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A Review on Use of FRP Mesh and Bamboo Fiber Composite Material for AAC Block Masonry Wall Strengthening and Water Resistance

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Abstract: For the purpose of strengthening masonry walls, externally bonded composite materials offer a desirable solution. Current studies in this area demonstrate that the use of fiber-reinforced polymers (FRPs), which are externally bonded composite materials, improves the strength, stiffness, and ductility of the wall under loads while maintaining the wall's integrity at failure.
Keywords: FRP, Flexural, Shear, AAC , Bamboo Fiber

I. INTRODUCTION

Nowa days construction industry mostly using Autoclaved Aerated Concrete block (AAC blocks) for masonry work. Though they have many advantages like it is a green material, light in weight , it has better fire resistance etc, but for making this material lightweight the air is entrained in the mortar while manufacturing, due to which interconnected air voids are present in AAC blocks to meet specific requirements of density and strength.

AAC block masonry displays brittle failure in tension, to increase its flexural strength and making it more ductile as a masonry, an alternative solution is to be proposed.

Many attempts have been made to increase the flexural strength and ductility of masonry walls by many different methods, such as adding reinforcement while constructing the masonry, earlier mud plaster mixed with grass was widely used in almost all parts of the Indian continental.

In modern construction with AAC blocks there are many cases have been observed that, the masonry wall show major cracks in flexure as well as in shear, they are more susceptible to failure in impact or cyclic load. To minimize this problem, mere plastering the wall is not sufficient, but some more practicable solution has to be proposed, which will increase its strength and also reduce the problem of its moisture absorption.

A. *Problem Identification*

1) AAC blocks has high interconnected void ratio it leads low strength to the masonry wall.
2) AAC block shows brittle nature.
3) It has high water absorption capacity .
4) It shows sudden failure in impact loading.

B. *Objective of Study*

1) Improve the strength of AAC masonry wall
2) Improve the water resistance capacity of ACC masonry wall
3) Use the composite material as crack filler and use for the strengthening of AAC masonry wall

II. LITERATURE REVIEW

This research assesses In the past, under-depth studies had been conducted on strengthening masonry walls in flexure and shear. This essay will review a collection of research findings on reinforced masonry walls that have been loaded both in-plane and out-of-plane. Different masonry units (such bricks and concrete blocks) can be utilized to create structural or non-structural walls (infill). A variety of composite materials, including steel reinforced polymers (SRP) and fiber reinforced polymers (FRP) made of carbon, glass, and aramid fibers, were used to strengthen masonry walls.[1]

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In this study, there were two different types of AAC blocks used to build the masonry wall. One was equipped with internal bar for reinforcement, whereas the other was not. Both casings have vertical perforations and grooves. The mechanical characteristics of the masonry wall and the behavior of the Wallette's were determined by compression Wallette tests and shear Wallette tests. The shear reinforcement effect of the internal reinforcement in the blocks under the shear force and confinement under the compressive force prevented the sharp post-peak drop and increased displacement capacity. Through experimental testing, the in-plane behavior of bearing walls constructed with AAC blocks was evaluated.[2]

The study began with an assessment of the structural characteristics of the AAC blocks, both individually and collectively, before conducting extensive testing on two (half-scaled) walls made of AAC blocks that are readily accessible in the marketplace. The reinforcing plan was carried out in a way that didn't add extra time to the construction schedule. The strength of the wall in the in-plane direction was greatly increased by the reinforcement. Along with a shift in the failure mode, the reinforced wall showed enhanced initial stiffness, higher ductility, and greater energy dissipation. Blocks sliding was the primary cause of reinforced wall failure, whereas compressive shear failure with wall elevating was the primary cause of unreinforced wall failure.[3]

The experimental and analytical findings highlight the special features of masonry wall lateral strengthening with composite materials. The early shear failure in lateral reinforced hollow concrete block walls is revealed and explained, while on the other hand, they show the possibility of lateral fiber-reinforced polymer strengthening of AAC masonry walls. The AAC masonry walls that have been laterally strengthened exhibit increased strength, deformability, and integrity at failure traits.[4]

This research assesses Despite the widespread use of surface composite reinforcement for masonry structures, the normative literature lacks sufficient information on how to calculate such reinforced structures. On the basis of experimental examinations of walls made of cellular concrete blocks, the article suggests a numerical model for assessing the impact of composite reinforcement on the bearing capacity of a compressed-bent masonry wall.[5]

We examine the FRP Composite material in this paper. The most discerning and promising material now on the market has been discovered to be composites. The market is seeing an increase in demand for lightweight materials with high strength for particular applications, which has led to composites reinforced with fibers of synthetic or natural materials gaining relevance. Not only does fiber-reinforced polymer composite have a high strength to weight ratio, but it also has remarkable durability, stiffness, damping property, flexural strength, and resistance to corrosion, wear, impact, and fire.[6]

In engineering, fibers can be utilized in a variety of ways, the most popular of which is as reinforcement. Bamboo fiber has gained popularity over other natural fibers due to its renewable short natural growth cycle and quantity of bamboo resources. Bamboo fiber is used in the textile, papermaking, construction, and composites industries because of its remarkable mechanical qualities despite its complex natural structure. However, bamboo fibers' limited use in engineering applications is due to their propensity for corrosion and ease of moisture absorption. Therefore, it is crucial to have a better grasp of bamboo fiber. The extraction and treatment methods used for bamboo fiber, as well as their impact on pertinent properties, are highlighted in this paper's assessment of all prior research on the mechanical characterization of bamboo fiber.[7]

The primary building materials that are widely employed in the building and construction sector are conventional bricks. Blocks of autoclaved aerated concrete are a recently used building material. Fly ash, lime, cement, water, and an aerating agent are combined to create the autoclaved aerated concrete (AAC). Prefabricated panels and cuboid blocks are the main production methods for AAC. A type of concrete called autoclaved aerated concrete is produced with a lot of closed air gaps. The AAC blocks are lightweight, less dense, and energy-efficient. It is made by mixing a foamy additive with concrete in molds of various sizes, depending on what is needed. Then, from the resulting "cake lump," these blocks or panels are wire-cut and heated with steam. The name of this procedure is autoclaving. It has been noted that this substance is a non-toxic, environmentally friendly building material that is created from industrial waste. In this study, an overview of AAC blocks has been provided with reference to their potential and sustainability as a cutting-edge building material. The report also compares the costs of AAC Blocks and Red Clay Bricks, as well as their appropriateness and possible applications in the construction sector.[8]

Despite the widespread use of surface composite reinforcement for masonry structures, the normative literature lacks sufficient information on how to calculate such reinforced structures. The paper suggests a numerical model based on experimental research on walls made of cellular concrete blocks for calculating the impact of composite reinforcement on a compressed-bent masonry wall's bearing capacity. The numerical model accounts for the masonry's plastic behavior under compression and the potential for fracture development. The relationship between the compressive force and the bending moment is used to derive theoretical curves for the bearing capacity of reinforced and nonreinforced brickwork. With bending occurring at a compressive load value equal to half the failure load under pure compression, it is demonstrated that the acceptable reinforcement has the largest impact across the range of loads from pure bending to compression.

Such a numerical design model can be used to assess the impact of reinforcing walls and vaults that have been eccentrically or obliquely loaded, as well as other structures of a similar nature.[9]

Because of their ongoing degeneration or the demand that they adhere to the most recent design standards set forth by Eurocodes, the need for retrofitting old masonry structures is becoming increasingly crucial. Textile-Reinforced Mortar (TRM) composite materials have become a viable repair technique for retrofitting structures. However, very little research has been done on their mechanical performance. The tensile and bond behaviors of a new mortar-based composite made of mineral additives, blended cement mortar, and stainless-steel grid are the subject of an experimental research in this paper. In binary and ternary systems, three different mineral additives—silica fume, fly ash, and blast furnace slag—were employed. The experimental study comprised bond tests on composite material used on a clay-brick base as well as uniaxial tensile coupon testing on composite specimens.[10]

III. CONCLUSIONS

This review paper highlights the insufficient study on AAC block masonry. It needs to be investigated. The study conducted over the past 20 years is revealed in this paper. It is clear from this context that many things are missing, such as the use of fiber on AAC block masonry, which has not yet been researched.

There have been no studies done to examine the flexural and shear behavior of masonry walls in relation to fire, moisture, water absorption.

There is no design code especially for FRP, To the best of the authors' knowledge, there aren't many design recommendations for strengthening masonry structures using FRPs. A code must be created to guide all engineers utilizing FRP after research in this area on FRP and its use as interior reinforcement for new construction and as external reinforcement for strengthening and of structures.

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