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Comparative Study of Light Weight Concrete

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Abstract:- **light weight concrete as become more popular in recent years owing to the tremendous advantages over the conventional concrete. The properties of light weight concrete can vary widely and it can be used in wide variety of applications. Light weight blocks can be used as an alternative to the conventional cement blocks that uses aerating agents like aluminum powder. concrete which is aerated using aerating or by using some expanding agents is known as light weight concrete, it is produced by initially making a slurry of cement + fly ash + water, which is further mixed with addition of aerators in an ordinary concrete mixer under ambient conditions. Application of light weight concrete is civil engineering works is broad as it can be used in almost every parts of building from superstructure right down to the substructure, including wall panels and roofing. In highway construction light weight concrete can be applied as a soil filling for sub base, bridge abutments and embankments. It is worth nothing that the use of light weight concrete in other countries such as Europe, Japan, and united kingdom etc.**

Keywords:-- **Autoclaved aerated concrete blocks, Conventional concrete, Foaming Agent, Light weight concrete.**

I. INTRODUCTION

Since concrete is the major building material, there is a wide scope in innovation of concrete. Now a day's Light weight concrete plays an important role in construction field. Light weight concrete can be defined as a type of concrete which includes an expanding agent in it that increases the volume of the mixture while reducing the dead weight. As it is lighter than a conventional concrete i.e. 35percent lower than a conventional concrete. The conventional concrete made with natural aggregate originating from hard rock has high density and represents large proportion of dead load on structure and high thermal conductivity. The main specialties of light weight concrete as its low density, low thermal conductivity, permits greater design flexibility and substantional cost savings, reduced dead load, small size structural members, less reinforcing steel and lower foundations costs. The types of light weight concrete are based on their curing methods such as foamed concrete & Autoclaved Aerated Concrete (AAC)

II. METHODOLOGY

In order to study the behavior of Autoclaved Aerated concrete (AAC), conventional concrete testing was done to determine the material and structural properties of each type of light weight concrete and how will these properties differ according to different type of mixture and its composition. Once concrete has hardened it can be subjected to a wide range of tests to prove its ability to perform as planned or to discover its characteristics. Raw materials collected are cement, fine aggregate, coarse aggregate, fly ash, and aluminum powder. Some physical tests were conducted on the raw materials such as normal consistency test, initial & final setting time, specific gravity etc. and the results are as follows

Table 1: Setting time of cement

Initial setting time	50minutes
Final setting time	5hours 40minutes

Table 2: Normal consistency of cement

Sl. no	Weight of sample in gm	% weight of water	Penetration in mm
1	300	27	18
2	300	28	11
3	300	29	5

Percentage weight of water = 29%

Calculation of mix design of M25 by referring IS

a) Grade designation : M25
b) Type of cement : OPC43 grade
c) Nominal size of coarse aggregate : 6mm
d) Specific gravity of cement : 3.12
e) Specific gravity of coarse aggregate : 2.7
f) Specific gravity of fine aggregate : 2.65
g) Water absorption
CA : 0.5%
FA : 1%

1) Target strength:

f'ck = fck+1.65s = **31.6 N/mm².**

For coarse aggregate 6mm of 208 liters

Aggregate = (208 + 6) / (100 x 208) **= 220.48 liters**

For 100mm slump

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2) Calculation of cement content

W/c = 0.5 Cement content = (220.48 / 0.5)

= **440.96 Kg/m^3**

440.96Kg/m^3 > 240K/m^3

Hence safe

3) From table, volume of CA corresponding to 6mm size aggregate and fine aggregate

(Zone 1) 0.5 = 0.44 (From referring Zone III)

Volume of CA = 0.46

Volume of FA = 1 - 0.46 = 0.54

4) Mix calculation:

a) Volume of concrete = 1 m^3

b) Volume of cement = (44 /3.12) x (1/1000)

= 0.014m^3

c) Volume of water = (220/1) x (1/100) = **0.22 m^3**

d) Volume of all in aggregate = a- (b + c)

= 1 - (0.014 + 0.220)

= 0.766 m^3

e) Mass of CA = (0.766 x 0.54 x 2.7 x 1000)

= 1116.82 Kg

f) Mass of FA = (0.766 x 0.54 x 2.65 x 1000)

= 1096.14 Kg

5) Mix proportioning:

Cement = 440 Kg/m3

Water = 220 Kg/m3

FA = 1097 Kg/m3

CA = 1117 Kg/m3

W/c ratio = 0.5

6) Mix ratio = 1: 2.49: 2.54

Casting, Curing And Testing Of Test Cubes

Mixing the materials according to the mix design and pouring into the mould size of 600x200x150mm.For conventional concrete blocks, cubes are casted and cured for 28days and tested its compressive Strength. For AAC blocks, the readymade blocks taken from Ultra-tech building products company, and its compressive strength as been tested for 28days.

MODELLING IN SAP 2000

Using SAP 2000 software wall load analysis has been done in 2D frame model for both conventional and AAC blocks. Taking single bay of 5m width of 5storey building each building is of height 3m.above beam 5,1m parapet wall load is applied and fixed supports are used.

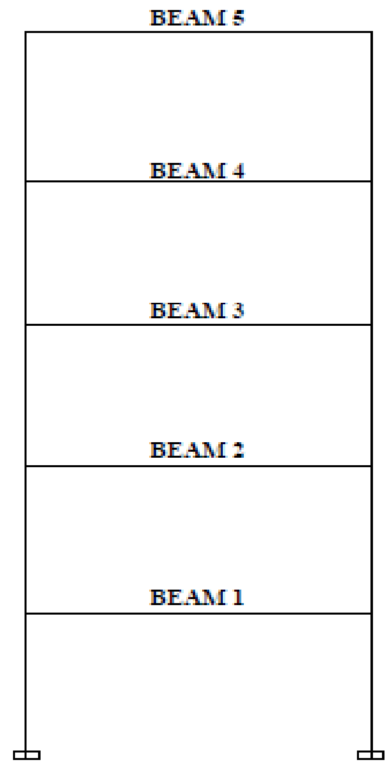

Figure 3.1 shows the 2D single bay frame of 5 storey building.

After creating a 2Dframe of building, beam (450x150mm) and column (300x150mm) sizes are assigned to a frame, later a uniformly distributed load is defined for a frame, for conventional blocks UDL of 8.04kN/m is assigned and UDL (parapet wall of 1m height) of 2.68kN/m is assigned., for AAC blocks UDL of 3.19kN/m is assigned and UDL (Parapet wall of 1m height) of 1.06kN/m is assigned.

WALL LOAD CALCULATIONS FOR A FRAME**:**

For Autoclaved Aerated Concrete (AAC) Blocks:

Density = 7.11 kN/m^3

Wall load = width of beam x height of the wall x density of block = 0.15 x 3 x 7.11

= 3.19 kN/m.

Wall load for = width of beam x height of parapet wall x density of block

Parapet wall

= 0.15 x 1 x 7.11

= 1.06 kN/m

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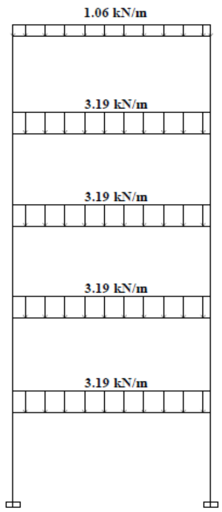

Figure 3.2 Assigned wall loads for Autoclaved Aerated Concrete (AAC) blocks

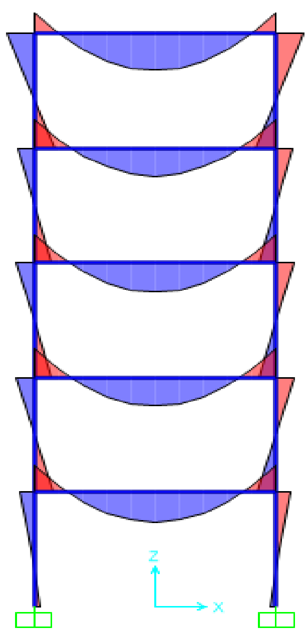

Figure 3.3 shows the bending moment diagram for wall load analysis for autoclaved aerated blocks.

For Conventional Blocks:

Density = 17.87 kN/m^3

Wall load = (width of beam x height of the wall x density of block)

= 0.15 x 3 x 17.87

= 8.04 kN/m

Wall load = width of beam x height of parapet wall x density of block parapet wall

= 0.15 x 1 x 17.87

= 2.68 kN/m

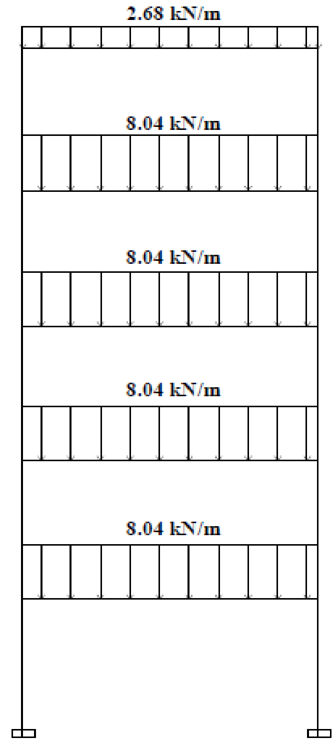

Figure 3.4 shows the assigned wall loads for Conventional blocks

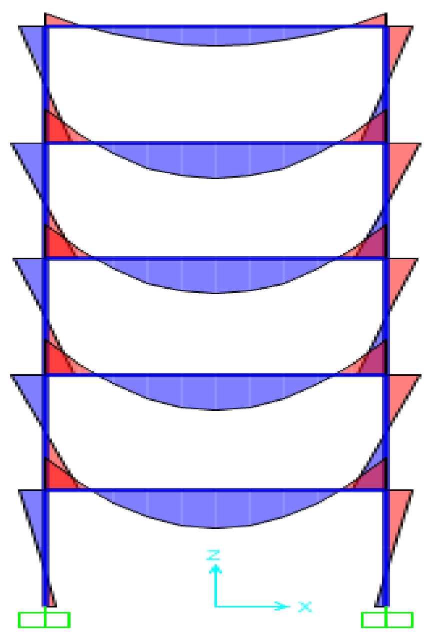

Figure 3.5 shows the bending moment diagram for wall load analysis between conventional and AAC blocks

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III. RESULTS

Comparative Study Of Density Between Autoclaved Aerated Concrete (Aac) Blocks And Conventional Concrete

The density, or more precisely, the volumetric mass density, of a substance is its mass per unit volume. The study of density of lightweight concrete leads important role in understanding the effect on strength, durability and resistance to permeability. For the determination of density of lightweight concrete, firstly weight the sample using weighing scale. After that we get the average weight of at least 3 samples. Finally find out the density using known formula-Table 3 represents the comparison of density between conventional and Autoclaved Aerated Concrete blocks.

DENSITY = MASS/VOLUME (Kg/m³)

Table 3 comparison of midpoint moments for wall load analysis between conventional and aac blocks.

Beam no	Midpoint moments for wall load analysis		
	Conventional concrete blocks (kN-m)	Autoclaved Aerated Blocks (kN-m)	Percentage variation
B1	24.32	12.19	50.12
B2	22.78	11.44	50.21
B3	22.98	11.54	50.21
B4	23.52	11.64	49.48
B5(parapet wall)	11.78	7.70	65.36

Comparative Study Of Compressive Strength Between Autoclaved Aerated Concrete (Aac) Blocks And Conventional Block

Compressive strength is the primary physical property of concrete (others are generally derived from it). Compressive strength is one of the most basic properties used for quality control for lightweight concrete. Compressive strength may be defined as the measured maximum resistance of a concrete specimen to axial loading. It is originate by computing the uppermost compression stress that a test cylinder or cube will support. There are three types of test that can be used to determine compressive strength; cube, cylinder, or prism test. The 'concrete cube test' is the most familiar test and is used as the standard method of measuring compressive strength for quality control purposes. The test

For determining the compressive strength is going to be done and is calculated by the formula-Table 4 that represents the comparison of compressive strength between conventional and AAC blocks.

COMPRESSIVE STRENGTH = LOAD/AREA (N/mm²)

Table 4 Comparison of support reactions for wall load analysis between conventional and AAC blocks

Support no	Joint reactions for wall load analysis		
	Conventional concrete blocks (kN)	Autoclaved aerated blocks (kN)	Percentage variation
Support 1	187.586	55.127	29.38%
Support 2	187.586	55.127	29.38%

Applications Of Light Weight Concrete

Light weight concrete can be used as follows.

1. As load bearing masonry walls using light weight concrete blocks.
2. Structurally aerated concrete is used mostly in the form of precast members or autoclaved blocks. It can also be used for floor construction in place of hallow tile floor.
3. As precast floor and roof panels in all types of building.
4. As partition walls in all types of building as residential, industrial, and institutional building.

IV. CONCLUSION

The initial findings have shown that the lightweight concrete has a desirable strength to be an alternative construction material for the industrialized building system. Lightweight concrete will be about 25 % lighter than conventional concretes. Aerated lightweight concrete is unlike conventional concrete in some mix materials and properties. Aerated lightweight concrete does not contain coarse aggregate, and it is possess many beneficial such as low density with higher strength compared with conventional concrete, reduced dead load in the could result several advantages in decrease structural elements and reduce the transferred load to the foundations and bearing capacity. Foamed concrete is different in agent of forming air-voids as compared with autoclaved aerated concrete. The air-voids in foamed concrete formed by foam agent, this operation is physical processing. Against the air-voids in autoclaved aerated concrete formed by addition aluminum powder to the other materials and reaction

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between them, and this operation is chemical processing. The air-voids is homogenous distribution within aerated lightweight concrete. Aerated lightweight concrete is considering economy in materials and consumption of by-product and wastes materials such as fly ash.

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