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Experimental Study on SIMBRI Fly Ash Brick Masonry Walls

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***Abstract:** This paper presents a brief experimental investigation into the seismic performance of fly ash brick masonry walls as a sustainable alternative to traditional clay brick masonry. Two full-scale wall specimens were tested under quasi-static lateral loading: an Unreinforced Fly Ash Brick Masonry (URFABM) wall and a Confined Fly Ash Brick Masonry (CFABM) wall. The confined wall demonstrated increase in lateral load capacity which is higher in initial stiffness, and also greater ductility compared to its unreinforced counterpart. Results show that confinement significantly improves seismic performance, delaying cracking and enhancing structural integrity. The study supports the use of confined fly ash brick masonry in low-rise buildings within moderate seismic zones.*
***Keywords:** Fly ash brick masonry, Quasi-static testing, Seismic performance, Confinement, Sustainable Materials.*

I. INTRODUCTION

Masonry has been one of the most ancient and widely used construction materials due to its simplicity and strength. Traditional clay brick production, however, involves the removal of topsoil and contributes to environmental degradation. Fly ash, a by-product of coal combustion, offers a sustainable substitute for clay in brick manufacturing [1]. This study focuses on assessing the seismic behavior of fly ash brick masonry walls and the benefits of confinement in improving their lateral performance [2].

II. LITERATURE REVIEW

This study presents an overview of brick masonry home development, which accounts for 62.38 percent of Pakistan's overall built environment. Brick masonry architecture spans from conventional one-story dwellings seen in rural regions to three-story structures (common in urban areas). Buildings of this sort are typically built without any formal technical involvement. This building type fared exceedingly poorly during recent earthquakes in Pakistan due to inherent deficiencies in the structural load bearing system as well as the use of poor grade construction materials. Because of a lack of clear construction norms and appropriate building permit legislation to govern such construction approaches, a large percentage of old and newer building stock is now under greater seismic hazard [3]. Masonry is one of the oldest materials used in the structures, but its mechanical properties has not yet been fully investigated. Recently, there has been some systematic guidelines and practices has been initiated for the evaluation of the properties of the masonry materials. Commonly masonry materials available are Red clay Bricks, Fly Ash Bricks. Because of having higher density for Clay Bricks of about 19000 Kg/m3, Fly Ash bricks has recently gained the market as it has a lower density of about 600 kg/m3. Present study deals with the testing of the constitutive materials as well as casting and testing of 5,6 and 7-Layered Red Clay Brick and Fly Ash Bricks PRISMS. The dimensions of the PRISM specimens are selected in such a way that the height to thickness ratio is in the range as specified in IS 1905-1987. The PRISM are tested under uniaxial compression loading in the UTM machine having capacity of 1000 kN. The mechanical properties like basic compressive strength and Modulus of Elasticity for both the type of materials has been obtained experimentally as per IS 1905-1987. Then these parameters are compared within themselves [4].

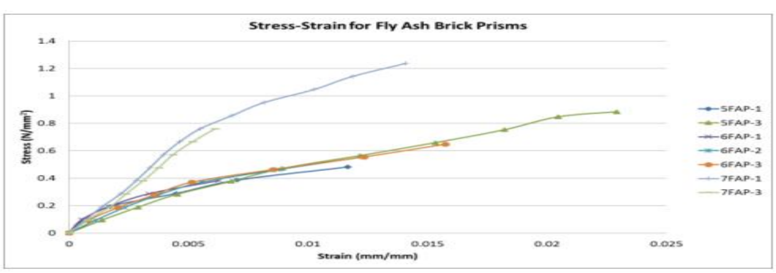

Figure 1Stress Strain curve for Fly Ash Brick PRISMS

III.METHODOLOGY

Two wall specimens—one confined (CFABM) and one unreinforced (URFABM)—were constructed using fly ash bricks composed of 60% fly ash, 33% sand, and 6% cement. Both specimens were tested under Quasi-Static Testing (QST) in a steel reaction frame at structure laboratory, following FEMA-461 protocols. Cyclic lateral displacements were applied incrementally to evaluate its strength strength under simulated seismic loads.

IV.DISCUSSION

The CFABM wall exhibited exceptional lateral strength, attaining a peak load of 108 kN, which is almost three times higher than that of the URFABM wall (38 kN). This substantial improvement clearly reflects the remarkable contribution of confining elements in enhancing the load-bearing and deformation capacity of fly ash brick masonry. The confinement not only delayed the onset of initial cracking but also maintained superior stiffness and integrity even under large cyclic displacements, demonstrating the potential of confined fly ash brick masonry as a robust and sustainable alternative to conventional unreinforced systems in seismic regions.

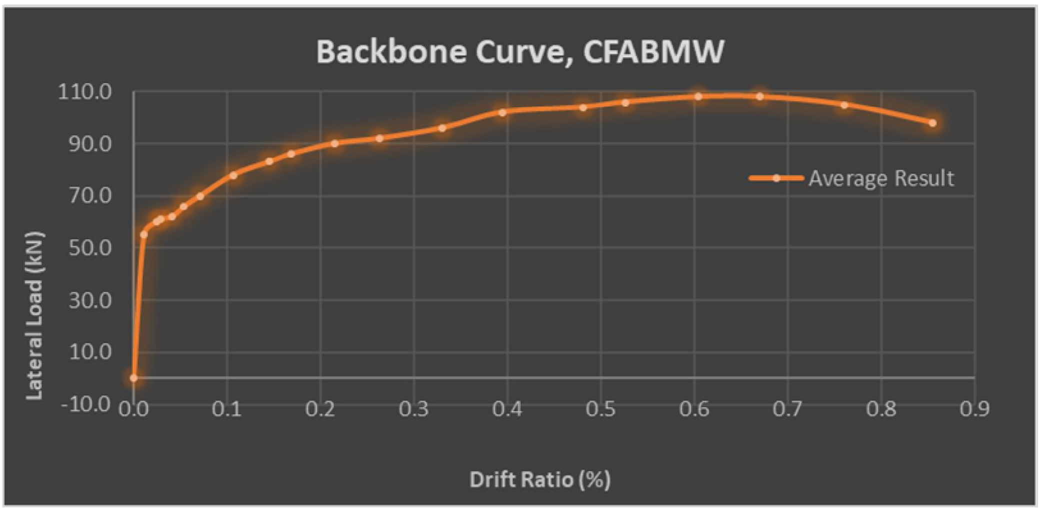

Figure 2 Backbone Curve CMW

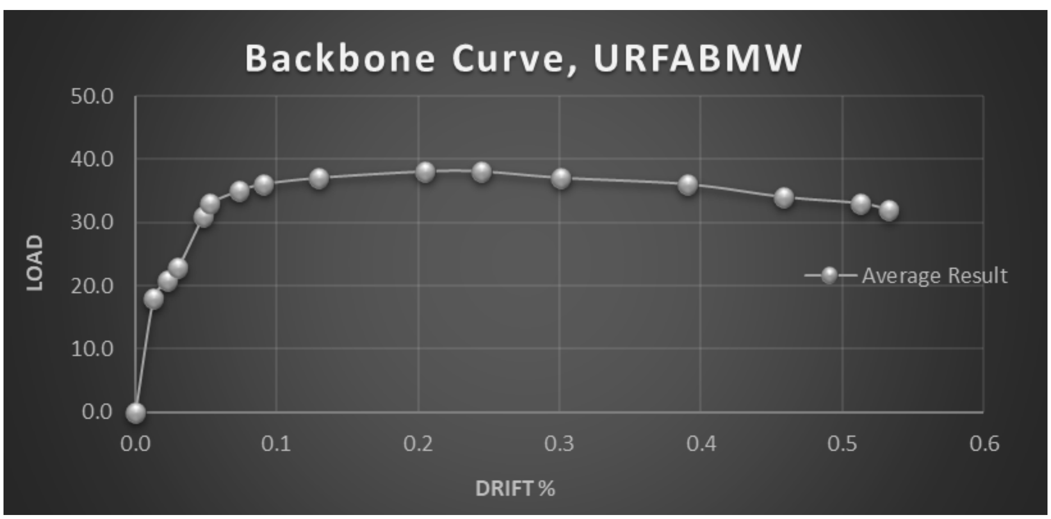

Figure 3 Backbone Curve UNCW

VI. CONCLUSION

The study concludes that confined fly ash brick masonry exhibits superior seismic performance over unreinforced masonry. Its higher strength, stiffness, and ductility make it a viable and eco-friendly choice for low- to mid-rise construction in moderate seismic regions.

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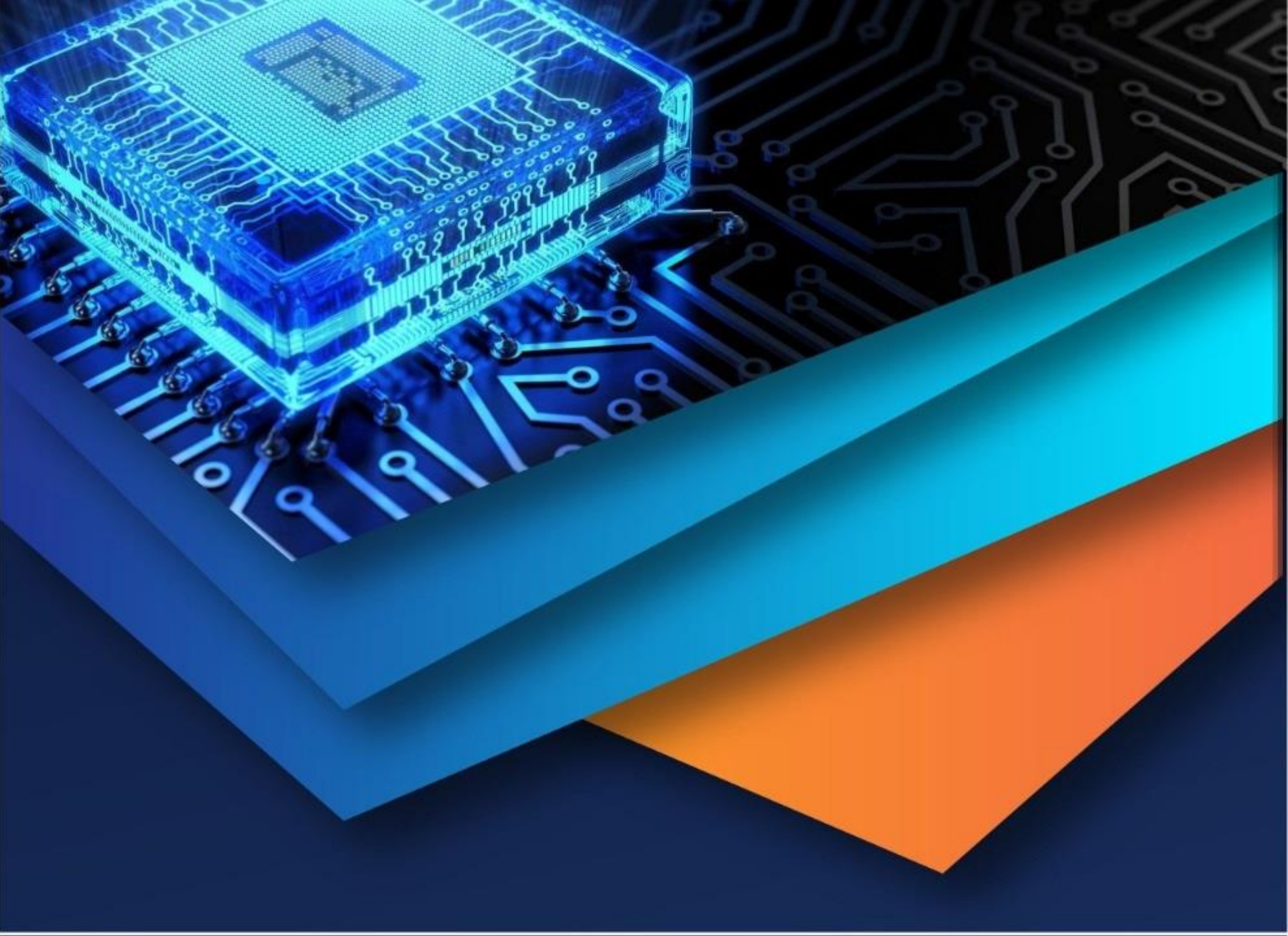

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