QUANTITY CALCULATION OF CELLULAR LIGHT WEIGHT CONCRETE

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Abstract
Concrete is one of the popular and oldest materials widely used in construction project, therefore it has been used extensively in the field of infrastructure and construction since ancient days. One of the best types of concrete whose popularity increases rapidly now days are light weight foam concrete (LWFC). CLC (Cellular light weight concrete) is another light weight concrete material which are widely used in making infrastructure and high rise building. The main ingredients of making CLC is cement(OPC grade 53), Fly ash (class F),sand (passing 2mm sieve) , foaming agent(synthetic based foaming agent) used. The target density of Foam concrete in between 800-1600kg/m3. In this project 15% of cement is replaced by class F fly ash and the fine aggregate is replaced by RHA from 10% to 30% with the interval of 5%. To make light weight concrete synthetic based foams are added at constant of 1%.The water cement ratio is 0.6. The cement :sand ratio is 1:3. In this project foam is generated through open air mechanical stirring without using Foam generator. Then after, generated foam is now mixing into the cement slurry (cement, sand and fly ash,rice hush ash is used in making cement slurry) so that it attains a light weight concrete when became hardening. In this study, compressive strength, fresh density and dry density is evaluated and compared with the conventional concrete specimens.
Key words: Foaming agent; Quantity calculation

1. Introduction

Light weight foamed concrete has become more popular in recent years owing to its tremendous advantages it offers over the conventional concrete. This chapter describes the nature of foamed concrete, its composition and properties and how it use in civil engineering works. Foamed concrete can be produced by introducing foaming agent. Concrete which is aerated using foaming agent is known as cellular light weight concrete.

1.1 Foaming agent

The containments holding foaming agent must be kept airtight and under temperatures not exceeding 250c. Once diluted in water the emulsion must be used soonest. Under no circumstances the foaming agent should not be brought in contact with any oil, fat, chemical or other material that might harm its function. (Oil has an influence on the surface tension of water). Foaming agents can be synthetic based or protein based.

1.2. Protein based foaming agent

Protein based foaming agents or hydrolyzed foaming agents are made by protein hydrolysis from animal proteins such as keratin (horn, meal and hoof), cattle hooves and fish scales, blood and saponin, and casein of cows, pigs and other remainders of animal carcasses. Their shelf life is one year under sealed conditions

1.3. Synthetic based foaming agent

Cellular light weight concrete has very good potential which helps to structure the cellular light weight applications. Using right category of foaming agent makes a huge difference in products such as the mechanical properties of concrete and its resistance etc. Synthetic foaming agents are such chemicals which reduce the surface tension of liquid and commonly used globally to make blocks, bricks, CLC concrete etc., where the high density is needed and it requires less energy for formation

as compared to other foaming agents. It is highly recommended to use in the constructional field where requirement of light weight concrete is increasing by time.

1.4. Materials for cellular light weight concrete

The following materials can provide for cellular light weight concrete:

- Cement(OPC 53)
- Fine aggregate
- Water
- Foaming agent
- Rice hush ash

1.4.1. Cement

There are several type of cements available in market. Among which ordinary Portland cement is well known. 53 grade ordinary Portland cement conforming to IS 12269:1987 was used in this project.

1.4.2. Fine aggregate

Aggregate which passed through 4.75mm sieve and retained on 75 micron IS sieve is termed as fine aggregate. Fine aggregate is added to concrete to assist workability and to bring uniformity in mixture. Usually, the natural river sand is used as fine aggregate. Ordinary river sand conforming IS 383-1970 is used in this project.

1.4.3. Water

The water should be fit for mixing. The water should not have high concentrations of sodium and potassium and there is a danger of alkali aggregate reactions. Natural waters that are slightly acidic are harmless, but water containing humic or other organic acids may adversely affect the hardening of concrete. Such water as well as highly alkaline water should be tested. The water should conform to IS 456:2000 standards. Generally, water satisfactory for mixing is also suitable for curing purposes. However, it is essential that curing water should be free from substances that attack hardened concrete like free CO2 etc. In this project locally available ground water is used.

1.4.4. Foaming agent

The containments holding foaming agent must be kept airtight and under temperatures not exceeding 250°c. Once diluted in water the emulsion must be used soonest. Under no circumstances the foaming agent should not be brought in contact with any oil, fat, chemical or other material that might harm its function. (Oil has an influence on the surface tension of water). Foaming agent we have used is synthetic based foaming agent.

1.4.5. Rice hush ash

Rice Hush Ash (RHA) is an agricultural by-product obtained from the process of burning rice husk under controlled temperatures below 800 °C. The by-product is black, grey, or pinkish-white, depending on the burning process. The burning process produces about 25% of ash containing 85% to 90% amorphous silica as well as about 5% alumina, which makes it highly pozzolanic.

2. Literature review

Khampee Jitchaiyaphum et al. (2011)said that cellular lightweight concrete (CLC) or sometimes might often call that foamed concrete is either a cement paste or mortar, classified as lightweight concrete, in which air voids are entrapped in mortar by suitable foaming agent. By proper control in dosage of foam content, a wide range of densities between 500 to 1600 kg/m3 can be achieved. The foaming agent used was hydrolysed protein foam and the cement used is ordinary portland cement grade 53, no fine river sand and class F fly ash confirming to ASTMC 618 were used.The foaming agent was diluted with water in ratio of 1:40 by weight and then aerating to the density of 45 kg/m3.The compressive strength of concrete is high when FA30 is used. But the water absorption is also high.

Norlia Mohamad Ibrahimet al.(2016)reviews that the performance of a fly ash lightweight aggregates (FALA) in foamed concrete cubes. The type of fly ash used is class C. The effects of using fly ash can be determine by its partial replacement of 5%, 10% and 15% in FALA. The effects of FALA can also be determine by its partial replacement in foamed concrete cubes of 25% and 50%. Three samples for each percentage is made to get the average readings. The test done divided into two which is on FALA and foamed concrete cubes. Among the test are density test, specific gravity test, water absorption test, scanning electron microscope (SEM) test, loading test and compression test. In conclusion for this paper report, the suitable

percentage of fly ash that can be used for partial replacement in cement is 15% and 50% for partial replacement of FALA in coarse aggregates. This sample reach the density of 1.498 kg/m^3 that include in the lightweight aggregates category with the compression strength of 13.442 MPa.

Ashish Kurwetiet al. (2017) explained that the one of the best types of concrete whose popularity increases rapidly now days are light weight foam concrete (LWFC). The synonyms of light weight concrete are Cellular Concrete, Foam Concrete or Aerated Concrete. This project describes the nature of foam concrete, its composition, its properties and its durability. CLC (Cellular light weight concrete) is another light weight concrete material which are widely used in making infrastructure and high rise building, the main ingredients of making CLC is cement (OPC grade 53), Fly ash (class F),sand (passing 2mm sieve) , foaming agent(protein based foaming agent) used. The target density of Foam concrete in between 800-1600kg/m3. In this project foam is generated through open air mechanical stirring without using Foam generator and by maintaining foam to water ratio 1:25 which means 1 part of foam is added into 25 part of water. Then after, generated foam is now mixing into the cement slurry (cement, sand and fly ash is used in making cement slurry) and entrained about 30% air by volume into the foam concrete so that it attains a light weight concrete block when became hardening.In this experiment the effect of fly ash in LWFC is also a part of attraction. In this experiments we conclude that if we increasing the quantity of sand particles the density of trail mixes are also increases.

3. Scope and objective

The objective of the study is to

- To study the influence of Mechanical properties of foamed concrete.
- To determine the Density and Strength of foamed concrete.
- To study the Flexural Behaviour of foamed concrete with that of conventional con1crete.

4. Quantity calculation

There is no standard mix proportion available for cellular light weight concrete. So we have to adopt the mix ratio 1:3. Water cement ratio is 0.6.

The details of number of specimens are shown in Table 4.1

***Table* 4.1:** *Specimen description for cubes*

specimen	*Mix A*	*Mix B*	*Mix C*	*Mix D*	*Mix E*	*Mix F*	*Mix G*
Cube	*9*	*9*	*9*	*9*	*9*	*9*	*9*

4.1. Mix Details

Mix-A - 100% cement +100% fine aggregate + water + foaming agent-1%.

Mix-B - 85% cement +15% fly ash +100% fine aggregate +water +foaming agent-1%.

Mix-C - 85% cement +15% fly ash +90% fine aggregate +10% RHA +water +foaming agent-1%.

Mix-D - 85% cement +15% fly ash +85% fine aggregate +15% RHA +water +foaming agent-1%.

Mix-E - 85% cement +15% fly ash +80% fine aggregate +20% RHA +water +foaming agent-1%.

Mix-F - 85% cement +15% fly ash +75% fine aggregate +25% RHA +water +foaming agent-1%.

Mix-G - 85% cement +15% fly ash +70% fine aggregate +30% RHA +water +foaming agent-1%.

4.2. Quantity calculation for CLWC

There is no standard mix proportion available for cellular light weight concrete. So we have to adopt the mix ratio 1:3. Water cement ratio is 0.6.

Cement :sand ratio =1:3
Size of cube =100mm x100mm x100 mm
Volume of 6 cube =6 x 0.1 x 0.1 x 0.1 =0.006m^3
Volume of cement require =(1/4) x (0.006) =0.0015m^3
Volume of fly ash=(0.15/4)x(0.0015) =0.00005625m^3
Volume of sand require=(3/4) x (0.006) =0.0045m^3
Density of cement =1425kg/m^3

Weight of cement require=0.0015 x 1425 =2.14kg
Density of fly ash =1679kg/m³
Weight of fly ash require =0.00005625 x 1679 =0.09kg
Weight of cement requir= 2.14-0.09 = 2.05kg
Density of sand = 1708kg/m³
Weight of fine aggregate=0.0045 x 1708 =7.69kg
Amount of water require=0.6 x 2.05 =1.23 kg

=1230ml
Amount of foaming agent =(1/100) x 2.14 =0.0214kg =21.4 ml

Table 4.2: Quantity calculation

Mix details	Cement (in m³)	Fly ash (in m³)	Fine aggregate (in m³)	RHA (in m³)	Water (in ml)	Foaming agent
MIX A	0.0015	0	0.00038	0	1230	21.4
MIX B	0.0015	0.000056	0.00038	0	1230	21.4
MIX C	0.0015	0.000056	0.00438	0.0001	1230	21.4
MIX D	0.0015	0.000056	0.00433	0.0002	1230	21.4
MIX E	0.0015	0.000056	0.00427	0.0002	1230	21.4
MIX F	0.0015	0.000056	0.00421	0.0003	1230	21.4
MIX G	0.0015	0.000056	0.00416	0.0003	1230	21.4

5. Conclusion

- The quantity calculation was arrived for cellular light weight concrete for mortar mix 1:3.

- Thus, this quantity calculation can be used for determination of various properties of cellular light weight concrete such as mechanical properties and flexural behavior.

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