EXPERIMENTAL STUDY ON AUTOCLAVED AERATED CONCRETE USING TERNARY BLENDING MATERIALS

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ABSTRACT: The scope of the present investigation is to assess the properties of Autoclaved Aerated Concrete (AAC) by using Ternary Blending Materials. Totally 24 specimens were casted, in that 16 specimens are AAC blocks & cubes and 8 specimens are concrete cubes. From this investigation AAC with TBM2 (AAC + Silica Fume) shows massive increase in the ultimate load of 10.5% when compared to control specimens. While TBM3 (AAC+NaOH solution) specimen, there is a marginal decrease in ultimate load of 3.5% and there is a reasonable increase in ultimate load of 8.45% for TBM1 (AAC+Metakaolin). While considering concrete specimens, the concrete with TBM2 shows 11.39% increase in the ultimate load. For concrete with TBM1 there is 10.28% increase in the ultimate load. When compared to control specimen, concrete with TBM 3 there is a slight decrease in the ultimate load of 1.78%.

INTRODUCTION

The basic needs of humans are food, clothes and shelter. Civil engineering not only fulfills the need of shelter but also contributes a part to complete the basic need like shelter. Construction industry is the biggest industry in the world which fulfills the need of shelter as well as help to achieve high living standard. Due to increase in population as well as living standards construction activities are very much increased.

Due to such needs the energy consumption in world is ever increasing. 40% primary energy is consumed by construction activity. Current problems faced by the construction industry are scarcity of conventional construction material, Shortage of labor, high energy consumption of conventional material, high carbon footprints and social problems caused by over exploration.

AUTOCLAVED AERATED CONCRETE (AAC)

AAC is manufactured from common and abundant raw materials. It is extremely resource efficient and environment friendly. The energy consumed in the production process emits no pollutants and creates no by products or toxic waste products. The use of AAC blocks can reduce indoor air pollutants. Blocks are completely inert and do not emit toxic gases, even when exposed to fire.

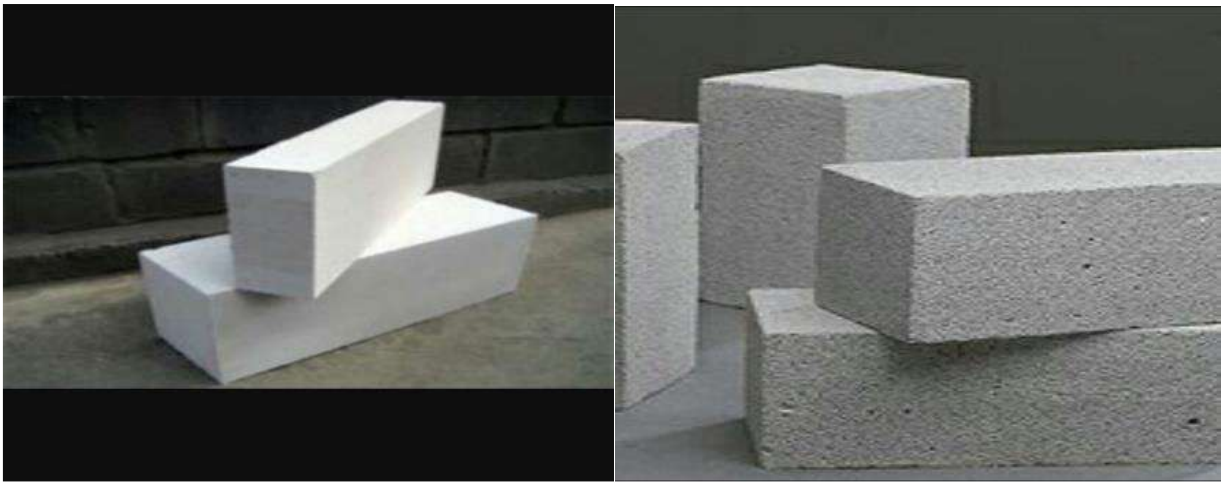

Fig1: View of AAC blocks

SCOPE

- To examine the compressive strength of Autoclaved Aerated concrete (AAC) blocks and cubes by partially replacing Ternary Blending Materials.

OBJECTIVES

- To determine the compressive strength of Autoclaved Aerated Concrete ternary blending materials such as silica fume, NaOH solution, metakaolin.
- To study the effect of AAC blocks on the structural element by comparing it with conventional material.

TERNARY BLENDING MATERIALS

TBM is a mixture of ordinary Portland cement and other materials such as furnace slag, hydrated lime, pozzolan etc. which is combined either during or after the finish grinding of the cement at the mill.

METAKAOLIN

Metakaolin is a dehydroxylated form of kaolinite clay mineral. Stone that are rich in kaolinite are known as china clay or kaolin, traditionally used in the preparation of porcelain. Metakaolin is an important admixture for concrete and cement applications. The actual specific gravity of china clay should between (2.70-2.80). The experimental value of china clay is 2.75**.**

Fig2:China clay

SILICA FUME

Silica fume is one of the most beneficial product in concrete manufacturing. Because of its physical and chemical properties, it is a very reactive pozzolan. The original specific gravity value of silica fume is (2.20-2.30). The experimental value of silica fume is 2.22. Silica fume is a by-product of producing silicon metal or ferrosilicon alloys.

Fig3: Silica Fume

LIMESTONE POWDER

Lime powder required for AAC production is obtained either by crushing limestone to fine powder at AAC factory or by directly purchasing it in powder form from a vendor. Although purchasing lime powder might be little costly, many manufacturers opt for it rather than investing in lime crushing equipment like ball mill, jaw crusher, bucket elevators, etc. Lime powder is stored in silos fabricated from mild steel (MS) or built using brick and mortar depending of individual preferences.

Fig4: Gypsum

ALUMINUM OXIDE POWDER

Aluminium powder/paste is easily available from various manufacturers. As very small quantity of Aluminium powder/paste is required to be added to the mixture, it is usually weighed manually and added to the mixing unit. It is added to a percentage of 0.05-0.08.

Fig5: Aluminium Powder

MIX DESIGN FOR CONCRETE

Mix design for M30 grade of concrete was carried out as per IS 10262: 1982, (Recommended guidelines for Concrete Mix Design) and accordingly used in the casting of specimens.

MIX RATIO COMPUTATION

a) Grade of cement : OPC 53

b) Grade of concrete : M30

c) Specific gravity of cement : 3.09

d) Specific gravity of fine aggregate : 2.60

e) Specific gravity of coarse aggregate : 2.70

f) Specific gravity of fly ash : 2.24

g) Size of coarse aggregate : 20 mm

Materials	Cement content	Fine Aggregate	Coarse Aggregate	Waterr Content
Mix ratio	1	1.75	2.23	0.40

EXPERIMENTAL INVESTIGATION

AAC Blocks are almost a whopping 70 percent less in weight in comparison to the red bricks and are more in size. This means less use of cement for binding and more saving.This also translates into a stronger building. AAC Block Manufacturer there are off course numerous differences existing between AAC Blocks and Red Bricks because of which AAC Blocks are now the preferred choice for construction. A reliable AAC Block Manufacturer is the best one to explain these differences as they are the ones who manufacture these blocks.

FOR AAC blocks

AAC(control specimen)	6 60% of flyash , 20% of lime, 10 % of gypsum , 8 % of cement , 2% of expanding and foaming agent.
AAC with TBM1 (METAKAOLIN	49% of flyash , 20% of lime, 10 % of gypsum , 8 % of cement , 2% of expanding and foaming agent, 19% of Metakaolin
AAC with TBM2 (SILICA FUME)	49% of flyash , 20% of lime, 10 % of gypsum , 8 % of cement , 2% of expanding and foaming agent, 11% of silica fume
AAC with TBM3 (ALKALINE SOLUTION)	60% of flyash , 20% of lime, 10 % of gypsum , 8 % of cement , 2% of expanding and foaming agent, 250ml of NaOH

FOR AAC CUBE

AAC(control specimen)	60% of flyash , 20% of lime, 10 % of gypsum , 8 % of cement , 2% of expanding and foaming agent
AAC with TBM1 (METAKAOLIN	49% of flyash , 20% of lime, 10 % of gypsum , 8 % of cement , 2% of expanding and foaming agent, 19% of Metakaolin.
AAC with TBM2 (SILICA FUME)	49% of flyash , 20% of lime, 10 % of gypsum , 8 % of cement , 2% of expanding and foaming agent, 19% of silica fume.
AAC with TBM3 (ALKALINE	60% of flyash , 20% of lime, 10 % of gypsum , 8 % of cement

SOLUTION)	, 2% of expanding and foaming agent, 250ml of NaOH.

Fig 6:Preparation of Specimen

Fig 7:Finished Product of AAC Block

Fig 8:Finished product of AAC Cube

Fig 9:Heating of AAC Cube and Block

TEST SETUP AND INSTRUMENTATION

After the desired curing period of 28 days, the specimen were subjected to compression strength test as per IS 516-1959. The test was carried out in a Universal testing machine of 40T capacity. After conducting all workability tests concrete, concrete cubes of 150 x 150 x 150 mm is casted with that concrete to find the compressive strength. Then the concrete cubes are allowed for 7, 14 and 28 days in water curing. The compressive strength test was conducted as per IS 516 -1959 in Compression testing machine.

Fig 10: Testing of AAC Cube

Fig 11: Testing of AAC Block

RESULTS AND DISCUSSION

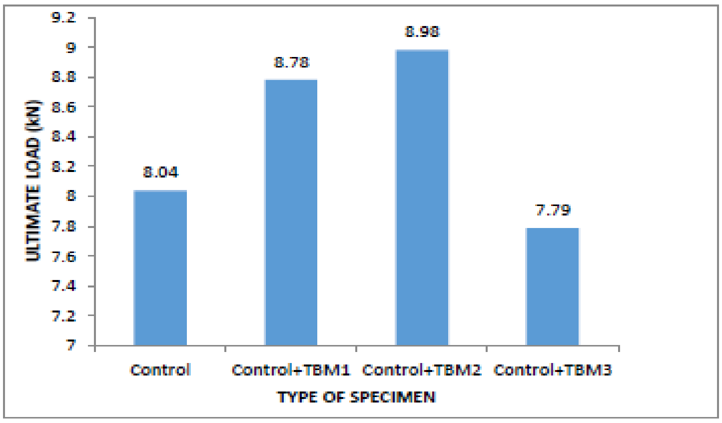

Fig 12: Compressive Strength of AAC cube after 7 days

Table 2: Results for AAC block

Sl.NO	TYPE OF SPECIMEN	SIZE OF SPECIMEN(mm)	FIRST CRACK LOAD (kN)	ULTIMATE LOAD (kN)
1 1	Control	400 x 200 x 100	20.57	28.57
2 2	Control+TBM1	400 x 200 x 100	23.20	31.20
3	Control+TBM2	400 x 200 x 100	23.92	31.94
4	Control+TBM3	400 x 200 x 100	19.72	27.726

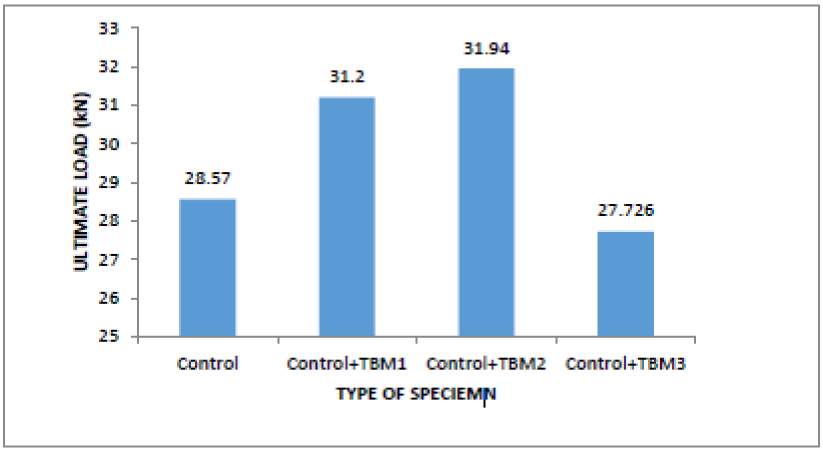

Fig13: Compressive Strength of AAC Concrete block after 28 days

Sl. N	TYPE OF SPECIMEN	SIZE OF SPECIMEN(mm)	FIRST CRACK	ULTIMATE LOAD (kN)

O			LOAD (kN)	
1	Control	150 x 150 x 150	20.99	34.99
2	Control+TBM1	150 x 150 x 150	24.89	38.89
3	Control+TBM2	150 x 150 x 150	25.49	39.49
4	Control+TBM3	150 x 150 x 150	20.375	34.375

Table 3: Results for AAC Cube after 28 days

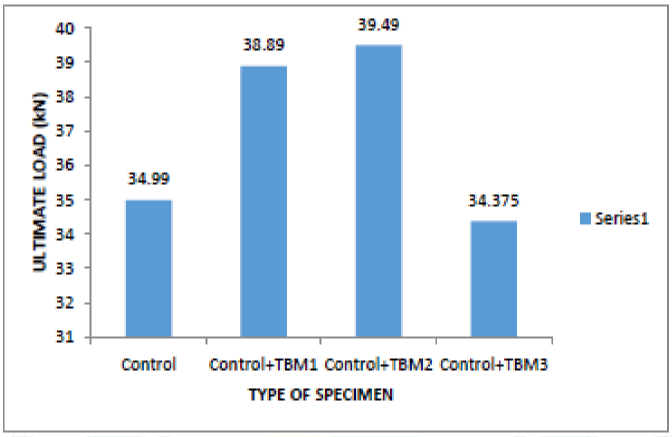

Fig13: Compressive Strength of AAC Concrete cube after 28 days

CONCLUSION

FOR AAC CUBES

- When compared to the control specimen, the AAC with TBM1 material has 8.42% increase in the ultimate load.
- When compared to control specimen, thee AAC with TBM2 material has enormous increase in the ultimate load of 10.5%.
- When compared to AAC with NaOH, the control specimen has marginal increase in ultimate load of 3.5%.

FOR AAC BLOCKS

- When compared to the control specimen of AAC blocks, there is 8.45% increase in the ultimate load for AAC blocks with TBM1.

- When compared to the AAC blocks, there is 10.55% enormous increase in the ultimate load for AAC blocks with TBM2 and little increase when compared to AAC blocks with TBM1.

- When compared to the AAC blocks, there is 3.44% decrease in ultimate load for AAC block with TBM3.

FOR CONCRETE

- When compared to the conventional concrete, the concrete with TBM1 there is 10.28% increase in the ultimate load.

- When compared to the conventional concrete, the ultimate load for concrete with TBM2 there is little increase (1.11%)when compared with concrete and TBM1. For concrete with TBM2 there is 11.39% increase in the ultimate load compared to AAC block (control specimen).

- When compared to control specimen concrete with TBM 3 there is a slight decrease in the ultimate load of 1.78%.

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