STUDIES ON REINFORCED HOLLOW CONCRETE BLOCK MASONRY

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Abstract

Masonry may be defined as the assemblage of building units joined with the help of cementitious material or any accepted joining material to perform required function. It has its own reputation and performs multi-functions in load bearing structures such as- supporting loads, dividing spaces, thermal and acoustic insulation, weather and fire protection etc, but it has to be provided separately in framed structures. In present scenario, there is a great demand for construction of Multi-storied residential buildings in urban area because of needful requirements. Most of such buildings are constructed using RC-framed structure. On the other hand RC-framed structures are expensive and relatively difficult to construct because of the need for formwork. Masonry has a great benefit since it does not need form work. If moderate to High strength Engineered hollow concrete blocks are available, one can think of providing reinforcement through the core of such Hollow blocks. In this project an attempt has been made to obtain the load carrying capacity of Reinforced Hollow Concrete Block Masonry through experimental investigation by considering two different percentages of steels - for this totally four number of Reinforced hollow concrete block masonry prisms (RHCBM) using 12 mm diameter bar and six number of Reinforced hollow concrete block masonry prisms (RHCBM) using 8 mm diameter bar were casted and tested. Further, an attempt has been made to compare the experimental load carrying capacity with the conventional mechanics based approach used for analyzing short columns. There was a fairly good co-relation between the analysis and experiments.

Key Words: *Unreinforced Masonry, Reinforced Hollow Concrete Block Masonry.*

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1. INTRODUCTION

Masonry may be defined as the assemblage of building units joined with the help of cementitious material or any accepted joining material to perform required function. Based on structural perspective masonry can be classified into two types- Plain masonry and Reinforced masonry.

Plain masonry is one where the building units are bonded (or joined) with the help of cementitious material or any accepted joining material without any reinforcements. And, this type of masonry gives little tensile strength- hence it cannot be used in horizontal spanning members like beams, slabs and also for column where it is subjected tensile stresses due to eccentric loading. Similarly, reinforced masonry is type masonry where reinforcements are used in addition to plain masonry to improve its strength in both tension and compression.

2. METHODOLOGY

The Methodology adopted is conventional tests on a. Unreinforced HCB b. Reinforced Hollow Concrete Block Masonry. Two different percentages of reinforcement were tried prior to experiments on RHCBM, all the basic properties of Hollow concrete block, Mortar and Concrete was evaluated.

3. EXPERIMENTAL INVESTIGATION

In present investigation the prism specimens and masonry triplets were casted using hollow concrete block of dimension 400×150×200 mm for Compressive test and Shear test respectively. Fe-415 steel of diameter 12 mm and 8 mm were taken for reinforcement in RHCBM and 53 grade of ordinary Portland cement was used in all cases. The cement mortar 1:4 with w/c ratio 0.7 (obtained by Flow table test) was adopted. M20 grade concrete has been used for filling the cells of block in RHCBM. Totally four number of Reinforced hollow concrete block masonry prisms (RHCBM) using 12 mm diameter bar , six number of RHCBM using 8 mm diameter bar and three number of unreinforced masonry prisms were casted for Compression test. Similarly, three number of masonry triplets in two sets were casted and tested for two different normal stresses to evaluate the behavior of Shear Strength.

Fig -1: Prism Specimen after casting

Fig -2: Masonry Triplet after casting

Table -1: Basic Properties of Hollow Concrete Block

Sl. No	Name of the Test	Test Results	Unit
1	Dimensionality	401.63x152.07x199.3	mm
2	Dry density	1.163	g/cc
3	Water absorption	5.33	%
4	Initial rate of absorption	1.25	kg/m²/min
5	Flexural strength	1.92	N/mm²
6	Compressive strength	6.08	N/mm²
7	Modulus of Elasticity	5898	MPa

Table -2: Basic Properties of Cement Mortar

Sl.No	Name of the Test	Test Results	Unit
1	Compressive strength	12.92	N/mm²
2	Flowability	0.7	-

Fig -3: Setup for Compression test

Fig -4: Setup for shear test

Table -3: Compressive strength of URM at 28 days

Sl No	Compressive Strength in Mpa	Correction Factor	Corrected Compressive strength in MPa	Average Compressive Strength in Mpa
1	3.73	1.31	4.88	6.83
2	6.22	1.31	8.15	
3	5.7	1.31	7.47	

Table -4: Compressive strength of RHCBM-12ϕ at 28 days

Sl No	Compressive Strength in Mpa	Correction Factor	Corrected Compressive strength in MPa	Average Compressive Strength in Mpa
1	7.23	1.31	9.48	11.1
2	7.75	1.31	10.16	
3	9.5	1.31	12.46	
4	9.37	1.31	12.28	

Table -5: Compressive strength of RHCBM-8ϕ at 28 days

Sl No	Compressive Strength in Mpa	Correction Factor	Corrected Compressive strength in MPa	Average Compressive Strength in Mpa
1	6.1	1.31	8	9.09
2	5.2	1.31	6.82	
3	8.02	1.31	10.51	
4	6.73	1.31	8.83	
5	7.33	1.31	9.62	
6	8.2	1.31	10.75	

Table -6: Shear Strength of Masonry Triplets at 28 days

Sl No	Normal Stress (N/mm^2)	Shear strength (N/mm^2)	Average Shear Strength (N/mm^2)
1	0.007	0.168	0.191
2	0.007	0.199	
3	0.007	0.207	
4	0.01	0.184	0.219
5	0.01	0.253	
6	0.01	0.222	

Also, an attempt has been made to calculate the load carrying capacity of RHCBM using the mechanics based approach and the details are mentioned below.

Table -7: Axial load capacity of RHCBM (Experimental and Analytical)

Steel	Experimental Load, P_o (kN)	Analytical Load, P_o (kN)	% Difference
URM	312.83 (avg. of 3 specimen)	364.8	16.61
4 x 8 ϕ	415.83 (avg. of 6 specimen)	429.44	3.27
4 x 12 ϕ	507.75 (avg. of 3 specimen)	477.19	6.01

Further, the shear strength of hollow concrete block masonry triplets compared with Ready-made mortar. The table given below gives the summary of the comparison of the shear strength v/s normal stress.

Table -8: Comparison of Shear Strength

Normal Stress Applied (Mpa)	Shear Strength of HCB Masonry Triplets using Conventional Mortar (1:4)	Shear Strength of HCB Masonry Triplets using Ready-Made Mortar
0.007	0.191	0.37
0.01	0.219	0.54

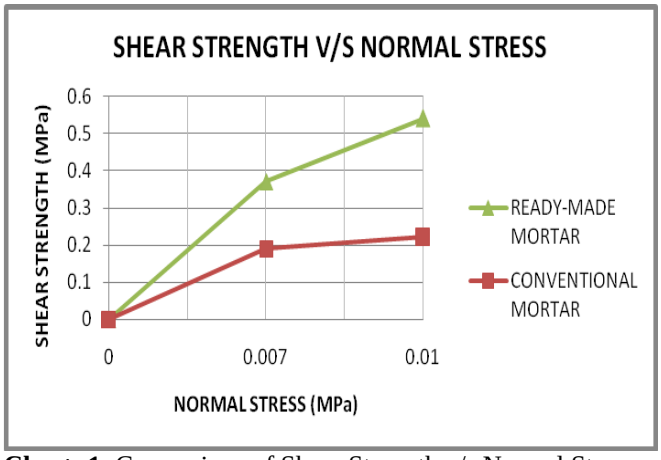

Chart -1: Comparison of Shear Strength v/s Normal Stress

4. CONCLUSIONS

The present investigation focused on the axial load carrying capacity of RHCBM based on the experimental and analytical investigation the following broad set of conclusions may be drawn:

[1]. Water absorption of HCB if found to be 5.33%.
[2]. The Block Density of HCB is found to be 1.163 g/cc.
[3]. IRA for HCB is found to be 1.25 $kg/m^2/min$.
[4]. The average Flexural Strength of HCB is 1.92 N/mm^2. This is indeed very high compared to conventional masonry units, because these HCB's are manufacture for a design mix under good quality control
[5]. The average compressive strength and modulus of elasticity of HCB blocks is found to be 6.08 N/mm^2 and 5898 Mpa.
[6]. The average Compressive Strength of Mortar Cube (1:4) with a w/c ratio of 0.7 is found to be 6.57 Mpa and 12.92 Mpa for 7 and 28 days respectively.
[7]. The average Compressive Strength and modulus of elasticity of URM is found to be 6.83 Mpa and 17265 MPa respectively with the masonry efficiency of 112.39 %. There is a need to explore this further since for such HCB with M1 grade mortar, efficiency is generally less than 100%.
[8]. The average Compressive Strength and modulus of elasticity of RHCBM-12ϕ (reinforced using 12 mm bar) is found to be 11.1MPa and 22072 MPa with the masonry efficiency of 182.5 %.
[9]. The average Compressive Strength of RHCBM-8 ϕ (reinforced using 8 mm bar) is found to be 9.09 MPa.
[10]. The simple mechanics based approach gives a very good co-relation for theoretically calculated ultimate load and experimental ultimate load.

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