOL CONTEST
BONITO/MS – 2015**

Educational Institution:																		
Material proprieties of concrete components																		
Material	Identification/ type/brand	Precedence/ producer	Density kg/m ³	Maximum dimension of the aggregate mm	Fineness modulus of the aggregate	Observations												
Cement																		
Water																		
Aggregate 1																		
Aggregate 2																		
Aggregate 3																		
Cementitious Material 1																		
Cementitious Material 2																		
Admixture 1																		
Admixture 2																		
Annex the Technical Report of the used cement																		
Concrete composition		Concrete properties																
Material	Quantity kg/m ³	Determination	Used method (Technical Standard)	Value	Unit													
Cement		Slump			Mm													
Water		Compressive strength			MPa													
Air-entrained		<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th colspan="3" style="text-align: center;">Information about the BALL's execution process</th> </tr> <tr> <td>Molding date</td> <td></td> <td>(day/month/year)</td> </tr> <tr> <td>Temperature and curing process</td> <td></td> <td>°C</td> </tr> <tr> <td colspan="3"> <ul style="list-style-type: none"> Detail the preparation of the formwork, concrete, weighing the materials, etc. and include photos of every step. </td> </tr> </table>					Information about the BALL's execution process			Molding date		(day/month/year)	Temperature and curing process		°C	<ul style="list-style-type: none"> Detail the preparation of the formwork, concrete, weighing the materials, etc. and include photos of every step. 		
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Aggregate 1																		
Aggregate 2																		
Aggregate 3																		
Cementitious Material 1																		
Cementitious Material 2																		
Admixture 1																		
Admixture 2																		

Team's professor mentor signature

ANNEX 3
RESPONSABILITY TERM
12nd CONCREBOL CONTEST
BONITO/MS - 2015

TO
INSTITUTO BRASILEIRO DO CONCRETO
A/C: 12nd CONCREBOL ORGANIZER COMMITTEE

RESPONSABILITY TERM

I, (Name of the mentor professor), RG, (CI, CREA or CAU)....., Mentor Professor of the team, from(Name of education institution)....., send to the 12nd IBRACON Competition – CONCREBOL 2015 Organizer Committee this Responsibility Term in which I declare that the BALLS registered on this competition are in conformity with the respective Regulation.

I certificate that all the registered students are architecture, engineering or technology students of this educational institution.

I also declare to be aware that any noncompliance with the Regulation will disqualify the team, that will have its procedures evaluated by the Judging Commission and may be prevented from participate for one or two editions of this competition.

..... 2015.

(Full name and signature of the mentor professor)
(Registration number on respective education institution)