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A Study on Low Cost Roof (Masonary Slab)

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ABSTRACT: *Bangladesh is a developing country with a very dense population. About 70% people lives in village. With most of the population living below poverty line. So the demand of low cost housing is increasing. In residential buildings, low cost roofing reduces the cost of housing. Slab made of brick module with or without beam is found to be practiced locally. Moreover brick masonry slab is easy to construct and durable with respect to fire proofing and corrosion if nominal or zero reinforcement is possible. This study investigates the performance of masonry slab of various dimensions and thickness. A number of 33 slabs of different size and thickness were cast and test. Test results revealed that flexural stress varies from 60 to 290 psi for brick masonry and for concrete masonry it is more than 350 psi. Combined failure both in joint and brick module was observed. In case of herring bone bond brick failure and other cases bond failure observed. The studies shows that herring bone bond masonry slab can resist maximum load which may be useful for low cost housing.*
Keywords: *Masonry Slab, Bond, Low Cost Housing, Failure.*

I. INTRODUCTION

The construction of stone, brick or tile which is termed as masonry. It may be defined as building units bonded together with mortar. The rapid progress over recent past in the understanding of the materials and considerable advances in the method of design have to led to the increasing acceptance of load bearing masonry as a variable structural material. By using masonry slab, housing cost can be reduced. The selection of the type of material and construction is made, keeping in view the requirements of the strength, water proofing, thermal insulation, fire resistance, durability and economy. Cement concrete masonry is coming into use in the form of slab blocks. Bricks masonry is one of the oldest building materials comparative superior to other alternative in terms of appearance, durability and cost. Cement concrete is largely used for construction purposes on account of its numerous advantages over the other building materials. Cement concrete may be used in the form of pre-cast concrete blocks, plain concrete slaps or reinforced concrete slabs. Reinforced masonry is durable, fire proofing, easy to construct and in the most cases it results in the increase of floor space due to adoption of brickwork or lesser thickness but relatively more cost than without reinforced masonry.

The cost of reinforcement is a great problem. This increases the cost of housing. So by using masonry slab housing cost can be reduced greatly. In addition to tremendous use of brick for low cost housing in Bangladesh, its use is getting popularity both in high rise structures and in factory buildings. The manufacturing method of masonry constituents such as brick, stone etc is labor extensive and easily adopted one as a result a huge employment in Bangladesh. Thus masonry plays a significant role in the construction industries of Bangladesh where natural stone are not available and other types of building material like concrete, MS sheets or CI sheets, timber and artificial materials are costly.

II. BACKGROUND OF RESEARCH

Reinforced concrete slab are widely used in high rise building. On the other hand reinforced brick slab are widely used in low cost rural housing. Design and code related to reinforced brick slab are well established (Dayaratnam P, 1988 and Kumar S, 2005).But high rate of corrosion in reinforcing bar and high cost of reinforcement has necessitated the study on brick slab and masonry concrete slab without reinforcement for the interest of cost and corrosion related damage of the slab .**Hossain M.M; Sk.Ali S and M Rahman A** (1997) represented the result of non-conventional experimental investigation of small burnt clay masonry sample. The in-situ deformation characteristics of bricks and mortar joints have been determined from 5 bricks high stacks bonded prisms. The deformation characteristics of individual bricks and mortar had also been determined and found to be different from in-situ characteristic. **Paulo B. Lourenco** (2000) proposed a model for the numerical analysis of masonry subjected to out of plate loading. The proposed of composite plasticity model was able to reproduce elastic and inelastic beheaviour in two orthogonal directions coinciding with the orientation of the bed and head joints of masonry.

K.M Sakr; P.E and V.V. NeisP.E had studied on "Load –Deflection analysis double Wythe unreinforced masonry wall" in2001. A new analysis method for unreinforced masonry double Wythe walls was developed and presented in that paper.

Therefore in this study low cost housing masonry slab of various parametric were constructed and tested. Parameter included – brick line, span and filler. Figure 1 shows one of their typical laying pattern and Figure 2 shows the loading arrangement for the test of slab.

Figure-1: Typical Laying Pattern

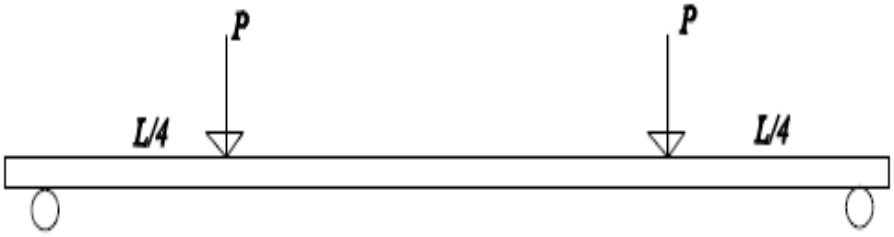

Figure-2: Application of Loading

III. METHODOLOGY

3.1 Preparation of Test Specimen

In this study concrete and brick masonry slab of different size and thickness were cast. In case of brick masonry slab brick module placed flat providing 4 inch & 3 inch thickness for the slab.

3.2 Materials Specifications

First class brick the average compressive strength 12.90 MPa
Mortar test (2'' x 2'') the average compressive strength 11.20 MPa
Mortar test (2'' x 2'') the average compressive strength 11.54 MPa
Cement mortar ratio 1:3
Concrete mortar ratio 1:2:4
Ordinary Portland cement
Washed Local sand with fineness modulus of 1.5

3.3 Construction Sequences

First of all, wooden platform was prepared and leveled before casting slab. A pylithine layer was laying in order to kept it water tight. Then in case of cement concrete masonry the slab were cast at a thickness 4 inch. For bricks masonry slab the bricks are laid in different pattern such as simple bond, English garden bond, herring bone bond placed with frog mark at to side keeping 2 inch gap or no gap. Layout and support position of the masonry slab has shown in Figure 3. Then a thin layer of concrete was cast on brick layer to fill the slab thickness as required. The interspaces between the modules (2 inch) are sealed with concrete mortar. After completing 28 days of curing period the formwork was removed and the slab was prepared for test.

3.4 Loading arrangement

The slabs were marked by chalk at a distance 3 inch on the both side from outer sides. The span between two marks was divided into three equal parts and marked by chalk. Two steel pipes were kept on the mark and a steel plate was placed on the pipes. A steel circular plate was placed on the steel plate. Then hydraulic jack was kept on the circular plate and a circular plate was placed on the hydraulic jack. A bamboo was kept on the circular plate and other end of the bamboo was support on the roof. The slab was then ready for test. This type of loading is also termed as "Two points loading." Loading arrangement figures are given below

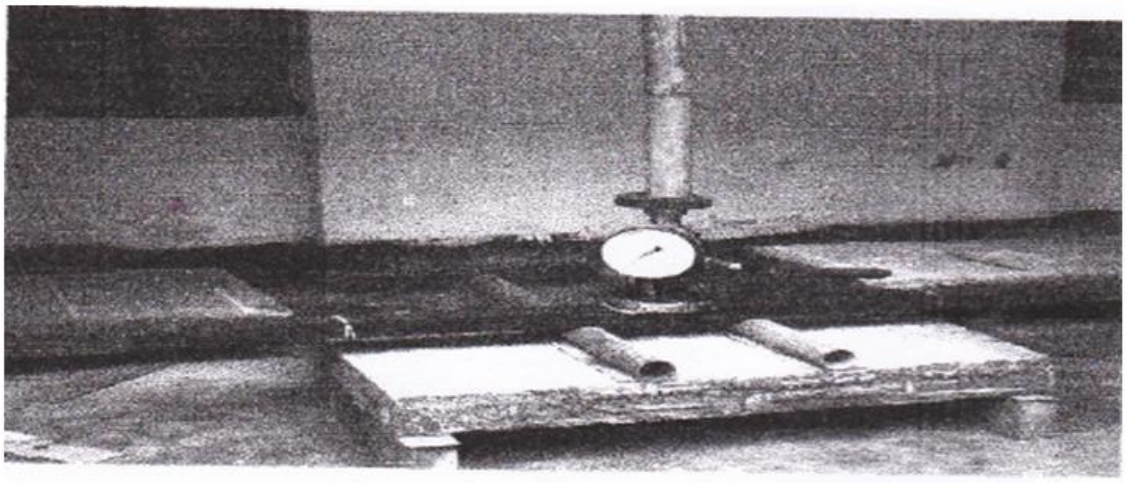

Figure-3: Loading Arrangement

IV. TEST PROCEDURE

After finished all the arrangement, the hydraulic jack was pumped slowly. The reading was recorded when the slab just broken. The weight of bamboo, hydraulic jack, steel rectangular plate, pipe etc was taken and adding this with recorded load, the total load was got. After that all calculation was performed.

Figure-4: Testing of Slab

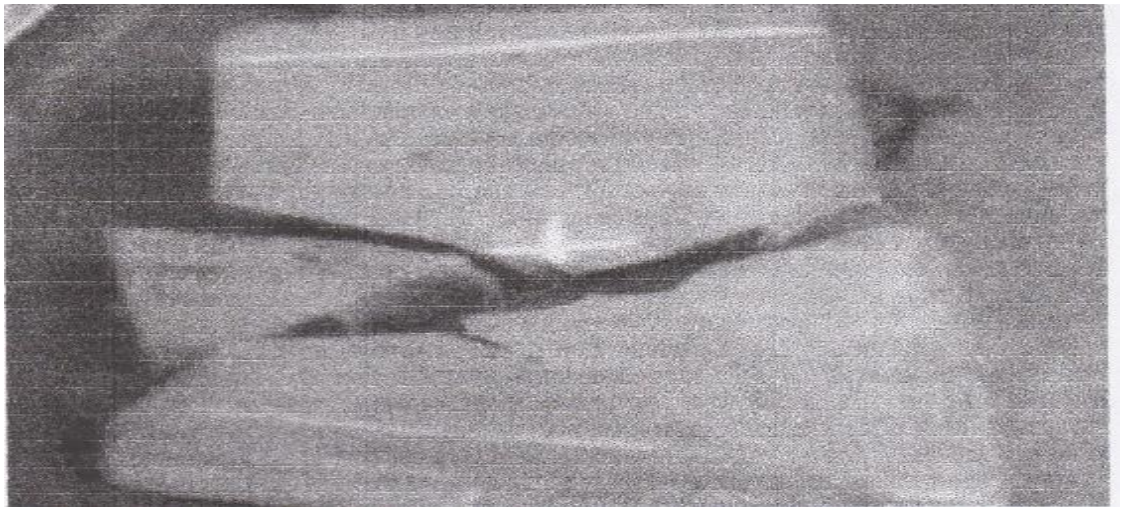

Figure-5: Failure pattern of a typical Slab

V. RESULTS

Table-1: Load test Results of different type of slab:

Sl No	Load carried by slab in ton	Average Load carried by Slab in Ton	Stress in psi	Description
01	2.08 2.13 2.04	2.08	358.83	Slab type: Cement concrete masonry slab Slab Size: 3'x2'x4'' Failure pattern: Bond Failure Pattern Line: none
02	0.736 0.736 0.740	0.737	253.88	Slab type: Cement concrete masonry slab Slab Size: 3'x1'x 4'' Failure pattern: Bond Failure Pattern Line: none
03	0.586 0.611 0.611	0.603	294.48	Slab type: Cement concrete masonry slab Slab Size: 3.67'x2'x4'' Failure pattern: Bond Failure Pattern Line: simple Gap between two bricks:2''
04	0.236 0.261 0.136	0.211	158.59	Slab type: Cement concrete masonry slab Slab Size: 3.67'x0.92'x4'' Failure pattern: Bond Failure Pattern Line: simple Gap between two bricks:2''
05	0.361 0.386 0.86	0.378	69.36	Slab type: Brick concrete masonry slab Slab Size: 3.17'x1.875'x 4'' Failure pattern: Bond Failure Pattern Line: simple Gap between two bricks:2''
06	0.286 0.186 0.180	0.201	61.44	Slab type: Brick concrete masonry slab Slab Size: 3.17'x1.875'x 4'' Failure pattern: Bond Failure Pattern Line: simple Gap between two bricks: 2''
07	0.68 0.58 0.58	0.610	105.06	Slab type: Brick concrete masonry slab Slab Size: 3.67'x2'x 4'' Failure pattern: Bond Failure Pattern Line: English garden Gap between two bricks: 2''
08	0.83 0.93 0.98	0.930	160.18	Slab type: Brick concrete masonry slab Slab Size: 3.67'x2'x 4'' Failure pattern: Bond Failure Pattern Line: English garden Gap between two bricks: 2''
09	0.78 1.03 1.03	0.950	290.70	Slab type: Brick masonry slab Slab Size: 3'x2'x 3'' Failure pattern: Brick Failure Pattern Line: Herring bone bond Gap between two bricks: no gap

10	0.88 1.03 0.98	0.960	293.95	Slab type: Brick masonry slab Slab Size: 3'x2'x 3'' Failure pattern: Brick Failure Pattern Line: Herring bone bond Gap between two bricks: no gap
11	0.53 0.63 0.58	0.580	267.50	Slab type: Brick masonry slab Slab Size: 3'x2'x 3'' Failure pattern: Brick Failure Pattern Line: Herring bone bond Gap between two bricks: no gap

VI. CONCLUSION & FUTURE RECOMMENDATION

6.1 Conclusion

Reinforcement is a great issue in the world. From the study it can be concluded that by using masonry slab reinforcement problem can be reduced and low cost housing can be possible for temporary purposes.

6.2 Future recommendation

For our researched small size of slabs were cast. For future it is recommended that:
(1) Room size slab can be cast for testing.
(2) Different filler can use instead of plain cement or cement mortar that was used.
(3) Ferro cement layer can be made above masonry slab.
(4) Temperature & shrinkage effect can be seen.
(5) Minimum reinforcement can be used in the gap between two bricks.

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