

22nd CONTEST REGULATION

EGG APPARATUS PROTECTION - APO 2015

1 OBJECTIVE

1.1 This contest intends to test the competitor's abilities on developing structural elements able to resist dynamic loadings, using the maximum of the advantages of reinforced concrete properties.

1.2 The proposed challenge consists of projecting and building a Moment-resisting frame in reinforced concrete, according to the model established in this Regulation, able to resist increasing impact loadings during the dynamic loading test provided in this Contest.

1.3 This structural element is denominated Egg Apparatus Protection (APO), because its function is to protect an egg placed under the Moment-resisting frame during the loading.

1.4 This Regulation establishes the requirements to be attended in order to participate in this Contest, to prepare the Moment-resisting frame and to perform the loading test. It also provides information about the offered prizes by IBRACON to the winner teams.

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 state 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 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 at the most of two Moment resisting frames per educational institution. In other words, if the institution is represented by only one team, they can participate with at the most two Moment resisting frames.



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 contest.

3 TEAMS APPLICATION

3.1 To perform the application, the 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 **Responsibility Term (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 **apo@ibracon.org.br** until the deadlines.

4 HANDLING THE MOMENT-RESISTING FRAME

4.1 The Egg Apparatus Protection (APO) 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 APO, they must verify if it meets the dimensional, form and mass requirements, according to 5.3. 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 specimen 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 Moment-resisting frame will be retained by the Commission until the moment of the tests.

4.5 It will not be accepted Moment resisting frames handled by thirds.

4.6 The tests will take place at **2pm** on **October 29, 2015**.

5 MOUNTING THE MOMENT-RESISTING FRAME

5.1 Materials

5.1.1 Portland Cement and active mineral cementitious material

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 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 datasheet must be informed.

It is not allowed the use of other types of binders (such as adhesives and polymers with organic origin), carbon nanotubes or any other material that is not provided in this Regulation.

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 allowed the use of any kind of fibers since its length is smaller than 25mm and its diameter smaller than 0,5mm. The fiber datasheet must be presented attached to the Technical Report (Annex 2).

It is mandatory to the fiber being disposed in a homogeneous and random way inside the concrete (not concentrated at one point or organized in a mesh shape, aligned in one direction, etc.). This rule will be verified after the test and if it is not attended, the team will be disqualified.

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.

5.1.5 Steel to the longitudinal reinforcement

Steel wires or bars must be used with a diameter less or equal to 1.65 mm.

It is not allowed the use of flat or corrugated plates made of any material.

5.2 Executive Procedure

5.2.1 Longitudinal reinforcement execution

The longitudinal reinforcement must be composed by at most 6 (six) steel wires (read 5.1.5) among the whole Moment-resisting frame, without amendments or undulations. It is not allowed the use of supporting system as easels. Applying tension in reinforcement is allowed.

NOTES

- 1) The disposition and configuration of the reinforcements at Moment-resisting frame's sections will be evaluated after the rupture to verify the compliance with the requirements of this Regulation.
- 2) No arguments from reinforcement deviations position from problems during concreting will be accepted.
- 3) The use of any material or procedure not provided in this Regulation will disqualify the team.
- 4) Metallic spacers will not be accepted.

5.2.2 Mounting the transversal reinforcement

It is allowed the use of at most **10 (ten)** stirrups with a diameter less or equal to 1.2 mm all over the Moment-resisting frame, with the spacing choose by the team. It is obligatory the existence of spacing between the stirrups. The allowed types of stirrups are shown in Figure 1.



Figure 1 – Allowed types of stirrups

NOTE: Each stirrup configuration presented will be counted as 1 (one) stirrup and the using of any configuration/model that is not provided in this Regulation will disqualify the team, including the using of stirrups with more than 2 (two) stirrup legs.

5.2.3 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 they are described in Technical Report.

5.2.4 Laboratorial procedures

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

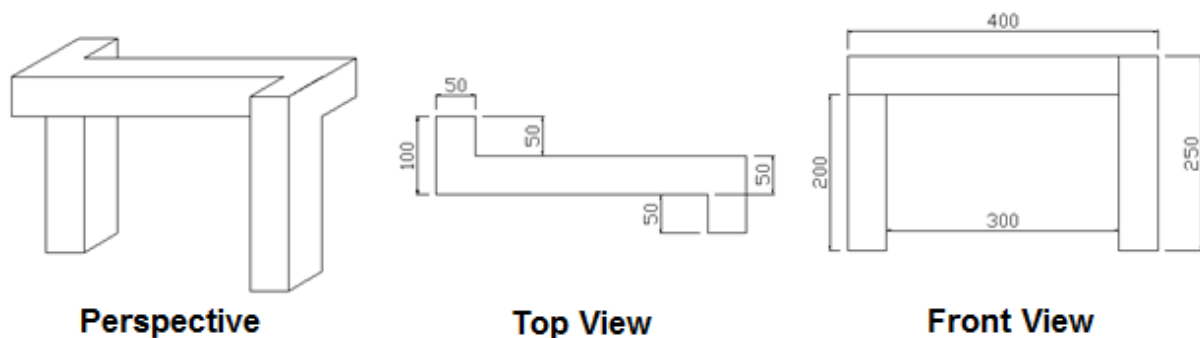
5.2.5 Markings

It is allowed to identify the Moment-resisting frame with the logo or name of the team's institution, since it is placed on the columns of the Moment-resisting frame. If this identification is made by adhesive material, it must be easy to remove. The Organizing Committee may request removal or reposition of this adhesive on the Moment-resisting frame.

5.3 APO: Characteristics, template position and template fixation

5.3.1 APO format and dimensions

The APO shall have its format and dimensions according to Figure 2.



NOTE: All the dimensions have + 1mm tolerance.

Figure 2 – APO format and dimensions

The APO superior surface cannot be taller than 250 mm, at any point, related to its base.

The APO must have a plane area (well-finished, without saliences or depressions) with at least 50 mm diameter, on the center of the superficial area, where the load will be applied.

Sanding is not allowed to adequate the Moment-resisting frame to the dimensions. It is not allowed exposed reinforcements.

5.3.2 Template

The dimensional accuracy is critical, especially bases' dimensions since the Moment-resisting frame shall fit into the template (see Figures 3 and 4). The template is used in order to positioning and fixing the apparatus over the egg, guaranteeing its alignment in relation to the loading dispositive.

The apparatus that do not attend to the format and dimensions requirements provided on this Regulation will not fit into the Template and will automatically be

disqualified.



Figure 3 – Photo of template with fixing ropes

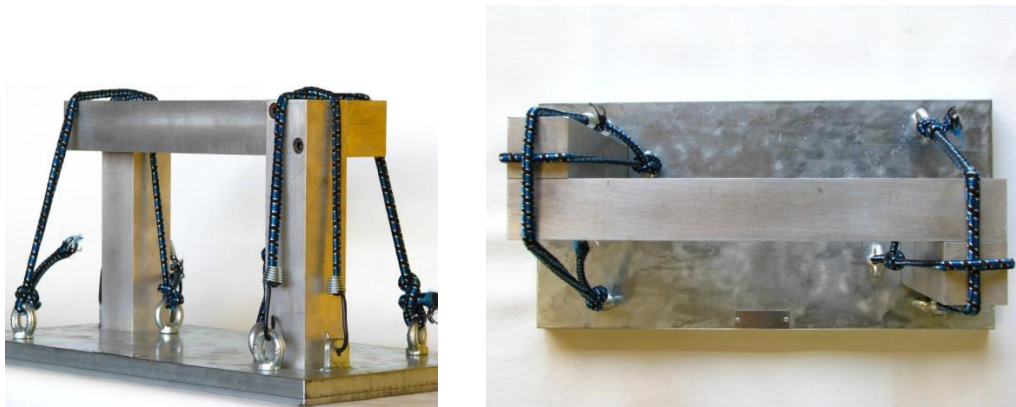


Figure 4 – Photo of APO fixed on the template

NOTE: The fixing dispositive (ropes) will be supplied to the teams by the Organizer Committee of the Contest at the time of preparation of each APO to realize the test.

5.3.3 Mass

The maximum mass of the APO must be at most **3 900 g (three thousand and nine hundred grams)**. It is not allowed any tolerance for this value. The mass checking will be realized at the time of APO's receiving.

6 TEST

6.1 Preparing the APO to the dynamic loading test

Only registered Moment-resisting frames, in other words, those which present mass and dimensions according to the Regulation, will be tested.

Before the start of the test, the APO must be set on the template through the dispositive shown in Figures 3 and 4. After, the APO must be centralized at the load

application point set by the four laser lights with the boiled egg placed under the APO.

6.2 Application of impact forces

The dynamic loading of the APO will be realized by releasing a metallic cylinder, with 50 mm diameter and 15 kg mass, of crescent heights, starting by the height of 1.0 m.

If the APO resists to the first impact, then the cylinder will be released at 1.5 m height, and the next height will be increased in 0.50 m, successively, until it reaches 2.5 m. Therefore, the cylinder will be released on the following heights: 1.0 m; 1.5 m; 2.0 m; 2.5 m.

The loading will be realized progressively, until the egg is dandified by the impossibility of the APO to keep protecting it. In this final situation, the egg can be damaged because of the ultimate carrying capacity of APO, or by detachment of pieces of the APO, that may hit the egg.

NOTE: If it is determined by the Organizer Committee that the egg is damaged because of vibrations during the test (and not because of factors related to the APO), the egg will be replaced by a new egg and the loading will proceed.

The maximum energy resisted by the APO before damaging the egg (load x height) will be the sum of the partial energies to each loading.

If the APO resists all impact loads, the test will be repeated up to three times the greatest load (falling cylinder maximum height of 2.5 m).

If a failure is not verified, the test will be finished after the third loading of 2.5 m height and the considered resisted loading will be the maximum foreseen in this Contest.

The Organizer Committee will be responsible for realizing the test. It is obligatory the presence of a member of each team to accompany its development.

After it is concluded all tests, the teams will receive information to remove the tested Moment resisting frames. The Organizer Committee may retain any Moment-resisting frame for checking.

7 SCORE AND RATING CRITERIA

7.1 Ascending sort by results

The rating of the teams will be realized considering the final score of each tested APO, in descending order.

The team whose APO support the highest energy before damaging the egg will be considered winner. The second and third places will be from the teams with APOs rated on this sequence.

Teams who registered more than one APO will be rated considering the APO with the best score. In this case, the APO 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 APOs 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 between teams with the same impact energy, it will be considered winner the APO with the lowest mass. During the realization of the test, the mass of each APO will be known only by the team who prepared it and the Organizer Committee.

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 Moment-resisting frames, 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 [**apo@ibracon.org.br**](mailto:apo@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.

(template model – digital filling)

**ANNEX 1
APPLICATION FORM**

**22nd APO 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.

(*template model – digital filling*)

**ANNEX 2
TECHNICAL REPORT
22nd APO 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%;"> <tr> <th colspan="3" style="text-align: center;">Information about the Moment-resisting frame's execution process</th> </tr> <tr> <td>Molding date</td> <td></td> <td style="text-align: center;">(day/month/year)</td> </tr> <tr> <td>Temperature and curing process</td> <td></td> <td style="text-align: center;">°C</td> </tr> <tr> <td colspan="3"> <ul style="list-style-type: none"> Detail the preparation of the formwork, concrete, the reinforcement (attach project of the transversal and longitudinal reinforcement configuration used), weighing the materials, etc. and include photos of every step. </td> </tr> </table>					Information about the Moment-resisting frame'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, the reinforcement (attach project of the transversal and longitudinal reinforcement configuration used), 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

(template model – digital filling)

ANNEX 3

RESPONSABILITY TERM

**22nd APO CONTEST
BONITO/MS – 2015**

**TO
INSTITUTO BRASILEIRO DO CONCRETO
A/C: 22nd APO 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 22nd IBRACON Competition – APO 2015 Organizer Committee this Responsibility Term in which I declare that the Moment-resisting frames registered in this competition are in conformity with the respective Regulation.

I certificate that all the registered students are architecture, engineering or technology students of this education 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)