MASONRY STRUCTURE BEHAVIOUR USING DIFFERENT TYPES OF MORTAR

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Abstract:
Masonry is one of the oldest building materials. The materials use, the quality of the mortar and workmanship and the pattern in which the units are assembled can substantially affect the durability of the overall masonry construction. In the present study an attempt has been made to assess the compressive strength of masonry structure using mortar and mortar with joint steel mesh considering various bonds. The compressive strength of masonry was determined by performing in laboratory tests on the prepared specimens. During the test results, the compressive strength of Stack bond with jointed steel mesh is decreased by 20.24% for 28 days respectively when compared with that of Stack bond with plain mortar. Also, the compressive strength of Flemish bond with jointed steel mesh is decreased by 31.28% for 28 days respectively when compared with that of Flemish bond with plain mortar.

Key words: *Masonry structure, Steel mesh, Flemish bond*

Introduction:

Construction using masonry remains relatively popular in many parts of the world and is practiced widely even today. Masonry is composed of two different materials i.e.., the masonry units and the mortar phase. Masonry units may be either solid on hollow and may be made of a wide variety of materials like clay bricks, blocks of stone, concrete blocks, pressed earth bricks, calcium silicate bricks. Soft mud etc. The materials use, the quality of the mortar and workmanship and the pattern in which the units are assembled can substantially affect the durability of the overall masonry construction.

Materials:

Cement: For the present study, Portland Pozzalana cement of 43 Grade conforming to IS 269-2012 was used throughout the experiment. Physical properties of cement are shown in Table no.1.

Table 1. Physical properties of cement

Sl. No.	Physical properties	Results obtained
1	Fineness (%)	1.4 % residue
2	Standard consistency (%)	31%
3	Initial setting time (min.)	133 min.
4	Final setting time (min.)	310 min.
5	Soundness	1 mm

Fine Aggregates: Locally available M-Sand double washed was used for the study. It was tested as per Indian Standard Specification IS:383-2015. The properties of fine aggregates are given in Table No. 2 and the results of sieve analysis are given in Table No.3

Table 2. Sieve analysis of fine aggregate

Sl. No.	IS sieve size mm	% of passing	Remarks
1.	10 mm	100	The fine aggregate belong to Zone – II
2.	4.75 mm	100	
3.	2.36 mm	84.7	
4.	1.18 mm	55.6	
5.	0.600	38.5	
6.	0.300	23.7	
7.	0.150	9.9	
	PAN	0	

Table 3. Physical properties of fine aggregates

Sl. No.	Physical properties	Results
1.	Specific gravity	2.65
2.	Fineness modules	2.87
3.	Bulk density	1.32 g/cc
4.	Bulking of sand	30 %

Water: Drinking water free from injurious salts was used for mixing and curing.
Burnt Clay Bricks: Size of bricks used is (224 x 103 x 68)mm
Joint Steel Mesh: Locally available joint steel mesh of 2.4mm thick is used for the present study.

Tests on Materials - Cement
Fineness Test: This test is mainly focused on the fineness percentage of cement to compare it with the requirement of percentage of fines as per IS: 12269-1987. The is carried out by dry sieving the cement using 90μm IS sieve.
Specific Gravity Test: Specific gravity is one of the major physical properties of cement and first and foremost data required for Mix Design. The test is conducted using Le-Chatelier apparatus as per IS: 4031 (PART XI) - 1988.
Standard Consistency Test: The method of testing is given in IS:4031(PART IV)-1988 and the same procedure has been adopted here. The main objective of this is to find the consistency of cement that is being used.
Setting Time Test: The initial and final setting time cement is found out to determine the time available for placing and hardening of the cement. The test is carried out by using the guidelines of IS:4031(PART V)-1988

Tests on Fine Aggregates
Fineness Modulus: This test is conducted to know the particle size distribution (grading of aggregates) and fineness modulus of fine aggregates as per IS: 2386 (PART I) – 1963. The results are compared with the values of Table 4 of IS: 383-1970 and the aggregates are graded based on that. The sieves of corresponding sizes conforming to IS: 460-1985 is used.

Specific Gravity of Fine Aggregate: The test is conducted using pycnometer bottle as per the procedure given in IS: 2386 (PART III) – 1963

Tests on Bricks

Compressive Strength of Bricks: The compressive strength of bricks is found out as 3.55 Mpa.

Tests on Mortar Cubes

Specimen Preparation: Standard Cement mortar cubes of size 70.5 mm X 70.5 mm X 70.5 mm were casted as per IS:4031(part 6)-2000.Cement and Double Washed M-Sand ratio used was 1:3 (by weight).Water is calculated by ($\boldsymbol{P4}$ + 3) % of weight of Cement and Sand , where P=Standard Consistency of Cement . The specimens were cured in water for 7 days and 28 days. Around 6 number of specimens casted for the experimentation purpose. Compressive strength of cement mortar cubes (mpa) is found out as 21.91.

Modeling & Construction of Masonry Structure Experimental Program

Materials: Cement –sand mortar of proportion (1:3) is prepared using PPC cement and M-Sand (Double Washed) conforming to Zone II of IS:383 .The compressive strength of mortar as determined by testing cubes of 50 Sq.cm face area as per IS: 2250.

Details of Specimens: In this study single brickwork prism specimen 3 units high were prepared using stack bond and Flemish bond in a total of two configurations for the compressive strength of masonry .The figure 1 shows the geometrical configuration of the various specimens used in the present study. Specimens were prepared for each of the two configuration using bricks and mortar of grade(1:3) and bricks and mortar with joint steel mesh . Totally 24 brick masonry of prisms and 4 specimens of running bond were prepared .A skilled mason was employed for making the specimens and the thickness of bed joint mortar was maintained approximately as 1inch for all joints. water content in the mortar mix was fixed based on IS code. All the specimens were cured for 7days and 28days by spraying water at regular intervals .These specimens were tested to determine the compressive strength of mortar.

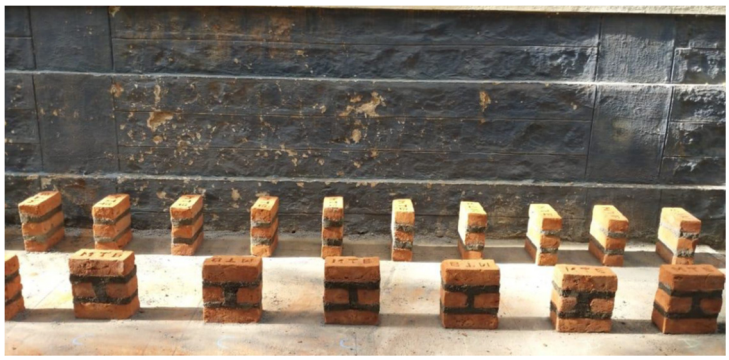


Fig. 1 Prism Specimens with different bonds

Results & Conclusion

Below table represents 28 days compressive strength of various prisms:

C1= Stack bond with mortar

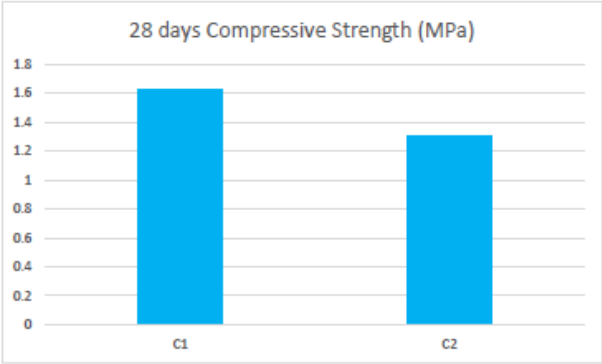
C2 = Stack bond with mortar and joint steel mesh

M1= Flemish bond with mortar

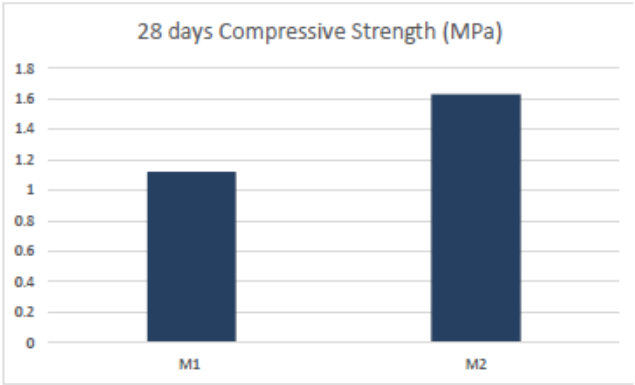
M2 = Flemish bond with mortar and joint steel mesh

Table. 4. 28 days compressive strength comparison

Sl. No.	Designation	Avg. compressive strength (Mpa)
1	C1	1.63
2	C2	1.30
3	M1	1.12
4	M2	1.63



From the above graph it is observed that the compressive strength of prism C2 is decreased by 20.24% compared with that of prism C1.



From the above graph it is observed that the compressive strength of prism M2 is decreased by 31.28% compared with that of prism M1.

Conclusion

Based on the present study the following conclusions have been arrived at:

1. The compressive strength of Stack bond with jointed steel mesh is decreased by 7% and 20.24% for 7 days and 28 days respectively when compared with that of Stack bond with plain mortar.
2. The compressive strength of Flemish bond with jointed steel mesh is decreased by 2% and 31.28% for 7 days and 28 days respectively when compared with that of Flemish bond with plain mortar.
3. The stack bond is strong compared to Flemish bond in cases of prisms with both plain mortar and mortar with jointed steel mesh.

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