iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** XII **Month of publication:** December 2022

DOI: https://doi.org/10.22214/ijraset.2022.48316

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue XII Dec 2022- Available at www.ijraset.com

Comparative Study About AAC Block with Porotherm Brick

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Abstract: ***Autoclaved Aerated Concrete (AAC) blocks are recently one of the newly adopted building materials. AAC is a product of fly ash which is mixed with lime, cement, and water and an aerating agent. The AAC is mainly produced as cuboid blocks and prefabricated panels. AAC is a type of concrete that is manufactured to contain lots of closed air voids. AAC blocks are energy efficient, durable, less dense, and lightweight. It is manufactured by adding a foaming additive to concrete in different sizes of molds as per requirement, then wire-cutting these blocks or panels from the resulting 'cake lump' and 'heating them with steam. This process is called as Autoclaving. Porotherm clay bricks are horizontally or vertically perforated clay bricks. they are manufactured in variety of sizes (common size is 400x200x200 mm) from natural clay, coal ash, rice husk, and granite slurry. The term Porotherm is used for this type of brick due to its desired thermal insulation characteristics. The perforation of the clay brick provides an exception walling system which facilitates thermal insulation resulting in cooler interiors in hot seasons and warm interior conditions in cold seasons. The Porotherm clay bricks are easy to use, economical, environmentally friendly, and it can be used for the construction of both non-load bearing walls and load bearing walls. The Porotherm bricks are low weight, durable, strong, and possess a satisfactory fire resistance. It can be used with dry mortar which eliminate the need for curing time. Various researchers throughout the world carried out numerous works to investigate and study the behaviour of AAC block and Porotherm brick. Those works were discussed in the review of literature. Different test were conducted in both blocks and its strength are noted. In this project, AAC block made of quartz sand (SiO_2 with impurities), calcined calcium sulfate (or plaster of paris), lime (CaO), cement, water and aluminum powder. In this regular practices, cement (26%), fly ash (25%), lime (38%), gypsum (2%), Aluminium powder (9%). In this project cement reduced to 20% , and fly ash increased to 30%. Various strength test can be performed and it can be compared with AAC block and Porotherm brick.***

I. INTRODUCTION

A. General

In this project, the works are made to comparative study about AAC block with Porotherm brick and yeast combined block are discussed. Based on the literature study, the methodology and future work process of the project will be discussed

B. Introduction

Construction industry which is rather growing at rapid phase due to the rapid advancing economy and rising standards of living and to meet the requirements of people. This rapid increase leads to increase in use of natural resources which are depleting alarmingly without the source to replenish it. Due to that reason we are forced to exploit other resources that are left behind during development of a society as waste. The concept of Reduce Recycle Reuse has now garnered tremendous attention by the people of present decade. So large technology arise to materials used in the construction purpose. AAC blocks are produced for its light weight and it indirectly reduce the usage of conventional materials. Porotherm is available in two main categories: Non-load Bearing (Infill/partition walls) and Load-bearing (G+1 construction without RCC). The non-load bearing hollow blocks include Porotherm HP (Horizontally Perforated), Porotherm HP G (Grinded) and Porotherm Thermo brick; whereas the load-bearing brick includes the brand Porotherm VP (Vertically Perforated). All blocks come in 3 sizes (4",6" and 8") along with half bricks. As a value add Wienerberger also provides END Bricks for wall endings & junctions, door & window jambs as well as 'T' & 'L' junctions.

II. LITERATURE REVIEW

A. Mohammad Arif Kamal , J. Build. Mater. Struct. (2020)

The traditional bricks are the main building materials that are used extensively in the construction and building industry. Autoclaved Aerated Concrete blocks are recently one of the newly adopted building materials.

The Autoclaved aerated concrete (AAC) is a product of fly ash which is mixed with lime, cement, and water and an aerating agent. The AAC is mainly produced as cuboid blocks and prefabricated panels. The Autoclaved aerated concrete is a type of concrete that is manufactured to contain lots of closed air voids. The AAC blocks are energy efficient, durable, less dense, and lightweight. It is manufactured by adding a foaming additive to concrete in different sizes of molds as per requirement, then wire-cutting these blocks or panels from the resulting 'cake lump' and 'heating them with steam. This process is called as Autoclaving. It has been observed that this material is an eco- friendly building material that is being manufactured from industrial waste and is composed of non-toxic ingredients. In this paper, an overview of AAC blocks with reference to its potential and sustainability as a novel building material has been presented. The paper also presents a comparative cost analysis of AAC Blocks with the Red clay bricks and its suitability and potential use in the construction in the building industry.

B. Sanjay Kumar Vaishnav , Rajesh Joshi.

The aim of this dissertation work is to study the utility of Autoclaved Aerated Concrete Blocks (AAC), which is a well known light weighted concrete blocks with many other advantages over traditional concrete blocks, like sound insulation, thermal insulation and many more. Brief of all the materials used in making of AAC blocks were discussed in the dissertation. Along with the material, processes involved in the making of AAC blocks were explained. For the study, AAC blocks were designed and then some preliminary estimation of physical and elastic properties was taken into account. The various parameters for AAC blocks, table moulded bricks (TMB), wire cut bricks (WCB), solid concrete blocks of size 100 mm, 150 mm and 200 (SCB -100, SCB-150 and SCB-200, respectively), hollow concrete block of size 150 mm (HCB-100) and stabilized mud block with 8% cement and size 143 mm (SMB-143) were compared to establish the feasibility of AAC blocks over all other variants available in market. Later, the studies were extended to obtain the strength and elastic properties of AAC masonry. Here, the focus was compressive strengthof prisms and wallettes, flexural strength and shear bond strength.

C. Khan Abdul Aasif , Shrivastava Sandeep 2

Fly ash brick and clay brick as masonry component. Burnt clay brick is a predominant construction material used in construction. As we also know that the brick manufacturing process involves CO2 emissions which leads to producing global warming. Hence to overcome these issues we have to focus on saving our environment. To fulfil this objective, new construction materials can be used for construction. Recently AAC blocks were used commonly for building construction and it is a far better alternative material for construction. Therefore this paper discusses the review of Building Construction by using Autoclaved Aerated Concrete Block (AAC), Fly ash brick and Clay brick as Masonry Component.

D. Shaikh Alim

Brick is the most commonly used building material in construction. AAC blocks are new construction material which is very light in weight. Compare to same size of (200mm x 100mm x 100mm,its 3 times lighter than traditional brick (clay brick);it means it covers more area in same weight as clay brick gives in one bricks. In this paper; attempt has been made to replace the clay brick with light weight AAC blocks. The usage of AAC block reduces the cost of construction up-to 25% as reduction of dead load of wall on beam makes it comparatively lighter members. The use of AAC block also reduces the requirement of materials such as cement and sand up-to 55%.

E. Bharat G. Bhudiya, Sanjay S. narola, Ashish H. makwana, Jayeshkumar Pitroda

Autoclaved Aerated Concrete (AAC) is a lightweight concrete building material cut into masonry blocks or formed larger planks and panels. Aerated concrete is relatively homogeneous when compared to normal concrete, as it does not contain coarse aggregate phase, yet shows vast variation in its properties. The properties of aerated concrete depend on its microstructure (void± paste system) and composition, which are influenced by the type of binder used, methods of pore-formation and curing. Although aerated concrete was initially envisaged as a good insulation material, there has been renewed interest in its structural characteristics in view of its lighter weight, savings in material and potential for large scale utilization of wastes like pulverized fuel ash. Many researchers have been done in the last few years however a deeper understanding is still needed to improve the quality of autoclaved aerated block in the construction industry by studying the current market behavior. The aim of this study is to get the latest information and to identify the key factors that affect on autoclaved aerated block. Data's are collected through questionnaires and distributed to respondents who work on various projects in wide areas in the charotar region of central Gujarat.

Respondents were required to rate and analyze using their experience and the factors were identified from past researches, which affects the project performance and then the level is measured based on their effect. The data collected are analyzed using Microsoft Excel or Statistical Package for the Social Sciences (SPSS Statistics 17.0) software which is analytical software.

F. Esraa Ahmed Sayed Khalil

Building materials selection is critical for the sustainability of any project. The choice of building materials has a huge impact on the built environment and the cost of projects. Building materials emit huge amount of carbon dioxide (CO2) due to the use of cement as a basic component in the manufacturing process and as a binder which harm our environment. Energy consumption from buildings has increased in the last few years; a huge amount of energy is being wasted from using unsustainable building and finishing material as well as from the process of heating and cooling of buildings. In addition, the construction sector in Egypt is taking a good portion of the economy; however, there is a lack of awareness of buildings environmental impacts on the built environment. Using advanced building envelops can help in reducing heat consumption, projects initial and long-term costs, and minimizing environmental impacts. Red Bricks is one of the materials that are being used widely in Egypt. There are many other types of bricks such as Autoclaved Aerated Concrete (AAC); however, the use of Red Bricks is dominating the construction industry due to its affordability and availability. This research focuses on the New Egyptian Administrative Capital as a case study to investigate the potential of the influence of using different wall systems such as AAC on projects cost and the environment. The aim of this research is to conduct a comparative analysis between the traditional and most commonly used bricks in Egypt which is Red bricks and AAC wall systems. Through an economic and environmental study, the difference between the two wall systems will be justified to encourage the utilization of uncommon techniques in the construction industry to build more affordable, energy efficient and sustainable buildings. The significance of this research is to show the potentials of using AAC in the construction industry and its positive influences. It analyzes the factors associated with choosing the suitable building without harming the environment and wasting materials that could be saved or recycled.

G. Amit Raj

Autoclaved Aerated Concrete (AAC) blocks are used for both load bearing and non-load bearing masonry walls. The tensile and shear strengths of such walls are greatly affected by the bond strength of block-mortar interface. This article investigates the bond strength of AAC block-mortar interface made of ordinary sand-cement mortar of different compositions and polymer modified mortars. A method of improving the bond strength (both tensile and shear) of ordinary sand-cement mortar without altering the block surface characteristics is proposed. In this method, the block surfaces are coated with a thin cement-slurry coating before applying a thick sand-cement mortar. For all types of interfaces, the shear bond strength of the masonry was studied using a triplet test, while the tensile bond strength was determined based on a cross-couplet test. The failure patterns during the bond strength tests were studied. Subsequently, costs were estimated for AAC walls of different types of interfaces. Considering the bond strength as well as cost, using a weak mortar along with cement-slurry coating was found superior to the ordinary sand-cement mortar and polymer modified mortar.

H. Vijay Kanth

Brick are widely used construction and building material around the world. In this study, bricks are prepared from natural waste material which comprises of granite powder and rice husk ash. The main objective of this study is to reduce the quantity of clay with natural waste material. On the other side, proper and efficient disposal of natural waste is being the key factor in solid waste management in most of the Indian states.so, we are efficient replacing the significant quantity of granite powder and rice husk ash in making lightweight bricks in appropriate proportions which gave compressive strength as similar as conventional brick. The average water absorption ratio and compressive strength obtain in this study are 15% and 3Mpa respectively.

I. R. Soundarya devi1,V. Mohana priya, C. Saranya, M. Selvalakshmi

Bricks are widely used construction and building material around the world. In this study, bricks are prepared from natural waste material which comprises of granite powder and rice husk ash. The main objective of this study is to reduce the quantity of clay with natural waste material. On the other side, proper and efficient disposal of natural waste is being the key factor in solid waste management in most of the Indian states. So, we are efficiently replacing the significant quantity of granite powder (2%, 4% & 6%) and rice husk ash (1%) in making lightweight brick in appropriate proportions which gave compressive strength as similar as conventional brick.

The average water absorption ratio and compressive strength obtain in this study are 13.7% and 8.5 N/mm2 respectively.

J. Sreevidya Venkataraman

Concrete is the one of the construction material produced worldwide. Here is the method to make the effective use of the material. In a simply supported RCC slab, the upper part of the slab is subjected to compressive forces while the lower portion is subjected to tensile forces. Concrete is very good in compression while it is weak in tension. Hence the steel reinforcement is placed in the tension zone. The concrete in this portion is only for holding together the steel reinforcement and has no structural purpose. By choosing the filler material judiciously, we could save about 30-35% of concrete compared to a traditional RCC slab. A light weight filler material also reduces the dead load hence less steel reinforcement is required. In all we may expect to save about 25% of the cost .And for strength and stability conditions is tested for the slabs with normal reinforcement and steel fiber strips. Finally the stability analysis of the slab element is done and the comparative results will be given.

III. TESTS FOR MATERIALS

AAC BLOCK

A. Cement

The suitable Cement for the manufacture of AAC blocks is OPC grade 53 that sets and hardens and can bind other materials together.

Fineness Test

1) This test is carried out to check the proper grinding of cement.
2) The fineness of cement particles may be determined either by the sieve test or permeability apparatus test.
3) In the sieve test, the cement weighing 100 gm is taken and it is continuously passed for 15 minutes through standard BIS sieve no. 9.
4) The residue is then weighed and this weight should not be more than 10% of the original weight.
5) In the permeability apparatus test, a specific area of cement particles is calculated. This test is better than the sieve test. The specific surface acts as a measure of the frequency of particles of average size.

B. Fly Ash

Fly ash is a waste industrial product used for the reduction of construction cost. The density of fly ash ranges from 400-1800 kg/m^3. It provides thermal insulation, fire resistance, and sound absorption. The type of fly ash used is Class C which contains 20% lime (CaO) and loss of ignition not be more than 6%.

Chemical Composition	*Fly Ash* (%)	Lime (%)
C	23.29	0
CaO	3.10	91.99
SiO_2	36.10	3.75
Al_2O_3	25.03	2.09
FeO	8.66	0.50
MgO	1.24	1.19
Na_2O	0	0.43
SO_3	0.59	0.05
TiO_2	0.91	0
K_2O	1.08	0
TOTAL	100.00	100.00

Compressive strength Test

1) For a general overview of the ash characteristics as a building material and design of the stability and capacity, the parameters, obtained by determining the uniaxial compressive strength and the free lateral spreading, are used.
2) For this experiment the cylindrical shape sample is used and prepared by the procedure of Proctor homogenized samples, with diameter of (D) 100 mm and hight of (h) 200 mm, which satisfied the standard height to diameter ratio of 2:1.
3) The samples were specially prepared in a three-part mold and compacted by Proctor procedure in five layers. All prepared samples were stored for a while before the failure.

4) The test was performed samples cured in a wet chamber for 7 days.
5) After 7 days in a wet environment the samples were taken, and tested on uniaxial compressive strength, and were in a strength 0.5 to 1.33 N/mm^2

C. Limestone

Limestone is obtained either by crushing to fine powder at the AAC factory or by directly purchasing it in powder form from a merchant.

Physical test

The physical properties of lime can be estimated by its color, smell, texture, etc. White color indicates pure limestone. The bluish-grey, brown, dark color indicates hydraulic limestone. Hydraulic limestone tastes like clay and produces an earthy smell. If limestone is glittering or shining, then it indicates the presence of free salts in it. Similarly, the presence of bulges or bumps indicates it as quick lime.

D. Aluminum Powder

Aluminum is an expansion agent. When the raw material reacts with aluminum powder, the air bubble introduced due to the reaction between calcium hydroxide, aluminum and water, and hydrogen gas is released.

IV. POROTHERM BRICK

A. Clay

Clay is a type of fine-grained natural soil material containing clay minerals (hydrous aluminium phyllosilicates, e.g. kaolin, $Al_2Si_2O_5(OH)_4$). Clays develop plasticity when wet, due to a molecular film of water surrounding the clay particles, but become hard, brittle and non–plastic upon drying or firing. Most pure clay minerals are white or light-coloured, but natural clays show a variety of colours from impurities, such as a reddish or brownish colour from small amounts of iron oxide.

B. Coal ash

Coal ash, a catchall term for several kinds of waste left over at power plants that burn coal, typically contains a number of substances harmful to human health—arsenic, chromium, lead, and mercury among them.

C. Rice husk

Rice hulls (or rice husks) are the hard protecting coverings of grains of rice. In addition to protecting rice during the growing season, rice hulls can be put to use as building material, fertilizer, insulation material, or fuel. Rice hulls are part of the chaff of the rice.

V. CONCLUSION

1) The fineness of cement particles may be determined either by the sieve test or permeability apparatus test is 6.95%.
2) After 7 days , uniaxial compressive strength of Fly ash be 0.5 to 1.33 N/mm^2.
3) Compressive strength of AAC block is 4.34 N/mm^2 and Porotherm brick is 3.4 N/mm^2.
4) Like wise Diagonal tests, Sliding test, Bulk density test, Durability test can be performed for AAC block, Porotherm brick and newly laid block can be done later.

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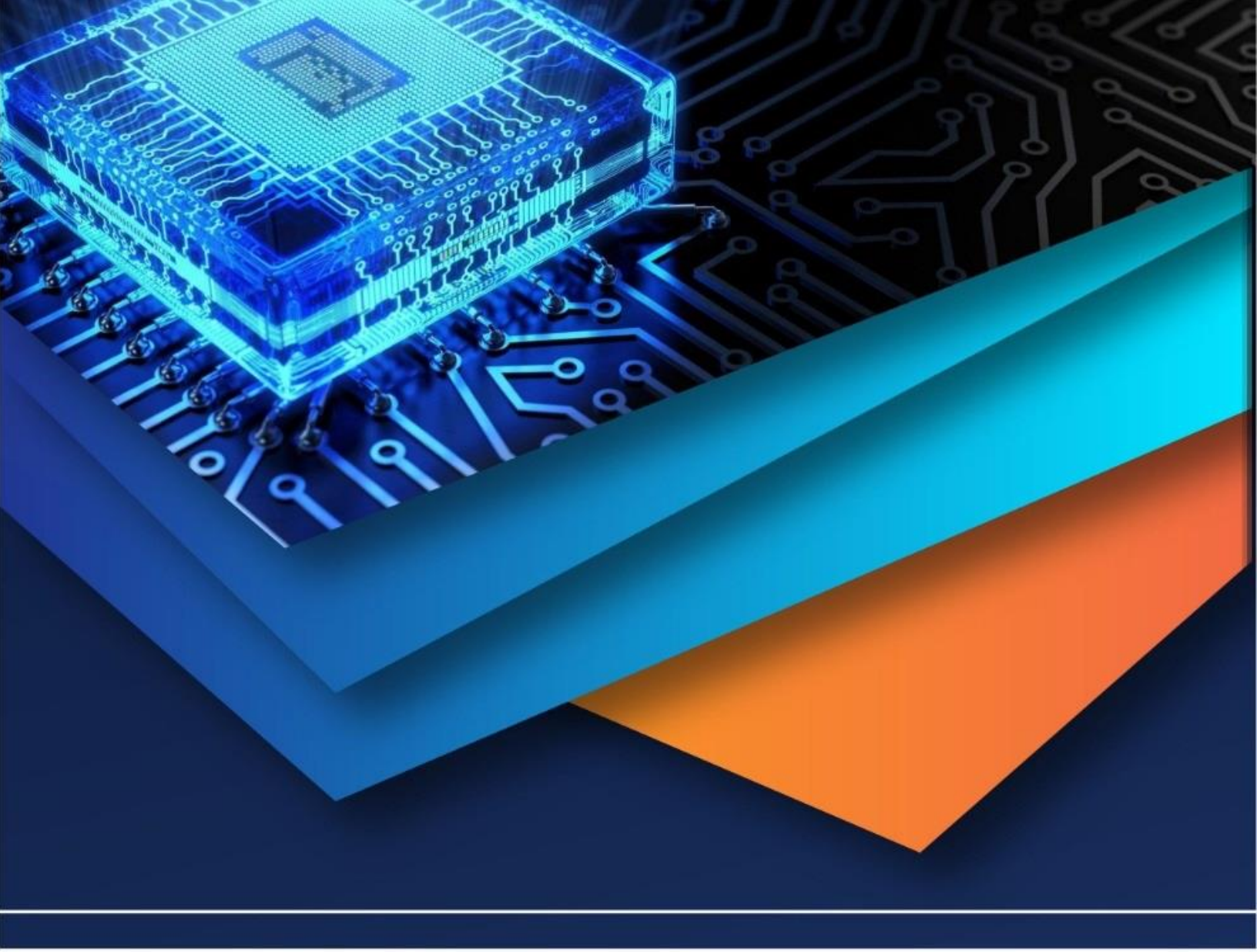

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