Study on Structural Behaviour of Brick Wall Using Different Meshes

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Abstract- *Due to its economic and functional advantages, flat slabs are a widely adopted solution for buildings now a day. For the present study , two floor post-tensioning floor systems were considered, being flat slab and flat slab with drop panel. For the equivalent frame system, four spans were considered for evaluating structural parameters such as synthetic fibre concrete. Two different time to depth ratio used for flat plate slab with drop panel and flat slab. Dead load is considered for analysis due to self-weight of the structure, live load and post-tensioned load. Concrete grade which directly affects flat plate deflection & Non PT steel(conventional steel). Factored moment at mid span and PT quantity are also studied with changing degree of concrete. Creation was carried out using the ADAPT-PT computer development programme. It is recommended to use ADAPT-PT due to its friendly usage and quick calculation capabilities. Using said software, the use of the IS-Code equivalent frame analytics method was performed.*

Keywords- flat slab, flexural behavior. design of post-tensioning flat slab, synthetic fiber concrete, using adapt-ptrc/2015.

I. INTRODUCTION

GENERAL

Masonry walls are used in almost all types of building construction in many parts of the world because of low cost material, good sound and heat insulation properties, easy availability, and locally available material and skilled labor. Brick masonry is a common construction material in India because of its abundance, low cost, good sound, heat insulation properties and availability of skilled labour. Masonry is extensively used in India as infill walls in reinforced concrete buildings. Clay brick masonry is a popular construction throughout India and in developing countries. Burnt clay bricks have better durability, strength and reliability and are easily available. India exhausting approximately 340 billion tonnes of clay every year and due to this extraction of top soil fertile land are turned into wastelands. In recent years, growing awareness on environmental impact of using fertile top soil for brick manufacturing has prompted the search for alternative systems of masonry units. On the other hand fly ash and pond ash is produced in large amount from thermal plants which causes environmental pollution. To overcome above problems fly ash and pond ash can is effectively utilized in making bricks as an alternative to clay in bricks and recommended to use in masonry construction. The structural behavior of masonry is influenced by the mechanical properties of the constituent materials. Therefore a full mechanical characterization is required for proper non-linear analysis of masonry structures. Hence uniaxial compressive test is carried out on unreinforced masonry and its constituents (clay brick, fly ash brick, coal ash brick and mortar).In this study, the finite element analysis approach is used to find stress strain behavior of masonry. Stress–strain properties of materials are required in the nonlinear analyses of structures. Stress–strain relationships for some construction materials such as concrete and steel are available in the literature and design codes. However, such relationships are not easily available for one of the most widely used construction material, i.e. masonry. In the present experimental study, compressive stress–strain relationships for masonry are determined using two different types of bricks such as clay brick and coal ash brick with cement mortar proportion of 1:5. Burnt clay bricks and pond ash brick with an average size of 230 mm x 110 mm x 75 mm (l x b x t) were used in the construction of the test specimens. OPC cement and river sand were used for the preparation of cement mortar with cement and sand in the ratio of 1:5. Three brick masonry wall specimens were cast using country bricks with strength mortar as used in the field construction, and tested with and without plastering under constant axial loads.

Axial deformation and strains will be recorded and the structural behaviour of masonry wall is studied.

II. LITERATURE REVIEW

GENERAL

The literature review gives detail about thematerials used and methods adopted in this investigation.

LITERATURE REVIEW

1. **Alagusundaramoorthy (2009),** studied the out of plane behaviour of brick masonry load bearing walls strengthened with glass fibre fabric. Three brick masonry wall specimens were cast using country bricks with low strength mortar as used in the field construction, and tested with and without strengthening under constant axial and monotonic out of plane loads The flexural strength and ductility were increased significantly on brick masonry walls strengthened with glass fibre fabric. The major problem of loss in human lives by falling of bricks from the brick masonry walls during an earthquake can also be avoided by full surface bonding of glass fibre fabric.

2. **Deodhar and Patel [1996]** 27 discussed the strength of brick masonry with respect to the strength of the brick and strength of the mortar. Frog in bonding the brick work, shape and size of frog affect the strength of brick masonry. The mortar joint of size 5mm to 10mm gave the maximum strength. The ratio of cement to sand ratio of 1:6 gave reasonably high compressive strength of brick masonry. For mortars richer than 1:6 ratios, though the increase in strength is considerable, the adhesion of cementing materials is very high compared to the benefit of increase in the crushing strength.

3. **Henry Liu et al [2009]58** developed the brick made of pure fly ash and the manufacture of the brick did not involve high temperature heating in kiln, in contrast to manufacturing clay bricks. Consequently, using of greenest brick not only eliminated waste disposal of fly ash and saved landfill space, it also saved much energy and eliminated all the air pollution and global warming problems caused by burning fossil fuel in kilns to manufacture clay bricks. Fly ash bricks made from fly ash do not emit mercury into air. On the contrary, they absorbed mercury from air, making the ambient air cleaner. Fly ash brick did not emit radon gas, but only at about 50% of that emitted from concrete. Thus, it was considered safe to use concrete or concrete products in buildings and it should be even safer to use fly ash bricks. Leaching of pollutants from fly ash bricks caused by rain was negligible. In addition, long-term observation of the compacted fly ash bricks revealed that the long-term growth of strength of fly ash bricks was due to carbonation caused by absorption of CO2 from the atmosphere which brings relief to global warming.

4. **Obada Kayali et al [2005]110** compared the properties of fly ash bricks to the clay bricks. The fly ash bricks produced were about 28% lighter than clay bricks. The bricks manufactured from fly ash possessed compressive strength higher than 40MPa. The technology used less energy than that needed in the manufacture of clay bricks. The mechanical properties of the fly ash bricks exceeded those of the standard load bearing clay bricks. Compressive strength was 24% better than good quality clay bricks. Bond strength of fly ash bricks was 44% higher than the standard clay brick. The density of fly ash brick was 28% less than that of standard clay bricks. This reduction in the weight of bricks resulted in a great deal of savings in the raw materials and reduction in transportation costs. The resistance of the bricks to repeated cycles of salt exposure showed zero loss of mass and indicated excellent resistance to sulphate attack.

5. **Khan Shahzada et.al (2012)** studied the enhancement of unconfined and unreinforced brick masonry walls against earthquake loadings in Pakistan. Different unreinforced brick masonry walls have been examined for compressive strength before and after retrofitting. In this research Ferro-cementing has been used for the strength improvement of unreinforced brick masonry. The impact of plaster on the durability of walls has also been regarded. The research of trial outcomes generate, that appropriate retrofitting can reduce the problems occurring due to future earthquakes. Retrofitting improved not only the overall strength of unreinforced brick masonry walls by 40 % and also enhanced its ductility. The biggest advantage of the ferrocement is the fact that it does not disintegrate after failure unlike normal masonry walls, hence reducing the falling hazard. The ordinary brick masonry walls fail suddenly leading to brittle failure

6. **Krishnamoorthy et al [1994]** investigated the quantum of fly ash added to soil for making good bricks. Fly ash obtained from Vijayawada thermal power station was mixed with the soil in varying ratios such as 0%, 10%, 20%, 30%, 40% and 50% described that the bricks cannot be manufactured with highly swelling soils without additives. The properties of strength and water absorption of bricks made with replacement of soil by 50% of fly ash were reasonably good and the strengths were ranging from 9.8 to 11.5 N/mm^2 but for the country brick, it was about 3.5N/mm^2 and no marked improvement was there with more addition of fly ash.

7. **Ritwik Sarkar et al (2007)** made an attempt to optimize the ratio of pond ash or fly ash to clay which can be

utilized in the brick manufacturing process without sacrificing the consistency in the quality of the products. Coal ash, a byproduct from thermal power plants creates environmental hazards. The study recommended that compositions up to 40 % weight of pond ash which would have a bulk density of 1500 kg/m^3, water absorption 26.6 % and crushing strength 11 MPa could be used to produce burnt ash-clay bricks. Up to 80 % of ESP grade fly ash can replace clay in brick giving rise to properties superior to conventional red clay bricks. Pond ash with high proportion of coarse particles may be incorporated up to 40 % without affecting the quality of the bricks. Utilization of coal ash in brick manufacturing can greatly reduce the need for dumping the ash in landfills or ash depots.

8. **Deodhar and Patel [1997]** presented that under compression, mortar deformed more than brick and expanded laterally causing failure of masonry. With the strength of brick and mortar, the compressive strength of brick masonry was evaluated with the constants given. It was found that rich mortar does not improved the strength of masonry but for low strength bricks a mortar ratio 1:4 or 1:5 gave considerably high strength .

9. **Deodhar [2000]** presented that the thickness of mortar material and brick material were very important factors that affect the strength of brick masonry prisms in compression. More the thickness of brick material in brick masonry compared to mortar thickness, more the strength of masonry. The joint thickness of 5mm to 10mm is optimum for metric bricks and for conventional bricks, and there is considerable reduction in strength of brick masonry beyond 10mm joint thickness. Stress – strain curve of brick masonry are similar to that of concrete. Strain corresponding to maximum stress was always higher and the brick strength does not affect the overall strain of brick work corresponding to maximum stress.

10. **Oliveira et al [2000]** carried out the tests on prisms under cyclic loading in order to evaluate the importance of stiffness degradation. The results obtained from each masonry component (bricks and mortar) were compared with the results from the masonry prisms and presented the specimen‘s behavior based on the failure modes. The stress-strain diagrams of the brick prisms showed a bilinear pre-peak behavior. Peak load was preceded by visible crack initiation, and post-peak was characterized by a stable behavior. While the extreme bricks presented slight damage, the central bricks were very damaged with visible cracks along the entire surface and aligned with the load direction. Stiffness degradation of the reloading branches occurred especially during post-peak, where stiffness suffered important decreases. It was observed that energy dissipation increased with the strain level. The average strength value of the prisms was much higher when compared to the mortar specimens, but less than the average strength of the single bricks. Mortar had a very large influence on prism deformation. A reduction on the peak strength was compensated by stable post peak behavior. The compressive strength of the masonry was highly influenced by the characteristics of the single components - brick and mortar.

11. **Mohamad et al [2005]** carried out experimental tests on masonry prisms to determine the response of masonry subjected to compression. The stress-strain diagrams were obtained with prisms made of concrete blocks and a wide range of mortar strengths. Here the cement : hydraulic lime : sand proportions in volume of the mortar type 1:0.5:4.5 agrees well with experimental results, while mortars 1:0.25:3 and 1:2:9 exhibited reasonable agreement for the initial stress but only moderate agreement close to the ultimate stress. The failure mechanism of masonry depends on the difference of elasticity modulus between unit and mortar. The mortar governs the non-linear behavior of masonry. A polynomial expression was the best fit curve between the elasticity modulus and compressive strength of masonry. This demonstrates that there was a non-linear relation between strength and the elasticity modulus.stress-strain characteristics of unconfined and confined clay brick masonry. Confinement plates dramatically improved the compressive strength of clay brick masonry. The plates increased the ultimate strength by as much as 40%. It was noted that confinement plates placed within the mortar bed joints restricted the lateral expansion of the joint and the differential expansion between the clay brick unit and the joint.

12. **Shamala Sambasivam et al (2004)** studied the structural behavior of clay brick masonry using finite element analysis and compared with experimental results. The finite element modeling was developed for homogeneous material and composite material of brick and mortar of masonry. The masonry prism was constructed for a height of 360 – 410 mm with the mortar thickness varying from 7.5 mm to 20 mm. Model had been discretized into 72 elements with eight-node isoparametric brick elements. The non-linear stress-strain curve was obtained from experimental results of masonry prism. Vertical compressive stress and strain for both homogeneous and composite model were obtained by using LUSAS software of finite element analysis. The properties of

masonry prism were used to create homogeneous model. The stress–strain curves were obtained from finite element analysis. They were non-linear because of material non-linearity. The homogeneous brick masonry model had 4 % high compressive strength compared to composite model from the stress-strain curves of masonry model. Uniform Building Code (UBC) recommends that 3/8" of mortar thickness attains high compressive stress for brick masonry. Increase in mortar thickness reduces the compressive stress of masonry as proved by both experimental results and numerical analysis. Experimental results showed that prism strength of masonry was 50 % higher than numerical results. The research concluded that the actual strength of brick masonry could be obtained with a factor 1.5 of finite element analysis.

III. CONCLUSION

1. The manufacture of coal ash bricks may save more energy as the manufacture of clay brick needs coal for burning the bricks in order to attain good strength. Also, the natural resource such as fertile soil is not utilized for making coal ash bricks.
2. The coal ash bricks have good mechanical properties than the clay bricks. The compressive strength of the coal ash bricks was found to be 8.59 N/mm^2 more than the clay bricks.
3. The weight density value of coal ash brick was found 14.83 kN/m^3 which is less than clay bricks. Hence the self weight of the structure is reduced while using coal ash bricks.
4. Coal ash based construction may yield good durability performance because the water absorption value of coal ash brick was 10.2 %.
5. Failure strain of coal ash brick masonry showed high ductility when compared to clay brick masonry and fly ash brick masonry.
6. The stress-strain behaviour of coal ash brick and masonry is similar trend with clay brick and masonry.
7. The experimental results of stress strain study was found to be good agreement with the numerical results obtained from Finite Element Method (ABAQUS)
8. Hence, the coal ash bricks are cost effective, energy-efficient and environment friendly and adopted for green building concept.

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