

## Rules for the concrete competition

### 1. Participants

Participants who would like to attend the activity have to be undergraduate students or students from an educational institution at which they are studying not higher than a bachelor degree level. Each educational institution has to send 2 or 3 teams and each team must not have over 3 members and each team must have a different competing name.

### 2. Concrete molding and testing

Example...

- Concrete molding date is Thursday 15 March 2012
- Concrete testing date is Friday 16 March 2012

### 3. Example of concrete that can be used in the competition

An example of concrete that can be used in the competition is the cubic shape which has measurements of 15.0x15.0x15.0 cm. ( $\pm$  not over 0.5cm for each side). The concrete can either have some subsidence or not after the slump test. Each team can mold not over 5 samples and only two can be used for testing purposes.

### 4. Molding and allocating the group for molding and testing

4.1 There are no regulations for how to mix or mold the concrete except that it must be done by the competitors manually.

4.2 For the molding process, the committee will allow each team to mold at the same time. The starting time for molding on the first day for each team is exactly 14:00hrs. On the second day, the compressive strength testing will be conducted. Lots will be drawn to determine the time for testing each team. The concrete testing times for each team within the same group will be determined by drawing lots. The first and second testing times will be done in reverse order. For example; 1, 2, 3, 4, 5, 6 and the second concrete block testing time as 6, 5, 4, 3, 2, 1. A team that has a first testing time of lot 1 will then have a second testing time of lot 6.

## 5. Materials for molding concrete samples

Materials for mixing concrete can consist of:

### 5.1 Controlled components (Compulsory components) including

- 1) Cement power (Portland cement type I)
- 2) Natural sand
- 3) Natural stone with a maximum size not over  $\frac{3}{4}$  inches or 20 mm.
- 4) Water

### 5.2 Additional components ( which can be added or not) that are allowed to be used for mixing include;

- 1) Pozzolan acid such as silica fume, metakaolin, coal fly ash, ground granulated blast furnace slag, rice husk ash, and oil palm ash.
- 2) Chemical admixtures such as water reducers, accelerators, retarders, air-entraining admixtures, and super plasticizer.

### 5.3 Mixture proportioning of concrete samples must include all the compulsory components and the additional components can either be added or not.

Notes: It is not allowable to use other materials apart from those mentioned above in 5.1 and 5.2. If there are any questions concerning materials which can be used for molding samples, the committee will consider and decide if any other additional material can be used or not. For example, iron powder, epoxy and latex etc.

## 6. Curing

There are not any rules for curing except that it must be done in a specific area and the sample of concrete must be kept in the mould's frame at all times. Electricity can not be used for maturing the sample but each team can use other sources of energy such as oil or liquid propane gas (LPG) or a battery to give heat for concrete curing. However, each competitor or team has to prepare and bring the sources by themselves. The committee will prepare a bowl for any team that would like to make curing using water and competitors have to take the

mould frame off the concrete in front of the committee at least 1 hour before testing the measurements and checking the sample's weight.

## 7. Rules and regulations for competitors

7.1 Competitors can bring all materials except Portland cement type I

7.2 Competitors can use stone and sand which the committee will prepare for each team.

7.3 Competitors have to prepare a report detailing the mixture proportioning of concrete giving all the necessary specific details. (not over 1 page A4)

7.4 If there are any disputes or problems, the committee will make a decision and offer advice or make any necessary judgments.

## 8. Goal of compressive strength testing of concrete

Competitors have to mold their sample of concrete and make the average compressive strength similar with the controlled target mean strength given. The committee will invite five honored persons to draw lots from a box. The lots have the compressive strength amounts of 200, 250, 300, 350, and 400 kg./cm<sup>2</sup> written on them. Each of the target mean strengths to be obtained has five draw lots. Every honored person will pick one draw lot in order to find the average compressive strength. The target mean strength is between 200 to 400 kg./cm<sup>2</sup>.

An example of how to determine the controlled target mean strength

If five honored persons pick up one draw lot each as follows;

- The first honored person has picked the draw lot with a compressive strength of 200 kg./cm<sup>2</sup>.
- The second honored person has picked the draw lot with a compressive strength of 200 kg./cm<sup>2</sup>.
- The third honored person has picked the draw lot with a compressive strength of 300 kg./cm<sup>2</sup>.
- The fourth honored person has picked the draw lot with a compressive strength of 250 kg./cm<sup>2</sup>.

- The fifth honored person has picked the draw lot with a compressive strength of  $400 \text{ kg./cm}^2$ .  
As a result, the compressive strength for the controlled target mean strength =  $(200+200+300+250+400) / 5 = 270 \text{ kg./cm}^2$ .

## 9. Criteria for Judgment

Two samples of concrete blocks will be provided by each team and the average compressive strength must be similar with the controlled target mean strength provided. (The compressive strength can be higher or lower than the target provided and has to be in units of  $\text{kg./cm}^2$ ). In addition, the 2 samples of concrete blocks have to be consistent and the compressive strength differences of each block can not be over 15 percent different from the target given. If it is over 15 percent, the sample cannot be used to win any prizes in the competition as it does not match with the criteria.

An example to show a winning team

If the compressive strength has shown the target mean strength as  $270 \text{ kg./cm}^2$  and in the compressive strength testing each team has the compressive strength as follows;

- Team A has tested the average compressive strength =  $280 \text{ kg./cm}^2$  which is different from the target mean strength by  $10 \text{ kg./cm}^2$ .
- Team B has tested the average compressive strength =  $252 \text{ kg./cm}^2$  which is different from the target mean strength by  $18 \text{ kg./cm}^2$ .
- Team C tested the average compressive strength =  $278 \text{ kg./cm}^2$  which is different from the target mean strength by  $8 \text{ kg./cm}^2$ .

From the results, the winning team for the competition is Team C because it has the average compressive strength closest to the target mean strength.

## 10. An example of calculation

If the competitor's team has a result of compressive strengths as follows;

	Example I	Example II
The tested compressive strength (kg./cm <sup>2</sup> )	200	250

The average compressive strength of 2 concrete blocks =  $\frac{1}{2} (200+250) = 222.5 \text{ kg./cm}^2$ .

The winning team has to have the difference of the compressive strength for each concrete block not over 15 percent for the average compressive strength of both concrete blocks.

$$\begin{aligned} \text{The differences} &= [250 - 222.5] = [22.5] \text{ kg./cm}^2 \text{ (No symbol)} \\ &= [222.5 - 200] = [22.5] \text{ kg./cm}^2 \text{ (No symbol)} \end{aligned}$$

However, the difference that can be accepted not over 15 percent =  $0.15 \times 222.5 = 33.375 \text{ kg./cm}^2$  so the result of testing for this team will pass the criteria for the consistency of the compressive strength.

#### 11. Prizes for competition

1. The winning team will receive 3,000THB prize with the certificate and trophy from the department head of the Civil Engineering program Faculty of Engineering Khon Kaen University.
2. The second winning team will receive 2,000THB prize with the certificate and trophy from the department head of the Civil Engineering program Faculty of Engineering Khon Kaen University.
3. The third winning team will receive 1,000THB prize with the certificate and trophy from the department head of the Civil Engineering program Faculty of Engineering Khon Kaen University.