Global Journal of Engineering Science and Research Management

LOW COST LIGHT WEIGHT CONCRETE MAKING BY USING WASTE MATERIALS

Mr.Dipanjan Mukherjee
M.Tech CIVIL ENGINEERING (Pursuing), B.Tech West Bengal University of Technology, West Bengal, INDIA
*Correspondence Author: ddiipp90@gmail.com

Keywords: Introduction, Importance of Light Weight Concrete, Fly Ash, Brick Bats, Over Burnt Brick Bats, Design Stipulations.

Abstract

This paper discusses about a very simple lab experiment of light weight concrete making. A concrete cube is prepared by using sand, cement, water, over burnt brick bats & fly ash. Fly ash is used as a cement replacement and over burnt brick bat is used as a coarse aggregate. Both fly ash & over burnt brick bats are considered as waste materials of thermal power plant & construction sites. Mix design is done for M20 grade of concrete As per IS 10262-2009. Finally it was seen that 16.67% reduction of weight without increase the cost. It was also seen that for M20 grade of concrete it provides 94.9% strength at 28 days compression test. This is quite significant & this ordinary mix design also gives satisfactory performance of lightweight concrete cube making.

Introduction

Structural lightweight concrete is which have a density 1440 – 1840 kg/m3 as compared to normal concrete density range 2240- 2400 kg/m3. For structural application of it should be higher strength 17 Mpa. Structural lightweight aggregate concrete solves weight and durability problems in buildings and exposed structures. Lightweight concrete has strengths comparable to normal weight concrete, yet is typically 25% to 35% lighter. Structural lightweight concrete offers design flexibility and substantial cost savings by providing: less dead load, improved seismic structural response, longer spans, better fire ratings, and thinner sections, decreased story height, smaller size structural members, less reinforcing steel, and lower foundation costs. Lightweight concrete precast elements offer reduced transportation and placement costs.

Figure 1 Concrete Cube

Importance of light weight concrete

- it helps reduction of dead load
- increases the progresses of building
- lowers haulage & handling cost
- very effective in case of foundation in weak soil
- relatively low thermal conductivity
- applicable in extreme climatic condition

Fly ash

Fly ash, also known as flue-ash, is one of the residues generated in combustion, and comprises the fine particles that rise with the flue gases. Ash which does not rise is termed bottom ash. In an industrial context, fly ash usually refers to ash produced

Global Journal of Engineering Science and Research Management

during combustion of coal. Fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys of coal-fired power plants, and together with bottom ash removed from the bottom of the furnace is in this case jointly known as coal ash. Depending upon the source and makeup of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial amounts of silicon dioxide (SiO2) (both amorphous and crystalline) and calcium oxide (CaO), both being endemic ingredients in many coal-bearing rock strata.

Figure 2 Fly Ash

Class F fly ash

The burning of harder, older anthracite and bituminous coal typically produces Class F fly ash. This fly ash is pozzolanic in nature, and contains less than 20% lime (CaO). Possessing pozzolanic properties, the glassy silica and alumina of Class F fly ash requires a cementing agent, such as Portland cement, quicklime, or hydrated lime, with the presence of water in order to react and produce cementitious compounds. Alternatively, the addition of a chemical activator such as sodium silicate (water glass) to a Class F ash can lead to the formation of a geopolymer.

Class C fly ash

Fly ash produced from the burning of younger lignite or subbituminous coal, in addition to having pozzolanic properties, also has some self-cementing properties. In the presence of water, Class C fly ash will harden and gain strength over time. Class C fly ash generally contains more than 20% lime (CaO). Unlike Class F, self-cementing Class C fly ash does not require an activator. Alkali and sulfate (SO

4) Contents are generally higher in Class C fly ashes.

Brick bats

Brick bats are one types of aggregates used in certain places where natural aggregate are not available or costly. The brick bat aggregate are not really brought under lightweight aggregates because the concrete made with this aggregate will not come under the category of light weight concrete. However weight can be reduced by using of these kinds of aggregates. Water absorb is less than other types of aggregate.

Over burnt brick

Over brunt bricks are those which have proper shape but slightly over brunt having some blackish color, require more cement mortar and foundation become weak. But strength of over burnt brick is 120-150 Kg/cm2. However these are poor in shape.

Global Journal of Engineering Science and Research Management

Figure 3 Brick Bats

Design stipulations

Grade of concrete:- M20

A. Characteristic compressive strength required at 28 days 20 N/mm2
B. Max size of aggregate (brick bats) 20 mm.
C. Degree of workability 0.90 compacting factor.

Test data for materials

A. Sp gravity of cement :- 3.15
B. Type of cement: - Portland pozzolana slag cement.
C. Sp gravity of coarse aggregate :- 1.9
D. Type of coarse aggregate: - Brick bats.(over burnt)
E. Type of fine aggregate: - Sand.
F. Sp gravity of fine aggregate :- 2.6
G. Sp gravity of fly ash :- 2.16
H. Replacement of cement by fly ash :-30% (by weight)
I. Water absorption of coarse aggregate :- 0.8%
J. Water absorption of fine aggregate :- 1%
K. Surface moisture of fine aggregate & fly ash: - Nil.
L. Sand conforming zone II (as per IS 383 1970)

Mix design

As per IS 10262-2009;

For M20:- Water: Cement: Fly ash: Coarse aggregate: Fine aggregate: Plasticizer = 0.56:1:0.33:3.8:3.19:0.02; (by weight).

Curing (As

(As per IS456-2000)

A. Methods of curing: - Water curing. (Immersion type).
B. No. of days of curing: - 28 days.

Test result

- ✓ Weight (Density) of concrete cube (150X150X150 mm) – 20 KN/m3
- ✓ 28 days compressive strength – 18.98 Mpa.

Global Journal of Engineering Science and Research Management

Figure 4 Concrete Cube Test

Conclusion

Although this experiment made only for M20 grade and locally available waste materials by using very simple method described in IS 10262-2009.

The required properties of the lightweight concrete will have a bearing on the best type of lightweight aggregate to use. If little structural requirement, but high thermal insulation properties, are needed then a light, weak aggregate can be used. This will result in relatively low strength concrete.

But the benefits of using lightweight aggregate concrete include:

- Reduction in dead loads making savings in foundations and reinforcement.
- Improved thermal properties.
- Improved fire resistance.
- Savings in transporting and handling precast units on site.
- Reduction in formwork and propping.

References

1. *http://www.concretecentre.com/*
2. *http://en.wikipedia.org/wiki/Fly_ash*
3. *Concrete in practice – NRMCA*
4. *ENGINEERING PROPERTIES OF STRUCTURAL LIGHTWEIGHT CONCRETE - Kenneth S. Harmon, PE; Carolina Stalite Company – United States*
5. *IS456-2000*
6. *IS 10262-2009*
7. *IS 383 1970*
8. *Managing Coal Combustion Residues in Mines, Committee on Mine Placement of Coal Combustion Wastes, National Research Council of the National Academies, 2006*
9. *Human and Ecological Risk Assessment of Coal Combustion Wastes, RTI, Research Triangle Park, August 6, 2007, prepared for the U.S. Environmental Protection Agency*