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"Design and Development the sustainable geopolymer mortar and Paver block by using Autoclave aerated concrete Waste"

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Abstract: Concrete is the basic building element for modern society. Every major construction project uses concrete in one form or another. It keeps us warm and safe; it allows us to get to work safely; it beautifies our homes and yards. Concrete is produced from some of the world's most abundant resources and without toxic byproducts. The concrete industry recycles and reclaims throughout the manufacturing process. It has a superior lifespan compared to other products. From the homeowner to the largest urban areas, concrete is playing a major role in protecting and maintaining our environment. Due to increasing use of concrete and also its high cost material it is important to decrease its cost and make it durable by adding some% of waste materials in it so that it will achieve its strength. The aim this research is make economic and environmental friendly paver block, and Reuse the waste of AAC waste. Autoclaved aerated concrete (AAC) is a lightweight cellular concrete that has been used more than 80 years. Currently however, no good recycling options for AAC from construction and demolition waste exist. The amount of AAC Waste which is recycled in the production of autoclaved aerated concrete (AAC).

Keywords: AAC Waste, compressive strength, hardener, Mortar, Super plasticizer.

I. Introduction

Autoclaved aerated concrete (AAC) is a lightweight, precast, foam concrete building material suitable for producing concrete masonry unit like blocks. Composed of quartz sand, gypsum, lime, cement, water and aluminum powder, AAC products are cured under heat and pressure in an autoclave. AAC simultaneously provides structure, insulation, and fire- and mould-resistance. Forms include blocks, wall panels, floor and roof panels, cladding panels and lintels.AAC products may be used for both interior and exterior construction, and may be painted or coated with a stucco or plaster compound to guard against the elements, or covered with siding materials. In addition to their quick and easy installation, ACC materials can be routed, sanded, or cut to size on site using standard power tools with carbon steel cutters.

Fig.1.AAC waste paver block

1.1. AAC Waste Blocks

Autoclaved Aerated Concrete is a Lightweight, Load-bearing; durable.AAC is relatively light in weight, having lower thermal conductivity, higher heat resistance, lower shrinkage, and faster in construction process when compared to the conventional concretes. AAC consist of silica sand, cement, lime, and water and expansion agent. To reduce the construction waste, an innovative AAC block has been developed by using recycled AAC in powder form to replace sands in the manufacturing process. The new developed AAC was conducted by replacing sand with recycled AAC in ratio of 0%, 15%, 20%, 25%, 30%, 45%, 40% and 45%.

1.2. Materials utilize

1.2.1. Cement

As per availability of cement in market we have use 43 grade OPC as per IS code. Material Admixture: Mineral admixture are used to replace the OPC with various percentage to find strength of concrete blocks. The AAC waste can be used in different following quantities.

Sr. No.	Size of AAC Waste	IS Code Recommended
1	75micron	IS 383
2	300 micron	IS 383

1.2.2. Admixture

Admixture which is used in construction of mortar block should be conforming to IS 9103 it is not affecting the property ofmortar block.

1.2.3. Water

The water used in production of paving block should be portable and having minimum PH value of 7 to 8 as per IS 456. The water cement ratio is 0.45.

II. Experimental Program

2.1. Size of Mould:

The square mould shall conform to IS 45658:2006, this mould is in the form of rubber the concrete directly put into it for final shape.

Fig.2. Mould Size 70mm X 70mm X 70mm

A base line is needed to establish an experimental design to conduct testing an observation for future development and research. All the baseline mortar material used in this study is shown in table.

Table No:-2. Specification of Material

Sr. No.	Baseline Element	Type
1.	Cement	53 grade OPC
2.	Sand	Fine particle
3.	Autoclaved Aerated Concrete	Fine particle

2.2. Weighing of Material

Weighing different types of material before it's used for mixing. Weighing is important for small type of mixing.

Fig.3. Weighing of Material

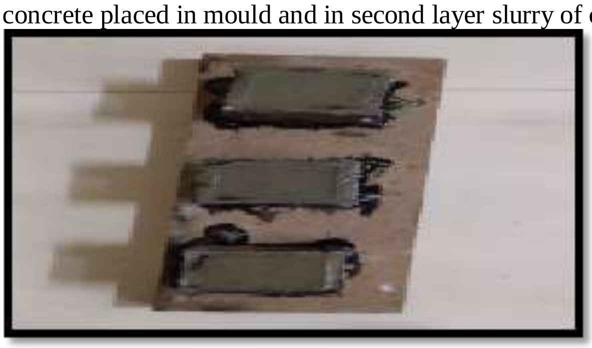
2.3. Mixing of material

Hand mixing procedures have to be carried out only for small concrete work. This means we must not mix large quantities at the same time. The whole mixing must be done neatly and uniformly without a hurry.

Fig.4. Mixing of materials

2.4. Placing of mortar in moulds

Mortar is placed in the moulds using a trowel in two layers, first layer is up to 10mm and second layer is 30mm. The first layer of concrete placed in mould and in second layer slurry of concrete is



placed.

Fig.5. Placing of concrete in mould

2.5. Vibration Machine

In the vibration machine we have placed the concrete mould in vibration table for settling the concrete and compacting also remove the air voids into mortar. The inclination angle of machine is 20 for sliding the block into another table.

2.6. Testing of Mortar Block

Compressive strength of mortar blocks was tested on CTM (Compression Testing Machine).
Compressive Strength is calculated by the formula:

$$CompressiveSrength\left(in\frac{N}{mm2}\right)=\frac{Total\,Load\,Applied}{Cross\,SectionalArea}$$

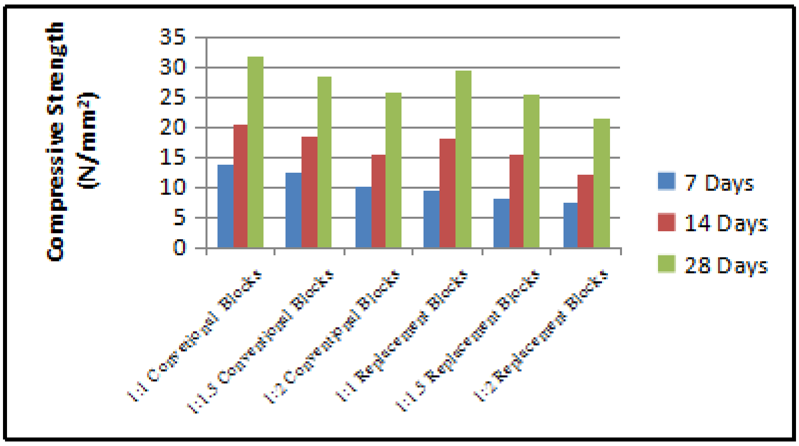
III. Summary

Size of mortar block we casted is 70mm x 70mm x 70mm. We have used various machines such as weighting machine, Vibration table, Compression testing machine, Universal testing machine.

IV. Results

Comparison of compressive strength

Conventional Block	7days N/mm^2	14days N/mm^2	28days N/mm^2
1:1	13.86	20.40	31.89
1:1.5	12.61	18.6	28.44
1:2	10.28	15.57	25.85
Replacement of Sand	7days N/mm^2	14days N/mm^2	28days N/mm^2
1:1	9.56	18.20	29.32
1:1.5	8.26	15.57	25.3
1:2	7.41	12.20	21.28



V. AAC Waste Paver Blocks

Autoclaved Aerated Concrete is a Lightweight, Load-bearing, durable. Building product which is produced on large scale is used for construction.

5.1. Materials utilize

5.1.1. Cement

As per availability of cement in market we have use 43grade OPC as per IS code. Material Admixture
Mineral admixture is used to replace the OPC with various percentages to find strength of concrete blocks. The fly ash can be use in different following quantities.

5.1.2. Aggregate

For casting of paver block we have use 6mm to10mm aggregate.

TableNo.1.SpecificationofMaterial

Sr.No	Size of Aggregate	IS Code Recommended
1	6mm	IS383
2	10mm	IS383

5.1.3. Admixture

Admixture which is used in construction of concrete block pavement should be conforming to IS-9103,it is not affecting the property of concrete block pavement.

5.1.4. Water

The water used in production of paving block should be portable and having minimum PH value of 7 to 8 as per IS-456.The water cement ratio is 0.45.

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VI. EXPERIMENTAL PROGRAM

6.1. Size of Mould

The rectangular mould shall conform to IS-45658:2006, this mould is in the form of rubber the concrete directly place in it for final shape.

Fig.7.MouldSize240mmX120mmX60mm

A base line is needed to establish an experimental design to conduct testing an observation for future development and research. All the base line concrete material used in this study is shown in table.

TableNo.2.SpecificationofMaterial

Sr .No.	Base Line Element	Type
1.	Cement	53grade OPC
2.	Sand	Fine particles
3.	Coarse Aggregates	10mm
5.	Autoclaved Aerated Concrete Waste	Fine particles

6.2. Weighing of Material

Weighing different types of material before it's used for mixing. Weighing is important for small type of mixing.

Fig.8.Weighing of Material

6.3. Mixing of Material

Hand mixing procedures have to be carried out only for small concrete work. This means we must not mix large quantities at the same time. The whole mixture mix properly.

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Fig.9.Mixing of materials

6.4. Placing of Concrete in Mould

Concrete is placed in the mould using a trowel in two layers, first layer is up to 10mm and second layer is 30mm. The first layer of mould is concrete slurry for proper combination of second layer in the mould.

Fig.10.Placingof concrete in mould

6.5. Vibration Machine

In the vibration machine we have placed the concrete mould in vibration table for settling the concrete and compacting also remove the air voids in to concrete. The inclination angle of machine is 20 for sliding the block in to another table.

Fig.11.Vibration Machine

6.6. Placing of Block

Block is placed in 7to8 layers for drying purpose on wooden plank of 25mm thickness.

Paver Blocks	7days N/mm^2	14days N/mm^2	28days N/mm^2
Conventional Block	14.9	20.86	25.86
25%AACWaste	17.91	23.84	30.48
50%AACWaste	12.17	15.43	22.41
100%AACWaste	8.69	11.86	17.24

Fig.12.Placing of Block

6.7. Testing of Paver Block

Compressive strength of paver blocks was tested on CTM (Compression Testing Machine).
Compressive Strength is calculated by the formula:

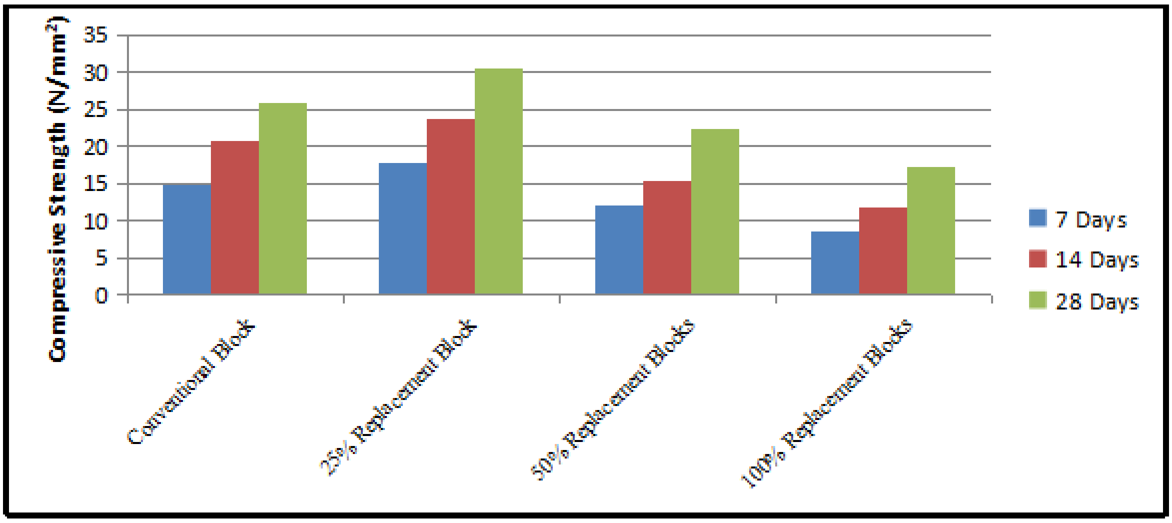
$$CompressiveSrength\left(in\frac{N}{mm2}\right) = \frac{Total\,Load\,Applied}{Cross\,Sectional\,Area}$$

VII. Summary

Size of paver block we casted is 250mmx116mmx75mm.We have used various machines such as weighting machine, Vibration table, Compression testing machine, Universal testing machine.

VIII. Results

TableNo.3.Comparison of compressive strength



IX.Conclusion

From experimental results we conclude that compressive strength of AAC Waste give good compressive strength then convention Mortar blocks. Therefore, AAC waste Mortar blocks can replace conventional mortar blocks.

X. Future Scope

AAC Waste is cheaply and readily available and it is economical in construction. Quality of construction is much better by using AAC Waste mortar Block rather than Conventional Mortar Block. AAC Mortar block is lightweight precast building materials that provide both construction economy and speed. It is an environment friendly product.

XI. Acknowledgment

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