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COMPARATIVE STUDY OF THE COMPRESSIVE STRENGTH OF UNREINFORCED BRICK MASONRY ON REPLACEMENT OF SAND BY STONE DUST IN MORTAR

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Abstract: *This research paper aims to evaluate and Compare Compressive strength of Unreinforced Brick Masonry constructed in Cement Sand mortar and Cement Stone dust mortar. To Evaluate the Compressive Strength Six Brick Masonry prisms were prepared, three each in Cement Sand Mortar and Cement Stone Dust mortar, and tested according to ASTM E 447. In order to follow the best local practice, water cement ratio 1.2 and cement to fine aggregate ration 1:5 were used. After testing it is concluded that compressive strength of Brick Masonry prisms fabricated in Cement Stone dust mortar increased 35% as compare to Cement Sand Mortar.*

Key words: *Stone dust as fine aggregate, Unreinforced Brick Masonry, Compressive Strength*

1. INTRODUCTION: Unreinforced brick masonry is one of the oldest Construction materials throughout the world. According to the report of World Housing Encyclopedia (WHE-2013), about 62.38% of the total buildings of Pakistan are unreinforced masonry buildings [1].

Pakistan is located in a more earthquake prone area of the world and been subjected to earthquake of varying magnitudes from time to time. On October 2005, an earthquake of magnitude 7.5 hit the northern areas of Pakistan causing loss of 73,000 lives and 80,000 remained homeless with a total estimated loss of US$ 5,198 [2]. In the wake of this earthquake this region has been declared active in seismic activity. The mass destruction take place in the northern areas, particularly in Batagram, Balakot, Mansehra, Abbottabad, Swat, Dir, Kohistan, Chitral etc raised certain questions regarding the Construction materials and techniques which are prevalent in Pakistan with particular reference to resistance against seismic forces. On October 26, 2015 Afghanistan–Pakistan Earthquake of magnitude 7.5 once again hit northern areas of Pakistan and Afghanistan. Most of the buildings were cracked and settled [3]. Since the people of the Northern areas start thinking to adopt all constructions techniques especially in buildings.

The use of Stone dust is a common practice in Northern areas of Pakistan due to the shortage of natural river sand. The current research study is more about to investigate the impact of local practice of Stone dust and its comparison against Normal Sand in mortar on Brick Masonry Works.

2. METHODOLOGY

i. Materials Used

Three different types of materials were used. Stone dust having Fines Modulus FM 3.1 was collected from Khyber agency. Sand having Fines Modulus 2.7 were collected from Nizampur. Local Manufactured Bricks giving average Compressive Strength 4500 Psi were used as shown in Figure 2.1(a). Cement Manufactured by Kohat Cement industry, confirming to ASTM C 150, were used for mortar preparation.

ii. Preparation of Samples

A total of six Brick Masonry Prisms were prepared, three each in Stone dust Mortar and three in Cement Sand mortar. It is common practice in Pakistan to use Cement: Aggregate ratio as 1:4, 1:5, and 1:6 by weight in the brick masonry works. To make the work easier and simple cement aggregate ration 1:5 were used. Similarly water cement ratio 1.0 was used for both

type of mortar mix. Mortar specimens were prepared and tested, according to ATM C 109 [4], on 28th days of moist curing as shown in Figure 2.1 (b). Masonry prisms were prepared and tested according to ASTM E 447 [5].

(a) (b)

Figure 1: Testing of (a) Bricks and (b) Mortar Specimens in UTM

iii. Experimental Work

Masonry Prisms prepared both in Cement Stone dust mortar and in Cement Sand mortar were tested for compressive Strength according to ASTM E 447 [5] as shown in Figure 2.2 (a) and (b). Stress-Strain Data were recorded through digital Data Logger via load cell and Strain gauges fixed on both side of Prisms as shown in figure 2.2. The compressive were calculated using Equation 2.1.

$$\text{Compressive Strength} = \left(\frac{\text{Peak Vertical Load}}{\text{X-Sectional Area}}\right) \text{------- (2.1)}$$

(a) (b)

Figure 2.2: Testing of Brick Masonry Prisms in UTM. (a) Showing Prism before testing (b) showing prism after testing

3. TESTS RESULTS

Average Bricks compressive strength were recorded as 4500Psi where as 28th day Average mortar compressive Strength were recorded as 1422 psi for cement sand mortar and 3699 psi for Cement Stone dust mortar. Table 1.1 Shows average Compressive Strength f_m of Stone Dust based prism (458Psi) increased 35% as Compared to Normal Sand based Prism (367 psi). Stress-Strain Data recorded via data Logger, plotted in Figure 2.3, showing higher brittle behavior for Stone Dust based Prism than Sand based prism.

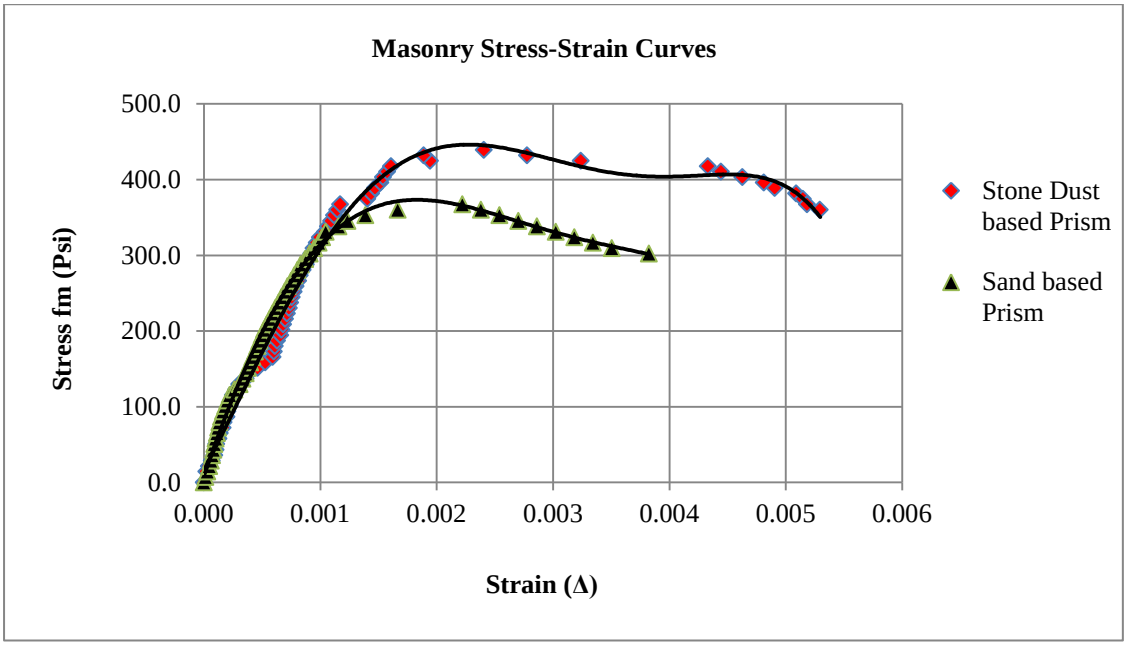

Figure 2.3: Stress-Strain Data for Compressive Strength

Table 1.1: Masonry Compressive Strength Tests of Brick Masonry Prisms

Size of Prisms		Length (in)		9.00	
		Width (in)		9.00	
		Height (in)		22.50	
		Area (in^2)		81.00	
Prisms type		**Ultimate Load applied (tons)**	**Compressive Strength (Psi)**	**Mean (Psi)**	**%CV**
Sand based Prisms	CS-1	14.5	417.4	365.5	14.4
	CS-2	12.8	367.0		
	CS-3	8.3	312.0		
Stone Dust based Prisms	CK-1	15.3	439.0	458.2	5.9
	CK-2	15.5	446.2		
	CK-3	17.0	489.4		

4. CONCLUSIONS

This paper presents Comparative Study and Analysis of Unreinforced Brick Masonry (URM) in the form of Compressive Strength fabricated in Cement Stone dust mortar and Cement Sand mortar. It has been concluded that Compressive Strength f_m of Stone Dust based prism increased 35% as Compared to Normal Sand based Prism.

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